

## FLEXIBLE PAVEMENT DESIGN USING SOIL FACTORS<sup>1,4</sup>

Required Gravel Equivalency (G.E. in inches) for various Soil Factors (S.F.)

For new construction or reconstruction use projected ADT or HCADT; for reconditioning projects use present ADT or HCADT

<p><b>7 TON : LESS THAN 400 ADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">7</td><td style="text-align: center;">7.3<sup>5</sup></td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">7</td><td style="text-align: center;">9.4<sup>5</sup></td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">7</td><td style="text-align: center;">11.5</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">7</td><td style="text-align: center;">12.4</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">7</td><td style="text-align: center;">13.2</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">7</td><td style="text-align: center;">14</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	7	7.3 <sup>5</sup>	75	7	9.4 <sup>5</sup>	100	7	11.5	110	7	12.4	120	7	13.2	130	7	14	<p><b>9 TON : 151 TO 300 HCADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">7</td><td style="text-align: center;">14</td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">7</td><td style="text-align: center;">17.5</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">7</td><td style="text-align: center;">21</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">7</td><td style="text-align: center;">22.4</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">7</td><td style="text-align: center;">23.8</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">7</td><td style="text-align: center;">25.2</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	7	14	75	7	17.5	100	7	21	110	7	22.4	120	7	23.8	130	7	25.2	<p><b>9 TON : 1101 - 1500 HCADT <sup>2</sup></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">8</td><td style="text-align: center;">20.3</td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">8</td><td style="text-align: center;">26.4</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">8</td><td style="text-align: center;">32.5</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">8</td><td style="text-align: center;">35</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">8</td><td style="text-align: center;">37.4</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">8</td><td style="text-align: center;">39.8</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	8	20.3	75	8	26.4	100	8	32.5	110	8	35	120	8	37.4	130	8	39.8															
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	7	7.3 <sup>5</sup>																																																																														
75	7	9.4 <sup>5</sup>																																																																														
100	7	11.5																																																																														
110	7	12.4																																																																														
120	7	13.2																																																																														
130	7	14																																																																														
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	7	14																																																																														
75	7	17.5																																																																														
100	7	21																																																																														
110	7	22.4																																																																														
120	7	23.8																																																																														
130	7	25.2																																																																														
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	8	20.3																																																																														
75	8	26.4																																																																														
100	8	32.5																																																																														
110	8	35																																																																														
120	8	37.4																																																																														
130	8	39.8																																																																														
<p><b>7 TON : 400 to 1000 ADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">7</td><td style="text-align: center;">9<sup>5</sup></td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">7</td><td style="text-align: center;">12</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">7</td><td style="text-align: center;">15</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">7</td><td style="text-align: center;">16.2</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">7</td><td style="text-align: center;">17.4</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">7</td><td style="text-align: center;">18.6</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	7	9 <sup>5</sup>	75	7	12	100	7	15	110	7	16.2	120	7	17.4	130	7	18.6	<p><b>9 TON : 301 TO 600 HCADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">7</td><td style="text-align: center;">16</td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">7</td><td style="text-align: center;">20.5</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">7</td><td style="text-align: center;">25</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">7</td><td style="text-align: center;">26.8</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">7</td><td style="text-align: center;">28.6</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">7</td><td style="text-align: center;">30.4</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	7	16	75	7	20.5	100	7	25	110	7	26.8	120	7	28.6	130	7	30.4	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>TYPE OF MAT'L</u></th> <th style="text-align: center;"><u>SPECIFICATION</u></th> <th style="text-align: center;"><u>G.E. FACTOR</u></th> </tr> </thead> <tbody> <tr><td>Bituminous Pavement</td><td style="text-align: center;">2360</td><td style="text-align: center;">2.25</td></tr> <tr><td>Cold-Inplace Recycling (CIR)</td><td style="text-align: center;">2331</td><td style="text-align: center;">1.5</td></tr> <tr><td>Rubblized Concrete</td><td style="text-align: center;">2231</td><td style="text-align: center;">1.5</td></tr> <tr><td>Full-Depth Reclamation</td><td style="text-align: center;">2331</td><td style="text-align: center;">1.0</td></tr> <tr><td>Stabilized Full-Depth Reclamation</td><td style="text-align: center;">2331</td><td style="text-align: center;">1.5</td></tr> <tr><td>Aggregate Base class 5 &amp; 6</td><td style="text-align: center;">3138</td><td style="text-align: center;">1.0</td></tr> <tr><td>Aggregate Sub-Base class 3 &amp; 4</td><td style="text-align: center;">3138</td><td style="text-align: center;">0.75</td></tr> <tr><td>Select Granular Mat'l</td><td style="text-align: center;">3149.2B2</td><td style="text-align: center;">0.5</td></tr> </tbody> </table>	<u>TYPE OF MAT'L</u>	<u>SPECIFICATION</u>	<u>G.E. FACTOR</u>	Bituminous Pavement	2360	2.25	Cold-Inplace Recycling (CIR)	2331	1.5	Rubblized Concrete	2231	1.5	Full-Depth Reclamation	2331	1.0	Stabilized Full-Depth Reclamation	2331	1.5	Aggregate Base class 5 & 6	3138	1.0	Aggregate Sub-Base class 3 & 4	3138	0.75	Select Granular Mat'l	3149.2B2	0.5									
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	7	9 <sup>5</sup>																																																																														
75	7	12																																																																														
100	7	15																																																																														
110	7	16.2																																																																														
120	7	17.4																																																																														
130	7	18.6																																																																														
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	7	16																																																																														
75	7	20.5																																																																														
100	7	25																																																																														
110	7	26.8																																																																														
120	7	28.6																																																																														
130	7	30.4																																																																														
<u>TYPE OF MAT'L</u>	<u>SPECIFICATION</u>	<u>G.E. FACTOR</u>																																																																														
Bituminous Pavement	2360	2.25																																																																														
Cold-Inplace Recycling (CIR)	2331	1.5																																																																														
Rubblized Concrete	2231	1.5																																																																														
Full-Depth Reclamation	2331	1.0																																																																														
Stabilized Full-Depth Reclamation	2331	1.5																																																																														
Aggregate Base class 5 & 6	3138	1.0																																																																														
Aggregate Sub-Base class 3 & 4	3138	0.75																																																																														
Select Granular Mat'l	3149.2B2	0.5																																																																														
<p><b>9 TON : LESS THAN 150 HCADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">7</td><td style="text-align: center;">10.3<sup>5</sup></td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">7</td><td style="text-align: center;">13.9</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">7</td><td style="text-align: center;">17.5</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">7</td><td style="text-align: center;">19</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">7</td><td style="text-align: center;">20.5</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">7</td><td style="text-align: center;">22</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	7	10.3 <sup>5</sup>	75	7	13.9	100	7	17.5	110	7	19	120	7	20.5	130	7	22	<p><b>9 TON : 601 TO 1100 HCADT</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>S.F.</u></th> <th style="text-align: center;"><u>Minimum Bit. G.E.</u></th> <th style="text-align: center;"><u>Total G.E.</u></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">50</td><td style="text-align: center;">8</td><td style="text-align: center;">18.5</td></tr> <tr><td style="text-align: center;">75</td><td style="text-align: center;">8</td><td style="text-align: center;">23.7</td></tr> <tr><td style="text-align: center;">100</td><td style="text-align: center;">8</td><td style="text-align: center;">29</td></tr> <tr><td style="text-align: center;">110</td><td style="text-align: center;">8</td><td style="text-align: center;">31.1</td></tr> <tr><td style="text-align: center;">120</td><td style="text-align: center;">8</td><td style="text-align: center;">33.2</td></tr> <tr><td style="text-align: center;">130</td><td style="text-align: center;">8</td><td style="text-align: center;">35.3</td></tr> </tbody> </table>	<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>	50	8	18.5	75	8	23.7	100	8	29	110	8	31.1	120	8	33.2	130	8	35.3	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>AASHTO SOIL CLASS</u></th> <th style="text-align: center;"><u>SOIL FACTOR (S.F.)</u></th> <th style="text-align: center;"><u>ASSUMED R-VALUE</u></th> <th style="text-align: center;"><u>GENERAL <sup>3</sup> PLASTICITY</u></th> </tr> </thead> <tbody> <tr><td>A - 1</td><td style="text-align: center;">50 - 75</td><td style="text-align: center;">70 - 75</td><td style="text-align: center;">NP</td></tr> <tr><td>A - 2</td><td style="text-align: center;">50 - 75</td><td style="text-align: center;">30 - 70</td><td style="text-align: center;">SP</td></tr> <tr><td>A - 3</td><td style="text-align: center;">50</td><td style="text-align: center;">70</td><td style="text-align: center;">NP</td></tr> <tr><td>A - 4</td><td style="text-align: center;">100 - 130</td><td style="text-align: center;">20</td><td style="text-align: center;">SP</td></tr> <tr><td>A-5</td><td style="text-align: center;">130+</td><td style="text-align: center;">na</td><td style="text-align: center;">na</td></tr> <tr><td>A - 6</td><td style="text-align: center;">100</td><td style="text-align: center;">12</td><td style="text-align: center;">P</td></tr> <tr><td>A - 7 - 5</td><td style="text-align: center;">120</td><td style="text-align: center;">12</td><td style="text-align: center;">P</td></tr> <tr><td>A - 7 - 6</td><td style="text-align: center;">130</td><td style="text-align: center;">10</td><td style="text-align: center;">P</td></tr> </tbody> </table>	<u>AASHTO SOIL CLASS</u>	<u>SOIL FACTOR (S.F.)</u>	<u>ASSUMED R-VALUE</u>	<u>GENERAL <sup>3</sup> PLASTICITY</u>	A - 1	50 - 75	70 - 75	NP	A - 2	50 - 75	30 - 70	SP	A - 3	50	70	NP	A - 4	100 - 130	20	SP	A-5	130+	na	na	A - 6	100	12	P	A - 7 - 5	120	12	P	A - 7 - 6	130	10	P
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	7	10.3 <sup>5</sup>																																																																														
75	7	13.9																																																																														
100	7	17.5																																																																														
110	7	19																																																																														
120	7	20.5																																																																														
130	7	22																																																																														
<u>S.F.</u>	<u>Minimum Bit. G.E.</u>	<u>Total G.E.</u>																																																																														
50	8	18.5																																																																														
75	8	23.7																																																																														
100	8	29																																																																														
110	8	31.1																																																																														
120	8	33.2																																																																														
130	8	35.3																																																																														
<u>AASHTO SOIL CLASS</u>	<u>SOIL FACTOR (S.F.)</u>	<u>ASSUMED R-VALUE</u>	<u>GENERAL <sup>3</sup> PLASTICITY</u>																																																																													
A - 1	50 - 75	70 - 75	NP																																																																													
A - 2	50 - 75	30 - 70	SP																																																																													
A - 3	50	70	NP																																																																													
A - 4	100 - 130	20	SP																																																																													
A-5	130+	na	na																																																																													
A - 6	100	12	P																																																																													
A - 7 - 5	120	12	P																																																																													
A - 7 - 6	130	10	P																																																																													

Values may not be exact due to rounding

**Notes:**

<sup>1</sup>For 10 Ton design see Bituminous Pavement Design Chart (Aggregate Base)

<sup>2</sup>For HCADT over 1500 more advanced design procedures should be used; please contact Mn/DOT's Pavement Design Unit

<sup>3</sup>General Plasticity: NP = nonplastic; SP= semi-plastic; P = plastic; na = not applicable (An A-5 soil rarely occurs in Minnesota)

<sup>4</sup>Safety edge (30° to 35° wedge) are recommended to minimize edge dropoff. See [www.dot.state.mn.us/stateaid/sa\\_safety\\_edge.html](http://www.dot.state.mn.us/stateaid/sa_safety_edge.html)

<sup>5</sup>These GE values are for the finished pavement section. During construction additional GE may be warranted for a construction platform.