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**DOCUMENTO TÉCNICO ZTI-DT-021-2025**

**SEÑORES:** INGEOCIM S.A.S.

**INGENIERO:** JUAN CARLOS PINEDA SUAREZ.

**CARGO:** DIRECTOR DE INTERVENTORÍA.

**FECHA:** 24 de abril de 2025.

**DIRECCIÓN:** Carrera 15 No. 98 – 26, Oficina 503.  
Bogotá D.C.

**PROYECTO:** Contrato de interventoría 4144 de 202. “INTERVENTORIA TECNICA, LEGAL, ADMINISTRATIVA, FINANCIERA Y AMBIENTAL PARA EL MEJORAMIENTO, MANTENIMIENTO DE LA VIA BLANQUITA - FRONTINO EN EL DEPARTAMENTO DE ANTIOQUIA EN EL MARCO DEL PROGRAMA COLOMBIA AVANZA”.

**ASUNTO:** Aprobación al documento “DISEÑO DE PAVIMENTO RÍGIDO, PROYECTO CORREDOR BLANQUITA FRONTINO DEPARTAMENTO DE ANTIOQUIA”. Versión 1.

Respetado Ingeniero,

En función de la revisión del informe “DISEÑO DE PAVIMENTO RÍGIDO, PROYECTO CORREDOR BLANQUITA FRONTINO DEPARTAMENTO DE ANTIOQUIA”, CL-0221-25-610-01-02-Rev 1, Versión 1, elaborado por la firma INTEINSA PAVIMENTOS el 17 de marzo de 2025, esta Interventoría se permite desarrollar el estado de las observaciones realizadas en el memorando ZTI-DT-018-2025, donde se realizaron los siguientes comentarios y/o salvedades:

1. No es clara la información que se tiene de basa de la subrasante o plataforma de apoyo. Se menciona que el granular existente presenta un CBR de 19% (según análisis estadístico, sin embargo, en las modelaciones numéricas se emplea 15% y en el texto se menciona 10%.

**Tabla 4. CBR de MG existente**

Fuente: Elaboración propia a partir del anexo 3

|      | CBR  |
|------|------|
| AP-3 | 21,8 |
| AP-4 | 23   |
| AP-5 | 20,7 |
| AP-7 | 23,9 |
| AP-8 | 18,5 |

**Nota:** a partir de un percentil 90%, se determina un CBR de MG existente de 19%

Por lo anterior, se realiza el cálculo del módulo combinado de la subrasante con 20 cm de material de tipo afirmado o existente de CBR 15%, para ello; se utiliza la metodología de IVANOV, para lo cual se parte de la siguiente formulación:

- h1 es el espesor del material seleccionado CBR 10%
- “a” es el radio de carga
- n relación entre el módulo de la subrasante y el material granular existente.

Fuente: Diseño de pavimentos, V0.

#### Estado de la observación:

Se atiende por parte del contratista. Se aclara que, aunque el estudio inicial arrojó un CBR del 19%, para fines de diseño estructural se adoptó el valor mínimo exigido por INVIAS (15%), ya que se considera que las zonas de ampliación y mejoramiento serán intervenidas con afirmado nuevo. El valor de 10% fue un error de forma ya corregido en la versión ajustada del documento.

2. Aclarar las premisas de diseño empleadas en el capítulo 7 según la siguiente imagen y en concordancia.

## 7. DIMENSIONAMIENTO DEL PAVIMENTO EN ESTRUCTURA RÍGIDA

### 7.1. MÓDULO DE REACCIÓN DE LA SUBRASANTE

La estructura de pavimento rígido se diseñó mediante la metodología de la PCA, para su dimensionamiento se ha utilizado un CBR de diseño igual a **3.5 %**, para este corresponde un módulo de reacción de la subrasante  $k$  de apoyo igual a **32 MPa/m**.



Imagen 6. Módulo de reacción de la subrasante.

Fuente: Software: Pavement Designer

Fuente: Diseño de pavimentos, V0.

#### Estado de la observación:

Se atiende por parte del contratista. Se realizaron los ajustes correspondientes al capítulo 7 para reflejar de manera coherente y completa las premisas de diseño, en concordancia con los criterios normativos y metodológicos aplicables.

3. Especificar de dónde se obtienen las cargas por ejes de los autos, buses y camiones empleados para el diseño, dentro del Anexo 2 no se mencionan. Incluso, dicho anexo hace referencia al manual de medios y altos volúmenes del INVIAS, lo cual no aplica para la zona de estudio.

#### Estado de la observación:

Se atiende por parte del contratista. Se especifica que las cargas por eje se tomaron del estudio de tránsito previamente elaborado para el proyecto, que sirvió de insumo para este diseño. Dicho estudio está referenciado en el Anexo 2, y no fue elaborado dentro del alcance del actual contrato.

4. El estudio de tránsito no contempla confiabilidad del 90% (empleado en el diseño de pavimentos). A continuación se presenta las cargas por eje obtenidas por esta interventoría en función del Anexo 2, lo cual requiere de verificar por parte del Consultor.

#### Estado de la observación:

Se atiende por parte del contratista. Se verificaron los espectros de carga propuestos por la interventoría, y se identificó una inconsistencia en el periodo acumulado (2026–2043 en lugar

de 2025–2044). Se confirma que los cálculos originales del consultor contemplan correctamente los 20 años de diseño.

| INFORMACIÓN TPD |       |                                                       |       |     |     |    |           |           |           |        |
|-----------------|-------|-------------------------------------------------------|-------|-----|-----|----|-----------|-----------|-----------|--------|
| AÑO No.         | AÑO   | TRÁNSITO PROMEDIO DIARIO EN UN SENTIDO DE CIRCULACIÓN |       |     |     |    |           |           |           |        |
|                 |       | TIPO DE VEHICULO                                      |       |     |     |    |           |           |           | VEHIC. |
|                 |       | AUTOS                                                 | BUSES | C2P | C2G | C3 | C4 (2-S2) | C5 (3-S2) | C6 (3-S3) |        |
| 0               | 2,025 | 24                                                    | 6     | 22  | 6   | 0  | 0         | 0         | 0         | 58     |
| 1               | 2,026 | 25                                                    | 6     | 23  | 6   | 0  | 0         | 0         | 0         | 58     |
| 2               | 2,027 | 26                                                    | 6     | 23  | 6   | 0  | 0         | 0         | 0         | 62     |
| 3               | 2,028 | 26                                                    | 7     | 24  | 7   | 0  | 0         | 0         | 0         | 64     |
| 4               | 2,029 | 27                                                    | 7     | 25  | 7   | 0  | 0         | 0         | 0         | 66     |
| 5               | 2,030 | 28                                                    | 7     | 26  | 7   | 0  | 0         | 0         | 0         | 68     |
| 6               | 2,031 | 29                                                    | 7     | 27  | 7   | 0  | 0         | 0         | 0         | 70     |
| 7               | 2,032 | 30                                                    | 7     | 27  | 7   | 0  | 0         | 0         | 0         | 72     |
| 8               | 2,033 | 31                                                    | 8     | 28  | 8   | 0  | 0         | 0         | 0         | 75     |
| 9               | 2,034 | 32                                                    | 8     | 29  | 8   | 0  | 0         | 0         | 0         | 77     |
| 10              | 2,035 | 33                                                    | 8     | 30  | 8   | 0  | 0         | 0         | 0         | 79     |
| 11              | 2,036 | 34                                                    | 8     | 31  | 8   | 0  | 0         | 0         | 0         | 82     |
| 12              | 2,037 | 35                                                    | 9     | 32  | 9   | 0  | 0         | 0         | 0         | 85     |
| 13              | 2,038 | 36                                                    | 9     | 33  | 9   | 0  | 0         | 0         | 0         | 87     |
| 14              | 2,039 | 37                                                    | 9     | 34  | 9   | 0  | 0         | 0         | 0         | 90     |
| 15              | 2,040 | 38                                                    | 10    | 35  | 10  | 0  | 0         | 0         | 0         | 93     |
| 16              | 2,041 | 40                                                    | 10    | 36  | 10  | 0  | 0         | 0         | 0         | 96     |
| 17              | 2,042 | 41                                                    | 10    | 38  | 10  | 0  | 0         | 0         | 0         | 99     |
| 18              | 2,043 | 42                                                    | 11    | 39  | 11  | 0  | 0         | 0         | 0         | 102    |
| 19              | 2,044 | 44                                                    | 11    | 40  | 11  | 0  | 0         | 0         | 0         | 106    |
| 20              | 2,045 | 45                                                    | 11    | 41  | 11  | 0  | 0         | 0         | 0         | 109    |
| 21              | 2,046 | 47                                                    | 12    | 43  | 12  | 0  | 0         | 0         | 0         | 112    |
| 22              | 2,047 | 48                                                    | 12    | 44  | 12  | 0  | 0         | 0         | 0         | 116    |
| 23              | 2,048 | 50                                                    | 12    | 45  | 12  | 0  | 0         | 0         | 0         | 120    |

  

| CÁLCULO DE ESPECTRO DE CARGA POR EJES (PAVIMENTO RÍGIDO) |      |       |       |     |     |    |           |           |           |  |
|----------------------------------------------------------|------|-------|-------|-----|-----|----|-----------|-----------|-----------|--|
| Periodo                                                  | Años | AUTOS | BUSES | C2P | C2G | C3 | C4 (2-S2) | C5 (3-S2) | C6 (3-S3) |  |
| 2025 - 2044                                              | 20   | 592   | 148   | 543 | 148 | 0  | 0         | 0         | 0         |  |

  

| Peso, Pi (t) |  |   |   |   |   |  |  |  |  | Total     |
|--------------|--|---|---|---|---|--|--|--|--|-----------|
| 1.00         |  | 2 |   | 1 |   |  |  |  |  | 216,209.0 |
| 3.00         |  |   |   |   |   |  |  |  |  | 99,095.8  |
| 3.50         |  |   | 1 |   |   |  |  |  |  | 27,026.1  |
| 6.00         |  |   |   | 1 | 1 |  |  |  |  | 126,121.9 |
| 8.20         |  |   | 1 |   |   |  |  |  |  | 27,026.1  |
| 6.00         |  |   |   |   |   |  |  |  |  | -         |
| 7.50         |  |   |   |   |   |  |  |  |  | -         |
| 10.00        |  |   |   |   |   |  |  |  |  | -         |
| 11.00        |  |   |   |   | 1 |  |  |  |  | 27,026.1  |
| 12.50        |  |   |   |   |   |  |  |  |  | -         |
| 14.00        |  |   |   |   |   |  |  |  |  | -         |
| 17.00        |  |   |   |   |   |  |  |  |  | -         |
| 21.50        |  |   |   |   |   |  |  |  |  | -         |
| 22.00        |  |   |   |   |   |  |  |  |  | -         |
| 23.50        |  |   |   |   |   |  |  |  |  | -         |
| 24.00        |  |   |   |   |   |  |  |  |  | -         |

*Ilustración 1. Espectros de carga calculados por esta interventoría.*

Fuente: Elaboración propia.

- Dentro del Anexo Técnico se señala que: “Las obras de drenaje vial son fundamentales en la vida del pavimento”, del cual no se hace ninguna relación dentro del documento.

#### Estado de la observación:

Se atiende por parte del contratista. Se incluyó un nuevo capítulo con recomendaciones generales de drenaje en la versión actualizada del informe, dejando claridad en que los aspectos hidráulicos específicos serán abordados en el estudio correspondiente, fuera del alcance del diseño de pavimento.

6. No se entrega plano de modulación de losas y detalles constructivos. Esto es perentorio para su correcta materialización.

**Estado de la observación:**

Se atiende por parte del contratista. Debido a la reciente entrega del levantamiento topográfico, la modulación de losas y detalles constructivos se encuentran en proceso de elaboración y serán incluidos en una versión próxima del informe técnico.

7. Dentro del cálculo del TPD o Cargas por eje, se recomienda tener en cuenta el tráfico de construcción.

**Estado de la observación:**

Se atiende por parte del contratista. Se acoge la recomendación de considerar el tránsito de construcción. Este ha sido cuantificado y se incluyó una mayoración para contemplar futuros desarrollos viales en la zona, asegurando una estructura con capacidad reforzada.

8. La alternativa con granular+cemento en lugar de la subbase granular convencional, presenta una diferencia de -5cm en espesor, lo cual debe ser objeto de análisis económico y análisis comparativo.

| Tabla 15. Resumen Alternativas. |              |      |             |
|---------------------------------|--------------|------|-------------|
| Fuente: Elaboración propia.     |              |      |             |
| Alternativa                     | Espesor [cm] |      |             |
|                                 | LOSA         | MGTC | SBG Clase C |
| 1                               | 18,0         | --   | 15          |
| 2                               | 17,5         | 15   | --          |

Fuente: Diseño de pavimentos, V0.

**Estado de la observación:**

Se atiende por parte del contratista. Inicialmente se había reportado una diferencia de 1.5 cm en espesor entre las alternativas. Sin embargo, tras los ajustes realizados, esta diferencia es de 1 cm. Se sugiere que este análisis sea complementado posteriormente con una evaluación económica comparativa para la selección definitiva.

**Tabla 19. Resumen Alternativas.**

Fuente: Elaboración propia.

| Alternativa | Espesor [cm] |      |             |
|-------------|--------------|------|-------------|
|             | LOSA         | MGTC | SBG Clase C |
| 1           | 19,0         | --   | 15          |
| 2           | 18,0         | 15   | --          |

Fuente: Diseño de pavimentos, V1.

9. Revisar los anexos ya que no coinciden en la numeración del documento con los adjuntos a él.

**Estado de la observación:**

Se atiende por parte del contratista. Se realizó la actualización y renombramiento de los anexos para que coincidan correctamente con su numeración dentro del informe principal, mejorando la trazabilidad del documento.

10. De acuerdo con la validación inicial de esta Interventoría y los datos suministrados por el Consultor, se tiene que el espesor de losa obtenido corresponde a 20cm según la metodología empleada. La configuración de capas de pavimentos será validada una vez se aclaren los puntos anteriores.

| PAVEMENT DESIGN METHOD PCA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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-------|----|-----------------------|------|-------------------|-------|---------|---------|-----------|-------|--------|--------|-----------|-------|---|------|------|-------|--------|--------|-----------|-------|--------|--------|-----------|--|-----|------|------|-------|---------|--------|-----------|-------|--------|--------|-----------|--|---|-------|-------|-------|---------|---------|-----------|-------|--------|--------|-----------|--|-----|-------|-------|-------|---------|--------|-----------|-------|--------|---------|------------|-------|---|-------|-------|-------|---------|---|-----------|-------|--------|--------|-----------|--|-----|-------|-------|-------|---------|---|-----------|-------|--------|---------|------------|-------|----|-------|-------|-------|---------|---|---------|-------|-------|--------|---------|-----------|----|-------|-------|-------|---------|--------|--------|--------|-------|--------|---------|-----------|------|-------|-------|-------|---------|---|-------|-------|-------|--------|---------|-----------|-----------------------|--|--|--|--|--|--|--|--|--|--|--|-------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|----------------|--|-----|----|----|---------|----|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|----------------|--|-------|-------|-------|-------------|-------|--|-------|--|----|-------|-------|-------|---------|---|-----------|-------|--------|---------|------------|-------|----|-------|-------|-------|---------|---|-----------|-------|--------|---------|-----------|-------|------|-------|-------|-------|---------|---|-----------|-------|-------|--------|---------|-----------|----|-------|-------|-------|---------|---|---------|-------|-------|--------|---------|-----------|------------------------|--|--|--|--|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|------|-------|-------|-------|---------|---|-----------|-------|--------|---------|---------|-------|----|-------|-------|-------|---------|---|-----------|-------|--------|---------|---------|-------|--------------|--|--|--|--|--|--|--|--|--|--|--|---------------|--|--|--|--|--|--|--|--|--|--|--|--------------|--|--|--|--|--|--|--|--|--|--|--|
| <b>GENERAL INFORMATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| <div> <div> <b>INPUT DATA</b> <table> <tr><td>Base thickness</td><td>15</td><td>5.91</td><td>in</td></tr> <tr><td>Trial thickness</td><td>20</td><td>7.87</td><td>in</td></tr> <tr><td>Subbase-subgrade reaction</td><td>56</td><td>206</td><td>pci</td></tr> <tr><td>Modulus of rupture</td><td>38</td><td>551</td><td>psi</td></tr> <tr><td>Load safety factor</td><td></td><td>1</td><td></td></tr> </table> </div> <div> <table> <tr><td>Dowled joints</td><td>YES</td></tr> <tr><td>Concrete shoulders (NS/WS)</td><td>NS</td></tr> <tr><td>Design period (years)</td><td></td></tr> <tr><td>thickness of base</td><td></td></tr> </table> </div> <div> <table> <tr><td>Pc (SA)</td><td>OTHER</td></tr> <tr><td></td><td>5.34</td></tr> <tr><td></td><td>OTHER</td></tr> <tr><td></td><td>OTHER</td></tr> </table> </div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |       |                   |                     |                  |           |                  |        |         |                       |                |  |  | Base thickness | 15                 | 5.91  | in                | Trial thickness     | 20               | 7.87   | in               | Subbase-subgrade reaction | 56 | 206                   | pci            | Modulus of rupture | 38   | 551 | psi | Load safety factor |   | 1 |    | Dowled joints | YES | Concrete shoulders (NS/WS) | NS | Design period (years) |      | thickness of base |       | Pc (SA) | OTHER   |           | 5.34  |        | OTHER  |           | OTHER |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |        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| Base thickness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15                 | 5.91  | in                |                     |                  |           |                  |        |         |                       |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                          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| Trial thickness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 20                 | 7.87  | in                |                     |                  |           |                  |        |         |                       |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                          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| Subbase-subgrade reaction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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| Modulus of rupture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| Load safety factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| Dowled joints                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| Concrete shoulders (NS/WS)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| Design period (years)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| <b>RESULTADO:</b><br>FATIGUE SATISFIED <b>YES</b> 63.72%<br>EROSION SATISFIED <b>YES</b> 0.87%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| Ec (Method datum) 4,000,000 psi<br>Ec (Current design datum) 4,030,598 psi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| <b>COMPUTED DATA</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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| relative stiffness ratio of slab-subgrade system 30.03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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| F2 COMPUTED 0.963                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| F3 0.894                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| F4 0.953                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| <table> <tr><td>f6</td><td>1</td></tr> <tr><td>f7</td><td>0.896</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| f6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| f7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| <b>SINGLE AXLE SA</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| 8 Equivalent stress 246.18<br>9 Stress ratio Factor 0.447<br>10 Erosion Factor 2.82                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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| <table> <tr><td colspan="2"><b>FATIGUE</b></td></tr> <tr><td>SAL</td><td>18</td></tr> <tr><td>Me</td><td>3048.04</td></tr> <tr><td>f1</td><td>1.017410755</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| <b>FATIGUE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| f1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| <table> <tr><td colspan="2"><b>EROSION</b></td></tr> <tr><td>Pc</td><td>5.33604443</td></tr> <tr><td>C1</td><td>0.9951</td></tr> <tr><td>Dequiv</td><td>0.02586496</td></tr> <tr><td>f5</td><td>1</td></tr> <tr><td>P</td><td>19.8572763</td></tr> <tr><td>C2</td><td>0.06</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| <b>EROSION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| C1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| Dequiv                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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| C2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| <table> <tr> <th>Axle load kips</th> <th>Multiplied for LSF</th> <th>F1</th> <th>EQUIVALENT STRESS</th> <th>Expected repetition</th> <th colspan="2">Fatigue analysis</th> <th colspan="3">Erosion Analysis</th> <th>Allowable Repetitions</th> <th>Damage Percent</th> </tr> <tr> <th>1</th> <th>2</th> <th></th> <th></th> <th>3</th> <th>4</th> <th>5</th> <th>f5</th> <th>Dequiv</th> <th>P</th> <th>6</th> <th>7</th> </tr> <tr> <td>1</td> <td>2.20</td> <td>2.20</td> <td>0.141</td> <td>34.059</td> <td>216.209</td> <td>UNLIMITED</td> <td>0.122</td> <td>0.0028</td> <td>0.2371</td> <td>UNLIMITED</td> <td></td> </tr> <tr> <td>3</td> <td>6.59</td> <td>6.59</td> <td>0.395</td> <td>95.660</td> <td>99.096</td> <td>UNLIMITED</td> <td>0.366</td> <td>0.0085</td> <td>2.1335</td> <td>UNLIMITED</td> <td></td> </tr> <tr> <td>3.5</td> <td>7.68</td> <td>7.68</td> <td>0.457</td> <td>110.576</td> <td>27.026</td> <td>UNLIMITED</td> <td>0.427</td> <td>0.0099</td> <td>2.9040</td> <td>UNLIMITED</td> <td></td> </tr> <tr> <td>6</td> <td>13.17</td> <td>13.17</td> <td>0.758</td> <td>183.527</td> <td>126.122</td> <td>UNLIMITED</td> <td>0.732</td> <td>0.0170</td> <td>8.5342</td> <td>UNLIMITED</td> <td></td> </tr> <tr> <td>8.2</td> <td>18.00</td> <td>18.00</td> <td>1.017</td> <td>246.162</td> <td>27.026</td> <td>UNLIMITED</td> <td>1.000</td> <td>0.0232</td> <td>15.9400</td> <td>30.324.872</td> <td>0.09%</td> </tr> <tr> <td>6</td> <td>13.17</td> <td>13.17</td> <td>0.758</td> <td>183.527</td> <td>-</td> <td>UNLIMITED</td> <td>0.732</td> <td>0.0170</td> <td>8.5342</td> <td>UNLIMITED</td> <td></td> </tr> <tr> <td>7.5</td> <td>16.46</td> <td>16.46</td> <td>0.936</td> <td>226.357</td> <td>-</td> <td>UNLIMITED</td> <td>0.915</td> <td>0.0212</td> <td>13.3347</td> <td>75.160.020</td> <td>0.00%</td> </tr> <tr> <td>10</td> <td>21.95</td> <td>21.95</td> <td>1.226</td> <td>296.645</td> <td>-</td> <td>175.790</td> <td>0.00%</td> <td>1.219</td> <td>0.0283</td> <td>23.7061</td> <td>6.517.854</td> </tr> <tr> <td>11</td> <td>24.15</td> <td>24.15</td> <td>1.341</td> <td>324.449</td> <td>27.026</td> <td>42.411</td> <td>63.72%</td> <td>1.341</td> <td>0.0311</td> <td>28.6844</td> <td>3.476.045</td> </tr> <tr> <td>12.5</td> <td>27.44</td> <td>27.44</td> <td>1.512</td> <td>365.875</td> <td>-</td> <td>5.245</td> <td>0.00%</td> <td>1.524</td> <td>0.0353</td> <td>37.0407</td> <td>1.580.417</td> </tr> <tr> <td colspan="12"><b>TANDEM AXLE TA</b></td> </tr> <tr> <td colspan="14">           8 Equivalent stress 210.23<br/>           9 Stress ratio Factor 0.381<br/>           10 Erosion Factor 2.94         </td> </tr> <tr> <td colspan="14"> <table> <tr><td colspan="2"><b>FATIGUE</b></td></tr> <tr><td>TAL</td><td>36</td></tr> <tr><td>Me</td><td>2603.00</td></tr> <tr><td>f1</td><td>1.017410755</td></tr> </table> </td> </tr> <tr> <td colspan="14"> <table> <tr><td colspan="2"><b>Pc (TA)</b></td></tr> <tr><td>OTHER</td><td>6.144</td></tr> <tr><td>OTHER</td><td>6.143771557</td></tr> <tr><td>OTHER</td><td></td></tr> <tr><td>OTHER</td><td></td></tr> </table> </td> </tr> <tr> <td>14</td> <td>30.73</td> <td>30.73</td> <td>0.877</td> <td>181.169</td> <td>-</td> <td>UNLIMITED</td> <td>0.854</td> <td>0.0228</td> <td>15.3988</td> <td>35.569.112</td> <td>0.00%</td> </tr> <tr> <td>17</td> <td>37.32</td> <td>37.32</td> <td>1.052</td> <td>217.442</td> <td>-</td> <td>UNLIMITED</td> <td>1.037</td> <td>0.0277</td> <td>22.7054</td> <td>7.566.640</td> <td>0.00%</td> </tr> <tr> <td>21.5</td> <td>47.19</td> <td>47.19</td> <td>1.312</td> <td>271.153</td> <td>-</td> <td>1,151,946</td> <td>0.00%</td> <td>1.311</td> <td>0.0350</td> <td>36.3168</td> <td>1,676,866</td> </tr> <tr> <td>22</td> <td>48.29</td> <td>48.29</td> <td>1.341</td> <td>277.077</td> <td>-</td> <td>669,423</td> <td>0.00%</td> <td>1.341</td> <td>0.0358</td> <td>38.0256</td> <td>1,461,211</td> </tr> <tr> <td colspan="12"><b>TRIDEM AXLE TRI</b></td> </tr> <tr> <td colspan="14">NR Repeticiones 1.00</td> </tr> <tr> <td>23.5</td> <td>51.58</td> <td>51.58</td> <td>0.975</td> <td>201.373</td> <td>-</td> <td>UNLIMITED</td> <td>1.433</td> <td>0.0382</td> <td>43.3877</td> <td>990.178</td> <td>0.00%</td> </tr> <tr> <td>24</td> <td>52.68</td> <td>52.68</td> <td>0.994</td> <td>205.398</td> <td>-</td> <td>UNLIMITED</td> <td>1.463</td> <td>0.0390</td> <td>45.2536</td> <td>875.863</td> <td>0.00%</td> </tr> <tr> <td colspan="12"><b>Total</b></td> </tr> <tr> <td colspan="12"><b>63.72%</b></td> </tr> <tr> <td colspan="12"><b>0.87%</b></td> </tr> </table> |                    |       |                   |                     |                  |           |                  |        |         |                       |                |  |  | Axle load kips | Multiplied for LSF | F1    | EQUIVALENT STRESS | Expected repetition | Fatigue analysis |        | Erosion Analysis |                           |    | Allowable Repetitions | Damage Percent | 1                  | 2    |     |     | 3                  | 4 | 5 | f5 | Dequiv        | P   | 6                          | 7  | 1                     | 2.20 | 2.20              | 0.141 | 34.059  | 216.209 | UNLIMITED | 0.122 | 0.0028 | 0.2371 | UNLIMITED |       | 3 | 6.59 | 6.59 | 0.395 | 95.660 | 99.096 | UNLIMITED | 0.366 | 0.0085 | 2.1335 | UNLIMITED |  | 3.5 | 7.68 | 7.68 | 0.457 | 110.576 | 27.026 | UNLIMITED | 0.427 | 0.0099 | 2.9040 | UNLIMITED |  | 6 | 13.17 | 13.17 | 0.758 | 183.527 | 126.122 | UNLIMITED | 0.732 | 0.0170 | 8.5342 | UNLIMITED |  | 8.2 | 18.00 | 18.00 | 1.017 | 246.162 | 27.026 | UNLIMITED | 1.000 | 0.0232 | 15.9400 | 30.324.872 | 0.09% | 6 | 13.17 | 13.17 | 0.758 | 183.527 | - | UNLIMITED | 0.732 | 0.0170 | 8.5342 | UNLIMITED |  | 7.5 | 16.46 | 16.46 | 0.936 | 226.357 | - | UNLIMITED | 0.915 | 0.0212 | 13.3347 | 75.160.020 | 0.00% | 10 | 21.95 | 21.95 | 1.226 | 296.645 | - | 175.790 | 0.00% | 1.219 | 0.0283 | 23.7061 | 6.517.854 | 11 | 24.15 | 24.15 | 1.341 | 324.449 | 27.026 | 42.411 | 63.72% | 1.341 | 0.0311 | 28.6844 | 3.476.045 | 12.5 | 27.44 | 27.44 | 1.512 | 365.875 | - | 5.245 | 0.00% | 1.524 | 0.0353 | 37.0407 | 1.580.417 | <b>TANDEM AXLE TA</b> |  |  |  |  |  |  |  |  |  |  |  | 8 Equivalent stress 210.23<br>9 Stress ratio Factor 0.381<br>10 Erosion Factor 2.94 |  |  |  |  |  |  |  |  |  |  |  |  |  | <table> <tr><td colspan="2"><b>FATIGUE</b></td></tr> <tr><td>TAL</td><td>36</td></tr> <tr><td>Me</td><td>2603.00</td></tr> <tr><td>f1</td><td>1.017410755</td></tr> </table> |  |  |  |  |  |  |  |  |  |  |  |  |  | <b>FATIGUE</b> |  | TAL | 36 | Me | 2603.00 | f1 | 1.017410755 | <table> <tr><td colspan="2"><b>Pc (TA)</b></td></tr> <tr><td>OTHER</td><td>6.144</td></tr> <tr><td>OTHER</td><td>6.143771557</td></tr> <tr><td>OTHER</td><td></td></tr> <tr><td>OTHER</td><td></td></tr> </table> |  |  |  |  |  |  |  |  |  |  |  |  |  | <b>Pc (TA)</b> |  | OTHER | 6.144 | OTHER | 6.143771557 | OTHER |  | OTHER |  | 14 | 30.73 | 30.73 | 0.877 | 181.169 | - | UNLIMITED | 0.854 | 0.0228 | 15.3988 | 35.569.112 | 0.00% | 17 | 37.32 | 37.32 | 1.052 | 217.442 | - | UNLIMITED | 1.037 | 0.0277 | 22.7054 | 7.566.640 | 0.00% | 21.5 | 47.19 | 47.19 | 1.312 | 271.153 | - | 1,151,946 | 0.00% | 1.311 | 0.0350 | 36.3168 | 1,676,866 | 22 | 48.29 | 48.29 | 1.341 | 277.077 | - | 669,423 | 0.00% | 1.341 | 0.0358 | 38.0256 | 1,461,211 | <b>TRIDEM AXLE TRI</b> |  |  |  |  |  |  |  |  |  |  |  | NR Repeticiones 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |  | 23.5 | 51.58 | 51.58 | 0.975 | 201.373 | - | UNLIMITED | 1.433 | 0.0382 | 43.3877 | 990.178 | 0.00% | 24 | 52.68 | 52.68 | 0.994 | 205.398 | - | UNLIMITED | 1.463 | 0.0390 | 45.2536 | 875.863 | 0.00% | <b>Total</b> |  |  |  |  |  |  |  |  |  |  |  | <b>63.72%</b> |  |  |  |  |  |  |  |  |  |  |  | <b>0.87%</b> |  |  |  |  |  |  |  |  |  |  |  |
| Axle load kips                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Multiplied for LSF | F1    | EQUIVALENT STRESS | Expected repetition | Fatigue analysis |           | Erosion Analysis |        |         | Allowable Repetitions | Damage Percent |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2                  |       |                   | 3                   | 4                | 5         | f5               | Dequiv | P       | 6                     | 7              |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.20               | 2.20  | 0.141             | 34.059              | 216.209          | UNLIMITED | 0.122            | 0.0028 | 0.2371  | UNLIMITED             |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6.59               | 6.59  | 0.395             | 95.660              | 99.096           | UNLIMITED | 0.366            | 0.0085 | 2.1335  | UNLIMITED             |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 3.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7.68               | 7.68  | 0.457             | 110.576             | 27.026           | UNLIMITED | 0.427            | 0.0099 | 2.9040  | UNLIMITED             |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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    |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 13.17              | 13.17 | 0.758             | 183.527             | 126.122          | UNLIMITED | 0.732            | 0.0170 | 8.5342  | UNLIMITED             |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 8.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 18.00              | 18.00 | 1.017             | 246.162             | 27.026           | UNLIMITED | 1.000            | 0.0232 | 15.9400 | 30.324.872            | 0.09%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 13.17              | 13.17 | 0.758             | 183.527             | -                | UNLIMITED | 0.732            | 0.0170 | 8.5342  | UNLIMITED             |                |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 7.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 16.46              | 16.46 | 0.936             | 226.357             | -                | UNLIMITED | 0.915            | 0.0212 | 13.3347 | 75.160.020            | 0.00%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 21.95              | 21.95 | 1.226             | 296.645             | -                | 175.790   | 0.00%            | 1.219  | 0.0283  | 23.7061               | 6.517.854      |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 24.15              | 24.15 | 1.341             | 324.449             | 27.026           | 42.411    | 63.72%           | 1.341  | 0.0311  | 28.6844               | 3.476.045      |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 12.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 27.44              | 27.44 | 1.512             | 365.875             | -                | 5.245     | 0.00%            | 1.524  | 0.0353  | 37.0407               | 1.580.417      |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| <b>TANDEM AXLE TA</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| 8 Equivalent stress 210.23<br>9 Stress ratio Factor 0.381<br>10 Erosion Factor 2.94                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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| <table> <tr><td colspan="2"><b>FATIGUE</b></td></tr> <tr><td>TAL</td><td>36</td></tr> <tr><td>Me</td><td>2603.00</td></tr> <tr><td>f1</td><td>1.017410755</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| <b>FATIGUE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| <table> <tr><td colspan="2"><b>Pc (TA)</b></td></tr> <tr><td>OTHER</td><td>6.144</td></tr> <tr><td>OTHER</td><td>6.143771557</td></tr> <tr><td>OTHER</td><td></td></tr> <tr><td>OTHER</td><td></td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| <b>Pc (TA)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| OTHER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| OTHER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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| OTHER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| OTHER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 30.73              | 30.73 | 0.877             | 181.169             | -                | UNLIMITED | 0.854            | 0.0228 | 15.3988 | 35.569.112            | 0.00%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 37.32              | 37.32 | 1.052             | 217.442             | -                | UNLIMITED | 1.037            | 0.0277 | 22.7054 | 7.566.640             | 0.00%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 21.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 47.19              | 47.19 | 1.312             | 271.153             | -                | 1,151,946 | 0.00%            | 1.311  | 0.0350  | 36.3168               | 1,676,866      |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 48.29              | 48.29 | 1.341             | 277.077             | -                | 669,423   | 0.00%            | 1.341  | 0.0358  | 38.0256               | 1,461,211      |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| <b>TRIDEM AXLE TRI</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |       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| NR Repeticiones 1.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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    |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 23.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 51.58              | 51.58 | 0.975             | 201.373             | -                | UNLIMITED | 1.433            | 0.0382 | 43.3877 | 990.178               | 0.00%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 52.68              | 52.68 | 0.994             | 205.398             | -                | UNLIMITED | 1.463            | 0.0390 | 45.2536 | 875.863               | 0.00%          |  |  |                |                    |       |                   |                     |                  |        |                  |                           |    |                       |                |                    |      |     |     |                    |   |   |    |               |     |                            |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   |       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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|       |       |       |        |         |           |                       |  |  |  |  |  |  |  |  |  |  |  |                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |     |    |    |         |    |             |                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |                |  |       |       |       |             |       |  |       |  |    |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |           |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| <b>63.72%</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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    |       |        |         |           |       |      |       |       |       |         |   |           |       |       |        |         |           |    |       |       |       |         |   |         |       |       |        |         |           |                        |  |  |  |  |  |  |  |  |  |  |  |                      |  |  |  |  |  |  |  |  |  |  |  |  |  |      |       |       |       |         |   |           |       |        |         |         |       |    |       |       |       |         |   |           |       |        |         |         |       |              |  |  |  |  |  |  |  |  |  |  |  |               |  |  |  |  |  |  |  |  |  |  |  |              |  |  |  |  |  |  |  |  |  |  |  |
| <b>0.87%</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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  |    |                       |      |                   |       |         |         |           |       |        |        |           |       |   |      |      |       |        |        |           |       |        |        |           |  |     |      |      |       |         |        |           |       |        |        |           |  |   |       |       |       |         |         |           |       |        |        |           |  |     |       |       |       |         |        |           |       |        |         |            |       |   |       |       |       |         |   |           |       |        |        |           |  |     |       |       |       |         |   |           |       |        |         |            |       |    |       |       |       |         |   |         |       |       |        |         |           |    |       |       |       |         |        |        |        |       |        |         |           |      |       |       |       |         |   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Ilustración 2. Revisión de diseño, espesor de losa de 20cm sobre 15cm de subbase y 20cm de granular existente.

Fuente: Elaboración propia.

### Estado de la observación:

Se atiende por parte del contratista. El Consultor menciona que el diseño estructural considera la contribución del afirmado existente, lo cual no fue tenido en cuenta por esta

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interventoría en su cálculo independiente. Se validan las premisas y los espesores de las alternativas presentadas.

Tras la revisión del documento “DISEÑO DE PAVIMENTO RÍGIDO, PROYECTO CORREDOR BLANQUITA FRONTINO DEPARTAMENTO DE ANTIOQUIA” en su versión 1, se han atendido las observaciones técnicas planteadas, y se considera que el diseño de pavimentos presentado por el Consultor es coherente con las premisas metodológicas y especificaciones técnicas (ver espesores relacionados en el numeral 8), por lo que puede considerarse técnicamente válido. No obstante, para poder dar inicio al proceso constructivo en campo, es indispensable que se entregue a el plano de modulación de losas y los respectivos detalles constructivos, ya que estos documentos son fundamentales para garantizar una correcta ejecución de la estructura proyectada y la trazabilidad técnica durante la obra.

Cordialmente,



**DIEGO ARMANDO OLAYA**  
I.C. M. Eng. Geotecnia UNAL  
ZENTAR INGENIERÍA S.A.S.

C. Controlada: Carpeta del proyecto  
Anexos: N.A.

Documento Técnico elaborado a los 24 días del mes de abril de 2025.

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