CHAPTER E
INTERCHANGES

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CHAPTER E
INTERCHANGES

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E.1 GENERAL

Interchanges are relatively complex and have many components which need to be designed to suit the through and connecting highways as well as the traffic volumes, speed, rural or urban settings and any constraints imposed by the physical environment. This manual does not deal comprehensively with the subject of interchanges.

In Alberta, the conceptual or functional design of interchanges that identifies the configuration and general layout, is normally done at the planning stage. This sometimes involves identifying several stages of development for the interchange. As planning work is often done many years in advance of design, there is a need to review the technical details of a planning study to ensure that current design vehicles, speeds and practices have been used. Much of that information is contained in other chapters of this manual.

E.2 RAMPS

For detailed design of interchanges, designers may use the drawings contained in this chapter for layout of on-ramps and off-ramps on the through highway.

E.2.1 Exit Terminal Design

For single lane exit terminals, either the direct taper (as shown on Figure E-1.3) or a parallel lane design (not shown here) may be used. In the parallel lane design, a short taper is used to develop a lane of constant width for some distance gradually widening at the nose. Exiting vehicles are expected to change lanes and decelerate without impeding the through traffic. This type of layout offers some advantages when the exit terminal is located on or under a structure (effectively reducing the length of structure required compared to the direct taper design).

In the direct taper design, the right edge of the ramp terminal gradually widens from the beginning of the ramp terminal to the nose. Exiting vehicles are expected to maintain close to full speed until they are entirely off the through lanes to avoid impeding through traffic.

E.2.2 Entrance Terminal Design

Single lane entrance ramps may be either direct taper design (as shown in Figure E.1.2) or parallel lane design (not shown). In the parallel lane design, an auxiliary lane of constant width is added to the right of the through lanes and is discontinued, by means of a taper, some distance downstream. The driver entering a parallel lane is expected to accelerate to a suitable speed before merging with through traffic. The parallel lane design offers some advantages (lower capital costs) where the entrance terminal is located on top of or under a structure.

The direct taper layout provides a uniform taper from the entrance nose to the edge of through lane. The taper rate is chosen to allow vehicles entering the highway to accelerate to close to the through traffic speed before having to merge.

Two lane entrance ramps may be of the direct taper or parallel type design.

E.2.3 Ramp Junctions

On the intersecting highway or roadway, the junction with the ramp may be treated as a stop condition (for example at a diamond interchange) or as a free flow merge condition (for example at a cloverleaf interchange) as per the planning study. The design and layout of these terminals should be suitable for the traffic as well as being consistent with previous Alberta practice for this type of junction. The layout should be suitable for the turning template of all appropriate design vehicles.

E.3 REFERENCE DOCUMENTS

As this Design Guide does not fully cover the subject of Interchange Design, designers are referred to the following documents for additional information.

- Geometric Design Guide For Canadian Roads (1986) – TAC
- Urban Supplement to the Geometric Design Guide for Canadian Roads (1995) – TAC
- A Policy on Geometric Design of Highways and Streets (1994) - AASHTO
- Highway Capacity Manual (1994) – FHWA

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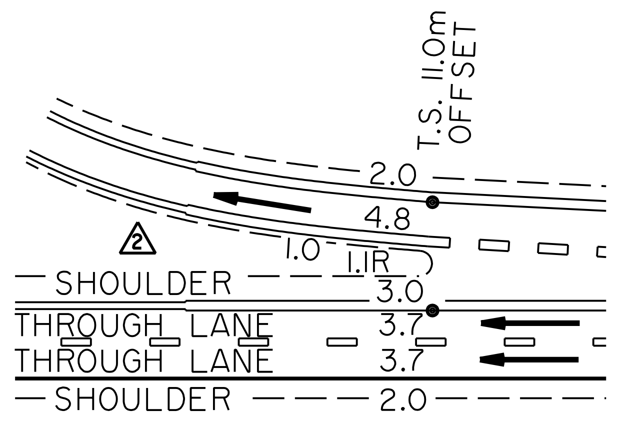
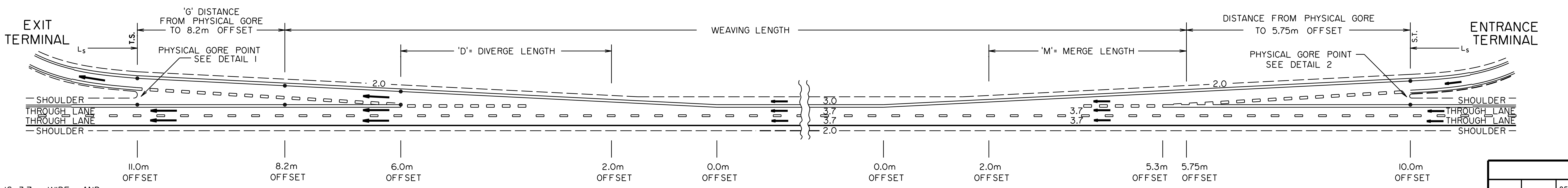
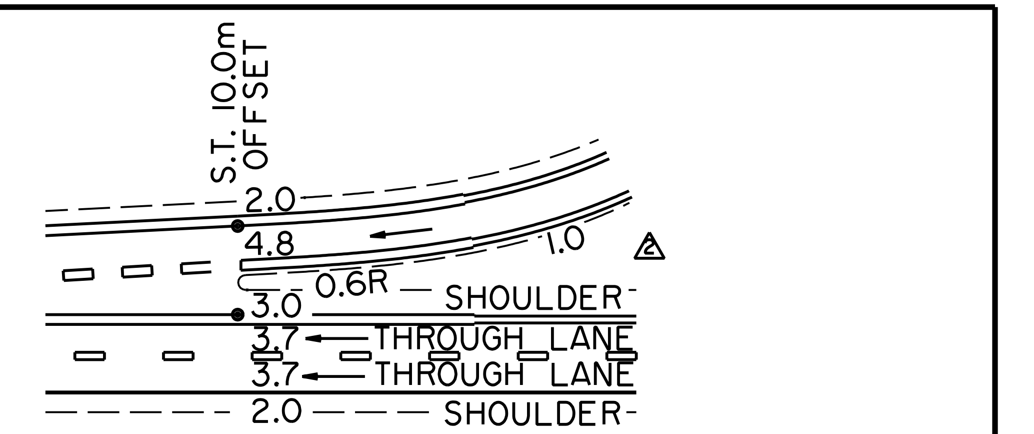


DETAIL 1





DETAIL 2

* DECELERATION BEGINS AFTER TAPERED LANE IS 3.7m WIDE AND RATE OF DECELERATION IS COMFORTABLE.(NO BRAKING REQUIRED).

FOR TAPER DIMENSIONS, REFER TO FIGURE E-1.3

FOR TAPER DIMENSIONS, REFER TO FIGURE E-1.2

NOTE:
WEAVING LENGTH IS MEASURED FROM A POINT WHERE LANE EDGES AT THE MERGE ARE 0.5m APART TO WHERE LANE EDGES AT THE DIVERGE ARE 3.7m APART, AS ILLUSTRATED ABOVE. AN AUXILIARY LANE TO ACCOMODATE WEAVING MAY BE ADDED WHERE REQUIRED. GENERALLY AUXILIARY LANES ARE USED WHERE THE WEAVING LENGTH IS LESS THAN 1000m.

FACILITY			DESIGN WARRANTS				EXIT TERMINAL FROM HIGHWAY (SEE FIGURE E-1.3)							
MAINLINE SPEED			CONTROLLING RADIUS m				SPEED AT GORE (11m OFFSET) (km/h)	DESIGN CRITERIA (NORMAL) (m) GRADE -3% TO +3%			DESIGN CRITERIA FOR GRADIENTS OVER 3% (m) ⚠ -3% TO -5%	-5%	+3% TO +5%	+5%
DESIGN SPEED	TYPICAL POSTED SPEED	85th PERCENTILE RUNNING SPEED ALBERTA 1989	DESIRABLE RADIUS FOR RAMPS	MINIMUM RADIUS FOR RAMPS	DESIRABLE RADIUS FOR LOOP	MINIMUM RADIUS FOR LOOP	20% REDUCTION OF ASSUMED RUNNING SPEED *	TAPERED DECELERATION LANE LENGTH FROM BEGINNING TO 11m OFFSET AT PHYSICAL GORE	'G' DISTANCE FROM PHYSICAL GORE (11.0m OFFSET) TO 8.2m OFFSET	DIVERGE DISTANCE 'D' FROM 2m OFFSET TO PAINTED WEDGE (6m OFFSET)	TAPER RATIO FOR DECELERATION LANE AT EXIT TERMINAL	TAPER RATIO FOR DECELERATION LANE AT EXIT TERMINAL	TAPER RATIO FOR DECELERATION LANE AT EXIT TERMINAL	TAPER RATIO FOR DECELERATION LANE AT EXIT TERMINAL
km/h	km/h	km/h	m	m	m	m	km/h	m	m	m	m	m	m	m
60	50	60	90	55	55	55	48	165@15:1	42.0	60	220 @ 20:1	20:1	15:1	15:1
80	70	80	190	55	55	55	64	220@20:1	56.0	80	275 @ 25:1	25:1	20:1	15:1
100	90	100	250	90	90	55	80	220@20:1	56.0	80	275 @ 25:1	25:1	20:1	15:1
110	100	109	340	130	90	55	87	275@25:1	70.0	100	330 @ 30:1	35:1	25:1	20:1
120	100	112.5	440	130	90	70	90	275@25:1	70.0	100	330 @ 30:1	35:1	25:1	20:1
130	110	116	440	190	90	90	93	330@30:1	84.0	120	385 @ 35:1	440@40:1	30:1	25:1

ENTRANCE TERMINAL TO HIGHWAY (SEE FIGURE E-1.2)								
SPEED AT 2m OFFSET (km/h)		DESIGN CRITERIA (NORMAL) (m) GRADE -3% TO +3%			DESIGN CRITERIA FOR GRADIENTS OVER 3% (m) ⚠ -3% TO -5%	-5%	+3% TO +5%	+5%
DESIRABLE RUNNING SPEED	8km/h LESS THAN RUNNING SPEED	TAPERED ACCELERATION LANE LENGTH FROM 10m OFFSET AT PHYSICAL GORE TO END	LENGTH OF PAINTED WEDGE FROM PHYSICAL GORE (10m OFFSET) TO PAINTED GORE POINT (5.3m OFFSET)	MERGE DISTANCE 'M' FROM 5.75m TO 2m OFFSET	TAPER RATIO FOR ACCELERATION LANE AT ENTRANCE TERMINAL	TAPER RATIO FOR ACCELERATION LANE AT ENTRANCE TERMINAL	TAPER RATIO FOR ACCELERATION LANE AT ENTRANCE TERMINAL	TAPER RATIO FOR ACCELERATION LANE AT ENTRANCE TERMINAL
km/h	km/h	m	m	m	m	m	m	m
60	52	200@20:1	94	75	200 @ 20:1	20:1	25:1	30:1
79	71	≥ R90 200@20:1 R55-R90 250@25:1	94 117.5	75 93.75	250 @ 20:1	20:1	≥ R90 30:1 R55-R90 35:1	≥ R90 35:1 R55-R90 40:1
95	88	≥ R130 350@35:1 R55-R130 400@40:1	164.5 188	131.25 150	350 @ 35:1	35:1	≥ R130 50:1 R55-130 60:1	≥ R130 60:1
102	94	≥ R160 500@50:1 R55-R160 550@55:1	235 258.5	187.5 206.25	400 @ 40:1	40:1	DUE TO THE LONG DISTANCES REQUIRED FOR ACCELERATION, CONSIDERATION SHOULD BE GIVEN TO REDUCING MAINLINE GRADIENT, OR PROVIDING A PARALLEL ACCELERATION LANE, SUCH THAT VEHICLES OBTAIN A MINIMUM SPEED OF 8km/h LESS THAN RUNNING SPEED OF THE MAINLINE BEFORE MERGING. SEE CHAPTER D OF **THIS MANUAL FOR TYPICAL** VEHICLE PERFORMANCE CHARACTERISTICS.	
109	101	≥ R190 500@50:1 R70-R190 600@60:1	235 282	187.5 225	500 @ 50:1	40:1		
116	108	≥ R215 500@50:1 R90-R215 600@60:1	235 282	187.5 225	500 @ 50:1	40:1		

CONTROLLING RADIUS - BASED ON DESIGN SPEED OF TURNING ROADWAY AND MAINLINE ROADWAY
"A" PARAMETER REQUIREMENTS - FOR EXIT AND ENTRANCE TERMINALS

Design speed (km/h)	40 km/h MINIMUM R55	45 km/h MINIMUM R70	50 km/h MINIMUM R90	55 km/h MINIMUM R110	60 km/h MINIMUM R130	65 km/h MINIMUM R160	70 km/h MINIMUM R190	75 km/h MINIMUM R215	80 km/h MINIMUM R250	90 km/h MINIMUM R340	100 km/h MINIMUM R440	110 km/h MINIMUM R600	120 km/h MINIMUM R750	130 km/h MINIMUM R950
	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06	e=0.06
60	P=3.205 O=32.345 60 Lc=64.430 Ls=65.455	P=2.154 O=29.993 65 Lc=59.860 Ls=60.357	P=1.801 O=31.125 75 Lc=62.166 Ls=62.500	P=1.629 O=32.744 85 Lc=65.422 Ls=65.682	P=1.242 O=31.094 90 Lc=62.149 Ls=62.308	P=1.016 O=31.210 100 Lc=62.394 Ls=62.500	P=0.889 O=31.812 110 Lc=63.605 Ls=63.684	P=0.869 O=33.461 120 Lc=66.904 Ls=66.977	P=1.024 O=39.168 140 Lc=78.314 Ls=78.400	P=0.694 O=37.632 160 Lc=75.253 Ls=75.294	P=0.706 O=43.161 195 Lc=86.313 Ls=86.350	P=0.587 O=45.973 235 Lc=91.939 Ls=91.963	P=0.525 O=48.593 270 Lc=97.182 Ls=97.200	P=0.420 O=48.940 305 Lc=97.877 Ls=97.889
80	P=5.874 O=43.589 70 Lc=86.520 Ls=89.091	P=3.799 O=39.741 75 Lc=79.187 Ls=80.357	P=2.328 O=35.371 80 Lc=70.619 Ls=71.111	85	90	100	110	120	140	160	195	235	270	305
100	P=12.427 O=62.679 85 Lc=123.224 Ls=131.364	P=7.778 O=56.564 90 Lc=112.239 Ls=115.714	P=4.604 O=49.625 95 Lc=98.901 Ls=100.278	P=3.111 O=45.197 100 Lc=90.221 Ls=90.909	P=2.764 O=46.340 110 Lc=92.548 Ls=93.007	P=2.103 O=44.882 120 Lc=89.684 Ls=90.000	P=1.481 O=41.054 125 Lc=82.066 Ls=82.237	P=1.196 O=39.258 130 Lc=78.488 Ls=78.605	140	160	195	235	270	305
110	85	90	95	100	110	120	125	130	140	160	195	235	270	305
120	✱	P=9.600 O=62.684 95 Lc=124.134 Ls=128.929	P=5.638 O=54.857 100 Lc=109.241 Ls=111.111	P=4.543 O=54.545 110 Lc=108.783 Ls=110.000	P=3.907 O=55.051 120 Lc=109.373 Ls=110.769	P=2.475 O=48.677 125 Lc=97.257 Ls=97.656	P=1.732 O=44.393 130 Lc=88.731 Ls=88.947	P=1.608 O=45.513 140 Lc=90.981 Ls=91.163	P=1.348 O=44.951 150 Lc=89.870 Ls=90.000	160	195	235	270	305
130	✱	✱	100	110	120	125	130	140	150	160	195	235	270	305

ASSUMED SPEED PROFILE AT EXIT TERMINALS (ALBERTA)

DESIGN SPEED km/h	NORMAL TAPER RATIO	85th PERCENTILE RUNNING SPEED (ALBERTA) km/h	SPEED AT 3.7m OFFSET km/h	LENGTH OF TAPER AVAILABLE FOR DECELERATION (7.3m x RATIO)	SPEED AT 11m OFFSET (GORE) (20% REDUCTION)	SPIRAL	CONTROLLING RADIUS
60	15:1	60	60	109.5	48	VEHICLES ARE EXPECTED TO BRAKE COMFORTABLY ON SPIRALS PRECEDING LOOPS.	RUNNING SPEED SHOULD BE LESS THAN DESIGN SPEED OF CONTROLLING RADIUS CURVE.
80	20:1	80	80	146	64		
100	20:1	100	100	146	80		
110	25:1	109	109	182	87		
120	25:1	112.5	112.5	182	90		
130	30:1	116	116	219	93		

IT IS ASSUMED THAT VEHICLES EXITING THE HIGHWAY WILL MAINTAIN THE MAINLINE SPEED (85th PERCENTILE RUNNING SPEED) UNTIL THE POINT WHERE THE TAPERED LANE IS 3.7m WIDE. AT THE GORE POINT (11.0m OFFSET), IT IS ASSSUMED THAT VEHICLES HAVE SLOWED DOWN TO 80% OF THE MAINLINE SPEED. THIS DECELERATION RATE IS VERY GRADUAL AND CAN GENERALLY BE ACHIEVED BY STANDARD TRANSMISSION VEHICLES IN GEAR WITHOUT BRAKES BEING APPLIED. THE SPIRAL LENGTHS ARE DESIGNED TO ALLOW A COMFORTABLE TRANSITION TO THE CONTROLLING SPEED OF THE CIRCULAR CURVE. GENERALLY ON RAMPS WHERE THE RAMP DESIGN SPEED EXCEEDS 70 km/h, THE REDUCTION IN SPEED ON THE TRANSITION IS VERY GRADUAL AND CAN BE ACHIEVED WITHOUT BRAKING. HOWEVER, WHERE CONSTRAINTS EXIST, FOR EXAMPLE AT LOOP EXITS WITH DESIGN SPEEDS LESS THAN 70 km/h, THE DESIGN LENGTH PROVIDES FOR COMFORTABLE BRAKING. ALTHOUGH SOME BRAKING IS REQUIRED ON APPROACHES TO LOOPS, THE RATE OF DECELERATION IS GENERALLY LESS THAN HALF THAT REQUIRED ON THE APPROACH TO TURNING ROADWAYS AT CHANNELIZED INTERSECTIONS AND IS WELL WITHIN THE RANGE OF COMFORTABLE BRAKING.

*NOTES:
1. THE AVERAGE 85th PERCENTILE RUNNING SPEED RECORDED FOR PASSENGER VEHICLES ON FOUR LANE DIVIDED HIGHWAYS IN ALBERTA IN 1989 WAS 116 km/h WHERE THE POSTED SPEED WAS 110 km/h IN DAYTIME. THE CORRESPONDING SPEED WAS 109 km/h WHERE THE POSTED SPEED WAS 100 km/h.

2. FOR TYPICAL PAVEMENT MARKINGS FOR INTERCHANGE RAMPS REFER TO THE TRAFFIC CONTROL STANDARDS MANUAL. A RUNNING SPEED OF 112.5 km/h IS USED HERE IN CONJUNCTION WITH A 120 km/h DESIGN SPEED IN ORDER TO PROVIDE SOME INTERMIDIATE VALUES.

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2	REVISED DIMENSIONS	TG	07/99
1	REVISED NOTE	TDN	06/98

Alberta INFRASTRUCTURE

FIGURE E-1.1

Date: APRIL 1995

DESIGN STANDARDS OF EXIT & ENTRANCE TERMINALS FOR DIVIDED HIGHWAYS AT INTERCHANGES

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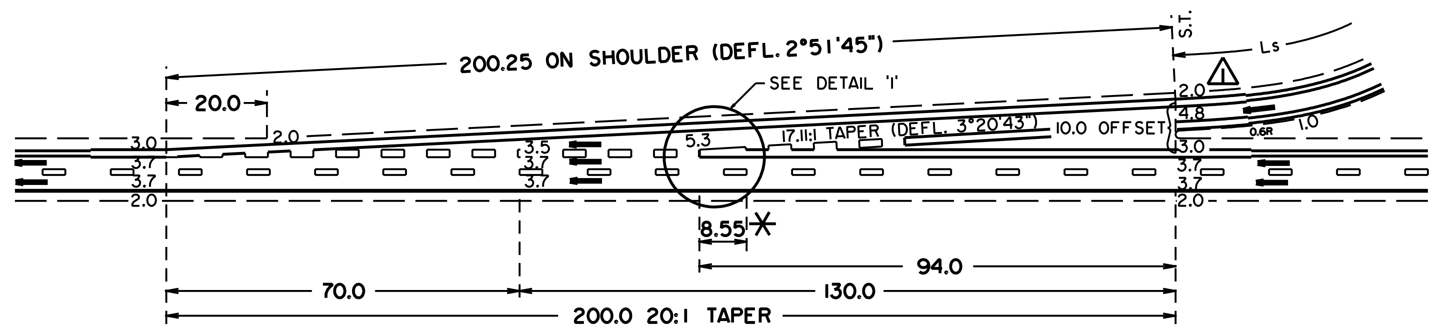
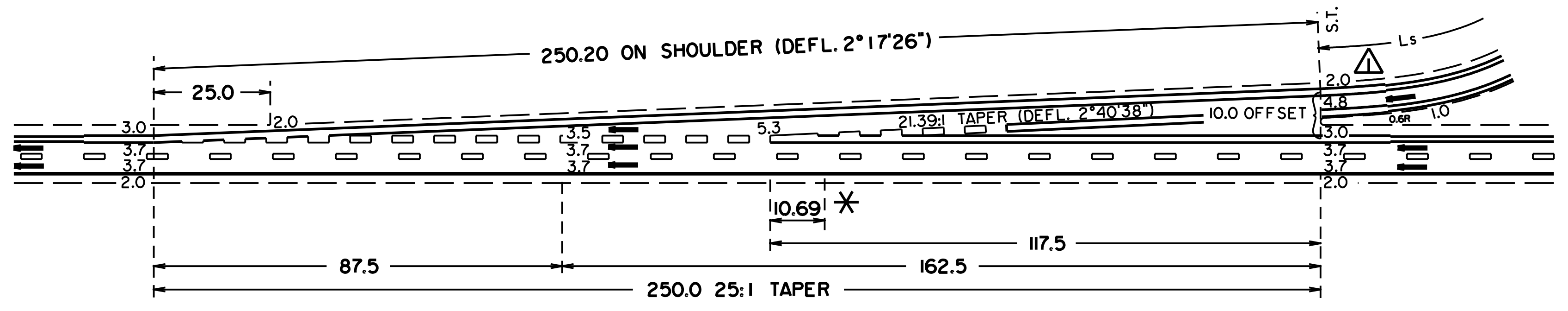
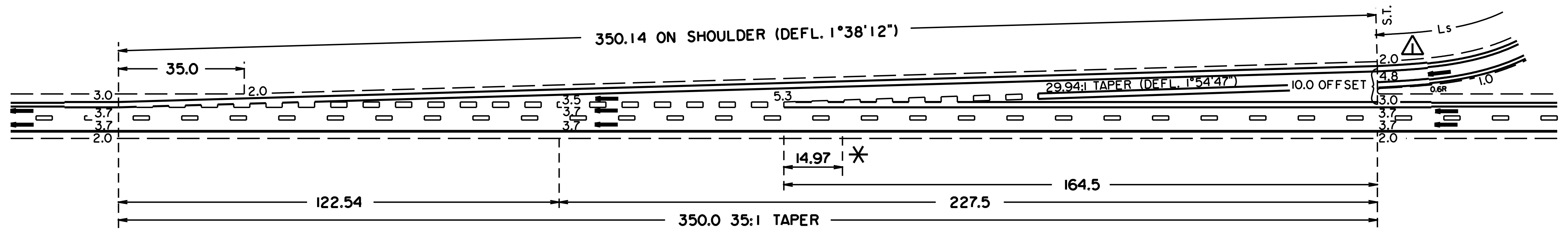
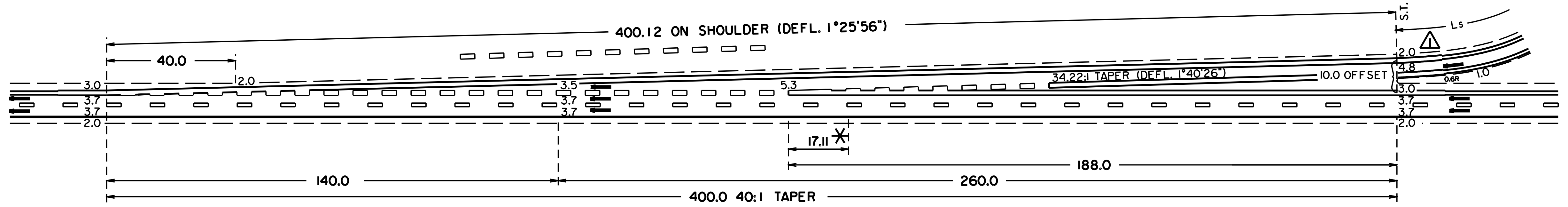
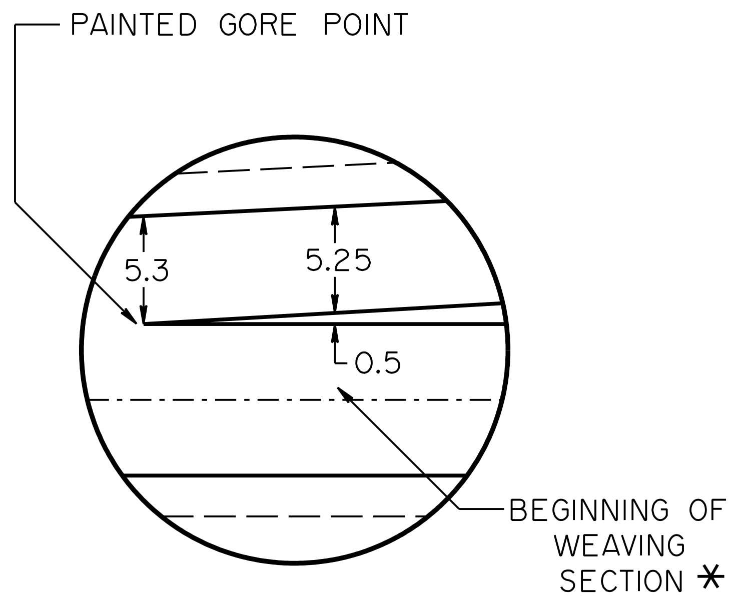


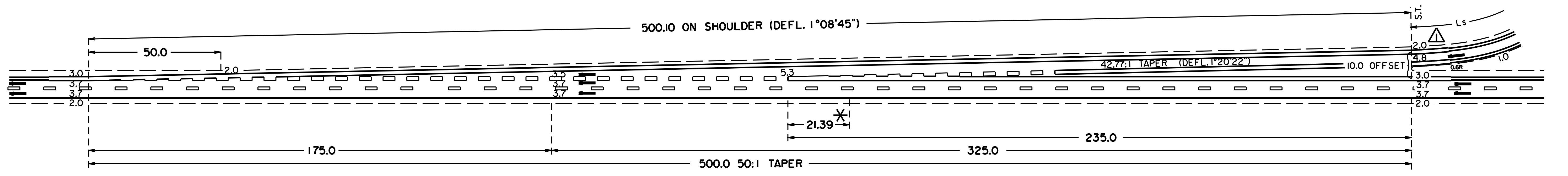


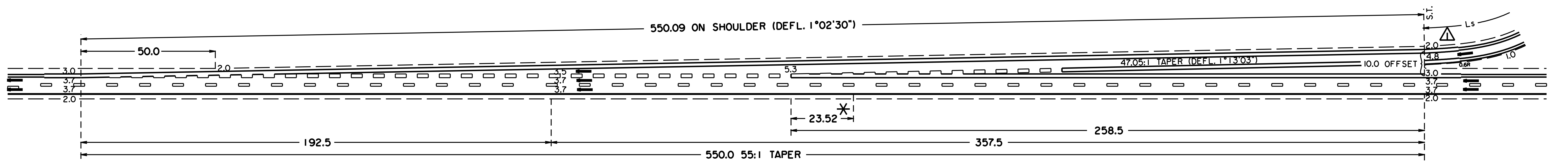


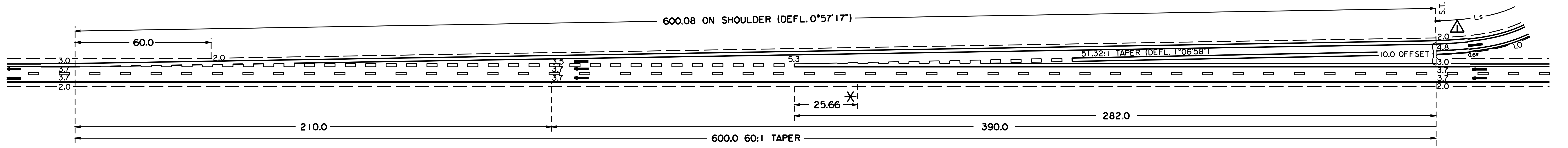




DETAIL 'I'







NOTES:

1. THE CHOICE OF TAPER RATIO SHOULD BE MADE BASED ON DESIGN SPEED AND GRADIENT; SEE FIGURE E-1.1
2. DECISION SIGHT DISTANCE SHOULD BE AVAILABLE AT THE MERGE AREA. (REFER TO SECTION B.2.6)
3. FOR TYPICAL PAVEMENT MARKINGS REFER TO THE TRAFFIC CONTROL STANDARDS MANUAL.
4. FOR WEAVING LENGTH REFER TO FIGURE E.1.1

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Alberta INFRASTRUCTURE

FIGURE E-1.2

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DETAILS OF ENTRANCE TERMINALS ON DIVIDED HIGHWAYS AT INTERCHANGES

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DETAILS OF TAPERED DECELERATION LANES FOR INTERCHANGES

NOTES:

1. THE CHOICE OF TAPER RATIO SHOULD BE MADE BASED ON DESIGN SPEED AND GRADIENT; SEE FIGURE E-1.1
2. DECISION SIGHT DISTANCE SHOULD BE AVAILABLE AT THE DIVERGE AREA. (REFER TO SECTIONB.2.6)
3. FOR TYPICAL PAVEMENT MARKINGS REFER TO THE TRAFFIC CONTROL STANDARDS MANUAL.
4. FOR WEAVING LENGTH REFER TO FIGURE E.11.

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1	REVISED WEAVING DIMENSION	TDN	06/98

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FIGURE E-1.3

Date: APRIL 1995

DETAILS OF EXIT TERMINALS ON DIVIDED HIGHWAYS AT INTERCHANGES

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