

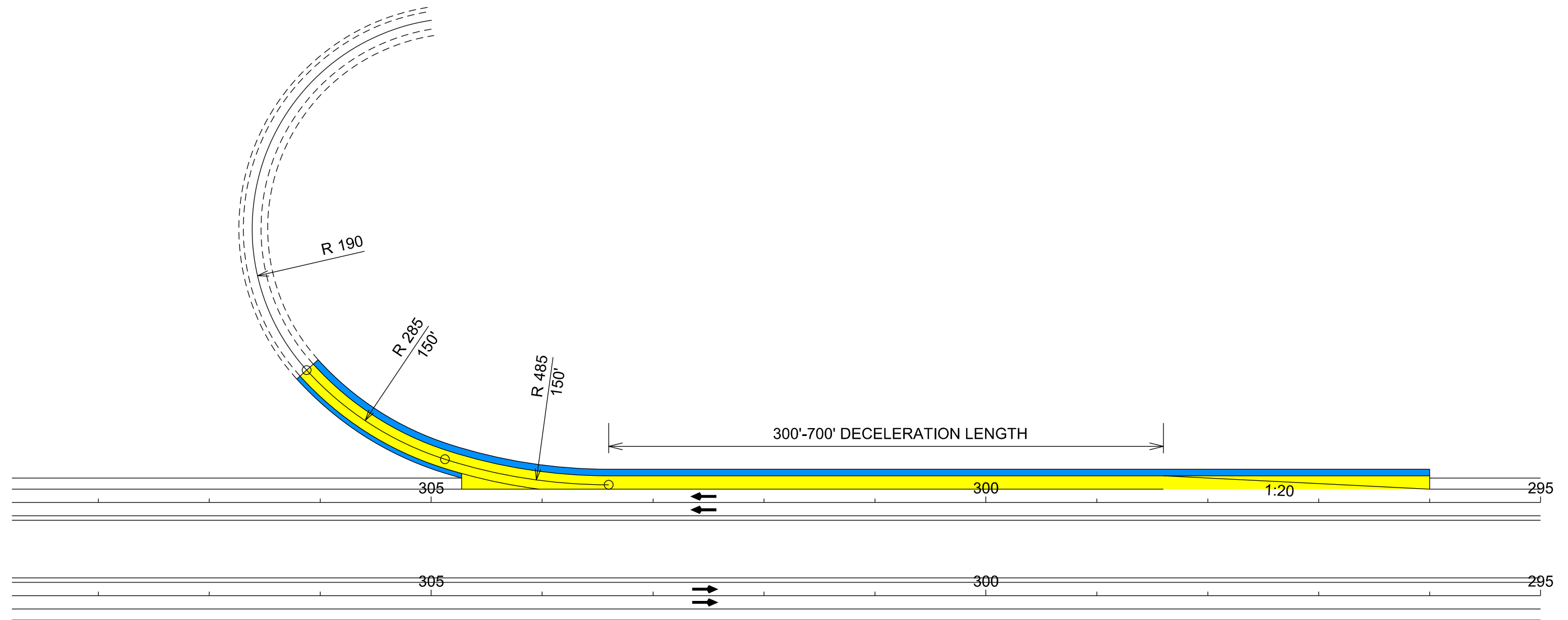


GDSU DESIGN DETAILS

THE PURPOSE OF THIS DOCUMENT IS TO SHARE BEST PRACTICES AND PROVIDE CONVENIENT ACCESS TO DESIGN PREFERENCES FOR OUR DESIGNERS. ADDITIONAL DETAILS WILL BE ADDED AS TIME ALLOWS AND AS NEW SITUATIONS THAT WARRANT DETAILS ARE ENCOUNTERED. CONTACT GDSU IF UPDATES ARE NEEDED OR TO RECOMMEND ADDITIONAL DETAILS TO BE INCLUDED.

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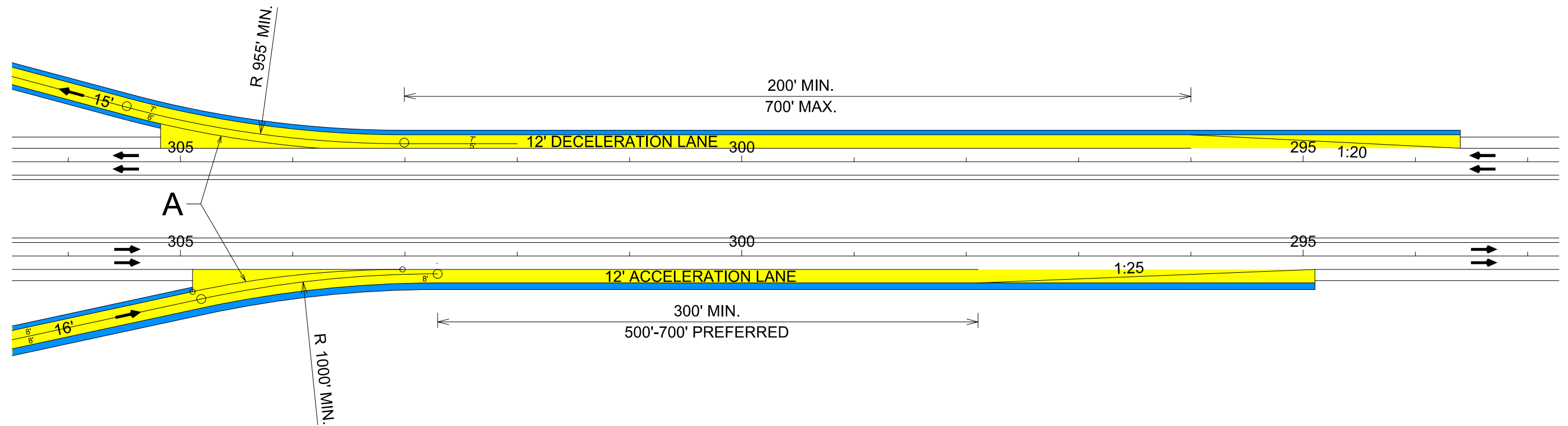
DISCUSSION:

EXPERIENCE HAS SHOWN THAT THE METHOD OF INTRODUCING A LOOP CAN HAVE A GREATER IMPACT ON SAFETY PERFORMANCE THAN THE CHOSEN RADIUS. 230-FT. RADIUS LOOPS HAVE EXHIBITED PERFORMANCE PROBLEMS, WHILE 170-FT. RADIUS LOOPS WITH GOOD ENTRY DESIGNS HAVE PERFORMED WELL. ENTRY DESIGN (AS SHOWN ABOVE) ARE RECOMMENDED REGARDLESS OF LOOP RADIUS.

RECOMMENDATION:

USE A ~300-FT. SPIRAL TRANSITION TO INTRODUCE LOOP RAMPS. A 3-CENTERED CURVE CAN BE USED AS AN ALTERNATIVE TO THE SPIRAL CURVE. THE 3-CENTERED CURVE SHOULD BE DESIGNED WITH A PAIR OF EQUAL LENGTH CURVES OF DIMINISHING RADII USING A 1.5: OR FLATTER (2:1 MAX) RATIO AS SHOWN ABOVE.

PARALLEL DECELERATION IS RECOMMENDED PRIOR TO LOOPS ON HIGH SPEED FACILITIES WHEN FEASIBLE, PARTICULARLY ON ROADWAYS WITH DOWNGRADES OF 3% OR GREATER. RESEARCH HAS SHOWN THAT DECELERATION LENGTH GREATER THAN 700-FT. CAN LEAD TO A REDUCTION IN SAFETY PERFORMANCE.



DISCUSSION:

WHILE TAPER AND PARALLEL ENTRY DESIGNS ARE BOTH CONSIDERED ACCEPTABLE, GDSU RECOMMENDS THE TAPER DESIGN BE USED WHEN THE MAINLINE HAS SUFFICIENT CAPACITY TO RECEIVE THE ENTERING VOLUME AND NO CONSTRAINTS EXIST I.E. RAMP PROVIDES SUFFICIENT ACCELERATION LENGTH AND ENTERING TRAFFIC DOES NOT IMPACT MAINLINE PERFORMANCE. IN THE ABSENCE OF THESE CONDITIONS, THE TAPER DESIGN IS PREFERABLE DUE TO SMOOTH OPERATION AND HIGHER ENTRY SPEEDS.

PARALLEL ENTRANCES ARE RECOMMENDED WHEN:

- ADDITIONAL ACCELERATION LENGTH IS NEEDED
- ADDITIONAL GAP ACCEPTANCE IS NEEDED
- ADVANTAGE GAINED BY MOVING THE RAMP NEARER THE MAINLINE E.G. AVOIDING WETLAND
- AN AUXILIARY LANE IS BEING ADDED
- TO SIMPLIFY THE DESIGN, E.G. ON A CURVING MAINLINE
- WHEN THE DESIGN YEAR PEAK HOUR EXCEEDS 400 VEHICLES

TAPER TYPE EXITS ARE THE BASE DESIGN FOR RURAL AND UNCONGESTED AREAS. PARALLEL TYPE EXITS SHOULD BE CONSIDERED WHEN:

- ADDITIONAL DECELERATION IS NEEDED
- THE LANE IS BEING DROPPED
- THE DESIGN IS GEOMETRICALLY ADVANTAGEOUS, E.G. EXITS ON MAINLINE CURVES
- THE DESIGN AVOIDS IMPACTS OR SITE CONSTRAINTS
- RAMPS WITH TIGHT EXIT RADII LOCATED ON DOWNGRADES

NOTE:

THE CURRENT AND FUTURE RAMP PAVEMENT WIDTHS ARE REPRESENTED IN THE DETAIL.

A FOR EXITS, THE CURVE DEFINING THE EDGE OF THE GORE SHOULD MIRROR THE ALIGNMENT. FOR ENTRANCES, PLACE A CURVE BEGINNING AT THE PHYSICAL NOSE THAT IS TANGENT TO THE APPROACHING PATH AND THROUGH LANE.

RECOMMENDATION:

USE A MINIMUM ENTRY CURVE RADIUS OF 1000 FT AND MINIMUM EXIT CURVE RADIUS OF 955 FT, WITH A MINIMUM CURVE LENGTH OF 200 FT. DECELERATION LENGTH IS MEASURED FROM THE POINT WHERE 12 FT OF DECELERATION LANE IS PROVIDED TO THE BEGINNING OF THE EXIT CURVE. ACCELERATION LENGTH IS MEASURED FROM THE END OF THE ENTRY CURVE AND INCLUDES THE LENGTH OF AN ENTRY SPIRAL, WHEN PROVIDED. RULE OF THUMB HAS BEEN TO CONSIDER THE FINAL 100FT OF AN ENTRY CURVE TO BE PART OF THE ACCELERATION LENGTH TO ACCOUNT FOR THE NATURAL SPIRAL DRIVERS CREATE. APPLICATION OF THIS RULE WILL BE CONSIDERED ON A CASE BY CASE BASIS.

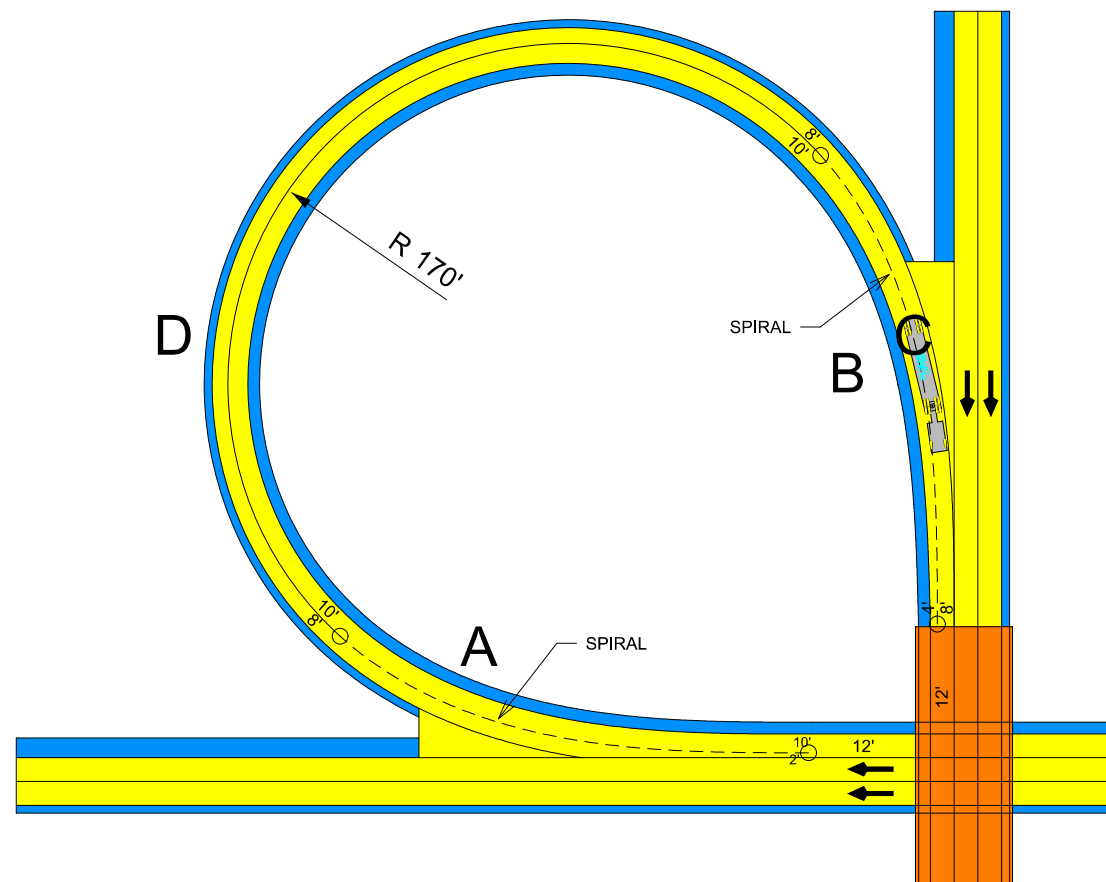
MAINTAIN A CONSISTENT WIDTH TO THE DRIVERS RIGHT, WITH EXTRA WIDTH TAPERING AWAY ON THE GORE SIDE. IN CASES WHERE THIS APPROACH RESULTS IN ABRUPT RAMP WIDTH CHANGES, AS IN ENTRANCE LOOPS, TAPER THE EXCESS WIDTH AWAY TO THE DRIVERS RIGHT AT A RATE OF 1:20 OR FLATTER.

ACCELERATION LANE LENGTHS OF 500-700-FT ARE RECOMMENDED, WITH REQUIRED GAP ACCEPTANCE (USUALLY 300 FT) BEING A FUNCTIONAL MINIMUM. IT IS PREFERABLE TO AVOID ACCELERATION LANES LONGER THAN 700 FT, AS FUNCTIONAL DISBENEFIT OCCURS FROM DRIVERS MISTAKING IT FOR AN ADDITIONAL LANE. IN CASES WHERE ADDITIONAL ACCELERATION LENGTH IS INDICATED, THE GUIDANCE FROM NCHRP 730 TO REDUCE THIS LENGTH BY 15% SHOULD BE CONSIDERED.

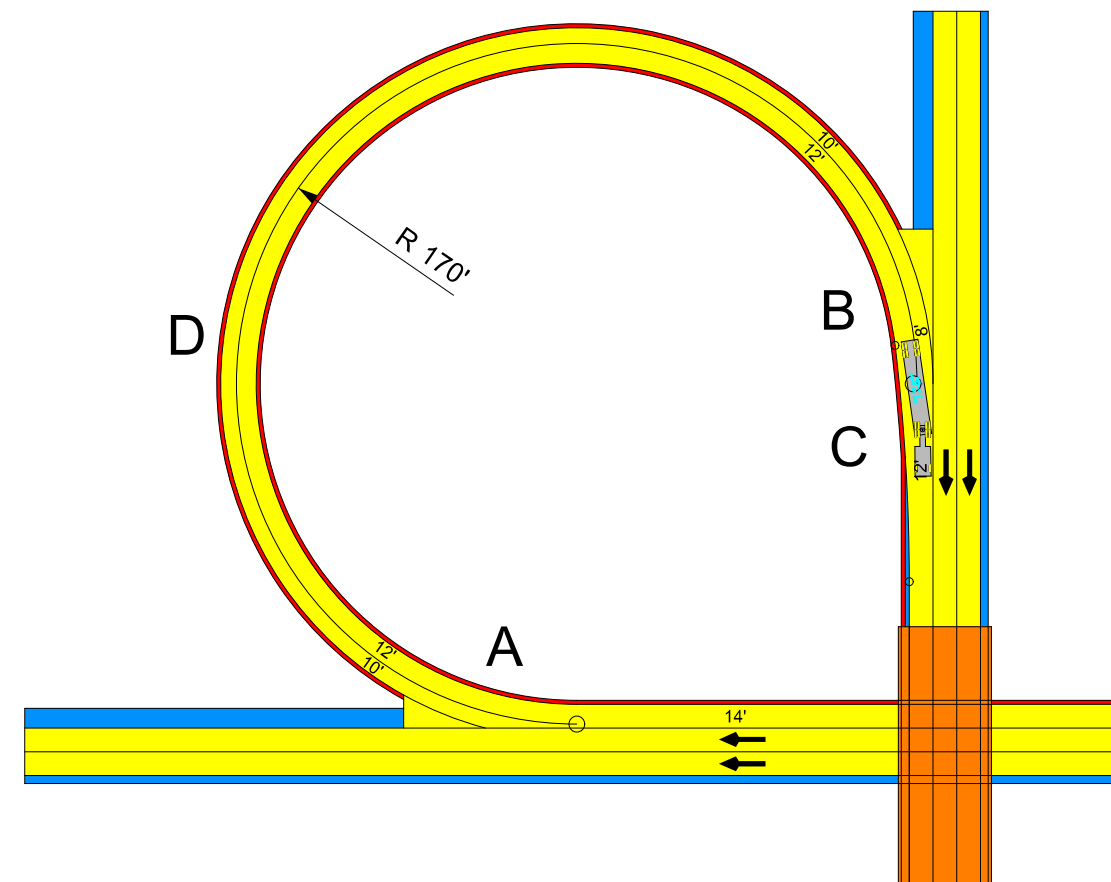
THE END TAPER MAY BE REDUCED TO LIMIT CONSTRUCTION FOR PARALLEL ACCELERATION LANES 500 FT OR GREATER. REDUCTIONS UNDER UNIQUE CIRCUMSTANCES WILL BE CONSIDERED ON A CASE BY CASE BASIS. A MINIMUM RATE OF 1:25 UP TO A MAXIMUM OF 1:1/2 DESIGN SPEED IS RECOMMENDED.

USE REQUIRED DECELERATION LENGTH AS A FUNCTIONAL MINIMUM, WITH 200 FT BEING ABSOLUTE MINIMUM LENGTH FOR DRIVEABILITY. DECEL LANES EXCEEDING 700 FT ARE GENERALLY DISCOURAGED. 1:20 IS THE PREFERRED TAPER RATE FOR INTRODUCING DECEL LANES.

SET ALIGNMENT POSITION TO MAINTAIN A CONSISTENT 8' TO THE DRIVER'S RIGHT ON BOTH THE ENTRANCE AND EXIT RAMPS. THIS WILL ALLOW CONSISTENCY IN MATCHING EXISTING RAMPS AND GORE DESIGN.



RURAL LOOP WITH SPIRALS



SINGLE CURVE LOOP WITH CURB & GUTTER

DISCUSSION:

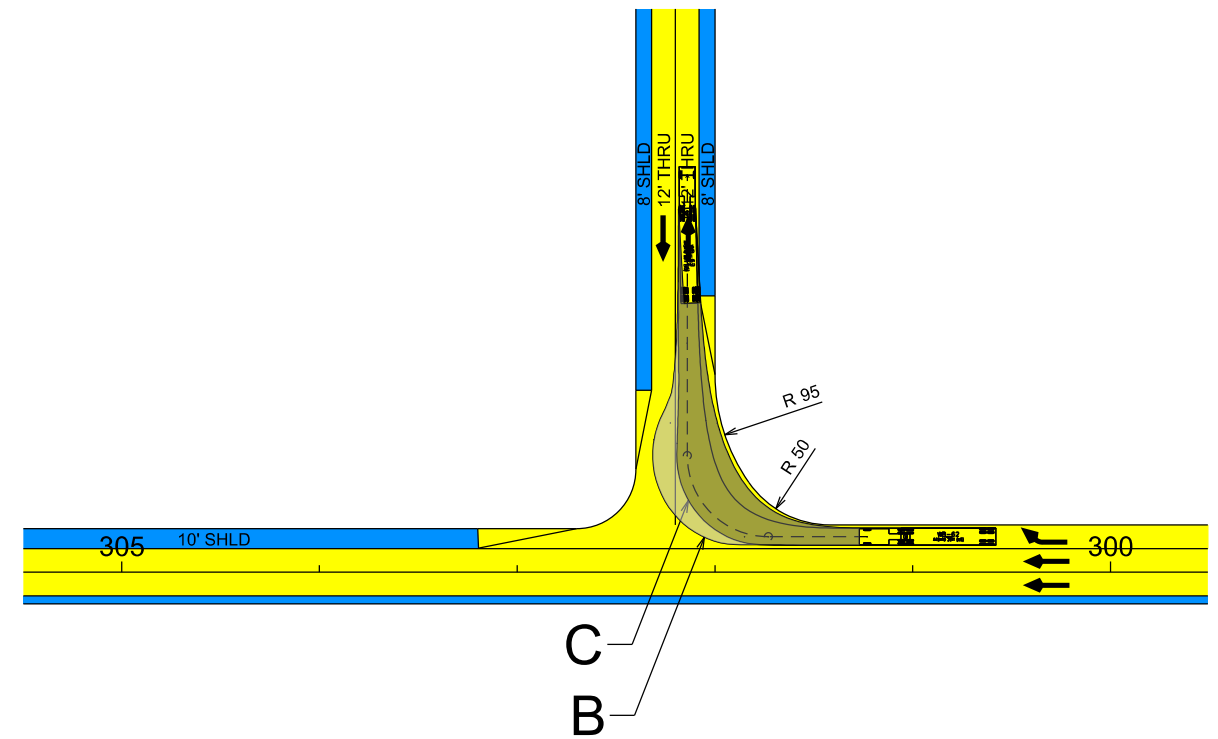
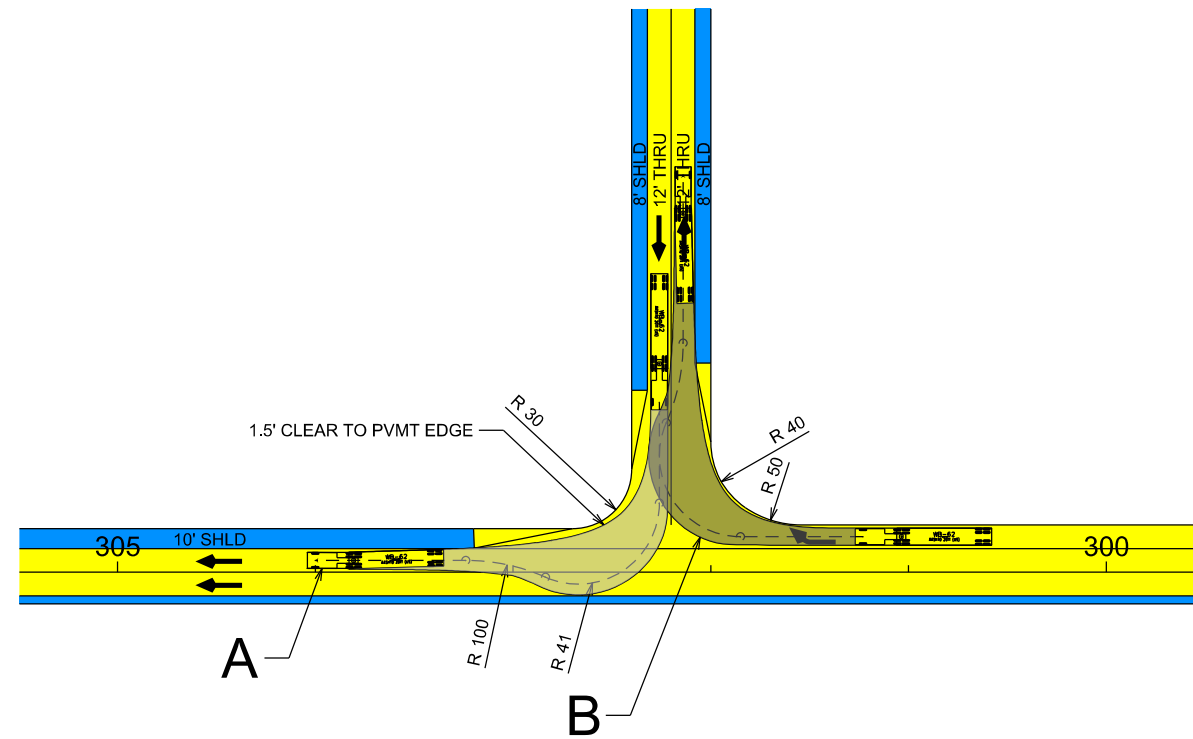
TRANSITIONING LANE WIDTH IN THE TRANSITION AREA OF LOOP RAMPS IS ACCOMPLISHED DIFFERENTLY THAN IN DIRECTIONAL RAMPS DUE TO THE GREATER PAVEMENT WIDTH BEING ADJUSTED AND SHORTER GORE AREAS WITH WHICH TO ACCOMPLISH THE TRANSITIONS. WHILE WIDTH CAN BE ABRUPTLY ADDED WITHIN THE GORE DURING THE EXIT FROM MAINLINE, GREATER CARE IS NEEDED TO PROVIDE A SMOOTH DRIVING PATH AND REMOVE WIDTH IN THE ACCELERATION AREA ON THE ENTRY SIDE.

SINGLE CURVE LOOPS EXIST WITHIN OUR SYSTEM BUT ARE NOT DESIRABLE. SPIRAL TRANSITIONS PROVIDE SUPERIOR DRIVE-ABILITY AND SPEED CHANGE REGIONS. 3-CENTERED CURVES, AS SHOWN IN RAMP DETAIL 1, MAY BE USED IN PLACE OF SPIRALS, WITH SINGLE COMPOUND CURVES BEING USED PRIMARILY IN RETROFITS.

SPIRAL TRANSITIONS AND COMPOUND CURVES USED TO REDUCE WIDTH WILL PREFERABLY NOT EXTEND ONTO OR UNDER ADJACENT BRIDGES IN ORDER TO AVOID INCREASING STRUCTURE COST. ADJUSTMENT OF SPIRAL LENGTH TO AVOID BRIDGE IMPACTS IS ACCEPTABLE.

RECOMMENDATIONS:

- A** EXIT SIDE: PROVIDE A CONSISTENT LANE WIDTH TO THE DRIVER'S RIGHT, AS THIS IS THE PAVEMENT EDGE FOLLOWED BY THE PREDOMINANT USERS, I.E. PASSENGER VEHICLES. ABRUPTLY ADDING WIDTH TO THE DRIVER'S LEFT PROVIDES SUFFICIENT WIDTH FOR LARGER VEHICLES AT THE POINT WHERE OFF-TRACKING BEGINS OCCURING.
- B** ENTRY SIDE: PROVIDE A CONSISTENT LANE WIDTH TO THE DRIVER'S LEFT, AVOIDING THE ABRUPT REDUCTION IN WIDTH THAT WOULD OCCUR WITHIN THE GORE AREA. WIDTH REDUCTION IN THAT FASHION TEND TO CAUSE LARGE VEHICLES TO ENCROACH INTO THE ADJACENT LANE INAPPROPRIATELY. REDUCE WIDTH ON THE DRIVER'S RIGHT OVER THE ENTIRE LENGTH OF THE SPIRAL.
- C** IN THE ABSENCE OF A SPIRAL TRANSITION, USE A COMPOUND CURVE TO REDUCE WIDTH SMOOTHLY AND AT A RATE NO FASTER THAN THE EXPECTED TRAVELED SPEED:1. TURN MODELING SOFTWARE SHOULD BE USED TO VERIFY THAT LARGE VEHICLE OFF-TRACKING IS ACCOMMODATED.
- D** THE ALIGNMENT IS POSITIONED SO THAT 8' OF RAMP PAVEMENT IS HELD ON THE DRIVER'S LEFT IN ALL DESIGNS, WITH OR WITHOUT CURB. ALIGNMENT POSITION MAY NEED TO BE ADJUSTED TO BEST FIT IN SOME CASES.



DISCUSSION:

DESIGN INTERSECTIONS APPROPRIATE TO THE CONTEXT AND PRIMARY USERS; LARGER DESIGN VEHICLES SHOULD BE ACCOMMODATED AS A SECONDARY PRIORITY. LARGER INTERSECTION RADII DO NOT PROVIDE POSITIVE GUIDANCE TO THE PRIMARY USERS FOR ALIGNING TO THE INTERSECTION AND RESULT IN THE SAME SAFETY DISBENEFITS AS A SKEWED APPROACH ROADWAY. ANOTHER DISBENEFIT OF LARGE RADII IS THE STOP SIGN CANNOT BE LOCATED WHERE VEHICLES SHOULD STOP AND BE VISIBLE TO THE APPROACHING ROADWAY AT THE SAME TIME.

RECOMMENDATION:

A MINOR ROAD RIGHT TO MULTILANE ROADWAY: TRUCKS SHOULD ENCROACH IN THE SECOND THROUGH LANE WHEN TURNING. WHEN SUFFICIENT GAPS ARE NOT AVAILABLE TO PROVIDE ADEQUATE PERFORMANCE, A CHANGE IN TRAFFIC CONTROL OR ACCELERATION LANE SHOULD BE CONSIDERED.

B RIGHT TURN TO MINOR ROADWAY-URBAN: GREATER CONSIDERATION SHOULD BE GIVEN TO INTERSECTION SIZE FOR PEDESTRIANS. TRUCKS SHOULD ENCROACH INTO THE OPPOSING LANE IN MOST CASES. HEAVY TRUCK USAGE COUPLED WITH HIGH ROADWAY VOLUMES MAY WARRANT NO ENCROACHMENT.

C RIGHT TURN TO MINOR ROADWAY-RURAL: TURN TRUCKS WITHOUT ENCROACHMENT AT RURAL INTERSECTIONS WITHOUT PED ACCOMMODATION. CONSIDER ENCROACHMENT WHEN PEDS ARE ACCOMMODATED OR MINOR ROAD VOLUMES ARE LOW.

*RADII ARE MARKED TO DEMONSTRATE DIFFERENCES BASED ON ENCROACHMENT. ACTUAL RADII WILL VARY BASED ON ROADWAY WIDTH AND SKEW.