IMPROVING DESIGN EFFICIENCY AND ACCURACY USING 3D MODELING • OTEC 2018

Ohio Department of Transportation

B&N BURGESS & NIPLE

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IMPROVING DESIGN EFFICIENCY AND ACCURACY USING 3D MODELING

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INTERSECTION INFORMATION

- SR 61, SR 656, Wilson Rd in Delaware County
- Posted 55 mph
- Developing area
CRASH HISTORY

- 32 crashes from 2014 - 2016, including injuries and 1 fatal
- Skew
- Crest/Sag Combo
POTENTIAL SOLUTIONS

- 5 alternatives studied and presented to public
  - No Build
  - 4-way Stop
  - Signalization
  - Roundabout
  - SR 61 Profile adjustment

- Roundabout chosen
PROJECT GOALS

- **Project Goals**
  - Single-lane roundabout
  - Limit R/W at NW and SE quadrants (existing homes)
  - Improve vertical geometry approaching intersection

- **Guidelines**
  - NCHRP Report 672
  - ODOT L&D Volume 1
ROUNDABOUT CONCEPTS

- 3 Roundabout Designs Investigated
  - Standard, Oval, Peanut

Wilson Rd

Wilson Rd
ROUNDABOUT PERFORMANCE CHECKS - PEANUT SHAPE

- Peanut Roundabout chosen
- Improved roundabout geometry
  - Fastest Path
  - Phi Angles
  - Angle of visibility
  - Intersection skew
FASTEST PATH

- Encourage slow vehicle speeds
- Turn movements
  - Thru = R1-R2-R3
  - Left = R4
  - Right = R5

Image courtesy of NCHRP 672
PHI ANGLE

- Angle between approach to crossing departure
  - $20^\circ - 30^\circ$ preferred
  - Short (~3’) tangent at approach
SWEPT PATH ANALYSIS (TRUCK TURNS)

- WB-62 design vehicle
- Drives truck apron placement/size
- Check for tractor weight shift
Roundabout design is iterative
- Performance checks
- Swept path (truck turns)
- Minimize footprint

OpenRoads = greater design efficiency
OPENROADS (SS4)

- Can be used on any type of project
- Best used in iterative design
- Greater efficiency
- Three conceptual roundabout layouts (horizontal, vertical, 3D model) in one week
OPENROADS

- OpenRoads and detailed design
- Microstation Add-in
  - “Smart” linework
  - 3D emphasis
- OpenRoads = Select Series 4
Developed using OpenRoads

Can be used for...
- Conceptual quantities for cost estimate
- Drive simulation
- Cross sections and elevations in detailed design
PROFILES

- Graphical profile design
- Relate horizontal to vertical
- Linked profiles
- 3D linestring built automatically
STAKEHOLDER ENGAGEMENT

- **Key Stakeholders**
  - ODOT District 6
  - DCEO
  - Kingston Township

- **3D Model and OpenRoads**
BUILDING THE 3D MODEL

- Two 3D modeling methods:
  - Corridor Modeling
  - Terrain Modeling

- Both methods create same output
BUILDING THE 3D MODEL

- Define pavement elevations from baseline profile
- 3D elements built once profile defined
- 3D = H+V
BUILDING THE 3D MODEL
BUILDING THE 3D MODEL

- Develop curb, grading, etc. from templates
- Pavement buildup applied from surface
BUILDING THE 3D MODEL
SOUTHBOUND THROUGH MOVEMENT - 3D MODEL
SOUTHBOUND THROUGH MOVEMENT
EASTBOUND THROUGH MOVEMENT - 3D MODEL
EASTBOUND THROUGH MOVEMENT
WESTBOUND LEFT TURN MOVEMENT - AUTOTURN
CROSS SECTIONS

- Cut from 3D model(s)
- Viewable during design iterations
- Functions as SS2
  - T-cell
  - Active chain control
  - Cross section sheets
- Can cut non-perpendicular sections
OPENROADS AND 3D MODEL

- Developed using OpenRoads
- *Can be used for...*
  - Conceptual quantities for cost estimate
  - Drive simulation
  - Cross sections and elevations in detailed design
OPENROADS FOR QUALITY CONTROL

- 3D model = real time design quality check
- Linked profiles to ensure vertical tie-ins match
PROJECT WORKFLOW - GEOPAK SS2

Design (GEOPAK SS2) → Plan Production (GEOPAK SS2) → Submit
PROJECT WORKFLOW - OPENROADS (SS4)

Design (OpenRoads) → Plan Production (GEOPAK SS2) → Submit
KEY TAKEAWAYS

- OpenRoads improves efficiency in iterative design
- 3D models improve clarity of design and accuracy
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