Chapter III
I-69 Design Exceptions Notebook

Project Location

This project is situated in Lyon, Caldwell, Hopkins, Webster and Henderson Counties in Western Kentucky. The project corridor runs along the Wendell H. Ford (Western Kentucky) Parkway, from I-24 near Eddyville in Lyon County to the Edward T. Breathitt (Pennyrile) Parkway in Hopkins County, then along the Breathitt Parkway north to Henderson at or near the Henderson Bypass (KY 425) in Henderson County. The larger towns situated along and/or near the project corridor are Eddyville, Dawson Springs, Madisonville and Henderson.

Study Purpose

The purpose of this study is to review existing conditions along those segments of the Ford and the Breathitt Parkways within the project corridor, identifying locations where the Parkways do not adequately meet current AASHTO highway design guidelines for interstates. These design elements, along with the degree to which they fall short of those guidelines, have been documented in order to identify potential options for making improvements necessary to bring these elements up to current interstate standards and to identify those for which design exceptions will be appropriate.

Design Exception Criteria

There are 13 controlling design criteria (those for which design exceptions will be necessary if not met) as specified by the Federal Highway Administration (FHWA). These criteria are:

Design Speed
Lane Width
Shoulder Width
Bridge Width
Structural Capacity
Horizontal Alignment
Vertical Alignment
Grade
Stopping Sight Distance
Cross Slope
Superelevation
Vertical Clearance
Horizontal Clearance (not including clear zone)

Design Exception Features

Through field investigations, "as-built" plan checks and other supplemental information, the following design criteria has been considered along the project corridor. Specific items have been noted as being substandard for current AASHTO standards:

A. **Design Speed** – Given that the study corridor is mainly rural with Rolling Terrain, a Design Speed of 70 mph was used for determining the geometric criteria for this study. The existing roadway meets these criteria.

B. **Lane Width** – AASHTO dictates that all driving lanes for interstate routes are at least 12 feet wide. All driving lanes of the existing parkways meet these criteria.

C. **Shoulder Width** –

Outside Shoulders: AASHTO requires outside shoulders to be a minimum of 10 feet. All outside shoulders are paved the required minimum width of 10 feet and are graded a minimum of 12 feet wide with the exception of MP 34.271 to MP 46.069 on the Breathitt Parkway, which is graded (and paved) only 10 feet wide. AASHTO also states where truck traffic exceeds 250 Directional Design Hour Volume (DDHV), a paved shoulder width of 12 feet should be considered. Based on truck projections, a portion of the route (Breathitt MP 34 to MP 45) near Madisonville will surpass this threshold by the 2030 design year.

Inside Shoulders: All inside shoulders where a 36 foot wide depressed median occurs (Ford Parkway MP 0.0 to MP 9.855 & the entire length on the Breathitt Parkway) have been graded a minimum of 6 feet but have been paved only 3 feet wide. This is less than the 4 foot width AASHTO requires.

D. **Bridge Width** – Bridges on routes being incorporated into the interstate system must have a minimum width of 37.5 feet, allowing for two 12 foot driving lanes, a 10 foot outside shoulder and a 3.5 foot inside shoulder. Long bridges (200 feet long or more) may be more narrow, but must maintain a minimum width of 31 feet. This provides two 12 foot driving lanes and a minimum of 3.5 feet for both the inside and outside shoulders. 12 bridges along the Wendell H. Ford Parkway fail to meet these requirements. 8 bridges along the Edward T. Breathitt Parkway fail to meet these requirements. There are also 4 bridges along the Ford Parkway and 10 bridges along the Breathitt Parkway that have existing brush block curbs which should be updated. See **Bridge Data Tables C.1** and **C.3** in **Appendix C** for details.

E. **Structural Capacity** – There are no deficiencies concerning Structural Capacity for the existing bridges along this corridor.

F. **Horizontal Alignment** – The horizontal curvature of both parkways meets AASHTO minimum radius requirements.

G. **Vertical Alignment** – The vertical alignment is the combination of grades and sight distance. The vertical grades on the two roadways meet criteria. The stopping sight distance issues are discussed in paragraph I.

H. **Grade** – For a Design Speed of 70 mph, AASHTO limits the maximum grade for Rolling Terrain to 4.0 percent. All vertical grades on the two parkways meet this constraint.

I. **Stopping Sight Distance** – A minimum Stopping Sight Distance of 730 feet is required by AASHTO standards for a Design Speed of 70 mph. There are five vertical curves on the Ford Parkway and three vertical curves on the Breathitt Parkway that do not meet this requirement. See **Stopping Sight Distance Table C.5** for details.

J. **Cross Slope** – In general, the mainline Cross Slopes along the study corridor meet current AASHTO requirements. However, while the minimum of 1.5 percent is met (utilizing a Cross Slope of 3/16":1'), the majority fail to meet the desired 2 percent Cross Slope for driving lanes. The exception to this is a segment of the Ford Parkway (MP 0.00 – MP 3.729) that has a Cross Slope of ¼":1' or 2.08 percent. Also, Cross Slopes for paved shoulders should fall in the range of two to six percent. There is a segment of the Breathitt Parkway (MP 34.271 - MP 46.069) where the inside and outside paved shoulders are actually sloped ¾":1' (or 6.25 percent), which is technically outside of this given range of slopes. Pavement rehabilitation along the parkways has in the past brought the cross slopes to the desired 2 percent.

K. **Superelevation** – The majority of the existing Superelevation rates along the study corridor do not meet current AASHTO recommendations. The Superelevation rates taken from the existing plans were compared to current AASHTO Superelevation rates and included in **Superelevation Table C.6**. Although not matching AASHTO's rates precisely, the superelevation rates are functionally adequate and should not require any independent correction. Pavement rehabilitation along the parkways has in the past brought the superelevation rates to numeric compliance.

L. **Vertical Clearance** – AASHTO requires Vertical Clearance of structures at underpasses to be a minimum of 16 feet. There are six overpasses along the Ford Parkway and two overpasses along the Breathitt Parkway that fail to meet minimum clearance. Two of the overpasses on the Ford Parkway fail to meet clearance on the shoulder only. One of the overpasses on the Breathitt Parkway fails to meet clearance on the shoulder only. Data collected for this item have been included in **Bridge Data Tables C.2 and C.4**.

M. **Horizontal Clearance** (not including clear zone) – Horizontal clearance would include any appurtenances along the roadway including bridge rails. The only horizontal clearance issues would include the existing bridge widths. These are considered in the bridge width discussion.

Design Variances

The following design variances are essential design elements that are not included in the FHWA's 13 controlling design criteria. They also include any variances from the AASHTO Design Standards for Interstate System.

A. **Interchange Ramp Acceleration and Deceleration lengths** – Several interchange ramp acceleration and deceleration lengths do not meet AASHTO guidelines and/or KYTC common practice. See **Interchange Data Table C.7** for details.

B. **Median Width** – Median width for interstate routes should be a minimum of 36 feet wide according to current AASHTO standards. There is a portion of the Ford Parkway (MP 9.855 – MP 38.332) that does not meet this condition. See **Median/Ditch Data Table C.8** for details.

C. **Guardrail End Treatments** - There are 89 Type 7 Guardrail End Treatments (41 on the Ford Parkway and 48 on the Breathitt Parkway) that need to be replaced along the study corridor. The type 7 end treatments should be replaced with current standard end treatments. There are 30 Type 3 Guardrail End Treatments (19 on the Ford Parkway and 11 on the Breathitt Parkway) that are substandard and need to be replaced. See **Guardrail Data Table C.9** through **C.13** for details.

D. **Interchange Spacing** – According to AASHTO Design Standards for Interstate System, minimum interchange spacing in rural areas should be 3 miles or 1 mile in urban areas. There is one location on the Ford Parkway and one location on the Breathitt Parkway where the minimum spacing is not met. On the Ford Parkway, this occurs between Exit 12 (KY 91) and Exit 13 (KY 293). On the Breathitt Parkway, this occurs between Exit 44 (KY 281) and Exit 45 (US 41). Auxiliary lanes can be constructed between the two interchanges which will allow them to perform as an individual interchange.

E. **Ditch Width** – The existing ditches along both parkways are primarily 8' with 3:1 foreslope. Common practice would suggest 10' ditches with a required minimum 4:1 foreslope.

Preliminary Cost Estimates

Preliminary cost estimates to upgrade the substandard features mentioned above have been determined and are as follows:

Outside Shoulder Width – The estimated cost to widen the outside shoulder from 10 feet graded and paved to 10 feet paved and 12 feet graded, in order to accommodate widening for guardrail is:

Breathitt Parkway MP 34.271 to MP 46.069 is $825,860 (or $70,000 per mile).

Inside Shoulder Width- The estimated cost to widen the inside shoulder from 3 feet to 4 feet is:

Ford Parkway MP 0.0 to MP 9.855 is $689,850 (or $70,000 per mile).
Breathitt Parkway MP 34.271 to MP 76.258 is $2,939,090 (or $70,000 per mile).

Bridge Width – The Wendell H. Ford Parkway has 12 bridges that need widening at an estimated total cost of approximately $1.133 million. The Edward T. Breathitt Parkway has 8 bridges that need widening at an estimated total cost of approximately $748,000. There are also 4 bridges along the Ford Parkway and 10 bridges along the Breathitt Parkway that have existing brush block curbs which should be updated. These can be replaced with constant slope face wall for an estimated cost of approximately $286,000. See **Bridge Data Tables C.1** and **C.3** for details.

Stopping Sight Distance –There are five vertical curves on the Ford Parkway and three vertical curves on the Breathitt Parkway that do not meet minimum criteria. The total estimated cost to bring the vertical curves to current standards is approximately $1.7 million. See **Table C.5 Stopping Sight Distance Data** for detailed information.

Vertical Clearance - There are six overpasses along the Ford Parkway and two along the Breathitt Parkway that fail to meet minimum clearance. In order to determine preliminary costs, it is assumed that these bridges will be replaced with full shoulders. Further study may prove solutions such as undercutting or jacking as being less costly. However, the current study assumes complete replacement. The estimated cost to replace seven of the overpasses is approximately $4.5 million. See **Bridge Data Tables C.2** and **C.4** for details. The KY 109 Bridge over the Ford Parkway will likely be replaced with the reconstruction of the interchange, therefore, that cost was included in the construction estimate shown in the discussion for interchange ramps.

Interchange Ramps acceleration and deceleration lengths - Several interchange acceleration and deceleration lanes do not meet AASHTO taper length requirements. Other ramps meet or exceed these standards but do not conform to KYTC common practice. It is recommended that these tapers be lengthened as shown in **Table C.7 Interchange Data**. The preliminary total cost of improving the substandard acceleration and deceleration lanes falling below common practice is approximately $6.4 million. This does not include Ford Parkway KY 109 Exit 24 and Breathitt Parkway KY 56 Exit 63 which are existing Toll Booth style interchanges. These interchanges should be reconstructed due to the deficient ramp configurations and are estimated to cost approximately $10 million each. The above estimate also does not include the I-24/Ford Parkway system interchange or the Ford Parkway/Breathitt Parkway system interchange. The system interchanges have been studied to determine how to maintain route continuity for I-69. These are shown in the discussion for system interchanges.

Median Width – There are approximately 28.5 miles of 30 foot median along this portion of the Ford Parkway. Since widening the median will most likely be cost prohibitive, it is suggested to construct a median barrier to minimize crossover crashes. 28.5 miles of cable guardrail would cost approximately $4 million.

Guardrail End Treatments - There are 89 Type 7 Guardrail End Treatments (41 on the Ford Parkway and 48 on the Breathitt Parkway) that need to be replaced along the study corridor. There are 30 Type 3 Guardrail End Treatments (19 on the Ford Parkway and 11 on the Breathitt Parkway) that are substandard and need to be upgraded. Utilizing an average cost of $3500 per end treatment to replace the Type 7's, it will cost approximately $311,500 to replace. Utilizing an average cost of $1000 per end treatment to upgrade the Type 3's, it will cost approximately $30,000. The total cost to replace and upgrade the guardrail end treatments is $341,500. See **Guardrail Data Table C.9** for details.

Interchange Spacing - Auxiliary lanes are proposed between the Ford Parkway Exit 12 and Exit 13 interchanges which will allow them to perform as an individual interchange. The construction estimates for these auxiliary lanes is $2.6 million. An auxiliary lane is also proposed between the Northbound Breathitt Parkway Exit 45 US 41 and Exit 44 KY 281. An auxiliary lane was constructed for the southbound Breathitt Parkway between Exit 45 and Exit 44 during a pavement rehabilitation project. The estimated cost for adding the northbound auxiliary lane is $200,000.

Ditch Width – Based on investigation of segments along the Ford Parkway and the Breathitt Parkway, an estimated 22 miles of the Ford Parkway and 23 miles of the Breathitt Parkway are in cut sections. The estimated cost to widen the ditches along the Ford Parkway is $3.4 million. The estimated cost to widen the ditches along the Breathitt Parkway is $3.6 million. These estimates do not include potential right of way costs.

Systems Interchanges

There are two system interchanges within the I-69 study area: I-24 with the Ford Parkway and the Breathitt Parkway with the Ford Parkway. The implementation of I-69 will require adjustments to these locations to accommodate through interstate traffic movements.

I-24 with the Ford Parkway

The existing I-24 interchange is a trumpet-style configuration with four connecting ramps between the roadways. The inclusion of the parkway into the interstate system will make ramps A and B (eastbound I-24 to eastbound Ford and westbound Ford to westbound I-24) through interstate movements, subject to full interstate design criteria. Upgrading this facility to these standards at or near the current location will cause extensive impacts due to the proximity of various features. The I-24 interchange with KY 293 is 3.1 miles away; an inlet of Barkley Lake and its associated causeway are also located 4500 feet east of the interchange with the parkway. An inlet of Barkley Lake, its bridge and causeway stand 1300 feet west the existing interchange. An interchange with US 62 is 2 miles west of the parkway/I-24 interchange. A major electrical transmission line runs north of and parallel to I-24 in the immediate vicinity.

The creation of a modern Interstate System interchange for I-24 with future I-69 and I-66 at or near the current I-24/Ford Parkway interchange location would lead to extensive impacts and extremely high costs. A conceptual design was developed, shown in **Figure C.1** in **Appendix C**, including AASHTO-compliant through movements for each interstate and auxiliary lanes to address spacing requirements between the existing US 62 and KY 293 interchanges. This configuration relocates the Ford Parkway 3000 feet to the southeast and I-24 1500 feet north to create a three level structure. Portions of the existing I-24 alignment would be utilized as I-69 through movements and ramps. Construction limits would extend from the I-24/US 62 interchange in the east to the I-24/KY 293 interchange in the west and 2300 feet north of KY 3305 along the parkway alignment. Construction cost estimates for this configuration come to around $74 million in addition to $5.1 million for right-of-way acquisition and $5.8 million for utility relocations, resulting in a total project cost of $84.9 million.

To minimize costs and environmental impacts, it would be reasonable to seek a design exception for the I-24/Ford Parkway interchange. As shown in **Figure C.2**, adding lanes to the existing Ramps A and B will provide the required additional width/capacity. However the design speed remains at 45 mph on Ramp A and 50 mph on Ramp B. By adding a third lane to eastbound I-24 just east of the structure and extending the second lane on Ramp A back to the mainline, two lanes for both I-69 and I-24 are provided at the eastbound divergence. A third lane added to the westbound parkway north of the interchange and carried along Ramp B provides a two lane through movement on I-69 and a one lane, left handed exit ramp to eastbound I-24. Preliminary costs for this strategy are estimated at $7 million for new construction (including $3.1 million for pavement rehabilitation within the interchange area), $60,000 for additional right-of-way, and

$100,000 for utility relocations . This brings the total estimate for this interchange to $7.26 million.

Ford/Breathitt Interchange

As portions of the Ford and Breathitt Parkways are designated as I-66 and I-69, the interchange between the two roadways becomes more complex than the existing infrastructure allows. As shown in **Figure C.3,** interstate design criteria can be met for this facility by moving the I-66/I-69 split west of the existing interchange. A flyover for northbound I-69 allows I-69 to separate from I-66 eastbound movements and rejoin the existing alignment north of the existing Ford/Breathitt interchange. Six of the eight ramps at the existing interchange provide connectivity between I-66 and the remaining Breathitt parkway. All interstate through movements maintain a 2 lane, 70 mph design speed. Estimated new construction costs for this scenario are approximately $37 million (including $2.4 million for pavement rehabilitation). Right-of-way acquisition and utility relocation costs are estimated at $4 million each for a total cost of approximately $45 million anticipated for this interchange.

Design Exceptions/Variances

Attached on page III-9 is a table listing the FHWA 13 controlling design criteria and the potential design variances involved in the subject project. As the I-69 project progresses, pursuing design exceptions and/or compliance with accepted design practice for some deficiencies may become advisable. Based on current data, design exceptions may be appropriate for design speed at the Ford/Breathitt system interchange and the I-24 system interchange, stopping sight distance, superelevation, median width, interchange spacing, and ditch width.

- As explained in the system interchange discussion, it would be reasonable to request a design speed exception to accommodate the I-69 through movements at the I-24 and Ford/Breathitt system interchanges.
- Stopping sight distances are substandard on eight vertical curves in the study section. It is reasonable to request design exceptions since these vertical curves are close to meeting current criteria.
- The superelevation rates vary along the roadway. Many of the areas along the parkways have been rehabilitated, improving superelevation rates to current standards. The remaining sections will be upgraded with future pavement rehabilitation projects. Therefore, it is reasonable to request a design exception.
- The median width is deficient by AASHTO interstate standards along approximately 28.5 miles of the Ford Parkway. This can be remedied by adding a barrier median. However, a design exception may be appropriate initially due to low traffic volumes and as traffic increases along the parkway, a determination for constructing the barrier median could be considered based on safety performance at that time.
- A similar argument can be made for the interchange spacing. The spacing between Exit 12 and 13 on the Ford Parkway and between Exit 44 and 45 on the Breathitt Parkway can be resolved by adding an auxiliary lane in each direction between the interchanges. It would be appropriate to request a design exception. As traffic increases along the parkway, a determination for the need of the auxiliary lane can be made based on the resulting roadway performance and vehicle crash history.

- The ditch widths/slopes along both parkways don't meet current KYTC guidance. A design exception should be considered.

A significant consideration for approving a design exception is the relationship between the deficient features and crash rates. An analysis was completed to determine whether any correlation existed between the noncompliant features and high crash rates. The analysis did not indicate a correlation between geometry and vehicle crashes. Therefore, design exceptions are reasonable for above features. As traffic volumes increase, the safety performance of each roadway should be monitored and consideration given to any necessary hazard mitigations.

Planned Future Projects

The 2006 Enacted Six-Year Highway Plan FY 2007-2012 indicates a number of projects along the Ford Parkway and Breathitt Parkway within the study area. The following are pavement rehabilitation projects:

Wendell H. Ford Parkway

Caldwell Co.	Item No. 2-2051	MP 14.85 to 18.26	Let March '07
Hopkins Co.	Item No. 2-2049	MP 27.52 to 36.962	Let March '07

Edward T. Breathitt Parkway

Hopkins Co.	Item No. 2-2050	MP 35.55 to 37.07	Let November '06
Webster/Henderson	Item No. 2-2041	MP 61.85 to 65.393	Let December '06
Henderson Co.	Item No. 2-2038	MP 70.45 to 75.63	Let July '06

There is also a Henderson Co. (Item No. 2-8304) project to reconstruct/complete the half interchange at KY 416 (Exit 68) to facilitate access to and from the south. There is approximately $5 million of state funds with design in FY '07, right of way and utilities in FY '08 and construction in FY '09.

Tables and Attachments **Page**

Additional tables and attachments may be found in **Appendix C**.

Design Exceptions Summary	III-9
System Interchange Figures 1 - 3	Apx. C
Bridge Data Tables (1-4)	Apx. C
Stopping Sight Distance Table 5	Apx. C
Superelevation Data Table 6	Apx. C
Interchange Data Table 7	Apx. C
Median/Ditch Data Table 8	Apx. C
Guardrail Data Tables (9-13)	Apx. C

DESIGN EXCEPTIONS SUMMARY

	Meets Criteria (Yes or No)	Cost to Cure ($)	Design Exception/Variance should be requested	Explanation
13 Design Criteria				
Design Speed	No		Yes	See the explanation for the I-24/Ford Parkway System Interchange and the Ford/Breathitt Parkway System Interchange.
Lane Width	Yes			
Shoulder Width	No	$4.45 million	No	The inside shoulders need to be widened from 3' to 4' paved from MP 0 to MP 9.855 on the Ford Parkway and for the entire length of the Breathitt Parkway. The outside shoulders need to be widened on the Breathitt Parkway from MP 34.271 to MP 46.069 to accommodate guardrail.
Bridge Width	No	$2.17 million	No	There are 12 bridges on the Ford Parkway & 8 bridges on the Breathitt Parkway that need to be widened. There are 4 bridges on the Ford Parkway & 10 bridges on Breathitt Parkway with brush blocks.
Structural Capacity	Yes			
Horizontal Alignment	Yes			
Vertical Alignment	Yes			
Grade	Yes			
Stopping Sight Distance	No	$1.7 million	Yes	There are 5 deficient vertical curves on the Ford Parkway and 3 deficient vertical curves on the Breathitt Parkway. Only one of these deficient vertical curves is a crest and all are close to meeting criteria.
Cross Slope	Yes			
Superelevation	No	N/A	Yes	Although not matching AASHTO's rates precisely the superelevation rates are functionally adequate. Pavement rehabilitation along the parkways has in the past brought the superelevation rates to numeric compliance.
Vertical Clearance	No	$4.5 million	No	There are 6 overpasses on the Ford Parkway & 2 overpasses on the Breathitt Parkway that do not meet vertical clearance requirements. This does not include the KY 109 overpass which is proposed to be reconstructed with the interchange.
Horizontal Clearance	Yes			
Design Variances				
Acceleration & Deceleration lengths	No	$6.4 million	No	This does not include the Ford Exit 24 Interchange or the Breathitt Exit 63 Interchange. These are old toll booth interchanges with reconstruction costs of $10.65 million and $10.25 million[1], respectively. This also does not include the I-24/Ford System Interchange or the Ford/Breathitt System Interchange.
Median Width	No	$4 million	Yes	There are 28 miles of 30 foot median. To fix this, a median barrier must be constructed (use cable guardrail).
Guardrail End Treatments	No	$341,500	No	There are 89 Type 7 End Treatments that need to be replaced and 30 Type 3 End Treatments that need to be upgraded.
Interchange Spacing	No	$2.8 million	Yes	Auxiliary lanes are needed on the Ford Parkway between Exit 12 and Exit 13 and on the NB Breathitt Parkway between Exit 45 to Exit 44.
Ditch Width	No	$7 million	Yes	It would cost $3.4 million to fix the Ford and $3.6 million to fix the Breathitt. This does not include potential right of way costs
I-24/Ford Parkway Interchange	No	$7.3 million[1]	Yes	Due to physical constraints, add width to existing ramps and request a design exception for 45 mph design speed.
Ford/Breathitt System Interchange	No	$45 million[1]	Yes	Construct I-66/I-69 split west of existing Ford/Breathitt Interchange.

[1] Costs include right-of-way, utilities, and construction cost estimates