



BACK TO BASIC SIGNAL, SIGNING AND LIGHTING DESIGN 89th Purdue Road School



Presenters:

Gary Mroczka, PE – Manager



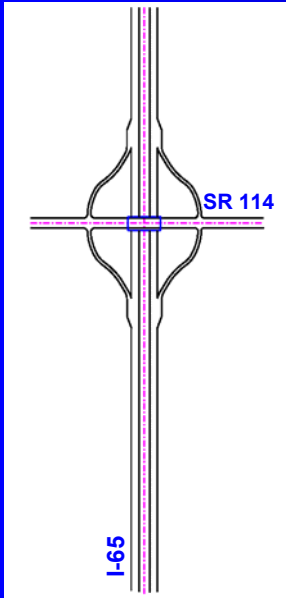
Pankaj Patel, PE – Sign Design Engineer
Shariq Husain, PE – Lighting Design Engineer
Prakash Patel, PE – Signal Design Engineer



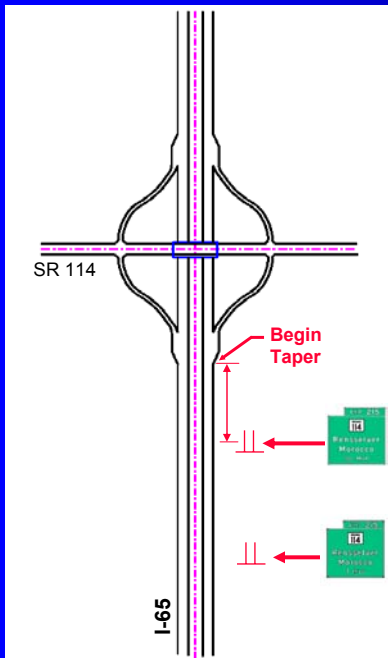
**Specialty Projects Group Section
Design Division**

TRAFFIC SIGN DESIGN

- FREEWAY OR EXPRESSWAY INTERCHANGE
- TWO STATE OR US ROUTE INTERSECTION
- PLAN DEVELOPMENT



TYPICAL SIGNAGE FOR DIAMOND INTERCHANGE (FREEWAY)



GENERAL GUIDELINE

Advance Sign

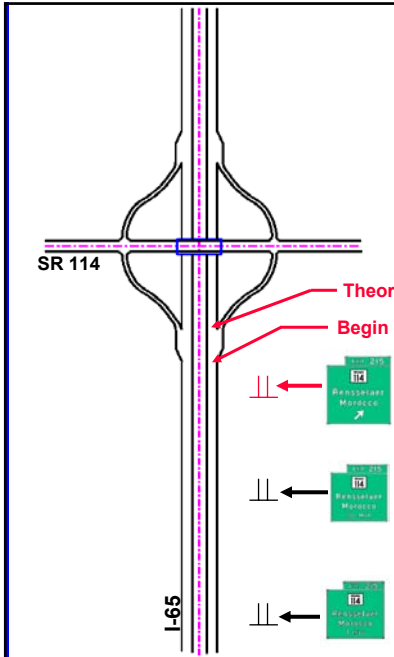
- At least 2 advance Guide Signs on main line (I-65) should be used. Generally 1 Mile and 1/2 Mile Signs. Distance should measure from beginning of taper (deceleration lane).
- Advance Guide Signs should be overhead for Freeway to Freeway interchange or heavy traffic interchange.



GENERAL GUIDELINE CONT.

Exit Directional Sign

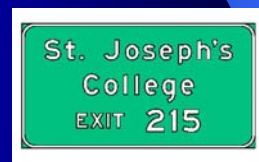
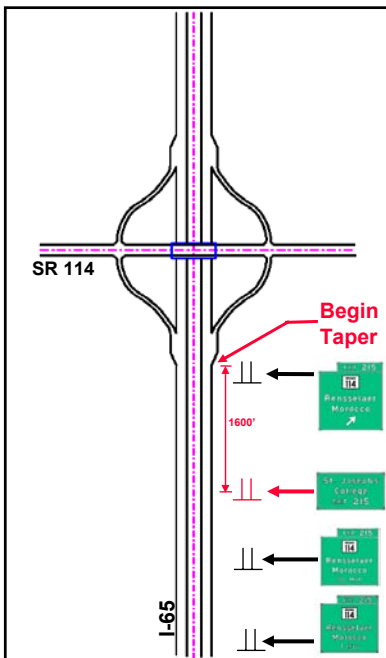
- Ground Mounted Exit Directional Sign should be located at beginning of taper (deceleration lane), while Overhead Sign should be located at or near theoretical gore point.

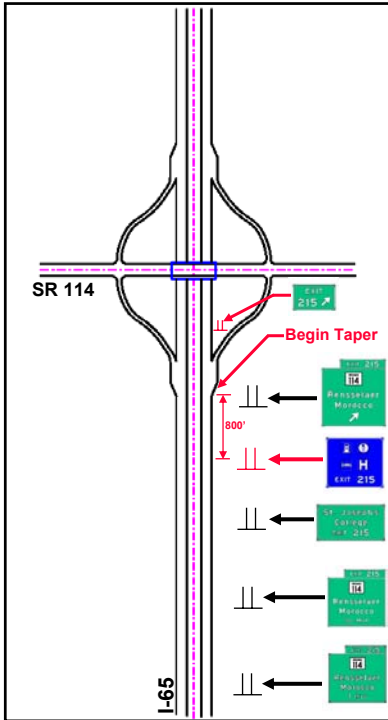


GENERAL GUIDELINE CONT.

Supplemental Sign

- Supplemental Guide Sign if any, then should be 1600 ft. from beginning of taper.
- No more than one Supplemental Guide Sign should be used on each interchange approach.
- Supplemental Guide Sign shall not be installed at freeway to freeway interchange.

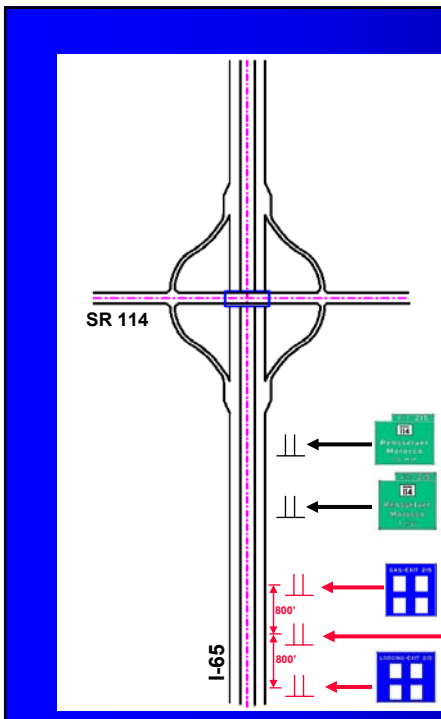




GENERAL GUIDELINE CONT.

General Service and Gore Sign

- General Service Sign if any, then should be 800 ft. from beginning of taper.
- Exit Gore Sign should be located in the area between the main line and the ramp. Sign should be number if interchange numbering is used.

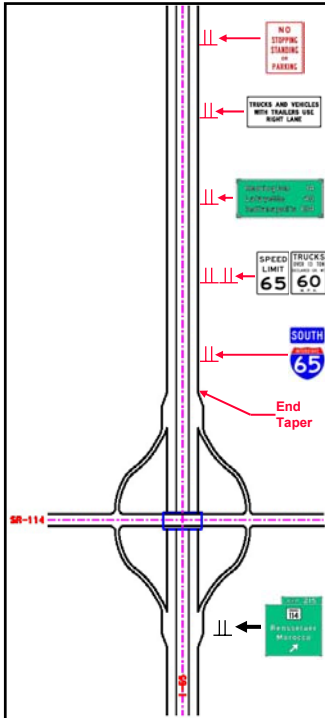


GENERAL GUIDELINE CONT.

Business Logo Sign

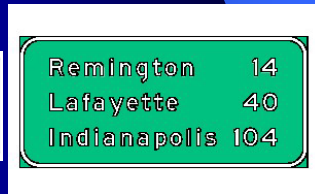
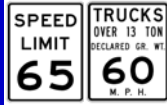
- Business Logo Signs should be before the first advance Guide sign (In this case before 1 Mile).
- In direction of traffic flow, first Lodging, then Food, then Gas and 800 ft spacing between them.
- Business Logo Signs own by private company so before relocating these signs contact "Indiana Logo Sign Group".





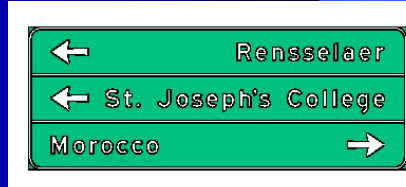
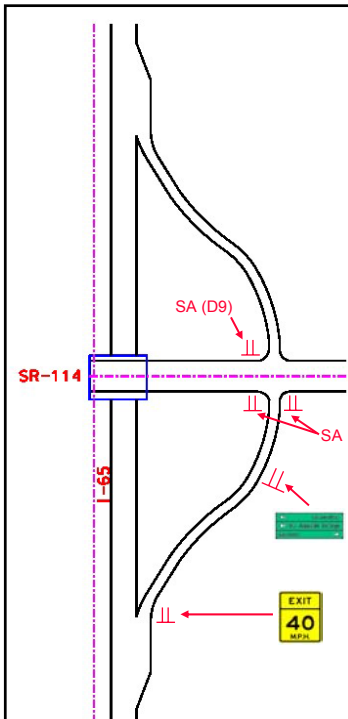
GENERAL GUIDELINE FOR POST INTERCHANGE SIGN

- First Sign 500 ft. from the End of the Taper (acceleration lane) then 500 ft. in between them.
- If space between interchanges are not enough then install only RMA and Speed Limit Signs.



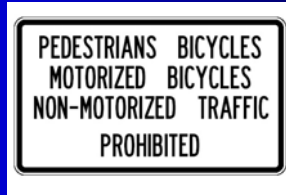
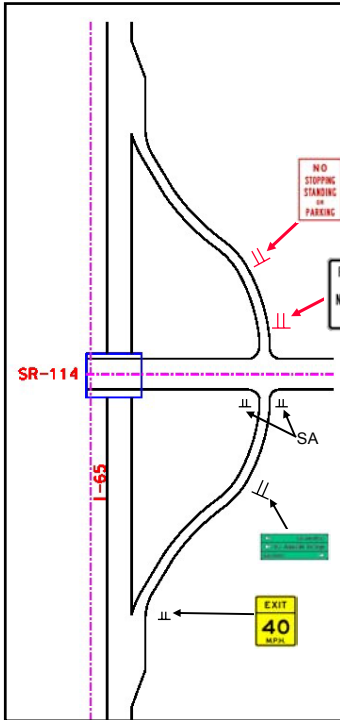
EXIT RAMP SIGNS

- Install Advisory Exit Speed Limit Sign just beyond the gore point.
- If you can see the intersection with crossing route from bottom of the Ramp then don't need to install Stop Ahead or Signal Ahead Sign. Engineering judgment indicates a need, then install otherwise not.
- Install Guide sign for destination at least 400 ft. advance of the Ramp intersecting with the crossing Route.
- Install Sign Assembly (SA) at intersection. Assembly will be of following Signs: Stop Sign (if stop control intersection), Do Not Enter Sign (other side) and One way Signs.
- Install General Service Sign Assembly (D9) for directing traffic left or right of intersection for their kind of service.



ENTRANCE RAMP SIGNS

- Install sign for “Pedestrians Bicycles ...” 50-100 ft. from intersection so as to clearly visible to all drivers which has exclusion on Freeway.
- No “Stopping Standing or Parking” install where ever problem exist on Ramps.



CROSS ROUTE SIGN AT FREEWAY INTERCHANGE

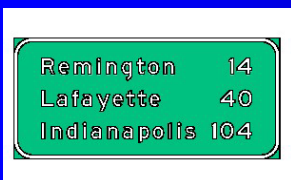
- Install Overhead Guide Sign between two ramps intersection on cross route for Freeway. After the bridge if Freeway is underpass and before the bridge if Freeway is overpass.
- Approx. 300 ft. advance of the Ramp intersection approach install Guide Sign (destination) for freeway.





SUPPLEMENTAL SIGN

- Signs can be used to provide information regarding destinations accessible from an interchange, other than places shown on the standard interchange signing. Destination on sign should be like College, University, Park or other traffic generators.
- Sign should not list more than two destinations.
- Sign action message should be “EXIT NUMBER”.



DISTANCE SIGN

- Sign shall consist of a two or three line destinations.
- Top line should be next interchange cross route or town.
- Second line should be the regional control city and bottom line shall be a national control city.
- All distance should be measured from the sign to the intersected road, city hall, or courthouse.

GENERAL SERVICE SIGN



- Use symbolic sign and they should be displayed as follows:
 - A. For Six Services:
 1. Top row – GAS, FOOD, and LODGING
 2. Bottom Row - PHONE, HOSPITAL, and CAMPING
 - B. For Four Services:
 1. Top row – GAS and FOOD
 2. Bottom row – LODGING and PHONE
- If interchange are not numbered, an action message such as NEXT RIGHT or SECOND RIGHT should be used.

CROSSROAD GUIDE SIGN



- Top line Freeway route no. and cardinal directional.
- Second line national control city.
- Bottom line action message.



- Top line second exit with national control city.
- Bottom line next exit with national control city.

LETTER AND NUMERICAL SIZES FOR GUIDE SIGNS

Advance, Exit Direction, and Overhead Signs (Freeway & Expwy.)



10"-15"

45"x36"

20"/15" – 16"/12"(Overhead)

18"-12"



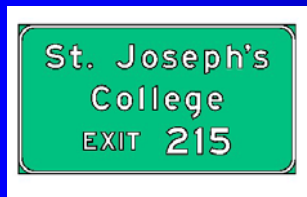
12"



22"x34"

LETTER AND NUMERICAL SIZES FOR GUIDE SIGNS

Supplemental & Gore Signs



13.3"/10"

10'-15"



12"

18" – 18"x28"

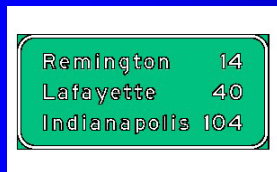
LETTER AND NUMERICAL SIZES FOR SIGNS

General Service & Distance Signs



24"x24"

10"-15"



8"/6"-8"

LETTER AND NUMERICAL SIZES FOR GUIDE SIGNS

Exit Direction, and Overhead Signs (One Lane Approach)



36"x36" – 15"/12"

13.3"/10"

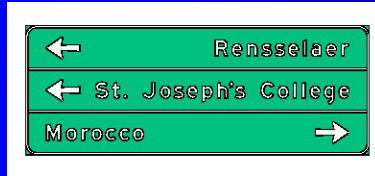
18"x28"



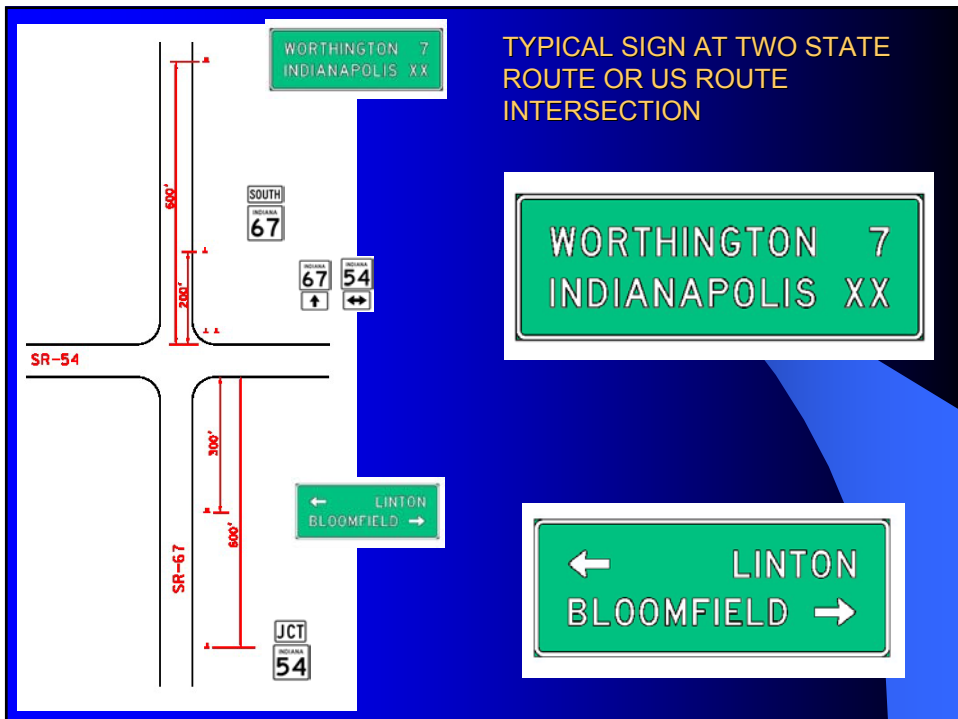
18"x28" – 13.3"/10"

LETTER AND NUMERAL SIZES FOR GUIDE SIGNS

Ramps (Freeway & Expwy.)



18"x28" – 13.3"/10"



LETTER AND NUMERAL SIZES FOR CONVENTIONAL ROAD

Destination Sign (D1) and Distance Sign (D2)



6"x9" - 6" SERIES-D



6" SERIES-D

SIGN SIZE PROGRAM

- GuidSIGN 4.1
By Transoft Solutions
- SignCAD V4.70
By SignCAD Systems, Inc.

SIGN PLAN DEVELOPMENT

- Title sheet with map.
- Index sheet
- Existing sign plan (Freeway only)
 1. Station, code number, and legend.
 2. Message of each panel sign.
- Proposed sign plan
 1. Station, code number and legend.
 2. Proposed panel sign message.
- Proposed Route Marker Assembly (RMA) details.
- Sheet sign details.
- Panel sign layout
 1. Size of sign.
 2. Border and radius.
 3. Letter ht. of message and arrow size.

SIGN PLAN DEVELOPMENT CONT.

- Cross section sheet
 1. Panel sign (Ground mount and overhead).
 2. Sheet sign (if mounted on overhead structure).
- Traffic sign details sheet 2 (for overhead sign structure).
- Foundation details for non-standard design.
- Special design details, if required like guardrail.
- Quantity sheets
 1. Panel sign summary.
 2. Sheet sign summary.

REFERENCES

- MUTCD, Millennium Edition
- Sign Design Guide, May 2002 Edition
- INDOT Design Manual, Part VII Traffic Design
- INDOT Design Manual, Part II Plan Development
- Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2001 Edition
- INDOT Standard Drawings

QUESTIONS

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BASIC OF ROADWAY LIGHTING DESIGN

LIGHTING METHODOLOGIES

ILLUMINANCE

LUMINANCE

SMALL TARGET VISIBILITY

DESIGN

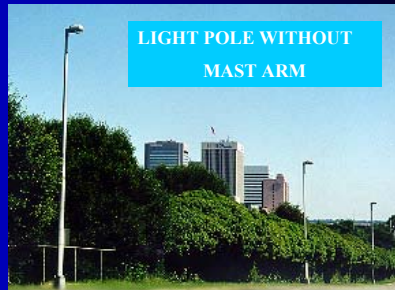
- **SOFTWARE**
 - VISUAL (BY HOLOPHANE)
 - ALADIN (BY G.E)
- **EQUIPMENTS**
 - CONVENTIONAL LIGHT POLES WITH BREAKWAY & NON BREAKWAY BASES
 - HIGHMAST LIGHT POLES WITH BOTTOM LATCH LOWERING SYSTEM
 - 250 & 400 WATT H.P.S ROADWAY LUMINAIRES
 - 1000 WATT H.PS HIGHMAST LUMINAIRE
 - 150 WATT H.P.S LUMINAIRES (FOR UNDERPASS LIGHTING)
 - 250 WATT M.V. LUMINAIRE (FOR SIGN LIGHTING)
 - # 4 & # 10 COPPER_CONDUCTORS

CONVENTIONAL LIGHTING POLE

LIGHT POLE WITH TRUSS ARM



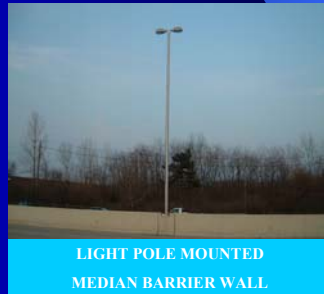
LIGHT POLE WITHOUT MAST ARM



LIGHT POLE WITH TRANSFORMER BASE



LIGHT POLE MOUNTED MEDIAN BARRIER WALL



LUMINAIRES

HIGHMAST



SIGN / UNDERPASS



COBERAHEAD WITH CUTOFF OPTICS



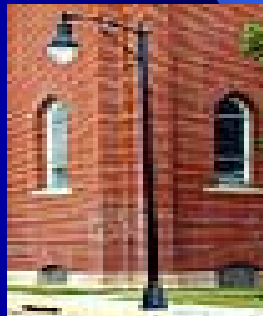
MONGOOSE



COBERAHEAD WITH NON CUTOFF OPTIC



DECORATIVE LIGHTING (USED BY LOCAL AGENCY)



HIGHMAST LIGHTING IN MEDIAN BARRIER WALL



INTERCHANGE HIGHMAST LIGHTING



LOWERING OF HIGHMAST TOWER LUMINAIRE RING



INSTALLATION OF HIGHMAST TOWER



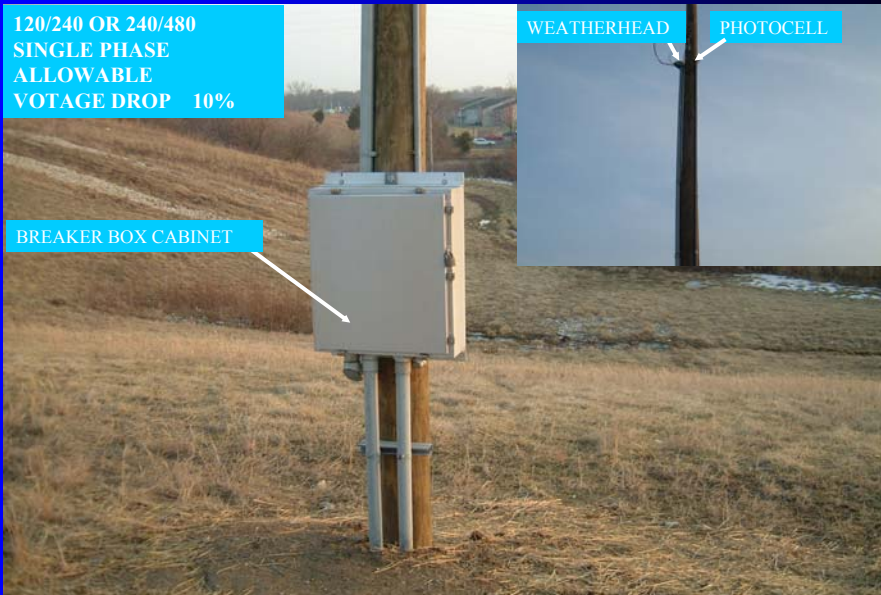
SERVICE POINT

120/240 OR 240/480
SINGLE PHASE
ALLOWABLE
VOTAGE DROP 10%

BREAKER BOX CABINET

WEATHERHEAD

PHOTOCELL



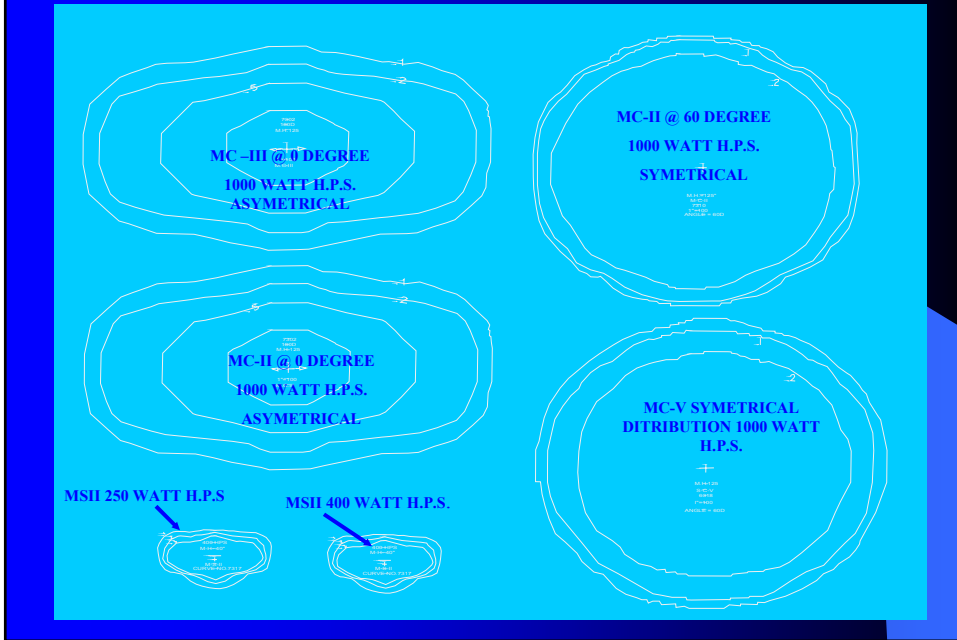
DESIGN CRITERION

	UNIFORMITY RATIO	AVERAGE MAINTAINED
● <u>I</u> NTERSTATE/FREEWAY	4:1	0.8 F.C.
● EXPRESSWAY	3:1	1.2 F.C.
● INTERSECTION & CITY ST.	4:1	0.9 F.C.
● WEIGH STATION & REST AREA RAMPS	3:1	0.6 F.C.
● WEIGH STATION & REST AREA PARKING	4:1	1.1 F.C.
● LAMP LUMEN DEPRECIATION FACTOR = 0.90		
● LUMENAIRE DIRT DEPRECIATION FACTOR = 0.87		
● TYPICAL POLE HEIGHT = 40'		

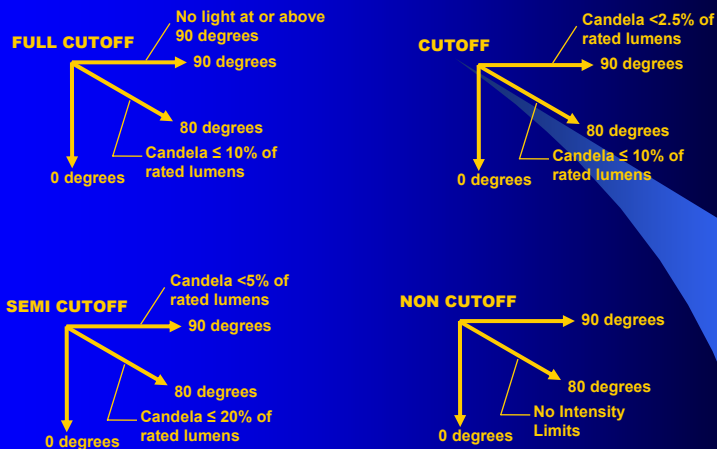
LIGHT DISTRIBUTION

- SPACING CLASSIFICATION
 - SHORT MOUNTING HEIGHT) (SPACEING UP TO 4 TIMES
 - MEDIUM MOUNTING HEIGHT) (SPACEING UP TO 5 TIMES
 - LONG MOUNTING HEIGHT) (SPACEING UP TO 6 TIMES
- WIDTH CLASSIFICATION
 - TYPE I
 - TYPE II
 - TYPE III
 - TYPE IV
 - TYPE V
- GLARE CONTROL CLASSIFICATION

LUMINAIRE TEMPLATES



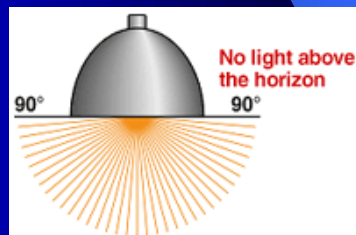
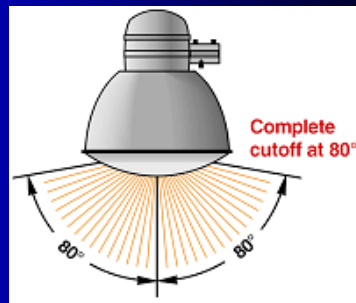
LIGHT OPTICS



HIGHMAST LUMINARIES 1000 WATT H.P.S.



ENCLOSED HIGHMAST LUMINAIRE



STATE AND LOCAL RESPONSIBILITY

- I. INDOT JURISDICTION
- II. LOCAL JURISDICTION

CONSTRUCTION PROJECTS

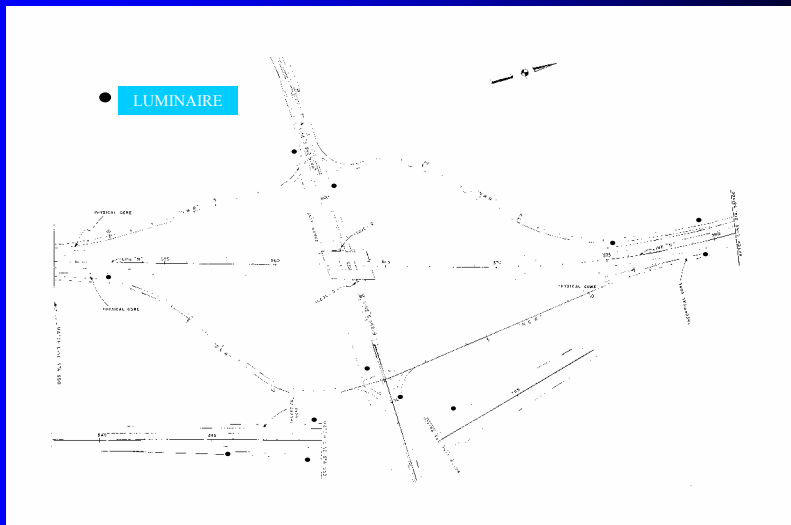
- I EXISTING LIGHTING SYSTEM OWNED BY INDOT
- II EXISTING LIGHTING SYSTEM OWNED BY LOCAL AGENCY
- III EXISTING LIGHTING SYSTEM OWNED BY UTILITY CO.

WARRANTS

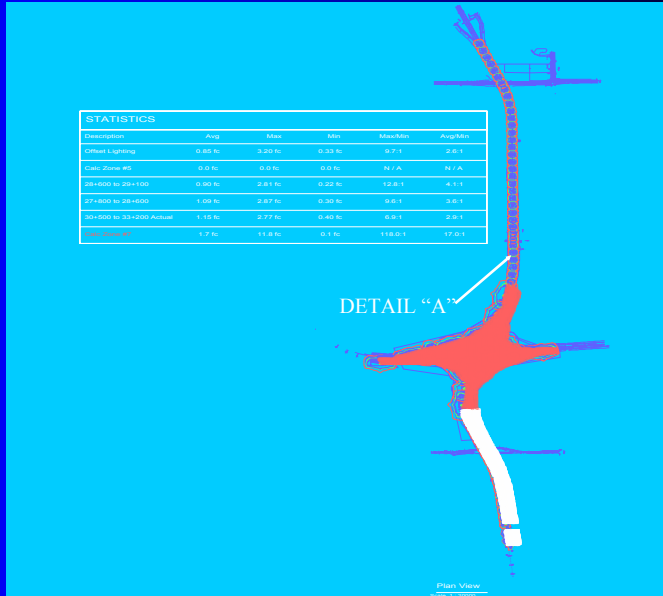
- Freeways
- Accidents.
- Nearby Development
- Ramp Terminals

- Highway Sign Lighting
- Rest Areas
- Truck Weigh Stations
- Bridge Structures
- Bikeways,
- Tunnels

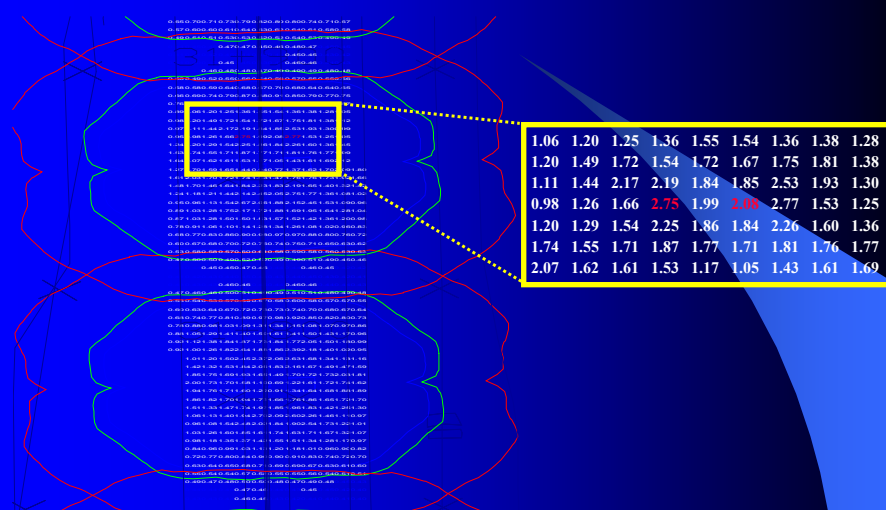
PARTIAL INTERCHANGE LIGHTING



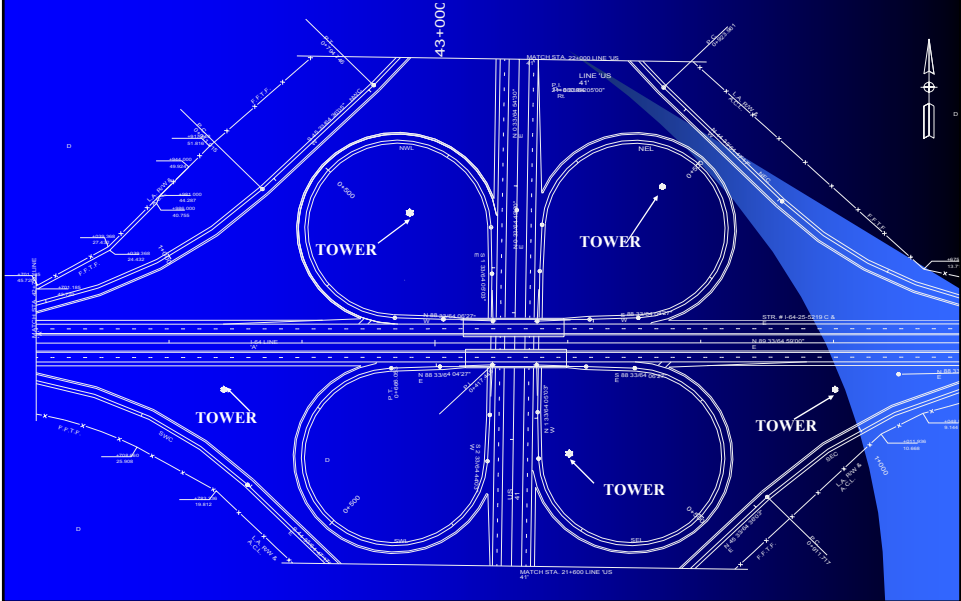
COTINUOUS LIGHTING BETWEEN INTERCHANGES



DETAIL "A"

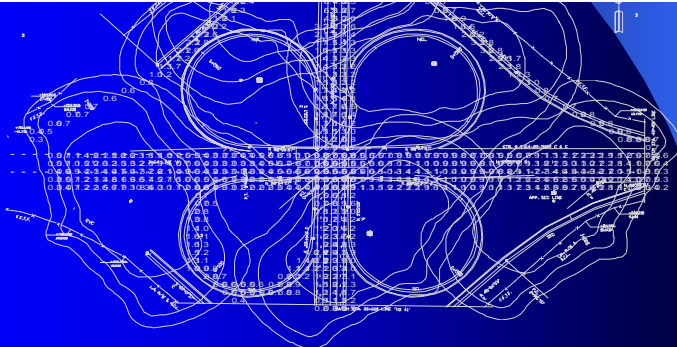


FULL INTERCHANGE LIGHTING



COMPUTER OUTPUT RESULTS

STATISTICS					
Description	Avg.	Max.	Min.	Max. / Min.	Avg. / Min.
Calc Zone #5	1.6 fc	10.3 fc	0.2 fc	51.5 : 1	8.0 : 1
Calc Zone #6	1.9 fc	7.0 fc	0.5 fc	14.0 : 1	3.9 : 1
Calc Zone #7	1.7 fc	3.7 fc	0.3 fc	12.3 : 1	5.5 : 1
Calc Zone #4	0.9 fc	1.8 fc	0.4 fc	4.5 : 1	2.4 : 1
Calc Zone #7	1.4 fc	3.6 fc	0.7 fc	5.1 : 1	2.0 : 1



Snap Shot # 3
Scale 1" = 100'

MONGOOSE



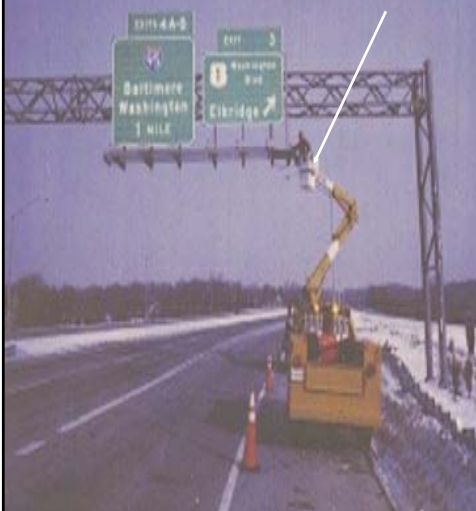
MONGOOSE LUMINAIRE ON MEDIAN BARRIER WALL

- I-465 between I-70 and Pendleton Pike

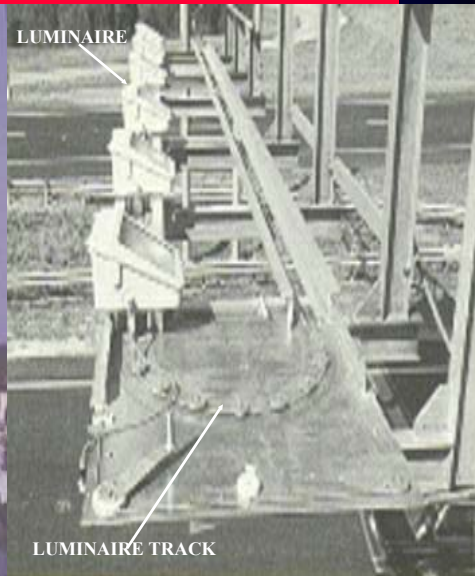


SIGN LIGHTING SYSTEM BY LUMI TRAK

WORKING ON THE LUMINAIRE FROM SHOULDER



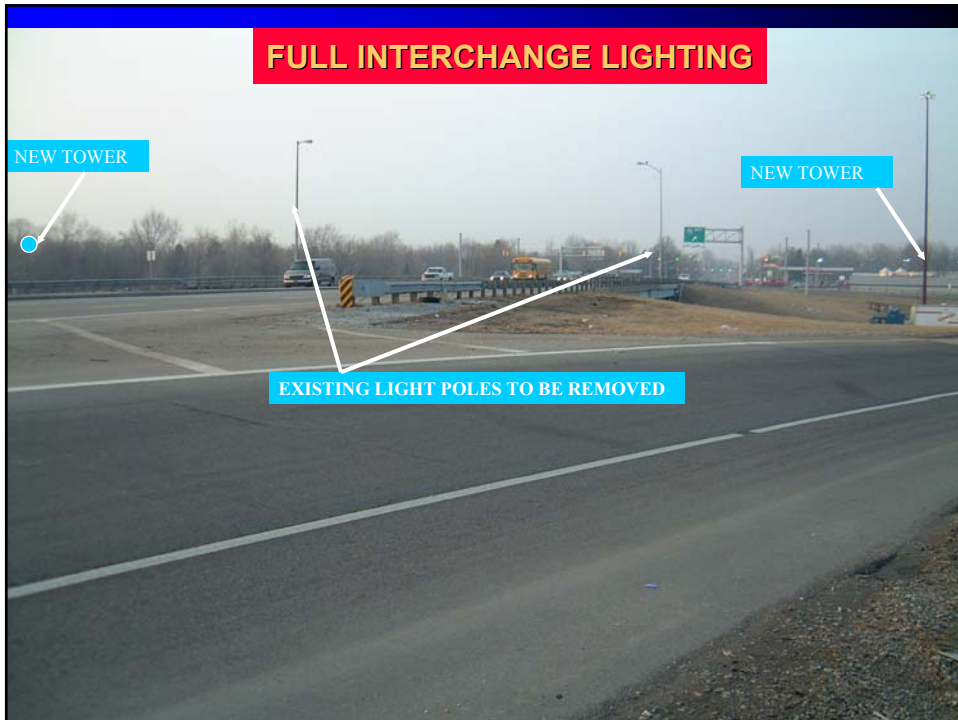
LUMINAIRE



LUMINAIRE TRACK

TUNNEL LIGHTING





PERMIT AND CO-ORDINATION

1. FAA (IF AIRPORT IN THE VICINITY)
2. CO-ORDINATION WITH UTILITIES COMPANIES
3. SOIL BORING FOR HIGHMAST TOWER FOUNDATION
4. FIELD CHECKS

REFERENCES

- 1. *An Informational Guide for Roadway Lighting*, AASHTO;
- 2. *Roadway Lighting Handbook*, FHWA;
- 3. *Roadway Lighting Handbook*, Addendum “Designing the Lighting System - Using Pavement Luminance,” FHWA;
- 4. *INDOT Design Manual*, Part VII “Traffic Design “ Chapter Seventy Eight
- 5. Chapter Forty-nine, “Roadside Safety,” *Indiana Design Manual*,
- 6. *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, AASHTO;
- 7. *INDOT Standard Drawings*, INDOT;
- 8. *INDOT Standard Specifications*, INDOT;
- 9. National Electrical Code;
- 10. National Electric Safety Code.

QUESTIONS

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Signal Design Basics

Overview

- Elements of the Signal Plan
- Vehicle Detection
- Operational Requirements
- INDOT preferred Signal Configurations
- Preemption (R/R and Emergency Vehicle)

Elements of Signal Plan , INDOT

- Ex. Or Proposed Geometry of the intersection
 - Turning Radius for the design vehicle
 - Opposing Left Turn Alignment
 - Stop Bar location
 - Typically between 5' to 30' from the adjacent thru lane
 - Left turn lane stop bar shall be clear of the turning path of the turning vehicle
 - Pedestrian Crossings and ramps if present
- Pedestrian Heads and Push Buttons
 - As close as possible to the Curb Ramp

Elements of Signal Plan , INDOT

- Signal Structures (ex. Strain Pole, Mast Arm Structure Preferred)
- should meet design standards for location (ex. 3R, 4R)



Elements of Signal Plan , INDOT (Continue)

- Traffic Signal head
 - LED heads except Amber Ball,
 - Use recurring specs 805-T-133 with every project includes signalized intersection.
 - Head should lined up with Driver's eye (Typically 4' from the left edge of the lane)
 - At least one head in the 40' to 150' range,
 - Use nearside head if it cannot be met or geometric features calls for it.
 - Ch. 77 INDOT Manual for Typical Head Placement
 - 40Degree Vision cone

Do's and Don'ts

- Keep intersection design uniform and predictable
 - Avoid unusual design
 - Geometry and
 - Phasing point of view
- Verify & confirm adequacy of preliminary geometry
 - Communicate with INDOT is deficiencies are noted
- Use turning templates to verify left turn separation
- Develop design considering pedestrian access
 - Locate median, stop bars based on the future crosswalk installations

Operational Requirement

- TS2 Type 1 controller to be used
- Call out recurring specs no. 913-T-137
- Maximum 16 lead inns in the typical controller, if more than 16 make sure to specify in the controller specs.



Vehicle Detection

- Presence Detection
- Pulse Detection

Presence Detection

- Detection at the Stop Bar
- Detects the presence of the vehicle
 - Locate the detection zone behind the stop bar
 - Should be clear of the detection from opposing traffic
 - In the case of wide lane add more detection
 - Make sure not to detect the parking areas

Pulse Detection

- Back loop
- INDOT criteria is to provide dilemma zone protection for speed limit 40 MPH and more
- Extends the green time
 - Located at a distance from the stop bar based on the posted speed limit
 - Ch. 77, Figure 77-5S for detection set back distances
- INDOT typically uses 5 seconds passage time

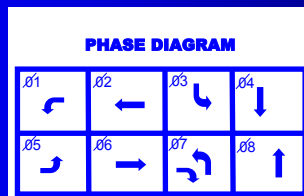
Do's and Don'ts

- INDOT likes to use Preformed loops in the case of new "Full depth Pavement" (which is wired directly in to the handhole).
- Check approved materials list for the different kind of the detection being used by INDOT
- Speed traps are done at the Back loop locations, 10' clear distance between the loops

Operational Requirement (Cont.)

Phase Diagram

- Preferential movement in the phase no. 2 and 6
- Provide RT overlap in the case of separate RT lane



Main Line is Preferential
Main Line Flashes Amber
S Line Flashes Red

Do's and Don'ts

- Preferentiality of Operation is set by “Official Action” (INDOT Projects)
- Do not change the Preferentiality
- Contact INDOT for any questions
- Do not provide lagging left turn phasing
 - Dangerous in most cases- Driver perception
- Split phasing is less desirable
 - Inefficient
 - Provide as a last resort
- In case of dual LT lanes provide protected only LT phasing

Service Installations

- Pole Mounted, typically on the Strain pole close to the Controller
- Metered Service Point due to the LED Heads (reduced electrical consumption)
- Service conduit routed to the controller foundation, (Typically separate conduit for service wire)
Coordinate with Utility Company for the Service Installation

**BREAKER BOX
CABINET**



Utility Considerations

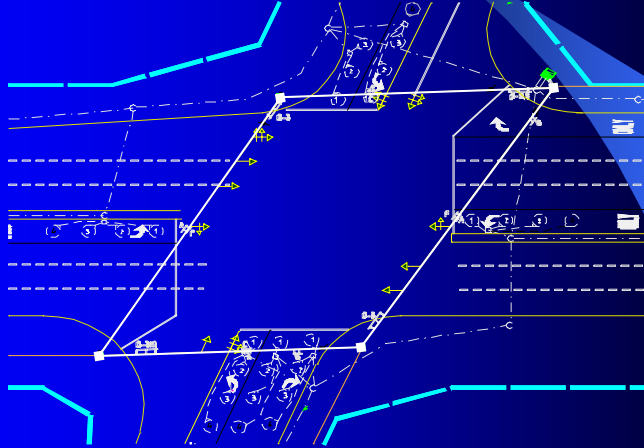
- Overhead Conflicts
 - Power/cable/phone
- Underground Conflicts
 - Culverts
 - Water/gas/sewer
 - Electric/cable/phone

SIGNALIZED INTERSECTION CONFIGURATIONS, INDOT

- By Order of preference
 - Box Configuration, Either by Strain Poles or Mast Arm Cantilevers
 - Z Configuration with Strain Poles only
 - In the case of wider Main line
 - Single Diagonal with Strain poles or mast Arm Cantilevers
 - Small intersection at a skew
 - Double Diagonal or V Configuration
 - In case of the wider Main line at a severe skew with 'S' line

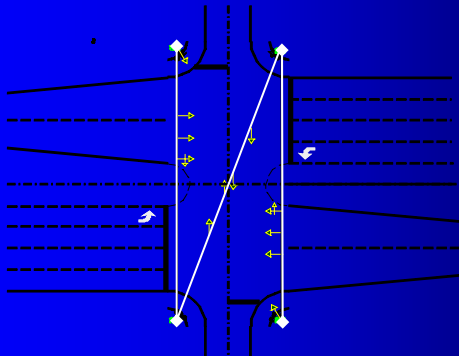
Box Configuration

- INDOT Preferred configuration
- Gives flexibility for the placement of the Heads & Lane Control Signs



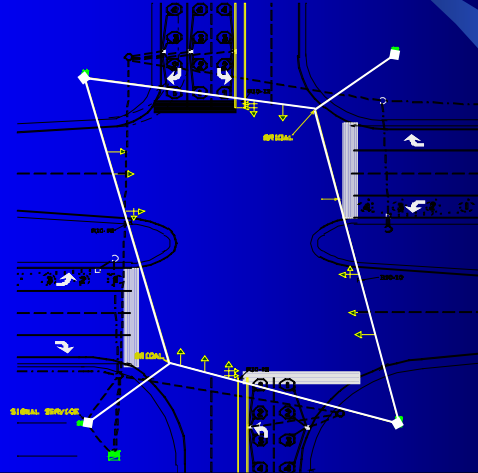
Z Configuration

- Usually in the case of wider main line
- Lane control signs are less desirable on the Diagonal span



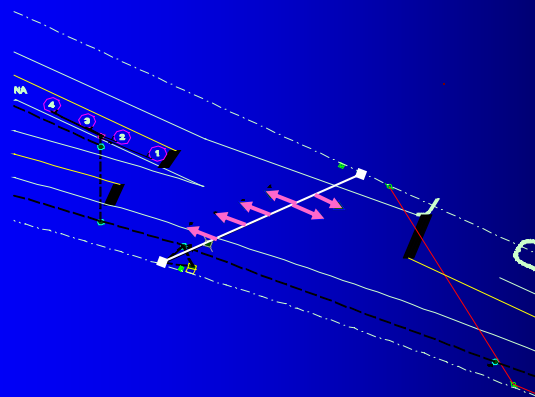
Box With BRIDAL Configuration

You can maintain BOX Configuration with Bridal to meet maximum 150' Distance for Head Placement



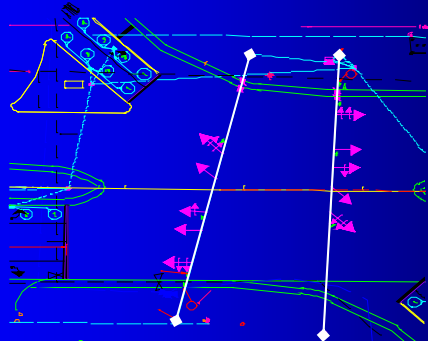
Single Diagonal

- Smaller Intersections
- For Flashing Beacon Installations
- Signs are not desirable on the span



Double Diagonal Or V Configuration

- Usually in the case of wider main line
- Intersection at severe skew
- Use directional heads, like optical programmable, louvers etc.



Preemption

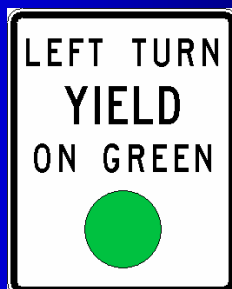
- Show R/R in the Vicinity of the Intersection (200') or Engineering Judgment
- Emergency Vehicle Preemption

Interconnection

- Fiber Optic preferred, hardwire, twisted Pair
- Spread Spectrum interconnection
- Typically locate the Master controller in the middle of the interconnection OR at the intersection of the two major routes along the interconnect
- Time Based Interconnection can be done for the predictable traffic patterns, no physical interconnection needed
- In the case of the closed loop system, provide counting loops for the system to be Traffic Responsive. Locate the system loops downstream of the intersection

Signal Related Signs

Use R10-12 with Protective /Permissive Left turn Head
(5 Section Head)



Signal Related Signs (Cont.)

Use R10-5 with Protective Left Turn movement
Head (3 section Left Arrow Head)



Signal Related Signs (Cont.)

Use R17-11 when Split Phase Operation



Signal Related Signs (Cont.)

Official Action are needed for “No Turn on Red” sign.

Contact District traffic before any changes to the sign .



Signal Related Signs (Cont.)

Show all the “Parking restriction “ on the Signalized Intersection Plans



Signal Related Signs (Cont.)

Call out R10-4b signs with all the “Push Buttons”.



Signal Related Signs (Cont.)

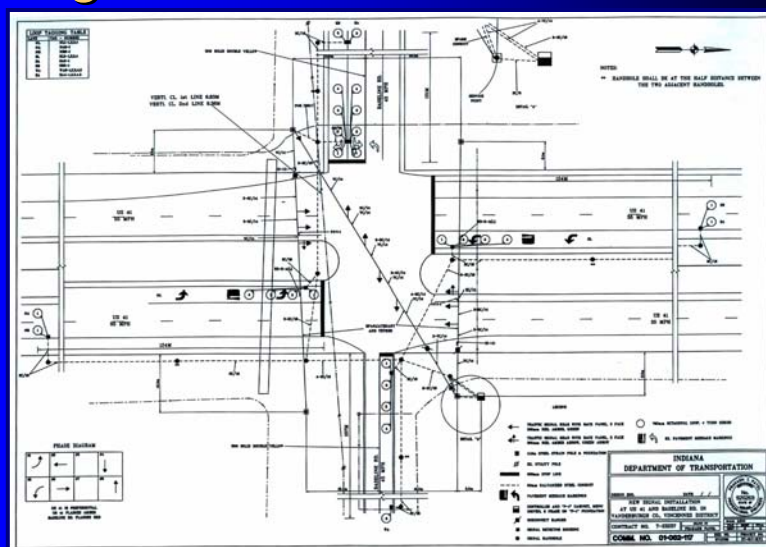
Show “Turn Only” Lane Control Signs



Where to Get More Information

- Indiana MUTCD, INDOT Design Manual Part VII, Manual of Traffic Signal design By ITE, Indiana Specification Book, Recurring Special Provision, Section 805 Standards
- INDOT Signal Design Squad, District Traffic Engineers

Signal Detail Sheet



QUESTIONS

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