AYRES ASSOCIATES

Intersection Design

Leah Ness, Craig Hardy and Eric Sorensen

OVERVIEW

- TYPES OF INTERSECTIONS
- SCOPING COORDINATION
- INTERSECTION EVALUATION
- HORIZONTAL AND VERTICAL LAYOUTS
- DESIGN COORDINATION
- CONSTRUCTION STAGING
- J-TURN INTERSECTIONS
- QUESTIONS

AYRES ASSOCIATES

TYPES OF INTERSECTIONS

- UNCONTROLLED
- STOP CONTROLLED
- SIGNALIZED
- ROUNDABOUT
- J-TURN

AYRES ASSOCIATES

SCOPING COORDINATION

- TYPE OF INTERSECTION
  - RAB REQUIRES REVIEWER
- TRAFFIC DATA COLLECTION
- SIGNAL PLANS
  - PERMANENT
  - TEMPORARY
- TMP

AYRES ASSOCIATES

INTERSECTION EVALUATION

- TRAFFIC DATA
  - TURNING MOVEMENT CLASSIFICATION COUNTS
    - PEAK HOUR COUNTS
    - 12 HOUR COUNTS
  - ORIGIN-DESTINATION STUDIES
  - HISTORICAL CRASH DATA
  - TRAFFIC FORECASTS

AYRES ASSOCIATES

INTERSECTION EVALUATION

- LANE DEDICATION
  - TRAFFIC VOLUMES
    - LEFT TURN
      - SINGLE EXCLUSIVE LEFT TURN = MINIMUM OF 100 VEH/HR
      - DUAL EXCLUSIVE LEFT TURNS = MINIMUM OF 300 VEH/HR
    - RIGHT TURN
      - EXCLUSIVE RIGHT TURN = MINIMUM OF 300 VEH/HR
  - STORAGE LENGTHS

FDM 11-25 Intersections at Grade

Table 2.4 Upstream Functional Length of Intersection Elements d1, d2, and d3 [A]

	Perception-Reaction Distance		Maneuver Distance		
	d1 (feet) des (min)		d2 (feet) des (min)	d3 (feet) des (min)	
Speed mph [B]	Rural [C] [E]	Urban / Suburban [C] [F]	[C] [G]	Turn lane [D] [H]	Thru lane [C] [I]
25	90 (55)	55 (35)	75 (75)	25 (25)	100 (75)
30	110 (65)	65 (45)	95 (95)	75 (50)	145 (105)
35	130 (75)	75 (50)	110 (110)	100 (75)	195 (145)
40	145 (90)	90 (60)	130 (130)	150 (100)	255 (185)
45	165 (100)	100 (65)	150 (150)	200 (150)	325 (235)
50	185 (110)	110 (75)	165 (165)	250 (175)	400 (290)
55	200 (120)	120 (80)	185 (185)	325 (225)	485 (355)
60	220 (130)	130 (90)	205 (205)	400 (300)	580 (420)
65	240 (145)	145 (95)	225 (225)	475 (350)	680 (495)
70	255 (155)	155 (105)	240 (240)	575 (425)	785 (575)

Notes for Table 2.4

FDM 11-25 Intersections at Grade

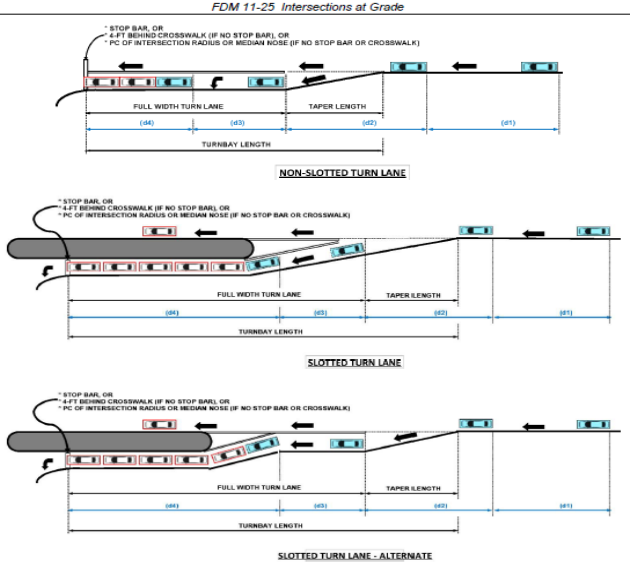


Figure 2.9 Turn Bay Elements and Correlation with Upstream Functional Length of Intersection

INTERSECTION EVALUATION

- INTERSECTION CONTROL EVALUATIONS
  - SAFETY
    - CRASH PATTERNS
  - OPERATIONAL ANALYSIS
    - ISOLATED INTERSECTION VERSUS CORRIDOR ANALYSIS
  - PRACTICAL FEASIBILITY

AYRES ASSOCIATES

INTERSECTION EVALUATION

- INTERSECTION CONTROL EVALUATIONS
  - ROW IMPACTS
  - COSTS
  - PEDESTRIANS AND BICYCLISTS
  - OSOW FREIGHT NETWORK
  - ENVIRONMENTAL IMPACTS

AYRES ASSOCIATES

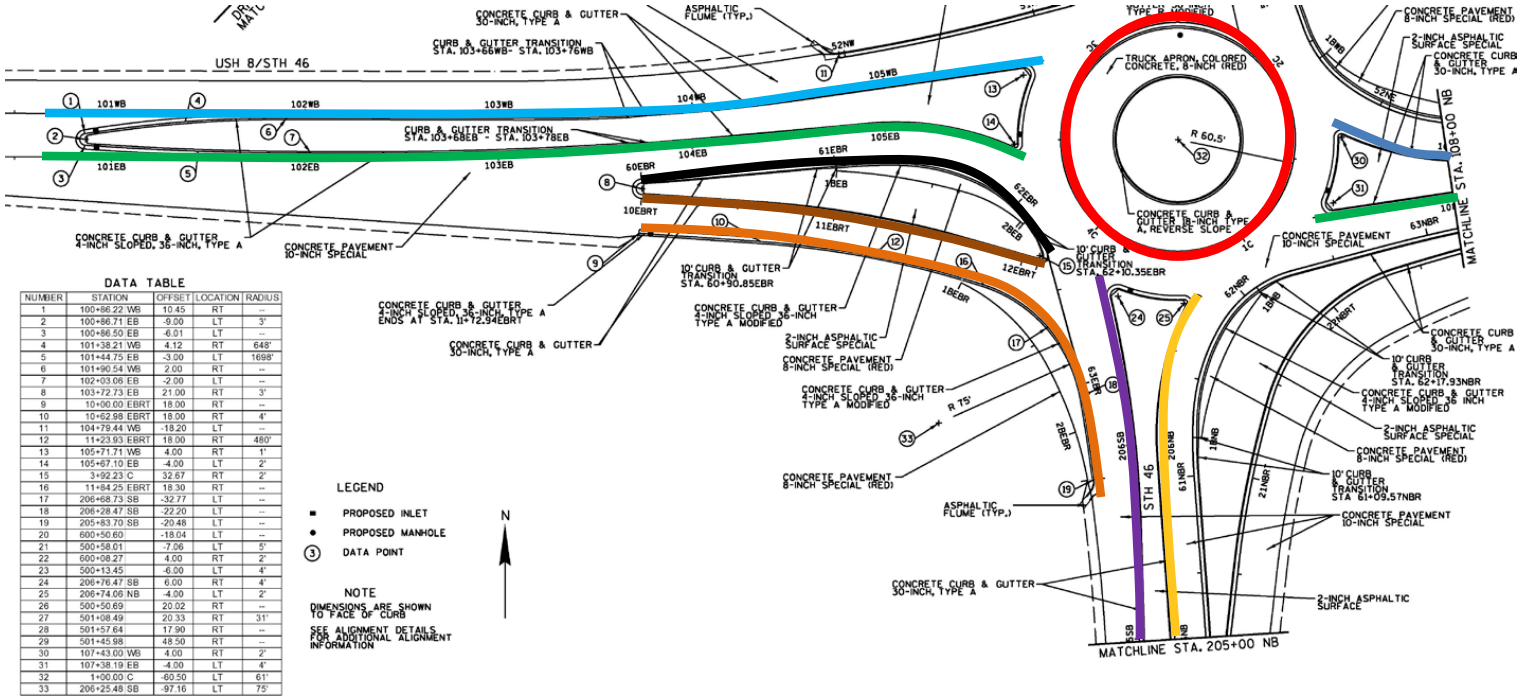
HORIZONTAL / VERTICAL LAYOUT

- TRUCK TURNING MOVEMENTS
  - TRUCK APRONS
  - ACCESS LOCATIONS
    - GAS STATION TANKERS
- PEDESTRIAN AND BICYCLE ACCOMMODATIONS
  - CROSSWALK AND RAMP LOCATIONS
  - WIDTHS OF BLVDS AND SIDEWALKS/MULTI-USE PATHS

AYRES ASSOCIATES

HORIZONTAL / VERTICAL LAYOUT

- ALIGNMENTS/PROFILES
  - MAIN EB/WB AND NB/SB
  - CIRCULATORY ROADWAY
  - RIGHT SIDE CURB LINES
  - BYPASS LANES

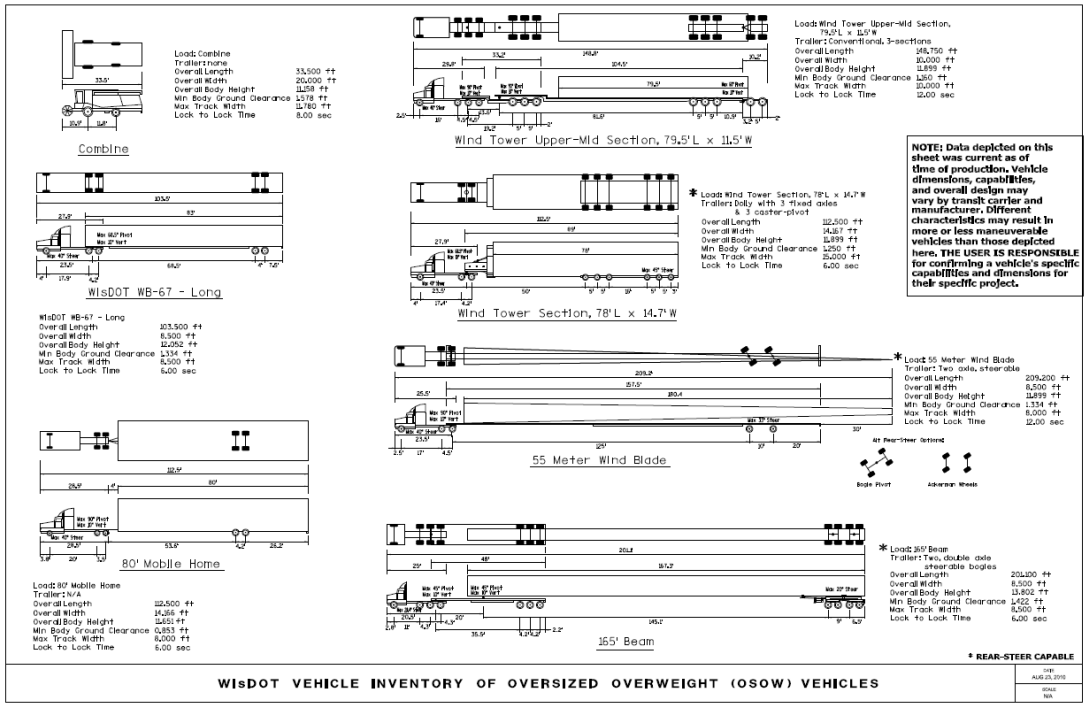


DATA TABLE

NUMBER	STATION	OFFSET	LOCATION	RADIUS
1	100+86.22 WB	10.45	RT	--
2	100+86.71 EB	-9.00	LT	3'
3	100+86.50 EB	-6.01	LT	--
4	101+38.21 WB	4.12	RT	648'
5	101+44.75 EB	-3.00	LT	1698'
6	101+90.54 WB	2.00	RT	--
7	102+03.06 EB	-2.00	LT	--
8	103+72.73 EB	21.00	RT	3'
9	10+00.00 EBRT	18.00	RT	--
10	10+62.98 EBRT	18.00	RT	4'
11	104+79.44 WB	-18.20	LT	--
12	11+23.93 EBRT	18.00	RT	480'
13	105+71.71 WB	4.00	RT	1'
14	105+67.10 EB	-4.00	LT	2'
15	3+92.23 C	32.67	RT	2'
16	11+84.25 EBRT	18.30	RT	--
17	206+68.73 SB	-32.77	LT	--
18	206+28.47 SB	-22.20	LT	--
19	205+83.70 SB	-20.48	LT	--
20	600+50.60	-18.04	LT	--
21	500+58.01	-7.06	LT	5'
22	600+08.27	4.00	RT	2'
23	500+13.45	-6.00	LT	4'
24	206+76.47 SB	6.00	RT	4'
25	206+74.06 NB	-4.00	LT	2'
26	500+50.69	20.02	RT	--
27	501+08.49	20.33	RT	31'
28	501+57.64	17.90	RT	--
29	501+45.98	48.50	RT	--
30	107+43.00 WB	4.00	RT	2'
31	107+38.19 EB	-4.00	LT	4'
32	1+00.00 C	-60.50	LT	61'
33	206+25.48 SB	-97.16	LT	75'

HORIZONTAL / VERTICAL LAYOUT

- OSOW RESTRICTIONS
  - DETERMINE DESIGN VEHICLE DIMENSIONS AND REQUIRED MOVEMENTS
    - CONTACT LOCAL BUSINESSES
    - WHAT STANDARD OSOW VEHICLES TO USE?



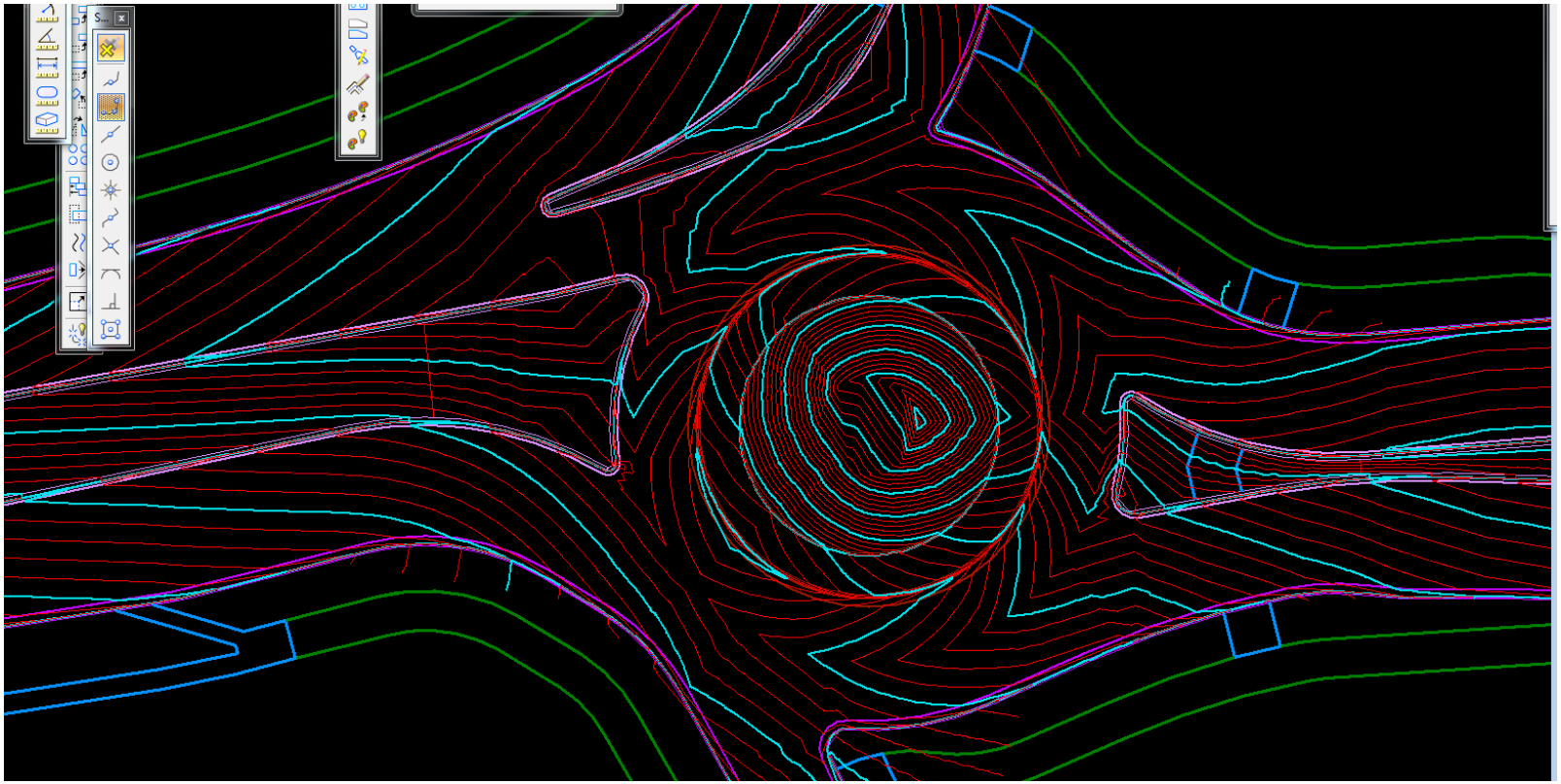
HORIZONTAL / VERTICAL LAYOUT

- OSOW RESTRICTIONS
  - CROWN IN INTERSECTION
  - REDUCED CURB HEAD HEIGHT FOR TRUCK APRON

AYRES ASSOCIATES

HORIZONTAL / VERTICAL LAYOUT

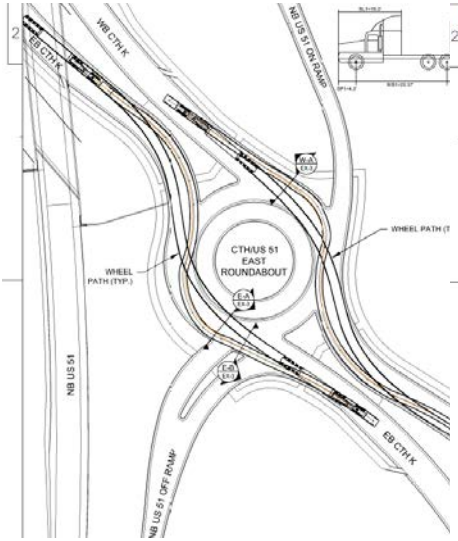
- HOW TO CHECK VERTICAL CLEARANCE
  - 3D MODELING - SURFACE

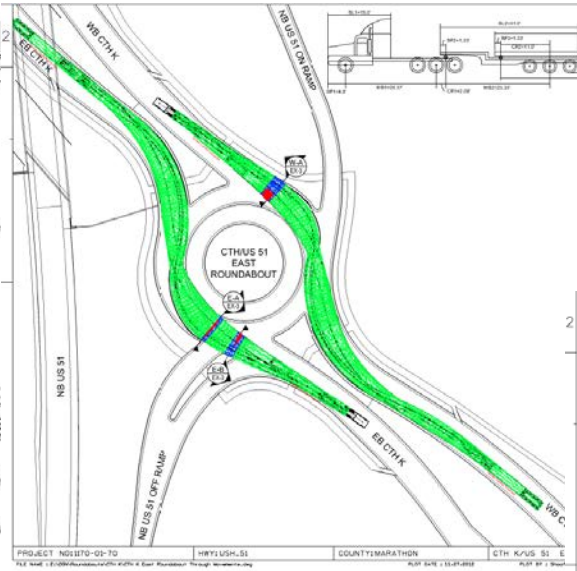


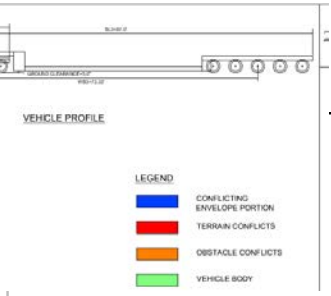
AYRES ASSOCIATES

HORIZONTAL / VERTICAL LAYOUT

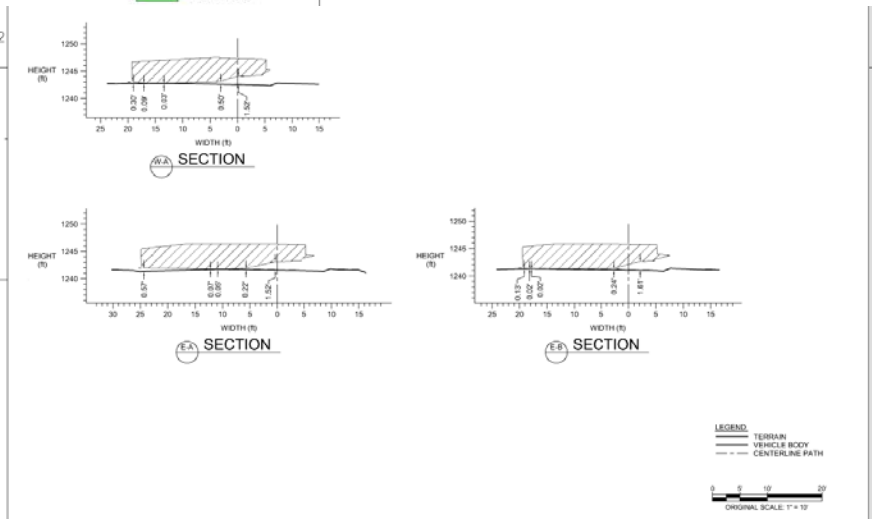
- HOW TO CHECK VERTICAL CLEARANCE
  - 3D MODELING







TS



AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - DEFINING PHYSICAL FEATURES

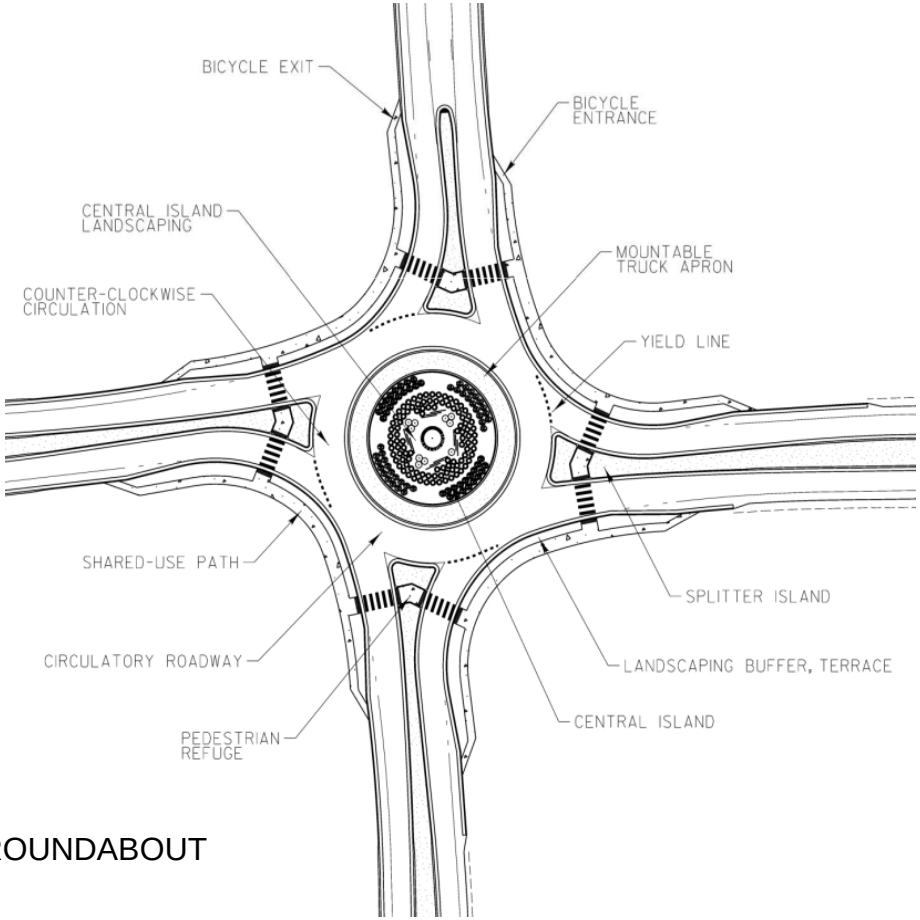


FIGURE 1.1 SINGLE-LANE ROUNDABOUT

AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - DEFINING PHYSICAL FEATURES

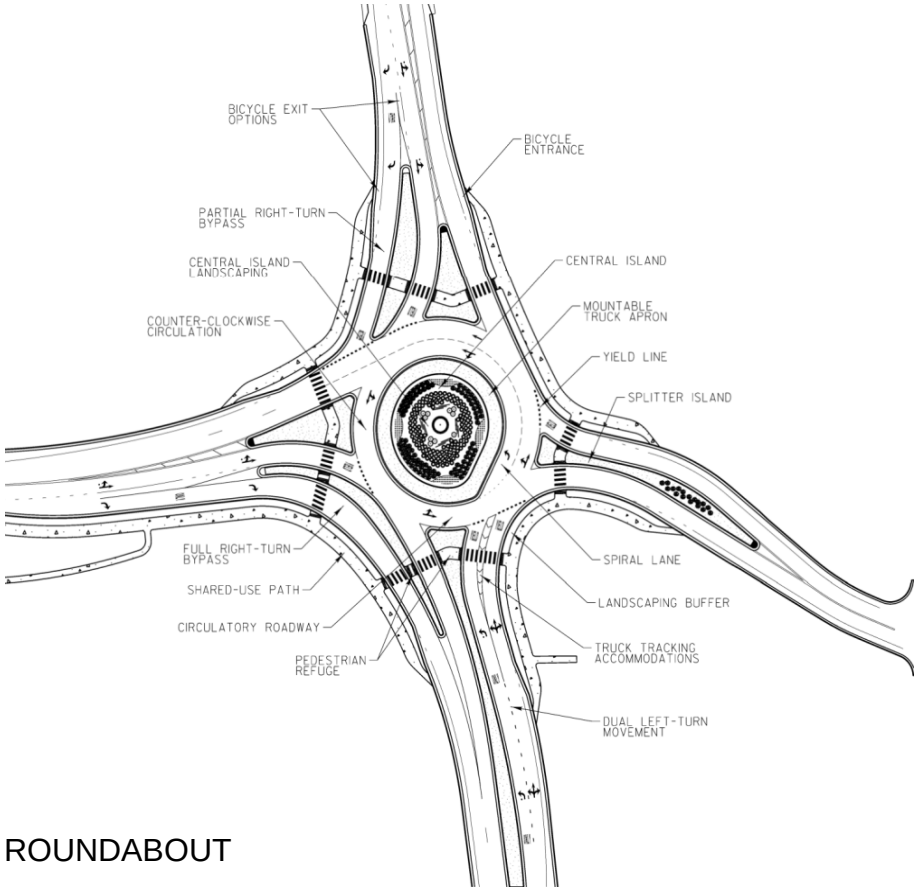


FIGURE 1.2 MULTI-LANE ROUNDABOUT

AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - WisDOT ROUNDABOUT DESIGN LEVELS
  - HIGH SPEED APPROACHES
    - CURVILINEAR AND TANGENTIAL APPROACHES
  - PATH OVERLAP

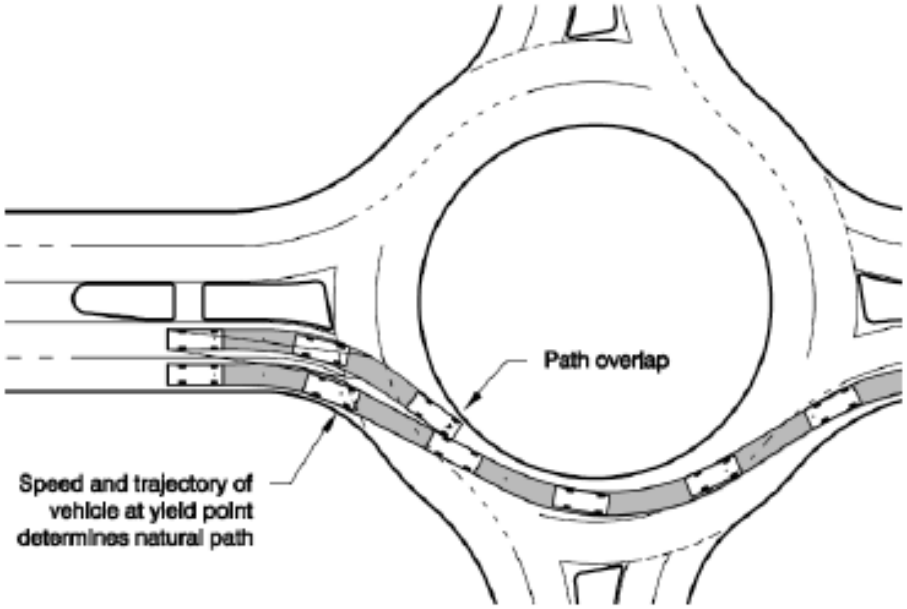
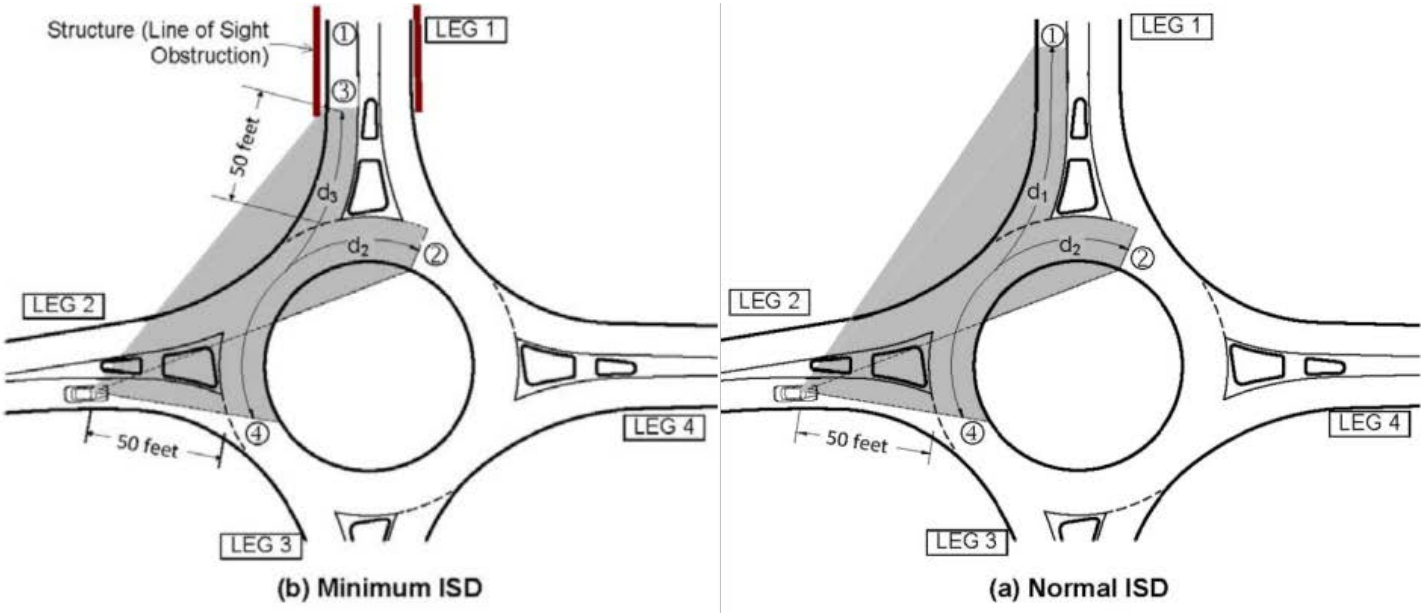


Figure 30.16 Entry Path Overlap

AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - INTERSECTION SIGHT DISTANCE



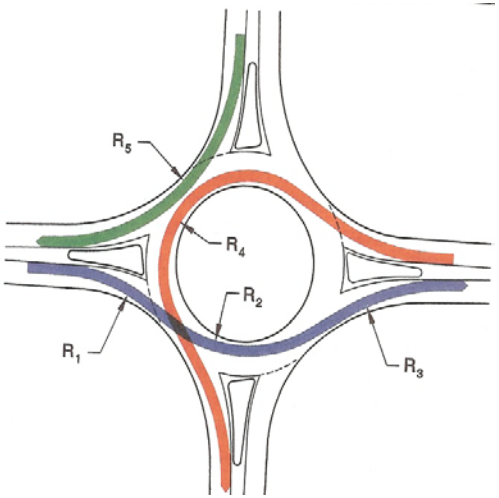
DESIGN COORDINATION

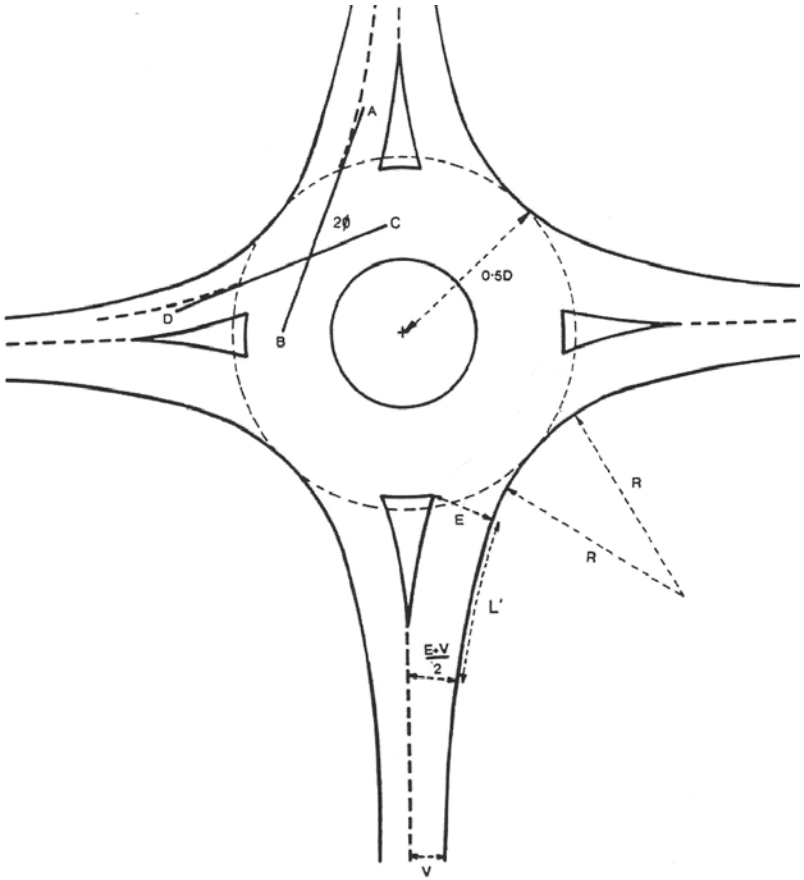
- ROUNDABOUT DESIGN
  - DESIGN GUIDANCE FOR LEGAL TRUCKS
    - CASE 1
      - » ALL TRUCKS TO ENCROACH INTO ADJACENT LANES AS THEY APPROACH, ENTER, CIRCULATE, AND EXIT
    - CASE 2
      - » ACCOMMODATE TRUCKS IN-LANE AS THEY APPROACH AND ENTER, BUT TRACKS CAN ENCROACH INTO ADJACENT LANES AS THEY CIRCULATE AND EXIT
    - CASE 3
      - » ACCOMMODATE TRUCKS IN-LANE AS THEY APPROACH AND TRAVERSE THE ENTIRE INTERSECTION

AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - CRITICAL PARAMETERS
    - HALF WIDTH
    - ENTRY WIDTH
    - EFFECTIVE FLARE
    - ENTRY RADIUS
    - ENTRY ANGLES
    - FAST PATHS





AYRES ASSOCIATES

DESIGN COORDINATION

- ROUNDABOUT DESIGN
  - SCHEDULE
    - TRAFFIC COUNTS
    - TRAFFIC FORECASTS
      - » PAVEMENT DESIGN REPORT
  - 60% ROUNDABOUT DESIGN COMPLETED PRIOR TO DSR
    - NEED CRITICAL DESIGN PARAMETERS TABLE SIGNED BY REVIEWER

AYRES ASSOCIATES

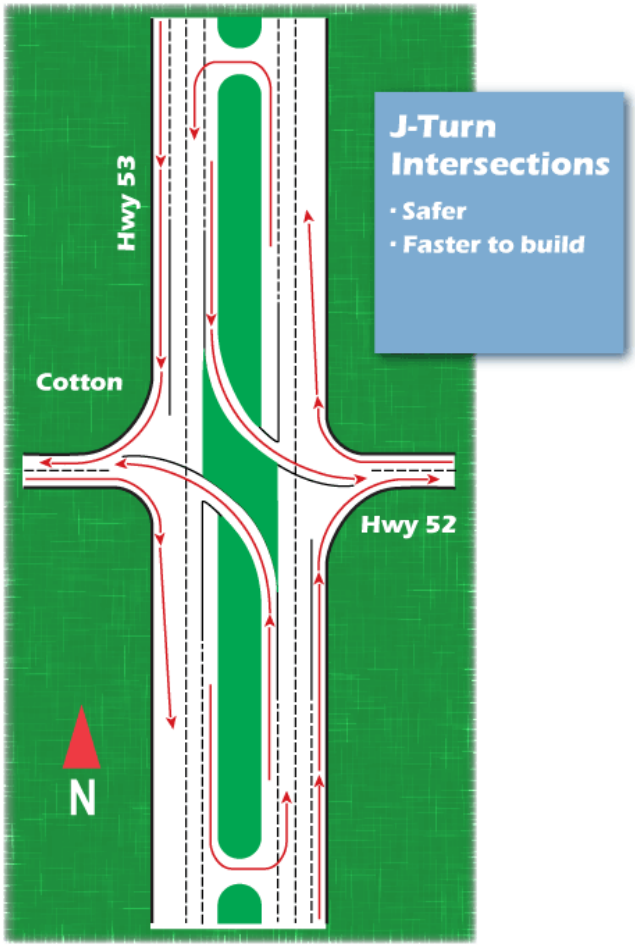
DESIGN COORDINATION

- CONSTRUCTION STAGING
  - TEMPORARY SIGNALS
    - LANE CONFIGURATION AND WIDTHS
    - TURNING MOVEMENTS
    - TIMINGS
  - ROUNDABOUT STAGING
    - CANNOT FUNCTION AS A ROUNDABOUT UNTIL LEGALLY SIGNED AND MARKED
    - TEMPORARY ROAD/INTERSECTION

AYRES ASSOCIATES

WHAT IS A J-TURN INTERSECTION?

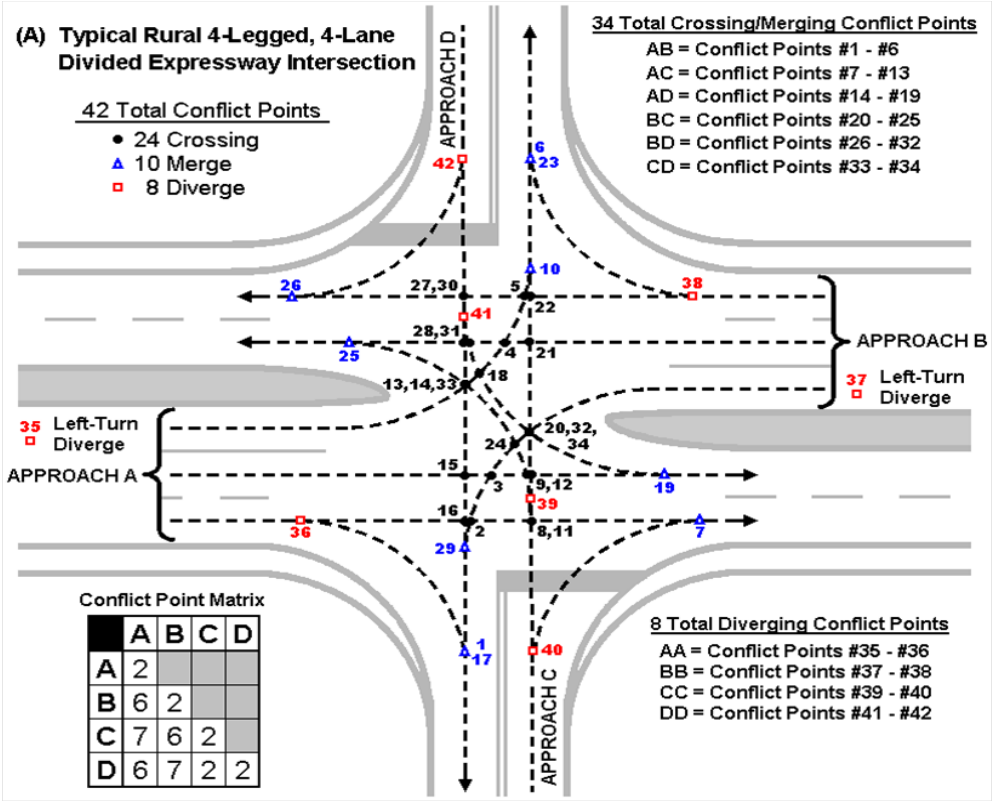
- CONSTRUCTED AT INTERSECTIONS WITH MEDIAN SEPARATED ROADWAY
- SIMILAR TO STOP CONTROLLED
- EXPRESSWAY ACCESS IS UNCHANGED
- MINOR ROAD MUST TURN RIGHT
- USE OF MEDIAN U-TURN TO KEEP MINOR ROAD ACCESS



AYRES ASSOCIATES

WHY CONSIDER A J-TURN?

- SAFETY



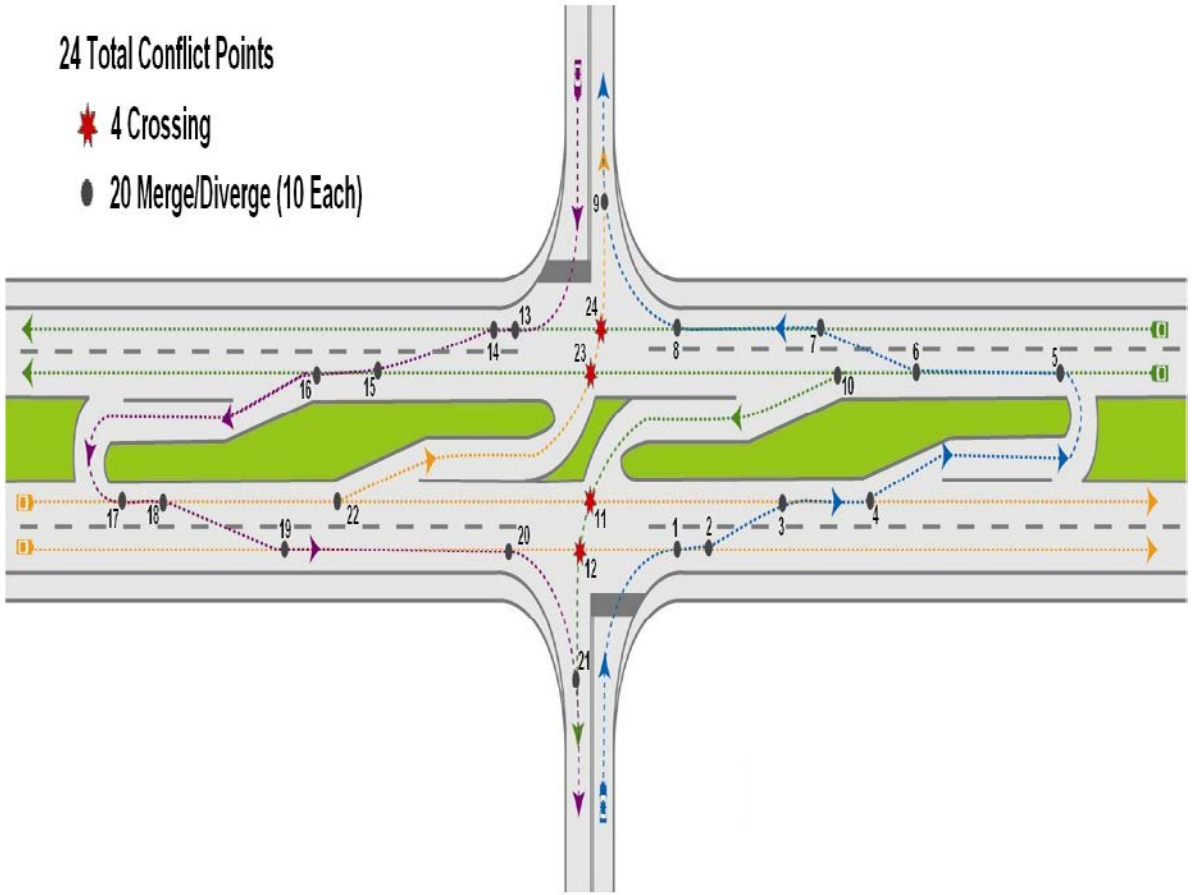
	A	B	C	D
A	2			
B	6	2		
C	7	6	2	
D	6	7	2	2

TRADITIONAL INTERSECTION

AYRES ASSOCIATES

WHY CONSIDER A J-TURN?

- FEWER CONFLICT POINTS



AYRES ASSOCIATES

J-TURN INTERSECTION

HISTORIC RESULTS

- MARYLAND – US 301 AND MD 313
  - 90% REDUCTION IN CRASHES
  - 100% REDUCTION IN FATALITIES
- WISCONSIN – USH 53/CTH B INTERSECTION (2011)

ADDITIONAL J-TURNS IN WISCONSIN

- STH 29 – CTH VV, BROWN COUNTY (2013)

AYRES ASSOCIATES

J-TURNS (OTHER CONSIDERATIONS)

- POSSIBLE PROBLEMS/CONCERNS
  - DRIVER CONFUSION
  - MEDIAN WIDTH NEEDED FOR LARGE TRUCKS
  - INCREASED TRAVEL TIMES (ESPECIALLY FOR EMERGENCY SERVICE VEHICLES)

AYRES ASSOCIATES

INTERSECTION DESIGN

QUESTIONS?

AYRES ASSOCIATES