Fort Street M-85 Bascule Bridge
Looking to the Past to Build Bridge for the Future

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Fort Street Bridge – 1891
Henry Ford’s Vision for River Rouge Facility

- Purchased Land in Dearborn 1915
- The 1915 Vision – Totally Integrated Facility (Construction 1917-1928)
  - Iron, Steel, Glass, Rubber, Plastic
  - Generating Plant for Electricity
  - In-Plant Railroad (100) Miles of Track
  - Raw Materials Materials in
  - Complete Vehicles out

- 16 Million Square Feet of Floor Space,
- 93 Buildings, 100,000 Employees

River Improvements Impacts

- 3 New Roadway Bridges and 3 New Railroad Bridges
Henry Ford

1916 Study by the War Department
National Defense and Commercial
Plan to Widen and Deepen the Rouge
Zug Island

Rouge River enlarged in 1920-22
Ford River Rouge Plant
Dredged 2x Depth & 2x Width
Destabilized Bridge Subpiers

Federal – Local Cost Sharing

Underwritten by Ford
Rouge River & Project Vicinity
Fort Street Bridge – Pre 1921
Rouge River & Project Vicinity
Fort Street Before Construction Begins
<table>
<thead>
<tr>
<th>Double-Leaf Bascule</th>
<th>Bascule Piers</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Lanes of Traffic</td>
<td>164 Feet Between Trunnions</td>
</tr>
<tr>
<td>2 Trolley Lines</td>
<td>88’-4” Wide, 46’-6” Long</td>
</tr>
<tr>
<td>8’-6” Sidewalks</td>
<td>278 Feet Overall</td>
</tr>
<tr>
<td></td>
<td>26 Feet Below Water Line</td>
</tr>
<tr>
<td></td>
<td>125 Foot Wide Channel</td>
</tr>
<tr>
<td></td>
<td>Four 12-Ft Square Caissons</td>
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</tbody>
</table>
Fort Street Bridge – 1922

Construction Begins
Fort Street Bascule Bridge – 1921

Pier Foundations

Four 12-Foot Square Caissons

Intent – 1 Foot Into Hardpan

Apparently Terminated above Hardpan or Rock

No Documentation

Hydrogen Sulfide Gas

Artesian Water
Fort Street Bridge Construction– 1921

Driving Timber Piles
Fort Street Bridge Construction – 1922

Bascule Pier Construction
Fort Street Bridge Construction – 1922

Wingwall and Abutment Piling
Fort Street Bascule Bridge – 1922

Double-Leaf Bascule

4 Traffic Lanes included
  2 Trolley Lines
Two 8’-6” Sidewalks
164 Feet Between Trunnions
278 Feet Overall
125 Foot Wide Channel, Reduced to 118 Feet
Fort Street Bridge – 1922
Fort Street Bascule Bridge
2002

Existing Bridge, 90 Years Old
Extensive Deterioration
Foundation Issues
End of Useful Life
Fort Street Bridge
Bridge Movement Analysis

Recorded Lateral Movement of the Bascule Bridge

- North Side
- South Side

Average Lateral Movement of 0.88° per 10 years

\[ R^2 = 0.9788 \]

Average Lateral Movement of 0.11° per 10 years

\[ y = 0.0107x - 17.887 \]
\[ R^2 = 1 \]

Average Lateral Movement of 1.14° per 10 years

\[ y = 0.1146x - 220.49 \]
\[ R^2 = 0.9923 \]

Average Lateral Movement of 0.01° per 10 years

\[ y = 0.0011x + 1.9121 \]
\[ R^2 = 1 \]

2003 Data with GPS Equipment
Fort Street Bridge
Bridge Movement Analysis

Figure 2: Vector Displacement Resulting From Changing Ground Surface Elevation from 1919 to 2005

M-65 Bascule Bridge
23
04/16/08
SOMAT Engineering, Inc.
Fort Street Bridge
Geotechnical Investigation

GENERALIZED SOIL PROFILE

Ref Line A (STA 148 + 35 )
Ref. Line B (STA 151 + 65 )

Fill Loose Sand
Medium to very stiff silty clay
Soft to medium silty clay

Rouge River, L.W. Datum 571.42
Rouge River Water

Loose to medium dense sand

Bedrock EL. 489 - 490
Limestone Bedrock EL. 492
Bedrock EL. 494 - 496

Short term cohesion ~550 psf

Approximate location of soil borings
Fort Street Bridge

Factor of safety for global stability was around 1.0

Global Stability is Influenced by Internal Angle of Friction
Multiple Factors

Shear Strength

Water Level in River

Surcharge on Approaches

Multiple Analyses Performed Determine Sensitivity to Each
Varying These Factors
Fort Street Bridge
Fort Street Bridge
Geotechnical Investigation

Use Pile Supported Concrete Slab
to Support Fill, Road, Live Load

87 Feet Wide by 64 Feet Long by 3 Feet Thick

Supported by 43 Steel Piles
HP 12 X 74

Determined to be Most Efficient Method to Achieve F.S. of 1.5
Fort Street Bridge
Bascule Pier Foundation

Options

Large Diameter Drilled Shafts
Limited Locations
Artesian Water
High Costs

Steel Piles Driven to Rock
Minimal Individual Footprints
HP 18 X 204
Large Capacity Per Pile
Cost Effective
Fort Street Bascule Bridge 2002

New Bridge

Efficient and Durable

Aesthetics & Community Involvement

Rolling-Lift Bascule

Modern Materials

Innovative Details
Fort Street Bascule Bridge – 2004
Alignment Option 1

Realign Fort Street

Pros
Fort is Primary Movement
At Oakwood Intersection

Cons
Very High ROW Costs
Fort Street Bascule Bridge – 2008
Alignment Option 2

On Existing Alignment

Pros
Minimal ROW Costs

Cons
Fort Street is less direct
Accommodate Tunnels and Existing Subpiers
Overhead Counterweight
Fort Street Bascule Bridge
Construction Difficulties

- Utility Tunnels
  - Michcon Gas Tunnel: 10'-0" in diameter
  - Detroit Edison Tunnel: 7'-6" in diameter

- Fort Street Bascule Bridge

General Plan:
- Showing Present Detroit Edison Co. Tunnel
- Location of tunnel proposed by East City Gas Co.
Fort Street Bascule Bridge
New Bridge Requirements

- Provide 135-ft wide navigation Channel
- Accommodate 5 traffic Lanes & 2 8-Foot Wide Pedestrian/Bikeways
- Minimize ROW Impacts
- Avoid Tunnels and Existing Subpiers
- Provide a Striking Visual Enhancement to the Community

Result:
An 86-ft wide, 176-ft Rolling-Lift Bascule with an Overhead Counterweight
2nd Largest and Heaviest Bascule Leaf in the World
Fort Street Bascule Bridge
New Single-Leaf Rolling-Lift Bascule

Five 12-Ft Traffic Lanes
Two 8-Ft Sidewalks/Bikeways
176-Ft Span
86-Ft Wide
Half-Filled Steel Grid Deck with 2-Inch Overpour

13-Ft Deep Trusses on 67’-8” centers
Floorbeams at 17’-3” Centers
Stringers at about 6’-3” Centers
Total Leaf Weight: 8.2 Million Pounds
Fort Street Bascule Bridge

Loads on Bascule Pier

<table>
<thead>
<tr>
<th>Load</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Total Dead Load, Pier &amp; Leaf</td>
<td>18,500 Kips</td>
</tr>
<tr>
<td>Rolling Dead Load</td>
<td>8,200 Kips moves 31’-3”</td>
</tr>
<tr>
<td>Rolling DL Moment</td>
<td>+/- 128,000 Ft-Kips</td>
</tr>
<tr>
<td>Wind Moment</td>
<td>+/- 56,000 Ft-Kips</td>
</tr>
</tbody>
</table>
Fort Street Bascule Bridge

Pile Layout

132 Steel Piles
HP 18 x 204

Fort Street Bascule Bridge Pile Layout

Approach Side

Channel Side

7'-6" Tunnel

10'-0" Tunnel

132 Piles

Existing 12' x 12' Caisson (typ)
Fort Street Bascule Bridge

Bascule Pier Foundation

132 HP 18 x 204

Fenders:
44 HP 16 x 88
at left
Fort Street Bascule Bridge
Bascule Supports

Two Grillages Support Each Track Girder

2 layers of S 24 x 121
Fort Street Bascule Bridge
Track Girders

Top flange: $3^{1/2}'' \times 32''$

Web $3'' \times 11'-1^{1/2}''$

Bottom flange $3'' \times 32''$

Material: M270 Grade HPS 70W
Fort Street Bascule Bridge

Treads & Tracks

I-Shape, High Strength Steel Castings
30” Wide x 16” Deep

Material:
ASTM A148, Grade 130-115

Shear Lugs: 5\(\frac{1}{4}\)” x 14”
Tread Radius: 24’-7\(\frac{1}{2}\)”
Length of Travel: 31’-3”
Fort Street Bascule Bridge
Segmental Girders

Material: M270 Grade HPS 70W

Top Flange: 3” x 32”
Web: 3” x 96”
Bottom Flange: 3½” x 32”

(shown in open position)
Fort Street Bascule Bridge
Heel and Counterweight Construction

Assembled in place on east side of river
Fort Street Bascule Bridge
Concrete Counterweight

6,000,000 Pounds of concrete supported by steel trusses
Fort Street Bascule Bridge
Bascule Leaf Field Assembly
Assembled on west side of river
Fort Street Bascule Bridge

Chords:
15” x 20”
Welded Boxes

Web Members:
Rolled W14s &
3-Plate Weldments

Deck
Steel Grid with 113.5 pcf
Lightweight Concrete
Half-filled and 2” over-fill

Roadway Barriers are
steel plate sections to
reduce weight
Fort Street Bascule Bridge
Two Steel Pony Trusses

13 Feet Deep
176 Feet Long
Fort Street Bascule Bridge
Launching the Bascule Leaf

Bigge System
Fort Street Bascule Bridge
Two Sections Joined

Leaf & Heel Joined and fully self-supporting, September 24, 2015

Bridge ready for first opening to allow navigation September 25, 2015
Fort Street Bascule Bridge
Snow and Ice Control

21 watts / sq. ft.
57 kw total
Fort Street Bascule Bridge

Aesthetics

Public Involvement
- Shape of Bridge Towers
- Color Scheme
- Fascia Railing

Concrete texture

Stainless Steel Cladding

Rendering used at Public Meetings
Fort Street Bascule Bridge
Special Pattern Railing

Infill panels are waterjet cut from 3/8” aluminum plate

Interesting shadow patterns
Fort Street Bascule Bridge

Links to Videos

Bridge Opening

https://www.youtube.com/watch?v=4S-AaE6M-4s