Chapter IV

THE CONDITION OF THE FREEWAY SYSTEM
AND NEED FOR RECONSTRUCTION

INTRODUCTION

This chapter provides an assessment of the existing condition of the freeway system and estimates the time frame during which each segment of that system will likely need to be reconstructed. To support this assessment, data on construction history and pavement and bridge condition was gathered for the 272 miles of pavement and 700 bridges on the freeway system in southeastern Wisconsin.

FREEWAY SYSTEM CONSTRUCTION HISTORY

The construction of the regional freeway system began in 1952 and continued through 1994, as shown on Map 4-1. All of the freeway system was constructed originally with concrete pavement. The original concrete pavement was designed to serve for a 20- to 25-year period, and then require an initial resurfacing. A 20-year design life is typical for concrete pavement with an undrained base, and a 25-year design life is typical for a concrete pavement with a drained base. Drained bases were not utilized for concrete pavements until the mid-1980’s. On average, based on historic construction data obtained from the Wisconsin Department of Transportation (WisDOT), the original pavement of the regional freeway system lasted about 19 years prior to requiring a first resurfacing. Factors contributing to the shorter than anticipated design life for the original freeway concrete pavement include greater than anticipated traffic, at least, in part due to the lack of completion of the original planned freeway system; greater than anticipated truck traffic volumes, weights, and axle loadings; and the effect of winter climate conditions including studded snow tires.
Map 4-1

ORIGINAL TIME PERIOD OF PAVEMENT CONSTRUCTION ON THE FREEWAY SYSTEM IN SOUTHEASTERN WISCONSIN

Source: Wisconsin Department of Transportation and HNTB
The first resurfacing or rehabilitation of a freeway pavement typically involves base patching and spot improvement of the original concrete pavement, and resurfacing with a hot asphaltic pavement mix. As an alternative to resurfacing with a hot asphaltic pavement mix, the original concrete pavement, following base patching and spot improvement, could undergo diamond grinding to restore a smooth pavement and ride quality. Typically, resurfacing with a hot asphaltic pavement mix has been the strategy favored by WisDOT, usually with a two-layer asphaltic pavement overlay. A first resurfacing should last for 12 to 15 years.

The second resurfacing or rehabilitation typically includes milling off all or part of the first asphaltic overlay, and replacing it with a new two-layer asphaltic overlay. As part of the second rehabilitation, WisDOT will often recycle a great portion of the milled pavement. The second pavement resurfacing, also typically includes base patching as necessary. A second resurfacing should last for 8 to 10 years. Because of the condition of the original concrete pavement, the base underlying that pavement, and the attendant stormwater drainage system, a freeway pavement usually requires reconstruction following the second resurfacing. However, third resurfacings, or rehabilitations, have been completed in the past and are scheduled for the future, as the funding for reconstruction has not been available and pavement repair has been needed before preliminary and final engineering for reconstruction could be completed and funding secured. Third resurfacings of the original pavement generally are not considered cost-effective, typically expected to last from 5 to 8 years. Owing to the continued deterioration of the underlying pavement, each subsequent resurfacing, or rehabilitation, does not last as long as the previous resurfacing or the original pavement. This pavement life cycle is illustrated in Figure 4-1.

**ESTIMATION OF FREEWAY PAVEMENT AND BRIDGE LIFE EXPECTANCY**

The life expectancy of the freeway system was determined by evaluating the existing condition and construction history of the pavement and bridges. Bridge data from WisDOT’s annual inspection program and pavement data from WisDOT’s biennial inspection program was used to rate the condition of individual freeway segments and project their life expectancy. The life expectancy of the system pavement was calculated in 0.10 mile segments. This information was then averaged for 35 individual freeway segments within the seven county Region. The life expectancies of the system bridges were also determined and then averaged for each of the 35 freeway segments to permit a comparison between the life expectancies of the freeway pavements and the freeway bridges.

**Pavement Life Expectancy Assessment**

The determination of the life expectancy of the freeway pavement is based on a methodology developed, refined and applied by WisDOT. The methodology considers the original construction date and subsequent resurfacing records of each 0.10-mile freeway segment. The record of resurfacing, or rehabilitation, of the freeway system through 1999 is graphically illustrated on Maps 4-2 through 4-4. Pavement resurfacing, or rehabilitation, projects which have occurred since 1999, and are programmed to occur prior to 2003, are summarized in Table 4-1 and
FIGURE 4-1

TYPICAL FREEWAY PAVEMENT LIFE CYCLE

Source: Wisconsin Department of Transportation and SEWRPC.
Map 4-2
FIRST REHABILITATION AND RESURFACING OF FREEWAYS IN SOUTHEASTERN WISCONSIN
(Through 1999)

Time Period of First Rehabilitation

- 1960 - 1969
- 1970 - 1979
- 1980 - 1989
- 1990 - 1999

Source: Wisconsin Department of Transportation and HNTB
Map 4-3
SECOND REHABILITATION AND RESURFACING OF FREEWAYS IN SOUTHEASTERN WISCONSIN
(Through 1999)

Time Period of Second Rehabilitation

- 1976 - 1977
- 1982 - 1989
- 1991 - 1999

Source: Wisconsin Department of Transportation and HNTB
Map 4-4
THIRD REHABILITATION AND RESURFACING OF FREEWAYS IN SOUTHEASTERN WISCONSIN (Through 1999)

Time Period of Third Rehabilitation

1994 - 1999

Source: Wisconsin Department of Transportation and HNTB
<table>
<thead>
<tr>
<th>Construction Year</th>
<th>County</th>
<th>Freeway</th>
<th>Construction Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Washington</td>
<td>USH 41/45</td>
<td>Rehabilitation #3</td>
<td>South of CTH Q to North of Pioneer Road, NB&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Waukesha</td>
<td>USH 41/45</td>
<td>Rehabilitation #2</td>
<td>Milwaukee Co. line to CTH Q, NB&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Milwaukee</td>
<td>USH 45</td>
<td>Rehabilitation #2</td>
<td>Capitol Drive to Good Hope Road, NB&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Milwaukee</td>
<td>USH 45</td>
<td>Rehabilitation #2</td>
<td>Zoo Interchange to Capitol Drive, NB&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Milwaukee</td>
<td>IH 894</td>
<td>Rehabilitation #3</td>
<td>Belton Overpass to Zoo Interchange, NB&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2001</td>
<td>Waukesha</td>
<td>IH 94</td>
<td>Rehabilitation #3</td>
<td>CTH SS Interchange</td>
</tr>
<tr>
<td>2001</td>
<td>Racine</td>
<td>IH 94</td>
<td>Rehabilitation #3</td>
<td>CTH SS to CTH G</td>
</tr>
<tr>
<td>2002</td>
<td>Milwaukee</td>
<td>IH 43</td>
<td>Rehabilitation #2</td>
<td>North Racine Co. Line to South Racine Co. Line</td>
</tr>
<tr>
<td>2002</td>
<td>Milwaukee</td>
<td>IH 43</td>
<td>Rehabilitation #2</td>
<td>Marquette Interchange to Lexington Boulevard</td>
</tr>
<tr>
<td>2003</td>
<td>Milwaukee</td>
<td>IH 894</td>
<td>Rehabilitation #3</td>
<td>Belton Overpass to Mitchell Interchange</td>
</tr>
</tbody>
</table>

<sup>a</sup> Rehabilitation and resurfacing in the southbound lanes of these segments was competed in 2000.

<sup>b</sup> Some locations within this freeway segment have already been resurfaced a third time. For these locations, this is the fourth rehabilitation.

Source: Wisconsin Department of Transportation and HNTB.
In addition, six relatively minor pavement reconstruction projects totaling seven miles have been completed since 1994: the interchange of CTH G with IH 94, the interchange of STH 16 with IH 94, the interchange of IH 43 and Silver Spring Drive, the North Interchange of USH 45 with USH 41, STH 100, STH 145, a segment of USH 41 in the vicinity of CTH K, and Miller Park Way. Reconstruction was performed at these locations to provide reconfigured and improved interchanges and to correct substandard physical design. Pavement replacement was completed as part of these projects, consisting of removing and replacing the entire pavement structure, including the base underneath the pavement.

WisDOT uses both a Pavement Serviceability Index (PSI) and Pavement Distress Index (PDI) to measure pavement condition. PSI is a measure of pavement ride quality. PSI is determined by measuring the deflections, rutting, and roughness of the pavement by means of a profilograph. PSI is measured on a scale from 0 to 5, with 0 being a poor ride quality and 5 an excellent ride quality. PDI is a measure of pavement structural condition. PDI is determined through field inspection of the elements of pavement distress, which may indicate material or structural problems in addition to natural deterioration of pavement over time. PDI may range from 0 to 100, and is a weighted average of eleven elements of distress for asphalt pavements and twelve elements of distress for concrete pavements. These elements of distress for each type of pavement are listed in Table 4-2. To calculate PDI, each element of pavement distress is identified in the field along with its severity. For example, longitudinal cracking in concrete pavement is assigned a severity based on the length and width of the crack.

The WisDOT pavement evaluation methodology permits a projection of pavement life expectancy, and the consequent need for resurfacing and reconstruction based on total expected cost over a total 50-year design life of the pavement segment, including the life of the original pavement and subsequent resurfacings (rehabilitations). The pavement life expectancy projection considers pavement condition as measured by PDI and PSI; total and truck average daily traffic volume; construction history, including the original construction date; and the number and timing of subsequent resurfacings (rehabilitations).

Map 4-6 and Figure 4-2 presents the results of the freeway system pavement life expectancy projections for the seven county Southeastern Wisconsin Region. Most of the freeway system in southeastern Wisconsin is expected to reach the end of its design life within the next twenty years. There are exceptions at several locations where reconstruction projects have already been completed or where life expectancy extends to 2030. Of the approximately 272 miles comprising the system, 40 miles of pavement may be expected to require reconstruction between the years 2001 and 2005, 73 miles between 2006 and 2010, 59 miles between 2011 and 2015, and 37 miles between 2016 to 2020. The remaining 63 miles includes about 7 miles which already have been reconstructed in recent years and 56 miles which would be expected to have a life expectancy between 2021 and
For some portions of IH 894, the programmed resurfacing and rehabilitation will be its fourth resurfacing and rehabilitation. This resurfacing is programmed at this time so that it will be open for traffic during reconstruction of the Marquette Interchange in 2004-2007.
### WISCONSIN DEPARTMENT OF TRANSPORTATION PAVEMENT DISTRESS INDICATORS

<table>
<thead>
<tr>
<th>ASPHALTIC PAVEMENTS</th>
<th>CONCRETE PAVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Cracking</td>
<td>Slab Breakup</td>
</tr>
<tr>
<td>Alligator Cracking</td>
<td>Joint Crack Filling</td>
</tr>
<tr>
<td>Transverse Cracking</td>
<td>Distressed Joints/Cracks</td>
</tr>
<tr>
<td>Longitudinal Cracking</td>
<td>Patching</td>
</tr>
<tr>
<td>Flushing</td>
<td>Surface Distresses</td>
</tr>
<tr>
<td>Edge Raveling</td>
<td>Longitudinal Joint Distress</td>
</tr>
<tr>
<td>Surface Raveling</td>
<td>Transverse Faulting</td>
</tr>
<tr>
<td>Patching</td>
<td>Wide Cracks</td>
</tr>
<tr>
<td>Rutting</td>
<td>Punch Outs</td>
</tr>
<tr>
<td>Transverse Distortion</td>
<td>Diagonal Cracking</td>
</tr>
<tr>
<td>Longitudinal Distortion</td>
<td>Pavement Deterioration</td>
</tr>
<tr>
<td></td>
<td>Delamination</td>
</tr>
</tbody>
</table>

*Source: Wisconsin Department of Transportation.*
Map 4-6
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE SOUTHEASTERN WISCONSIN FREEWAY SYSTEM

PROJECTED TIME PERIOD FOR RECONSTRUCTION
- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030
- RECENTLY RECONSTRUCTED

Source: Wisconsin Department of Transportation and HNTB.
Figure 4-2
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE SOUTHEASTERN WISCONSIN FREEWAY SYSTEM

Does not include seven miles of recently reconstructed freeway segments.

Source: Wisconsin Department of Transportation and HNTB.
2030. Maps 4-7 to 4-13 and Figure 4-3 illustrate the projected life expectancy for the freeway system pavements within each of the seven counties.

**Bridge Life Expectancy Assessment**

The projection for freeway bridge life expectancy was completed by estimating the original design life of each bridge, subtracting the age of the bridge, and subtracting additional years based on the evaluation of condition ratings of each bridge. Data provided by WisDOT for each bridge included structure type, age, history of work performed on the structure, load ratings, and condition ratings of major structural elements. The estimation of life expectancy specifically considered structure age, condition ratings of major structural elements, and structural load carrying capacity as defined by the following:

- Age of the bridge – Original construction date.
- Substructure Condition Rating – Condition Rating of the piers and abutments.
- Superstructure Condition Rating – Condition Rating of the beams and girders.
- Inventory Rating – Safe loading of a bridge for an indefinite time period.

The substructure and superstructure condition ratings were selected for consideration in the projection of bridge life expectancy because they most directly reflect the structural condition of the primary bridge elements, and directly relate to remaining bridge life. The condition rating of the bridge deck was not included in this evaluation since it is common practice to rehabilitate or replace bridge decks on an as-needed basis to extend the life of the bridge.

The structure age generally has the greatest influence on the remaining bridge life. The WisDOT Bridge Manual uses a life expectancy of 70 to 75 years for bridges designed with modern standards. For this study, a 60-year bridge life was used, for three reasons. First, the majority of the bridges in the study area were constructed 30 to 40 years ago, prior to implementation of bridge design practices such as the use of epoxy coated reinforcing steel and structural steel analysis which can account for fatigue cracking. Second, the bridges in southeastern Wisconsin carry high traffic volumes, in comparison to the rest of the State. Finally, the bridges have been exposed to severe climate changes and heavy salting applications.

The condition ratings are based on on-site inspections of each bridge structure, conducted as part of the WisDOT annual bridge inspection program. The superstructure and substructure ratings are on a numerical scale from 0 to 9. The FHWA National Bridge Inspection Standards define the rating scale:
Map 4-7

PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN KENOSHA COUNTY

PROJECTED TIME PERIOD FOR RECONSTRUCTION

- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030
- RECENTLY RECONSTRUCTED

Source: Wisconsin Department of Transportation and HNTB.
Map 4-8
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN MILWAUKEE COUNTY

PROJECTED TIME PERIOD FOR RECONSTRUCTION
- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030
- RECENTLY RECONSTRUCTED

Scale in Miles

Source: Wisconsin Department of Transportation and HNTB.
Map 4-9
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN Ozaukee County

PROJECTED TIME PERIOD FOR RECONSTRUCTION

- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030
- RECENTLY RECONSTRUCTED

Source: Wisconsin Department of Transportation and HNTB.
Map 4-10
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN RACINE COUNTY

PROJECTED TIME PERIOD FOR RECONSTRUCTION
- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030
- RECENTLY RECONSTRUCTED

Source: Wisconsin Department of Transportation and HNTB.
Map 4-11
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN WALWORTH COUNTY

PROJECTED TIME PERIOD FOR RECONSTRUCTION
- **2001 - 2005**
- **2006 - 2010**
- **2011 - 2015**
- **2016 - 2020**
- **2021 - 2030**

**RECENTLY RECONSTRUCTED**

*Source: Wisconsin Department of Transportation and HNTB.*
Map 4-12
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN WASHINGTON COUNTY

<table>
<thead>
<tr>
<th>PROJECTED TIME PERIOD FOR RECONSTRUCTION</th>
<th>SCALE IN MILES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001 - 2005</td>
<td>0 1 2 4</td>
</tr>
<tr>
<td>2006 - 2010</td>
<td></td>
</tr>
<tr>
<td>2011 - 2015</td>
<td></td>
</tr>
<tr>
<td>2016 - 2020</td>
<td></td>
</tr>
<tr>
<td>2021 - 2030</td>
<td></td>
</tr>
<tr>
<td>RECENTLY RECONSTRUCTED</td>
<td></td>
</tr>
</tbody>
</table>

Source: Wisconsin Department of Transportation and HNTB.
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE FREEWAY SYSTEM IN WAUKESHA COUNTY

Map 4-13

PROJECTED TIME PERIOD FOR RECONSTRUCTION

- 2001 - 2005
- 2006 - 2010
- 2011 - 2015
- 2016 - 2020
- 2021 - 2030

RECENTLY RECONSTRUCTED

Source: Wisconsin Department of Transportation and HNTB.
Figure 4-3
PROJECTED TIME PERIOD WHEN PAVEMENT RECONSTRUCTION WILL BE REQUIRED ON THE SOUTHEASTERN WISCONSIN FREEWAY SYSTEM BY COUNTY

Does not include seven miles of recently reconstructed freeway segments.

Source: Wisconsin Department of Transportation and HNTB.
9 Excellent condition
8 Very good condition—no problems noted
7 Good condition—some minor problems
6 Satisfactory condition—structural elements show some minor deterioration
5 Fair condition—all primary structural elements are sound, but may have minor section loss, racking, spalling or scour
4 Poor condition—advanced section loss, deterioration, spalling or scour
3 Serious condition—loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2 Critical condition—advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
1 “Imminent” failure condition—major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.
0 Failed condition—out of service—beyond corrective action.

The condition of the superstructure and substructure were weighted equally with regards to their impact on remaining bridge life. The evaluation deducts years from the remaining life relative to the severity of the bridge condition, with the lower the rating the higher the deduction for remaining life. The deductions are cumulative in that years may be deducted for both poor superstructure ratings and poor substructure ratings. The deductions are also based on a two-tier scale, defined by the structure age. A bridge of 30 years or more in age received deductions from its life expectancy of 20, 10, and 0 years for superstructure and substructure ratings of 3, 4, and 5 through 9, respectively. A bridge of less than 30 years in age received deductions from its life expectancy of 25, 15, 8, and 0 years for superstructure and substructure ratings of 0 through 3, 4, 5, and 6 through 9, respectively.

Inventory, or Load, Ratings were also factored into the evaluation to reflect the load carrying capacity of the structure. The bridge Inventory Rating is a measure of the bridge’s degree of serviceability. The American Association of State Highway and Transportation Officials (AASHTO) defines Inventory Rating as the load that can safely utilize an existing structure for an indefinite period. A typical bridge is designed for a minimum Inventory Rating of HS20. For all bridges evaluated, deductions of 10, 5, and 0 years were used for ratings of less than HS16, HS16 to less than HS20, and HS20 and above, respectively. These reductions pertained to all bridges, regardless of age. Table 4-3 summarizes the rating scales and the corresponding deductions. Table 4-4 shows an example of a calculation of remaining life for a bridge based on this methodology.
### Table 4-3

**BRIDGE RATING SCALE AND CORRESPONDING DEDUCTIONS**

<table>
<thead>
<tr>
<th>SUPERSTRUCTURE AND SUBSTRUCTURE RATING</th>
<th>INVENTORY RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older Bridges (Over 30 Years)</td>
<td>Ratings</td>
</tr>
<tr>
<td>0-3</td>
<td>20 years</td>
</tr>
<tr>
<td>4</td>
<td>10 years</td>
</tr>
<tr>
<td>5-9</td>
<td>0 years</td>
</tr>
<tr>
<td></td>
<td>6-9</td>
</tr>
<tr>
<td>Younger Bridges (Less than 30 Years)</td>
<td>Ratings</td>
</tr>
<tr>
<td>&lt; HS16</td>
<td>10 years</td>
</tr>
<tr>
<td>HS16 ≤ X &lt; HS20</td>
<td>5 years</td>
</tr>
</tbody>
</table>

*Source: Wisconsin Department of Transportation and HNTB.*
### Table 4-4

**BRIDGE LIFE EXPECTANCY EXAMPLE CALCULATIONS**

<table>
<thead>
<tr>
<th></th>
<th>Ratings</th>
<th>Deductions</th>
<th>Years</th>
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<tbody>
<tr>
<td>Original Life Expectancy</td>
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</tr>
<tr>
<td>Structure Age</td>
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<td>(32 years)</td>
<td></td>
</tr>
<tr>
<td>Inventory rating</td>
<td>HS18</td>
<td>(5 years)</td>
<td></td>
</tr>
<tr>
<td>Superstructure rating</td>
<td>7</td>
<td>(0 years)</td>
<td></td>
</tr>
<tr>
<td>Substructure rating</td>
<td>6</td>
<td>(0 years)</td>
<td></td>
</tr>
<tr>
<td>Total years deducted</td>
<td></td>
<td>(37 years)</td>
<td></td>
</tr>
<tr>
<td>Life Expectancy of Bridge</td>
<td></td>
<td></td>
<td>23</td>
</tr>
</tbody>
</table>

* Bridge B-67-134 (IH 43 northbound at Beloit Road)

Source: HNTB
IH 794 from the Marquette Interchange to Carferry Drive, including the Hoan Bridge, and the High Rise, or Menomonee Valley, Bridge (IH 94) south of the Marquette Interchange should be considered unique structures for this study due to their length. The life expectancies of these three structures will dictate their schedule for replacement, unlike other bridges where bridge replacement would likely occur along with roadway pavement replacement. The methodology described above for the minor structures was also used to estimate the remaining life of the major structures.

The unexpected failure of the northbound roadway approach structure to the Hoan Bridge in December of 2000 is an example of the uncertainty of estimating remaining bridge life. The evaluation of this segment of bridge indicated that the average remaining life for the Hoan Bridge and its approaches is 29 years. This is probably still a valid estimate for those roadway spans that are not composed of three girder systems. To date, it has not been determined if the superstructures for these approach structures will be rehabilitated or fully replaced. If they undergo rehabilitation, the three girder system approach structures should provide a life span of at least 29 years. If they undergo full superstructure replacement, the approach structures should provide a life span of at least that of the remaining life of the substructure.

The evaluation for the segment of IH 794, east of the Marquette Interchange to the Lakefront, indicated that the average remaining life for these bridge units is 14 years. Currently, a pre-design investigation is underway for the Marquette Interchange and this segment of IH 794. Two basic alternatives are under consideration. One is the Full Reconfiguration/Reconstruction of the Marquette Interchange. This requires removal and full replacement of the bridges carrying IH 794, to the lakefront. Another alternative is consideration for “Replace (Bridges) As Needed”. This alternative will require full removal and replacement or rehabilitation of the freeway bridges as determined appropriate on a case by case basis. The rehabilitation would provide an additional 30 years of remaining life for these bridges, but would not accommodate any operational or capacity improvements for the Marquette Interchange or its approach legs.

The evaluation for the High Rise, or Menomonee Valley, bridge (IH 94) south of the Marquette Interchange, indicated that the average remaining life for these bridge units is 25 years.

The bridge life expectancies prepared for this report are planning level estimates based on data provided by WisDOT and engineering experience and judgement. Although actual life expectancies for each bridge may vary from these estimates, the aggregate results are suitable for the planning level detail of this study. Most of the structures in this study have reached an age where normal rehabilitation such as deck rehabilitation or replacement
are required. These major rehabilitation expenditures will be required to reach the complete bridge lives summarized in this report.

Map 4-14 illustrates the expected freeway system bridge life and replacement/reconstruction need for the seven county Southeastern Wisconsin Region. A comparison of projected bridge life expectancy as shown in Map 4-14 and projected pavement life expectancy as shown on Map 4-6 indicates that remaining freeway bridge life is generally about 10 to 15 years greater than remaining freeway pavement life. As a result, it may be expected that freeway bridges will be replaced during reconstruction of the freeway pavement.

**SUMMARY AND CONCLUSIONS**

This chapter illustrated the need for reconstruction of the pavement structures and bridges on the regional freeway system and the time frame in which such reconstruction needs to be completed. The life expectancies of the pavements and bridges were determined by evaluating data received from WisDOT. The pavements and bridges were evaluated using separate parameters. Each bridge was evaluated individually and averaged over a segment length to compare the bridge life expectancy to that of the pavement life expectancy within the freeway segment.

The pavement evaluation was based on the original construction date as well as all subsequent rehabilitations that were performed on the pavement. The methodology used to evaluate the remaining life expectancy of the pavement considered the construction and rehabilitation history, total and truck daily traffic volume, and PSI and PDI indicators used by WisDOT for all freeway segments within their database.

The bridge evaluation was based on an estimated service life, age of bridge, substructure and superstructure ratings, and inventory ratings that indicate the load bearing capacity of the bridge. This data was obtained from WisDOT. These factors were then used to determine the average remaining life expectancy of the bridges within the freeway segment.

Based on the methodologies for the pavement and bridges, the life expectancy time frames were estimated for individual freeway segments for pavements and bridges. Most of the freeway system pavement was determined to require reconstruction in the time period 2005 to 2015, while the majority of bridges were estimated to need to be replaced between the years 2020 and 2030. As a result, it may be expected that the freeway bridges will be replaced during the reconstruction of the roadway pavement.

* * *
Bridge life expectancy was calculated for each individual bridge within the study area. Bridge data was not available for USH 12 in Walworth County, STH 16 in Waukesha County, and USH 41/USH 45 in Washington and Waukesha Counties, but will be added when it becomes available. This map represents the average bridge life over a segment.