Diverging Diamond Interchanges (DDI)

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Background

• EOE Corridor study (CH2M Hill)
• Two VISSIM models of DDI
  ➢ I-90 @ Elmhurst
  ➢ EOE @ Roselle
• Share what I learned about DDI
Outline

• What is a DDI?
• How does it work?
• History
• RWA Project application
• Real world experience
• Major advantages
• Major disadvantages
• Discussion
• Questions?
**What is a DDI?**

- A new type of freeway and arterial interchange design
- One of the best innovations in 2009 (engineering category) – *Popular Science* magazine
- The two directions of traffic on the non-freeway road *cross to the opposite side* on both sides of the bridge at the freeway
- Two signals: one at each end of the ramp terminals, no left-turn phasing for arterial road
How does it work?

- NB traffic
How does it work?

- SB traffic
How does it work?

- EB traffic
How does it work?

- WB traffic
How does it work?

- All traffic
History

- Before US built the first DDI, the only known diverging diamond interchanges were located in France in the communities of Versailles, Le Perreux-sur-Marne, and Seclin.
History (Cont’d)


• The first candidate was I-75 & US 244 in Findlay, Ohio. Due to safety concerns another alternative won over the DDI at the final selection.
History (Cont’d)

- FHWA studied the safety aspects of the DDI
  - Drivers were intuitively able to maneuver within the DDI and find the paths to their intended destinations
  - The initial concern about wrong way movements at the crossover areas was not warranted

- The Kansas City DDI was anticipated to be completed in 2008 and be the first DDI in the United States – delays prevented it from being constructed. However, due to this interest, FHWA did the human factors research with the Highway Driving Simulator.
  - properly designed DDIs will prove to be considerably safer than properly designed conventional diamond interchanges

- The winner of the first DDI built in the USA is …
History (Cont’d)

• I-44 and Kansas Expressway (SR 13), in Springfield, Missouri
  ➢ opened on June 21, 2009
  ➢ became the first DDI in the USA.
History (Cont’d)

• I-15 @ American Fork Main Street - American Fork, Utah – opened on August 23, 2010.
• I-270 and Dorsett Road, Maryland Heights, Missouri – opened on October 17, 2010.
• US 129 Bypass / SR 115 @ Middlesettlements Road / Bessemer Street, Alcoa, Tennessee – opened on December 17, 2010.
• IDOT and the City of Naperville are considering a DDI for the I-88 and IL 59 interchange. ( - Chicago Tribune, July, 2010). This could be the first in Illinois.
• More states are considering DDI.
Project application: I-90 @ Elmhurst

- Compare DDI and Parclo B Single designs
- Modeling Area - Elmhurst Road from north of Landmeier Boulevard to north of Oakton Street with the proposed lane configuration.
- Network Attributes –
  - Speed limits - Elmhurst Road crossing I-90
    - DDI – 30 mph
    - Parclo B – 40 mph
  - Signal timings – Synchro software
  - PM design hour volumes
I-90 @ Elmhurst – DDI
Simulations – Parclo B Single
Simulations – Parclo B Single
## I-90 @ Elmhurst – Delay Comparison

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Real world experience: I-44 & SR13

• Issues:
  - Congestion
  - Left-turn traffic backing up and blocking through traffic
  - Majority of crashes were rear-end crashes and left-turn right angle crashes
  - Limited funds

• Reasons to choose DDI
  - Utilizes most of the existing structure including the bridge
  - Cheaper than SPUI (Single Point Urban Interchange):
    - $3.2 million vs. $10 million
  - Quicker to build: it took about 6 months
  - Safer
  - Pedestrian walk way in the center
Real world experience: I-44 & SR13

- Statistics (first 6 months after the DDI opened)
  - 50% overall reduction of crashes
  - Right angle crashes eliminated (previously 33%)
  - Rear-end crashes reduced (previously 40%)

- Public perception survey
  - Mailed out 400 random surveys
  - 75 respondents (20% return)
  - Results
    - 96.7% - Safer
    - 95.1% - More convenient
    - 95.2% - Less congested
    - 86.9% - Easier to drive
    - 89.4% - Right transportation solution

- FHWA will evaluate operations 2 years after completion
Major advantages

- Safety
  - Eliminates the conflict of left turns and oncoming traffic, better accommodates left turn movements
  - Fewer conflict points
- Cost
  - Less than traditional diamond
- Travel Time
  - No turning phases are required
  - Shorter cycle length, less lost time, yellow and all red time
- Geometry
  - Reduce bridge size & ROW requirements
- Alleviates congestion
Major disadvantages

• Drivers’ unfamiliarity
• No free-flowing traffic in both directions (unlike Parclo)
• Off-ramp traffic can not re-enter the freeway when drivers mistakenly exit at the wrong interchange (problems with maintenance)
• Crossing over usually requires more space
• May not suit the situation where a cross road’s adjacent intersection is closely located with heavy traffic
Discussion

• No one design fits all
• How to compare
  ➢ What are the major constraints (ROW, bridge/underpass, cost)
  ➢ What are the characteristics of the traffic
    ➢ (balanced vs. unbalanced traffic, turning movement volumes)
  ➢ What are the costs and benefits under the same constraints
    (# of lanes, budget, LOS, …)
• How to improve DDI design
  ➢ Signal design
  ➢ Signage, pavement marking, lighting
  ➢ Number of lanes needed
Discussion (Cont’d)

• When to consider DDI
  - One of the left turning movements is high
  - and/or if thru movements are unbalanced during peak hours
  - Structure widening costs should be minimized

• If you have driven one please let us know how you like it
Questions?