Movable Bridges

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Movable Bridges

History/Purpose
Types/Function
Inspection/Maintenance
Movable Bridges

A vehicular bridge that can be opened to allow passage of a waterborne vessel
Michigan Avenue Lift Bridge
Movable Bridges

Multiple generations of movables at the same location or crossing
Movable Bridges

History/Purpose
Drawbridges

Early versions of Movable Bridges provided access to castle across mote
Earliest Movable Bridges

Tomlinson Bridge

- New Haven, Connecticut
- Built 1797
- Timber draw
Early Movable Bridges

Small Draws or Swings
Timber
Hand operated
Narrow channels
Short life span
Early Movable Bridges

Iron Trusses
1860’s and 1870’s
Longer spans
Early Movable Bridges

Bascules

Early 1900’s

Counterweight Balancing
Early Movable Bridges

Bascules
No center pier
Faster opening
More compact design
Movable Bridges

Vertical Lifts

Erie Canal Bridges

Larger spans in early 1900’s
Types

Vertical Lifts

Bascules

Swings
Types

Retractile

Transporter

Floating
Types of Movable Bridges

**Vertical Lifts**
Vehicular deck is raised to allow vessel passage
Types of Movable Bridges

Bascules
Vehicular deck pivots from horizontal position to vertical or near vertical position
Early Movable Bridges

Bascules

Scherzer rolling lift

Trunnion lift – Ferry Street
Types of Movable Bridges

**Swings**

Vehicular deck pivots in the horizontal plane creating two channels for vessel passage
Swing Bridges

Rim Bearing

Pivot Bearing
Components

Structural

Mechanical

Electrical
Mechanical Components

Reducers

Couplings
Mechanical Components

Reducers

Couplings
Coupling
Electrical Components

Bridge Control Systems

Drives

Control Panels
Variable Frequency Drives

- Sine Wave Power
- Operator Interface
- Variable Frequency Power
- Power Conversion
- AC Motor
- Mechanical Power
- Power Conversion
Variable Frequency Drives

Chopped DC (what the drive sends)

Approximated Sine Wave (what the motor “sees”)
Variable Frequency Drives

VFDs - Primarily control motor speed

Flux Vector Drives – control speed and torque
AASHTO Design Specifications

Section 8 – Electrical Design

8.6.1.5 – Variable Frequency Speed Control

“…In general, variable frequency drives should not be used for movable bridge drives.”
AASHTO Design Specifications

8.6.1.5 – Variable Frequency Speed Control

“…vfds have seen limited success…have historically lacked the ability for precise control of torque at low speed.”
Electrical Components

Control Panels
Provides interface with bridge operator
Traffic/Vessel Safety Devices

Signals
Barriers/Gates
Gongs
Navigation Lights
Fender systems
Movable Bridges

New Jersey Lift Bridge Accident
Safety Interlocks

Signals to red
Gates lowered
Barrier lowered
All Clear Signal
Open Bridge
Movable Bridges

Inspection/Maintenance
Complex Bridges

- Inspection Procedures
- Inspector training and experience
Inspection Guidelines

AASHTO’s Movable Bridge Inspection, Evaluation and Maintenance Manual
Types of Inspections

Routine

In-Depth
Types of Inspections

Routine

• Visual
• Trial Openings
• Some Instrumentation
Complex Bridges

• Inspection Procedures

• Inspector training and experience
- Annual Bridge Washing
  - Vegetation/Debris Removal
- Spot Painting
- Mechanical Lubrication
- Wearing Surface
## NYC Movable Bridge Projects

<table>
<thead>
<tr>
<th></th>
<th>Budget</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>Willis Avenue</td>
<td>$620 M</td>
<td>Under construction</td>
</tr>
<tr>
<td>3rd Avenue</td>
<td>$150 M</td>
<td>Completed in 2007</td>
</tr>
<tr>
<td>145th Street</td>
<td>$80 M</td>
<td>Completed in 2006</td>
</tr>
<tr>
<td>MaCombs Dam</td>
<td>$180 M</td>
<td>Completed in 2005</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1.03 Billion</strong></td>
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</table>
- Name the three primary types of movable bridge.
- What is the name of the Engineer who designed the first vertical lift bridge in the US?
- Where was it located?
Swing bridges can be rim bearing or bear on what?
- Early types of drawbridges provided access to what types of structures.

Homework – visit the four movables in the City of Buffalo
- Name
- Type
- Condition
Thank You