

### Abstract

Buck Creek split the northern and southern ends of Houston Road in Yardley, Pennsylvania, separating the neighborhoods located on either side and adding six minutes of travel time for all drivers, including emergency vehicles. The only way to cross the creek was via a path of slippery rocks, making it inaccessible to the general public and emergency vehicles. This project focused on the structural, hydrologic, and transportation components of connecting Houston Road and improving its accessibility. The design consists of an emergency vehicle road connection with an underlying culvert system, a sidewalk added along Houston Road, and a pedestrian bridge over the creek. The pedestrian bridge was designed with a 40' concrete slab of 7" thickness, supported by W8x15 floor beams which are supported by two W12x40 girders. The superstructure is held up by four 18"x18' concrete columns, each supported by four #3 rebar. The floor beams are separated by 4' and the columns are spaced apart by 16'. The hydrologic design was a set of seven 16' wide reinforced concrete box culverts: two 4'-tall culverts, two 6'-tall culverts, and three 8'tall culverts. This design accommodates the determined 100-year peak flow of 1161.2 cfs and prevents flooding upstream. A modern roundabout was placed at the intersection of Houston Road and Dolington Road to allow for more continuous traffic flow along with a high visibility crosswalk with a ladder design. The design also included rectangular rapid flashing beacons to alert motorists of crossing pedestrians.

## **Design/Methods**

**Structural** 

- Concrete deck design checked for deflection, shear, and moment in Visual Analysis
- Used Visual Analysis to check shear, moment, and deflection to ensure bridge would not fail
- Used AASHTO Standards to design the bridge columns to check that they support the load of the superstructures
- <u>Hydrologic</u>
- Used USGS StreamStats to delineate watershed area
- Used USDA WebSoilSurvey and land use tables to calculate average watershed curve number
- Used ArcMap and NRCS lag time equation to determine other watershed characteristics
- Used HEC-HMS to find 100-year storm peak discharge
- Designed culvert system and modeled flow through culverts with HEC-RAS

**Transportation** 

- Analyzed existing traffic conditions at the intersection and simulated volumes in Synchro
- Established connection of the two roadways in accordance with PADOT Roadway Design Manual
- Used elevations and contouring in Civil 3D to generate surface profiles and proper gradation
- Established a roundabout at the Dolington Road and Houston Road intersection following the FHWA Roundabouts informational guide
- Established traffic calming devices to further ensure safety using the FHWA Manual on Uniform Traffic Control Devices





#3 Rebar Typ.





Figure 7: Full Scope of Roadway Connection and Intersection Design

# Houston Road Redesign

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**Figure 3: Column Design** 

**Figure 4: Typical Floorbeam Layout** 

Figure 5: Culvert System Design

**Figure 6: Roundabout Intersection Redesign** 



**Figure 8: Connection between Houston Road** over Buck Creek





-W12x40 Girder

### Results

Concrete Deck	4 ksi
Deck Dimensions	40'x8'x7"
Floorbeam	W8x15
Girder	W12x40
Column	18"x18"
Rebar	4 #3 Rebar

<u>Structural</u>

### <u>Hydrologic</u>

Watershed Area	1.85 sq. mi.
Curve Number	76.6
Design Peak Flow	1161.2 cfs
Watershed Lag Time	131.5 min

### Conclusion

The structural design for the pedestrian bridge was determined to adequately support the required loading in accordance with AASHTO design specifications. The culvert system was deemed adequate through hydrologic analysis which showed it prevented upstream and at-crossing flooding for a 100-year storm. The transportation design redesigned both the roadway connection over Buck Creek and the intersection at Houston Road and Dolington Road. To further ensure safety, a high visibility crosswalk and RRFBs were implemented in accordance with the roundabout design at the intersection.

### References

- 1) FHWA LRFD For Bridge Super Structures (2015)
- 2) AASHTO Pedestrian Bridge Design (2009)
- 3) FHWA Roundabouts: An Informational Guide (2000)
- 4) PADOT Roadway Design Manual (2015)
- 5) Manual on Uniform Traffic Control Devices (2015)

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