Chapter 6 Presentation Script

Welcome

Welcome to the Manual on Uniform Traffic Studies,
also called MUTS, computer based training!
This training module will cover Chapter 6 - Data Collection
for Safety Analysis of Freeway Facilities.

This training contains audio, so please adjust your speakers accordingly.
An alternate version is available on the resources page.
To begin select the start button or press Shift + N on your keyboard.

Form Access

During this training module, we will refer to three forms in excel format
stored on the MUTS online library through the FDOT's Traffic Engineering
and Operations Office website.

Before continuing the training, consider scanning the QR code
using your phone camera which directs you to the online library shown in this slide.
The link to the form is also provided in the resources page to this training.
Please open Form numbers 750-020-06a, 750-020-06b and 750-020-06c
as we will refer to them later in the module.

Introduction

This chapter covers the data collection for transportation safety studies
on freeway facilities.
The goal of this chapter is to provide guidance on the data collection requirements
for conducting transportation safety studies on freeway facilities,
including the application of Highway Safety Manual
or HSM Chapters 18 and 19 methodologies
implemented using the Enhanced Interchange Safety Analysis Tool.
We will call this tool ISATe.

Safety Study Basics

Let’s take a look at some safety studies basics.
The purpose of a transportation safety study is to identify potential hazards
and select possible safety countermeasures.
Transportation safety studies can be broadly classified
as reactive to a given location's crash history
or predictive of a given location's potential crash frequency
based on its geometric and traffic characteristics.
This chapter focuses on the data collection requirements
for the predictive safety studies.

HSM Background – Predictive Method Procedure

The predictive method presented in Part C of the HSM allows for the computation
of the predicted average crash frequency and the expected average crash frequency
at a given location.
The expected average crash frequency combines
the predicted average crash frequency with recorded historical crash data
using weighting factors.
Let’s take a closer look at the components needed to calculate
the predicted crash frequency.

The predicted average crash frequency consists of three primary components,
the safety performance function, also called SPF,
which predicts average crash frequency for base conditions,
the crash modification factors also called CMFs
are for given geometric or traffic control features varying from the base conditions,
and the local calibration factor.

The calculation of the predicted average crash frequency is described in detail
in HSM Chapters 18 and 19.
This training focuses on the data collection activities
required to conduct this calculation.

FDOT has not yet developed local calibration factors for freeway
and ramp facilities so this will be 1.00 until these factors become available.
Refer to the FDOT Design Manual or FDM Chapter 122 for available calibration factors.
This training describes the data collection components required for the implementation
of the predictive method.

ISATe Tool & Resources

The ISATe Tool is a spreadsheet based on implementing
HSM Chapter 18 and Chapter 19 methodologies.
HSM Chapter 18 covers the predictive method for freeways and Chapter 19
covers the predictive method for freeway ramps.
This MUTS chapter will walk through the data collection needs for the ISATe Tool.

These data collection forms can also be used to record data for facility types
that are not currently covered under the methodologies
presented in HSM Chapters 18 and 19.
For further HSM training, visit the FDOT Roadway Design/Quality
Assurance/Training website.
The ISATe Tool and user manual can be accessed
through the Highway Safety Manual website at the provided link on the resources page.
Use the FDOT's Traffic Engineering and Operations Office website
as a resource to obtain a copy of the modified ISATe Tool
which have Florida based crash cost calculations capabilities.

Freeway Data Collection Needs

This chapter covers freeway data collection needs for three broad site types:
freeway segments, ramp segments, and ramp terminals.
While the traffic and geometric data collection needs are explained in detail,
further data collection information regarding historical crash data collection,
collision diagram development, and condition diagram development
can be seen in MUTS Chapter 5.

Freeway Segments

It is important to understand there are three basic segments
to the freeway – freeway, ramp, and crossroad which is the ramp terminal intersection.
Let’s take a closer look at the freeway segment.

The freeway consists of the freeway segment and the speed-change lane.
The freeway segment is for both directions of travel and the number
of through lanes should reflect this.

The number of lanes should not include any high-occupancy vehicle or managed lanes.
The length should be measured in the increasing milepost direction
of travel after the 2-foot-wide marked gore point.
Let’s take a closer look at the speed-change lane.

Freeway Segments: Speed Change Lanes

Speed change lanes should not be included in the freeway segment's length.
There are two types of speed change lanes - parallel and taper.
The speed change lane's length is defined as the roadway area
between where the marked gore is 2 feet wide and the taper point
of the ramp's merge or diverge area.

MUTS Chapter 6 Forms Overview

Before we dive into the data collection forms for Safety Analysis of Freeway Facilities,
it will be helpful to understand the resources available through the MUTS website.
Here is a snapshot of the process and the corresponding forms available.
The form selection varies based on the facility type being analyzed.
Let's start with HSM Chapter 18: Freeway Segments and its corresponding form.

These forms can be accessed by visiting the FDOT MUTS website
or by scanning the QR code on the slide with a cellphone camera.

Form No. 750-020-06a

Let's get started with the data collection requirements.
Form 750-020-06a is used for freeway segments.
The form is set up to match the data requirements of the ISATe Tool.
A separate form should be used for each freeway segment.
The data elements collected through this form contribute towards the computation
of 13 CMFs for the freeway segment.

There is basic header information to be included on the form.
The form is two pages with six data collection sections.
These are basic roadway data, horizontal curve data, cross section data,
roadside data, and ramp access data.

In addition to this roadway data, traffic and crash data will be required
to conduct the predictive analysis but are not included in this data collection form.
Let's take a look at this form in greater detail.

Basic Roadway Data

After completing the header part, we will get into the Basic Roadway Data.
The first is Area Type. This uses rural versus urban guidance
based on FHWA guidelines,
which specifies that places within urban boundaries with a population
greater than 5,000 are considered urban,
and places outside urban areas with population less than 5,000 are considered rural.

The FDOT urban boundary maps are an excellent source for this information.
The next input is the number of through lanes which is again a bi-directional value.
The next value is segment length measured in miles.
This is typically the distance between speed change lanes,
but other segmentation criteria provided in the HSM can be applied.

Horizontal Curve Data

The next data collection section is the presence of a horizontal curve
on one or both roadbeds.
This is the first question and is answered “Yes” or “No.”
If a horizontal curve is present, then there are three needed data elements.
The first is the curve radius entered in feet.
This is generally obtained from roadway plans.
If the two roadbeds have different radius, then each are separately recorded.

The next is the length of curve measured in miles.
This is measured from the point where the curve begins or P.C.
to the point where the curve ends or P.T.

The last element is the length of curve in the segment also measured in miles.
This is confined to the segment's boundaries so it cannot exceed
the segment or curve length.

Cross Section Data – Part 1

The cross section data starts with the lane width in feet.
This is the average for all through lanes.
The shoulder width is the paved shoulder width and is reported
separately for inside and outside shoulder.
Again, an average value should be used.

The median width, recorded in feet, is measured between edges
of opposite direction travel lanes which includes the inside shoulders if present.
If there is a substantial change in median width,
a new freeway segment should be created.

The presence of rumble strips on the outside and inside shoulders
is a yes/no question.
If answered “Yes,” the length of rumble strips in miles
for each direction of travel is to be recorded.

Cross Section Data – Part 2

Cross section data also includes the consideration for median barrier.
The first question asks if median barrier is present or not present.
If present, there may be multiple pieces of median barrier within a freeway segment.
Each piece of median barrier is measured, and its length is reported in miles.
The distance to the nearest travel lane in feet is also recorded.
Often this will vary as barrier tapers toward or away from the travel lane
and are reported as an average distance.

If a continuous median barrier is present, then report the barrier's width
and distance from the barrier to the nearest edge of the traveled way.

Roadside Data

The next data entry is for roadside data.
The first data element is the clear zone width in feet.
Then the presence of roadside barrier is reported as either none,
some or full using the dropdown menu.

If “Some” is selected, there are five entry points to provide the length of roadside barrier
in feet and the distance from the edge of travel lane to the barrier face.
If more than five entry points are needed,
consider using a second form to supplement the data collection.
Again, this is an average value for the barrier's length and is in feet.

If there is full barrier along both sides, then you only need to enter the values
at the bottom of the section for distance from edge of travel lane to the barrier's face.
This is done in two separate values for increasing and decreasing mileposts.

Ramp Access Data

The ramp access data takes a bit to understand, and we will take a few slides to cover.
First it is important to note that data collection is completed separately
for each direction of travel.

The form is set up for increasing milepost direction
followed by the decreasing milepost direction.
The methodology for these is the same.
Understanding two definitions is critical to entering the ramp access data.

These are Type B weave and the begin segment milepost related to the ramp gore points.
Let’s take a look at these data elements.

First, we will discuss the Type B weave.
This weaving section can have the following characteristics:
one of the two weaving movements can be made without making any lane changes,
the other weaving movement requires only one lane change,
and the entrance and exit ramps associated with the weaving section
are located on the freeway's right side.

Note that the weaving section length is measured
along the freeway's edge of travel lane from the gore point of the ramp entrance
to the gore point of the ramp exit.

Now, let’s take a look at how to locate any entrance and exit ramps
within or near the segment.
If there is no ramp within the segment or the ramp's gore point
is more than 0.5 miles from the segment,
there is no ramp, and the length is coded as 999.

The length is measured from the segment boundary to the ramp's gore point.
The images to the right provide two graphical representations
on the reference points to use when defining the begin mileposts
to measure the segment’s length.

For example, the length measured from the segment to the exit ramp gore point
for the exit ramps is shown in red.
In a similar fashion, the length measured from the entrance ramp gore point
to the segment is shown in blue.

Let's return to the ramp access data elements on the form.
The first data entry is whether there is an entrance or exit ramp in the segment.
The pull-down menu has *None, SC lanes or Speed change lanes* and *Add or drop a lane*.
Most ramps are speed-change lanes allowing traffic to accelerate
or decelerate for entrance or exit ramps, respectively.

When there is a speed change lane, you will need to enter the distance
from the begin milepost to the upstream entrance or exit ramp gore point in miles.
Again, the begin milepost is the milepost at the beginning of the segment.
There are three additional items of required information.
First is the length of ramp which is from the ramp's taper point
to the gore point measured in miles.
This was previously defined in the segmentation discussion as the speed change lane.
The next element is the length of ramp within the freeway segment.
For speed change lanes, you will also need to enter the roadway side
where the entrance or exit ramp is located.

The final part of the data entry regards whether there is a Type B weave in the segment.
If so, the length weaving section in miles as defined two slides ago and the length
of weaving section in segment are to be entered.

This completes the data entry requirements for Form 750-020-06a.
As previously noted, the analyst will need to collect two additional data requirements
for the freeway safety analysis: Traffic Data and Crash Data.
We will cover these next although these are not to be populated
under Form 750-020-06a.

Traffic Data

The values for bi-directional average annual daily traffic or AADT need to be entered.
Multiple years of AADTs both existing and future can be entered.
When entering the data into the ISATe Tool,
you will be asked the question of Proportion of AADT during high-volume hours.
This is defined as the proportion of a 24-hour day where the hourly volumes
exceed 1,000 vehicles per hour per lane.
The AADTs to be entered are freeway segment which are bi-directional volumes
in addition to each entrance and exit ramp volume.

ISATe: Traffic

Let's take a look at the ISATe Tool.
The bottom of the slide shows the available tabs within the tool.
The data input is arranged by facility type which includes:
freeway segments, ramp segments, and ramp terminals.
As shown on this screen capture, the traffic data is recorded by segment.
The AADT input should be entered for those years which data is available.
The tool will interpolate the missing years.

Within the Input Freeway Segments tab in the ISATe Tool,
the traffic data input is broken down as follows:
freeway segment data, entrance and exit ramp data for travel
in increasing milepost direction, entrance and exit ramp data for travel
in decreasing milepost direction.

Crash Data

The crash data is the final data requirement for the freeway segment analysis.
It is recommended five years of crash data be obtained
and each year can be entered into the ISATe Tool.
The crashes need to be broken into two broad categories
being Fatal and Injury Crashes and Property Damage Only or PDO crashes.
The freeway segment crashes need to be further categorized
as multiple and single vehicle crashes for both categories.
The ramp related crashes are those in the speed change lanes
for the entrance and exit ramps.

ISATe: Crash Data

Let's take a look at the ISATe Tool.
The data input for crashes within the tool is in the same tab as the traffic data or AADT.
For the Input Freeway Segments tab the crash data requirements
are broken down by Fatal and Injury crashes by year
and by Property Damage Only crashes by year.
For either severity level, the crashes are broken down by multiple-vehicle crashes,
single-vehicle crashes, ramp-entrance-related crashes,
and ramp-exit-related crashes.

Freeway Segments: Example

This example is part of a comparative evaluation of different interchange forms considered for a proposed interchange.
This example is for a diamond interchange.
This example will be used throughout this training module.
While the alternatives will have different ramp configurations the freeway's mainline needs to be considered in the analysis.
The study area's limits are established to have a common begin and end point for all interchange alternatives.
The study area begins at milepost 5.41 and ends at milepost 6.75.
The two red circles are in the begin and end points of the study area.

Freeway Segmentation

The first step in the freeway analysis is the segmentation.
The ramp's speed-change lanes are used for the segmentation.
Freeway Segment 1 extends from the Begin Study Area at milepost 5.41 to the northern most part of the southbound on-ramp speed change lane at milepost 5.66.
The speed change lane for the northbound off-ramp is included in Freeway Segment 1.

Freeway Segment 2 begins at milepost 5.66 and continues to milepost 6.25 where the northbound on-ramp speed change lane starts.
This segment does not contain any speed change lanes.

Freeway Segment 3 starts at milepost 6.25 where the northbound on-ramp's speed change lane begins and continues to the End Study Area at milepost 6.75.
This segment also contains the southbound off-ramp speed change lane.

Basic Roadway Data

For our project example, we would need to complete three versions of Form 750-020-06a, one for each freeway segment.
For purposes of this training, we will complete the form for Segment 1 only as it contains two speed change lanes.
We will begin with the basic roadway data.
This project location is in a rural area, so the rural area type is selected.

The interstate has three through lanes in each direction so the number of through lanes is six.
The segment length is the distance from milepost 5.41 to milepost 5.66 which is 0.25 miles.

You can also see additional data on the table from developing the interchange preliminary plans for today's training.
We will focus on Segment 1 for the purpose of this training.

Horizontal Curve Data

The next part of the data collection form is the horizontal curve data.
There is no horizontal curve present so using the pull-down menu select "Not present."
No further data needs to be entered for our example.

Cross Section Data

Proceeding on to cross section data, we will use the information shown in the table obtained from the preliminary plans.
The preliminary plans show this segment to have 12-foot-wide lanes and 12-foot-wide inside and outside paved shoulders.
The median width is 40 feet.
Rumble strips are proposed for the inside and outside shoulders throughout the project's length which is 0.25 miles.

The next part of the cross section data regards the presence of median barrier.
A continuous crossover median double-sided guardrail
is present at the northbound lanes edge of the paved shoulder.
This is entered in the pull-down menu for "presence of barrier in median" as “Offset”.
The median barrier is present throughout the segment's length which is 0.25 miles.
The distance from the edge of traveled way to the median barrier face is 12 feet.
No further data needs to be entered for additional barrier lengths.
The last input we will record on this section is the median barrier.
The median barrier width is calculated from the median width, 40 feet,
minus the offset distance of 12 feet and guardrail average width of 2 feet.
The median width is recorded as 26 feet.

Roadside Data

There is also roadside data to be entered which is for outside the traveled way.
The clear zone width is 30 feet.
As indicated in the table there is 150 feet of roadside barrier
at 15 feet from the lane or traveled way.
Because there is only a short section of roadside barrier,
select "Some" from the pull-down menu.
The length of the roadside barrier, 150 feet,
needs to be entered into the table in miles which is 0.0284 miles.
Lastly, the distance from the edge of the traveled way
to the roadside barrier face is 15 feet as noted in the table.

In this short segment, there is only one roadside barrier.
If a segment had multiple roadside barriers or barriers on both roadsides,
the additional barrier fields would be used.
If more than five entry points are needed, a second form can be used.

Ramp Access Data

The ramp access data is entered first in increasing milepost direction
and then in decreasing milepost direction.
The increasing milepost direction has an exit ramp
so for "ramp entrance in segment" we answer “No” in the pull-down menu
and no further data is required until we get to "ramp exit in segment".
This is a speed change lane ramp, so we selected “SC Lane” from the pull-down menu.

The next data entry is for the distance from the begin milepost
to upstream exit ramp gore in miles.
This is from mile post 5.41 to milepost 5.64 or 0.23 miles.
The length of ramp exit is from milepost 5.59 to milepost 5.64 or 0.05 miles.
Since the entire length of ramp exit is in the segment this is also 0.05 miles.
The ramp is on the freeway's right side so “Right” is selected for exit side.
There is no weaving section so select “No” for Type B weave in segment.

We now move to entering the freeway in decreasing milepost direction
for the ramp access data.
There is an entrance ramp in this direction which is a speed change lane or SC lane.
The distance from the begin milepost at 5.41 to the upstream entrance ramp
gore milepost at 5.66 is 0.25 miles.

The length of ramp entrance is from the taper point at milepost 5.48
to the gore point at milepost 5.66 or 0.18 miles.
The ramp is on the freeway's right side so “Right” is selected for entrance side.
The segment does not contain an exit ramp so “No” is selected
for "ramp exit in segment.”

There is no weaving section so select “No” for Type B weave in segment.
This completes data requirements for Form 750-020-06a.
You will still need to enter the freeway and ramp AADTs
into the ISATe Tool and the freeway crash data for this segment.

MUTS Chapter 6 Forms Overview

Now let’s continue with HSM Chapter 19: Freeway Ramp Segments,
its data collection requirements, and its corresponding form.

Form No. 750-020-06b

The freeway ramp segments data collection is reported on Form 750-020-06b.
There is basic header information to be included on the form.
The form is two pages and has five basic sections to include basic roadway data,
horizontal alignment data, cross section data, roadside data, and ramp access data.

To conduct the analysis in ISATe both traffic and crash data
are needed but not included on the form.
The data elements in the five sections listed contribute towards 9 CMFs.
An individual form is required for each ramp segment.

Freeway Ramp Segments

Before we get into the ramp segments data collection,
let's discuss some basic definitions for ramps.
First, the number of through lanes can only be one lane for rural ramp segments
and not greater than two lanes for urban segments.
Turn bays and auxiliary lanes are not included.

We will use the graphic on the screen to walk through these concepts.
First, you will need to complete ramp segmentation.
For example, this ramp has three segments.
Segment 1 is from the gore point at the exit to the begin taper to add the second lane.
Segment 2 is from the taper to add the second lane to the taper to add the turn bay.
And Segment 3 is from the taper to add the turn bay to the crossroad.

The number of lanes for Segment 3 in this graphic is 2 lanes.

It is also important to understand the locations
where the ramps begin and end and how the ramp length is determined.
There are two critical ramp locations.
One is the 2-foot gore point which is the beginning of ramp for an exit ramp
and the end of ramp for the entrance ramp.

The other is at the crossroad where the reference line
intersects the crossroad's edge of travel lane.
This is the beginning of ramp for an entrance ramp
and the end of ramp for an exit ramp.
The ramp will have a reference line which is along the right edge
of the ramp's travel way.

The length of the reference line between the 2-foot gore point
and its intersection with the crossroad is the ramp's length.

Basic Roadway Data

The basic roadway data elements include the area type
which is given in the freeway segment and is unchanged.
The number of through lanes and ramp’s segment length which were explained
in the previous slides.
The average traffic speed on the freeway is for the non-peak hours
during a typical travel day.
This speed is used to calculate the speed into any ramp curves.

The segment types include either an entrance or exit ramp
and if the ramp is a collector-distributor or CD road.
There is also a connector ramp which is for a ramp to a service interchange.
The type of control at crossroad ramp terminal can be signal,
stop control, yield, or none.
None is used when there is an add lane at the crossroad.

Horizontal Curve Data

The horizontal curve data in ramp segments is very similar to the data elements for the freeway segment.
Initially, you will need to note if a horizontal curve is or is not present.
If present, there is one minor difference from the freeway segment as the ramp segment uses the ramp's reference line for the curve radius and length of curve as previously described.
The curve radius is reported in feet.

The length of curve is measured along the reference line from the point the curve begins or P.C. to the point where the curve ends, and the tangent begins or P.T. and is reported in miles.
The length of curve may extend into multiple segments.
The length of the curve within this segment needs to be recorded and is also in miles.

Cross Section Data

The cross section data elements start with the lane width.
This is the average width of the through lanes reported in feet.
The right and left shoulder width is the average width of the paved shoulder for each side of the ramp.

The presence of lane add, or lane drop by taper is a pull-down menu with “No” being not present, a lane add or lane drop.
As previously noted, a new ramp segment is frequently created at the taper point for adding or dropping a lane.
If this occurs, then the length of taper within the segment is recorded in miles.

Roadside Data

The roadside data elements cover the barriers along the ramp.
The form initially has the right side of the roadway or ramp and the next section is for the left side of the roadway or ramp.
Within these sections are two basic data elements.

First is the length of barrier.
This can be for the barrier's entire length or divided into sections.
The illustration divides the barrier into 2 sections with two lengths of barrier $L_{rb\ 1}$ and $L_{rb\ 2}$.
Each of these barriers will have their own distance from the edge of traveled way to the barrier's face shown as $W_{off\ r\ 1}$ and $W_{off\ r\ 2}$.

This distance would be the second input for the form:
distance from edge of the traveled way to the barrier face.
Please notice $W_{off\ r\ 1}$ is to the mid-point of the angled barrier representing the average offset distance.

Ramp Access Data

The ramp access data for ramp segments is only required when there is a ramp entrance or ramp exit on the ramp.
If present, this is identified as a lane add or speed change or SC lane.
Note there are separate entries for a ramp entrance and a ramp exit.

The length of the speed-change lane is shown in the illustration on the slide being either the ramp entrance length or the ramp exit length.
If the ramp entrance in the segment is a lane add, you will need to answer if there is a collector-distributor road and if it has a weave section.
If “Yes,” the length of the weaving section and the length of the weaving section in the segment need to be provided.

Traffic Data

The final data elements for freeway ramp segments
include the traffic and crash data.
Similar with other HSM data requirements, the annual average daily traffic or AADT
for the ramp segment is needed.
At a minimum, the existing year is needed, and future year projections are desirable.
Let's take a look at the ISATe Tool.

ISATe: Traffic Data

The bottom of the slide shows the available tabs within the tool.
The data input required for the Input Ramp Segment is only required
for the ramp segment.
As shown on the screen capture, the traffic data is recorded by segment.
The AADT input should be entered for those years which data is available.
The tool will interpolate the missing years.

Crash Data

Five years of crash data is desirable.
This should be divided into fatal and injury crashes
and property damage only or PDO crashes.
Also, these crashes should be further divided into multiple vehicle
and single vehicle crashes.
The crash data collection for freeway ramp segments should not include
Ramp Entrance or Ramp Exit related crashes.
Let's take a look at the I-SAT-e Tool.

ISATe: Crash Data

The data input for crashes within the tool is in the same tab
as the traffic data or AADT.
Consistent with the Freeway Segments tab,
the Ramp Segments tab crash data requirements are broken down
by Fatal and Injury crashes by year and by Property Damage Only crashes by year.
For either severity level, the crashes are broken down by multiple-vehicle crashes
and single-vehicle crashes.

Freeway Ramp Segmentation

Going back into our example, we first need to see the ramp segmentation.
Again, this is when we have a taper to widen the ramp.
For this diamond interchange, each ramp has two segments as shown here.
Segment 1 is always the first segment in the direction of travel.
Segment 2 is the remainder length of the ramp.
For our example, we will use the northbound exit ramp circled in red.

Basic Roadway Data

First let's look at the segmentation.
From the graphic on the bottom right, we see the ramp is initially a single lane.
As it approaches the ramp terminal intersection, the ramp widens to have three lanes at the approach.
Northbound exit ramp Segment 1 is from the gore point
to the beginning of the lane add taper which is 0.20 miles.
Segment 2 is from the taper to the ramp terminal intersection which is 0.12 miles.

We will complete this form for Segment 1.
The basic roadway data again starts with the area type which is rural.
For Segment 1 there is one through lane.
The segment length is 0.20 miles.
The average traffic speed on the freeway is 70 miles per hour.
The segment type is an exit ramp.
The type of traffic control at the crossroad ramp terminal is a traffic signal.

Horizontal Curve Data

There is a horizontal curve in ramp Segment 1.
In the pull-down menu select "In Seg" for in segment.
The curve radius is 1,600 feet.
The length of curve is 400 feet and needs to be converted into miles
which is 0.0757 miles.

Since the entire curve is in the segment, the same is entered for this value.
There is only one horizontal curve in this ramp segment
so select “No” for horizontal curve #2.

Cross Section Data

The cross section data is from the preliminary design and is shown in the table.
The lane width will be 15 feet, the right paved shoulder width is 4 feet,
and the left paved shoulder width is 2 feet.
There is no lane add or lane drop by taper in this segment.
Note there would be a lane add in Segment 2.

Roadside Data

The roadside data regards the presence of barrier
on either the right or the left side of the ramp.
The preliminary design has not identified a need for barriers on either roadside,
so this has been left blank.

Ramp Access Data

Ramp access data regards when there is a ramp entering or exiting the ramp segment.
There are no ramps entering or exiting this proposed ramp
so the answer to these pull-down menus would be “No.”
There is also no weaving section on the ramp so this would also be “No.”

Form 750-020-06b is now complete for Segment 1.
This data collection process needs to be completed for the remaining ramp segments.
You will also need to enter the ramp AADTs into the ISATe Tool.
Since this is a proposed ramp, there is no existing crash data to be entered.

MUTS Chapter 6 Forms Overview

Let’s take a look at Freeway Ramp Terminals, its data collection requirements,
and its corresponding form.

Form No. 750-020-06c

Freeway ramp terminals are the intersection of the ramp with the crossroad.
The HSM predictive method computes the ramp terminal's
predicted average crash frequency for the limits of the intersection
and the ramp or crossroad legs for crashes attributed to the intersection.

Form 750-020-06c is used to record the data elements to be used in the ISATe Tool.
These data collection sections include basic intersection data, alignment data,
traffic control, cross section data, and access data.
These elements contribute towards the computation of 11 CMFs
used in the predictive analysis.

Before we get into the ramp terminals data collection,
let's discuss some basic definitions for ramp terminals.
There are seven total configurations,
and these will be shown over the next two slides.

Freeway Ramp Terminals

The first element for basic intersection data is ramp terminal configurations.
The three configurations on this slide are for diagonal ramps
typical of what you may see at a full or half diamond interchange.
There is the diagonal, exit or type D3ex and the diagonal,
entrance or type D3en for 3 leg ramps.
The 4-leg diagonal ramp is Type D4.

Freeway Ramp Terminals

The other four types of ramp terminal configurations are for Parclo interchanges.
Parclo stands for partial cloverleaf and there is a Parclo A and a Parclo B.
The Parclo A is where the loop ramp is the entrance ramp.

Parclo B is where the loop ramp is the exit ramp.
There are parclo interchanges with ramps in two of the interchanges
four quadrants known as a 2-quad parclo.
If there are ramps in all four quadrants it is known as 4-quad parclo
also known as full cloverleaf.

Basic Roadway Data

The freeway ramp terminal data collection starts with the basic roadway data.
Similar to the freeway mainline and ramps,
the first element is area type being urban or rural.
Then the selection of the ramp terminal configuration is done
using a pull-down menu.
The seven configurations discussed on the last two slides
are available through this drop-down menu.

The other data elements include the ramp terminal traffic control type
with the pull-down menu choices being signal, one stop and all-stop.
The last data element documents if the ramp terminal
is a non-ramp public street present at the terminal.
The answer to this is either “Yes” or” No.”

Alignment Data

The ramp terminal alignment data collection starts with the exit ramp skew angle.
This is measured as 90 degrees minus the intersection angle as shown in this graphic.
The intersection’s angle is measured between the crossroad
and the center of the vehicle at the stop bar.

For ramp terminals, the crossroad has inside and outside approaches
on the outside crossroad leg.
The inside approach is between ramp terminals while the outside approach
is in the opposite direction.

The next data element is the distance to the next public street intersection
on the outside approach in miles.
The final element is the distance to the adjacent ramp terminal
in miles measured between the inside approaches.

Traffic Control Data

The traffic control data elements are for signalized ramp terminals only
and looks at left-turn signal treatments.
The first data element is for the inside approach or between the ramp terminals.
Answer “Yes” or “No” if there is a left turn protected signal.
If it is a protected-permissive signal, this field should be answered as “No.”
Then do the same for the outside approach.
The exit ramp approach right turn movement traffic control type needs to be identified.
The pull-down menu choices are signal, stop, yield, merge or free.

Cross Section Data

The cross section data elements start with the crossroad median width in feet.
Next is the number of through lanes on the crossroad requiring three different entries.
First is the total number of through lanes for both approaches.
Then the number of inside through lanes at the approach must be entered.
This is followed by the number of through lanes at the outside approach.
For the number of lanes at the ramp exit approach this for all lanes, left, right and through.

Right turn channelization presence means there is a turning roadway
separated from the intersection by a triangular channelizing island
that can be painted or raised curb.
This field asks if right turn channelization is present
on the crossroad's inside and outside approaches and the ramp’s exit approach.

The cross section data also needs information about the left and right turn lanes
on the crossroad.
The presence of an inside approach left turn lane and if so, the lane width.
This is the total pavement width.
If there are two 12-foot left turn lanes, then enter 24 feet.
The same applies to the outside approach.
The last data element to be collected is presence of a right turn lane.
For the right turn lane, you only need to note their presence
for the inside and outside approaches.

Access Data

The access data pertains to the outside approach only.
The first question is the number of driveways on the outside crossroad leg.
This is within 250 feet of the approach’s stop bar.
It is applied to both sides of the crossroad and is for active driveway
being those with greater than 10 vehicles per day.
The second data element is the number of public street approaches within 250 feet
of the ramp terminal intersection and on both sides of the road.

Traffic Data

The final data elements for freeway ramp segments include the traffic and crash data.
The traffic elements needed for this analysis are the inside and outside crossroad AADTs and the exit ramp AADT.
As previously noted, it is desirable to have both existing and future year AADTs.
Let's take a look at the ISATe Tool.

ISATe: Traffic Data

The bottom of the slide shows the available tabs within the tool.
As shown on the screen capture, the traffic data is recorded by terminal.
The AADT input should be entered for those years which data is available.
The tool will interpolate the missing years.

Within the Input Ramp Terminals tab in the ISATe Tool,
the traffic data input is broken down as follows:
Inside Crossroad Leg Data, Outside Crossroad Leg Data,
Exit Ramp Data and Entrance Ramp Data.

Crash Data

If you are evaluating an existing facility, intersection related crash data can be added.
Including 5 years of data is desirable.
The crash data needs to be divided into fatal and injury crashes
and property damage only crashes.
Let's take a look at the ISATe Tool.

The data input for crashes within the tool is in the same tab as the traffic data or AADT.
For the Input Ramp Terminals tab, the crash data requirements are broken down
by Fatal and Injury crashes by year and by Property Damage Only crashes by year,
note no further classification is needed for this data entry.
The crashes to be considered for the ramp terminal analysis
include the crashes associated with unsignalized driveway
or public street approach located within 250 feet of the crossroad terminal.

Freeway Ramp Terminals Example

Let's look at a ramp terminal example at our proposed interchange.
The two diamond interchange ramp terminals are shown on this slide
with intersection approach geometry.
We will continue to focus on the northbound ramp.

Basic Roadway Data

The basic roadway data elements include the area type
which is given in the freeway segment and ramp segment as rural
and has not changed.

The ramp terminal configuration is for a diamond interchange with four legs
at the ramp terminals or D4.
The ramp terminal traffic control is a signal,
and this is selected from the pull-down menu on the corresponding cell.

There is not a non-ramp public street at the ramp terminal and “Not Present” is selected.
The exit ramp intersects the crossroad at 90 degrees, so the skew angle is 0 degrees.
The distance to the next public street intersection on the outside approach is 0.5 miles.
The distance to the adjacent ramp terminal on the inside approach is 0.15 miles.

Traffic Control Data

Let’s zoom in into the ramp terminal configuration.
The ramp terminal is signalized so the traffic control data needs to be entered.
The crossroad's inside approach is a dual left turn
with a protected movement so “Yes” is entered.

There is not an outside approach left turn movement
so this is selected as “No.”
The right turn movement at the exit ramp
is at the stop bar under signal control so “Signal” is selected.

Cross Section Data

The cross section data starts with the crossroad median width in feet
which is 22 feet obtained from the table.
The next three data elements regard crossroad through lanes.
The first is for both approaches which is 2 through lanes in each direction totaling 4 lanes.

The inside and outside approaches both have 2 through lanes.
The ramp exit has 2 left turn lanes and 1 right turn lane totaling 3 lanes.
There is not a separate right turn channelization present on any of the approaches,
so “Not present” for this data element was selected.
The next data elements regard the presence of a crossroad left turn lane.
The inside approach has 2 left turn lanes totaling 24 feet in lane width.
The outside approach does not have a left turn lane.
The final data element is whether a right turn lane is present
on the inside or outside approach.
The inside approach does not have a right turn lane and the outside approach
does have a right turn lane.

Access Data

Access data completes Form 750-020-06c.
This proposed interchange has limited access right-of-way
extending greater than 250 feet from the outside crossroad leg.
Therefore, there are no driveways or public approaches.
Both data elements are entered as “0”.

To prepare the ISATe Tool for analysis, you will need to enter the 2020 and 2039
inside and outside crossroad AADTs as well as the exit ramp AADT.
Since this is a proposed interchange, there is no crash history to be entered.

Summary and Forms

This training module covered the data collection requirements to use the ISATe Tool
for HSM analysis of freeway segments, ramp segment and ramp terminals.
The three forms described in this training can be accessed
by selecting the links on this resources page
or by scanning the QR code with a cellphone camera.

End of Lesson

[Web]

This concludes the Manual on Uniform Traffic Studies computer based training,
Chapter 6- Data Collection for Safety Analysis of Freeway Facilities.
You will now be directed to a 10-question quiz to test your knowledge
and understanding on the material presented in this computer-based training.

A passing grade of 70% is required to obtain the Certificate of Completion
for the training.
If a grade below 70% is obtained, the trainees are required
to re-take the full training until a passing grade of 70% or higher is obtained.

If you do not pass the quiz, please return to the Index page
by selecting the Index button below and re-take this training.
Once you've received your certificate, please continue to the next chapter
by selecting the "NEXT" button below this CBT.
On the next slide, please read the directions carefully before continuing to the quiz.
Thank you for your time and attention.

[LMS]

This concludes the Manual on Uniform Traffic Studies computer based training,
Chapter 6- Data Collection for Safety Analysis of Freeway Facilities.
You will now take a 10-question quiz to test your knowledge and understanding
on the material presented in this computer-based training.

A passing grade of 70% is required to obtain the Certificate of Completion
for the training.
If a grade below 70% is obtained, the trainees are required
to re-take the full training until a passing grade of 70% or higher is obtained.
If you do not pass the quiz, please return to the Course Content tab
and re-take this training.

You will receive your certification after completing the full MUTS training
and passing the quiz for each chapter.
please continue to the next chapter by returning to the MUTS course content tab
and selecting the next chapter in the training.
On the next slide, please read the directions carefully before continuing to the quiz.
Thank you for your time and attention.