DELIVERING THE STATE’S FIRST DIVERGING DIAMOND INTERCHANGE
State Route 120/Union Road Diverging Diamond Retrofit

Presented by:
Aaron Silva
Mark Thomas
PRESENTATION FOCUS

• Project History
• Interchange Innovation
• Existing Conditions
• Proposed Design
• Approval Process
• Final Details
PROJECT HISTORY
SR120/Union Road Interchange
PROJECT HISTORY

- Existing Interchange Configuration
- Growth in Manteca
- Congestion along SR 120
PREVIOUS DESIGN

Partial Cloverleaf (Type L-9)
- Provided Operational Improvements
- Required Bridge Replacement
- Non-Standard Design Features
- High Construction Costs
PREVIOUS DESIGN

- Project Study Report/Project Report – Approved 2010
- Initial Study/Mitigated Negative Declaration – Approved 2010
- 65% Design Plan Development

Results:
- High Construction Costs
- Adjacent Development Influence
ADJACENT DEVELOPMENT

- Existing & Planned Development
- Access Needs
- Timing Concerns
- Bicycles & Pedestrians
ADJACENT DEVELOPMENT

- Access Needs
INTERCHANGE INNOVATION

1950’s

SR120/Union Road Interchange
INTERCHANGE INNOVATION

1970’s

SR120/Union Road Interchange
REVISED APPROACH

- Traffic Conditions & Forecasts
- Cost Savings through Design
- Improved Development Access
- Long Term Operational Efficiency

SR120/Union Road Interchange
SR120/Union Road Interchange
Design Information Bulletin Number 90

Department of Transportation
Division of Design
Office of Standards and Procedures

DIVERGING DIAMOND INTERCHANGE

Approved By:

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March 25, 2016

1.0 INTRODUCTION

California Department of Transportation (Caltrans) values innovations and seeks creative solutions. The diverging diamond interchange (DDI), also known as a double crossover diamond (DCD), is proving to be an efficient interchange configuration. The DDI is a viable alternative to the conventional diamond interchange and other minor interchange forms such as partial cloverleaf. The primary difference between a DDI and a conventional diamond interchange is the design of the crossover movements on either side of the interchange.

The DDI design has been shown to improve the operations of turning movements to and from the freeway, facility and significantly reduces the number of vehicular-vehicular, vehicular-pedestrian, and vehicle-pedestrian conflicts compared to a conventional diamond interchange. The primary difference between the DDI and a conventional diamond interchange is the design of the crossover movements on either side of the interchange. Figure 1.0 shows the key characteristics of the diverging diamond interchange.

By moving through traffic to the left side of the roundabout, left-turn movements are removed from the crossover signal phasing. Traffic signals at DDIs are either with two phase signals compared to those at conventional diamond interchanges. This reduction in phase conflicts improves overall throughput on the minor road and left-turning traffic, and from the freeway. The DIB system efficiently time cross traffic with through movements or heavy left turns on or off the freeway ramps.

Figure 1.0
Key Characteristics of a DDI

Source: FHWA-SA-14-067, DDI Information Guide

By shifting cross stream traffic to the left side of the street between the signalized crossover intersections, vehicles on the crossover making a left turn on or off the freeway ramps do not
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RAMP PRIORITY
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PEDESTRIAN CIRCULATION
PEDESTRIAN CIRCULATION

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HDM 101.2 – Highway Design Speed Standards
A = 45 mph
M = 35 mph

DIB 90 – 25-35 mph
HDM Chapter 200 – Super Elevation Runoff & Curvature

DIB 90 – R=225’-250’ |e|=-2%

FHWA Guide Exhibit 7-14
SR120/Union Road Interchange

HDM 504.3(3) – Intersection Grade 4% or Less

DIB 90 – Grade shall be 5% or less (Advisory)
**HDM 301.1 and Table 504.3** – Lane widths

**DIB 90** – HDM Standard Applies

### Table 504.3
Ramp Widening for Trucks

<table>
<thead>
<tr>
<th>Ramp Radius (ft)</th>
<th>Widening (ft)</th>
<th>Lane Width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>150 – 179</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>180 – 209</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>210 – 249</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>250 – 299</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>&gt;300</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>
**HDM 1003.1 (8A)** – Bike Paths shall not be placed in median of a Local Roadway

**DIB 90** – Sidewalks, Multi-use Paths, Class II Bike Lanes Acceptable
<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fewer collisions than traditional interchanges</td>
</tr>
<tr>
<td>2</td>
<td>Reduced collision severity versus traditional interchanges</td>
</tr>
<tr>
<td>3</td>
<td>Reduced number of conflict points, especially crossing conflicts</td>
</tr>
<tr>
<td>4</td>
<td>Medians and curves provide traffic calming</td>
</tr>
<tr>
<td>5</td>
<td>Highly functional during power outage</td>
</tr>
<tr>
<td>6</td>
<td>Limits wrong way movement potential for highway ramps</td>
</tr>
<tr>
<td>7</td>
<td>Wrong way potential exists for crossover movement</td>
</tr>
<tr>
<td>8</td>
<td>Potential headlight glare from opposing traffic</td>
</tr>
<tr>
<td>9</td>
<td>Increase in turn movement capacities, decreases congestion</td>
</tr>
<tr>
<td>10</td>
<td>Serves high volume facilities, favors high volume turn movements</td>
</tr>
<tr>
<td>11</td>
<td>2-phase signal operation can favor peak period movements</td>
</tr>
<tr>
<td>12</td>
<td>Possibility of shortened cycle lengths</td>
</tr>
<tr>
<td>13</td>
<td>Increased green time</td>
</tr>
<tr>
<td>14</td>
<td>Accommodates re entry from highway</td>
</tr>
<tr>
<td>15</td>
<td>Higher failure potential, especially with short crossover distance &amp; high crossroad through traffic</td>
</tr>
<tr>
<td>16</td>
<td>Not suitable for high ramp traffic with high crossroad traffic</td>
</tr>
<tr>
<td>17</td>
<td>Locking crossover progression potential</td>
</tr>
<tr>
<td>18</td>
<td>Difficult crossroad progression</td>
</tr>
<tr>
<td>19</td>
<td>Through movements required to use crossover lanes</td>
</tr>
<tr>
<td>20</td>
<td>Spacing to adjacent intersection with more complex signal phasing</td>
</tr>
<tr>
<td>21</td>
<td>High delay savings per dollar expended, exceeds cost in few years</td>
</tr>
<tr>
<td>22</td>
<td>Context sensitive (retrofit interchanges)</td>
</tr>
<tr>
<td>23</td>
<td>Reduced cost versus bridge widening, low cost compared to SPUI</td>
</tr>
<tr>
<td>24</td>
<td>Shorter bridge spans (pillars in middle), narrower structures</td>
</tr>
<tr>
<td>25</td>
<td>Reduced construction time</td>
</tr>
<tr>
<td>26</td>
<td>Frey or simplified left turn movements (not out of direction)</td>
</tr>
<tr>
<td>27</td>
<td>Retrofits often require auxiliary lanes</td>
</tr>
<tr>
<td>28</td>
<td>Drivers adapt quickly to the concept, acceptance is high</td>
</tr>
<tr>
<td>29</td>
<td>Public confusion with new concept</td>
</tr>
<tr>
<td>30</td>
<td>Driving on opposite side of roadway</td>
</tr>
<tr>
<td>31</td>
<td>Free right and left movements complicate ped crossing</td>
</tr>
<tr>
<td>32</td>
<td>Flexibility of design variations, inconsistent signing potential</td>
</tr>
<tr>
<td>33</td>
<td>Short at grade pedestrian crossing</td>
</tr>
<tr>
<td>34</td>
<td>Bikes &amp; Pedestrians can be accommodated at grade</td>
</tr>
<tr>
<td>35</td>
<td>Peds may require 2-stage crossings; refuge structures</td>
</tr>
<tr>
<td>36</td>
<td>Medians and vertical separators required</td>
</tr>
<tr>
<td>37</td>
<td>Relatively simple pedestrian crossing when crossing in the middle</td>
</tr>
<tr>
<td>38</td>
<td>Complicated pedestrian crossing when crossing on the outside</td>
</tr>
<tr>
<td>39</td>
<td>Little space for snow storage, snow removal routes complicated</td>
</tr>
</tbody>
</table>
Caltrans is CEQA lead – Revalidation
Caltrans will own and operate the results
Draft DIB 90-DDI Guidelines (FHWA based)
Caltrans wants to set the proper precedence for future DDI
PROCESS STICKING POINTS

- Traffic Operations Analysis (new counts, calibration, analysis)
- Concern over non-typical DDI pedestrian crossing
- Advisory and Mandatory Design Exceptions
- Request to install ramp metering, although not likely to be used
- Air Quality - RTP consistency (SJCOG effort to update RTP)
- Structure Type Selection
- Public Acceptance
FINAL DETAILS

- Class I Bike Path/Pedestrians
- Ramp Metering
- Single Lane On-Ramp
- Stopping Sight Distance
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RAMP METER QUEUES
SCHEDULE

SPRING 2017
APPROVED TRAFFIC ANALYSIS

SUMMER 2017
ENVIRONMENTAL REVALIDATION

WINTER 2017
FINAL CONSTRUCTION DOCUMENTS

SPRING 2018
AWARD/CONSTRUCTION
QUESTIONS?