

Session 55

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FL. Dept. of Transportation

Movable Bridges/Mechanical Electrical

Topic Description

Structures Design Guidelines 2006 - Mechanical Revisions

Trunnion and Pinion Bearing Supports
Service Clearances
Hydraulic Drives and Cylinder Operated Bridges
Channel Clearances
Revisions to FDOT Standard Specifications

Speaker Biography

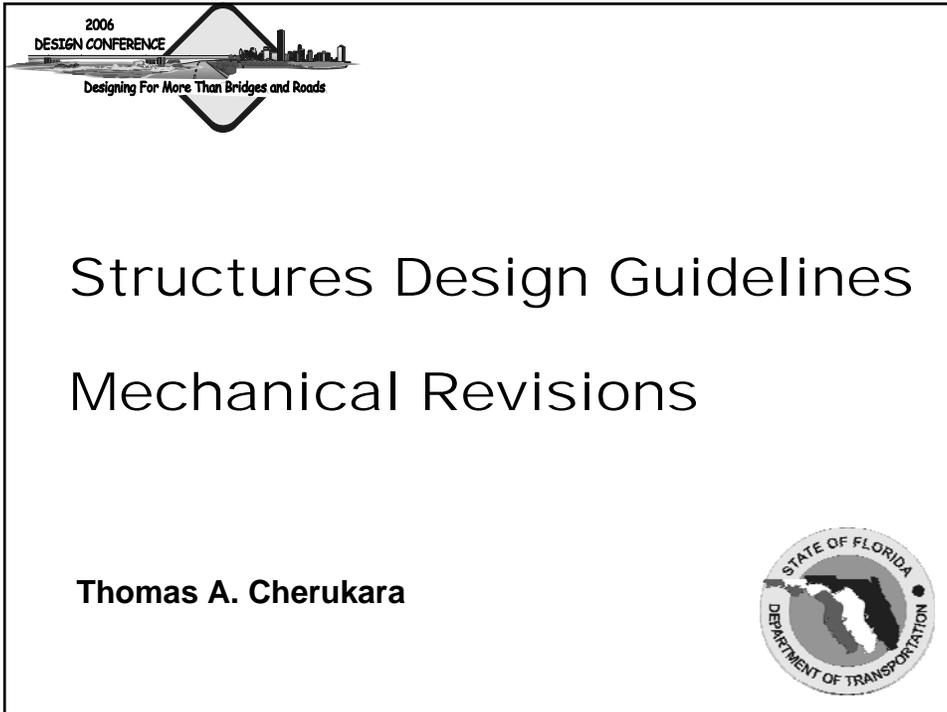
Tom Cherukara has a bachelor's degree in mechanical engineering, and a master's in materials engineering from the Rochester Institute of Technology.

He holds licenses in Florida and New Jersey.

He had worked as Project Engineer, Consultant, and Associate Professor in Mechanical Equipment and Systems.

Tom has been with the Florida DOT in Tallahassee for the past ten years, working as Mechanical Engineer for Movable Bridges. There he provides technical leadership and direction in the development and implementation of bascule projects.

Tom has researched and published several papers in bascule engineering and mechanical systems.

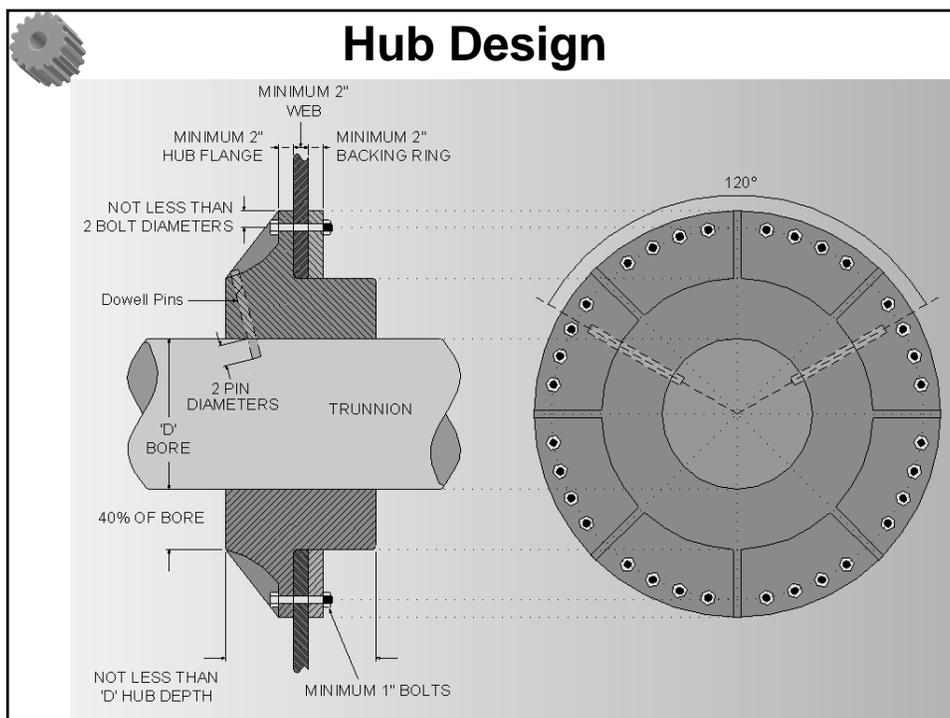


Contents

- **Hub design parameters**
- **Pinion bearings - Mounting**
- **Trunnion and pinion bearing - Supports**
- **Support machining & alignment tolerances**

Contents

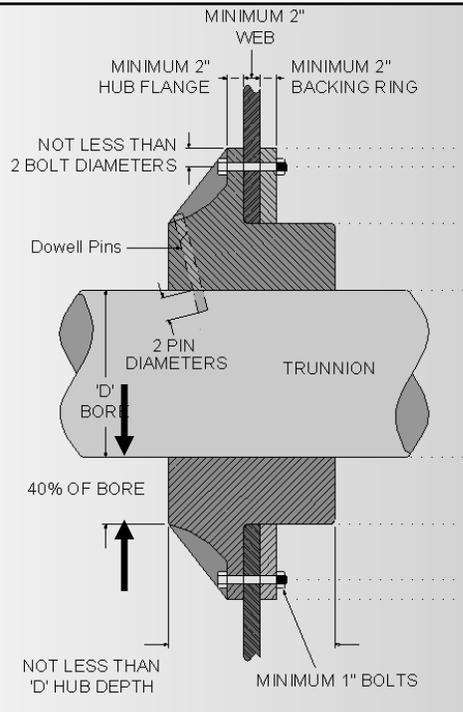
- Trunnion towers/columns
- Service clearances
- Unbalance and CG specifications
- Specifications - mechanical engineer



Radial hub thickness

~~20% of Bore~~

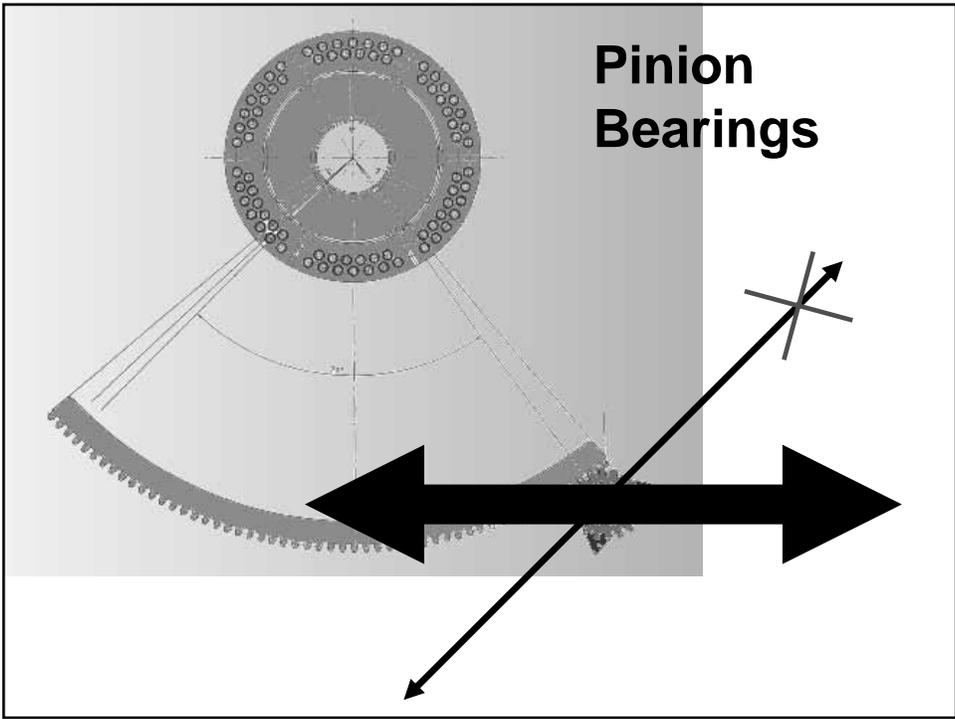
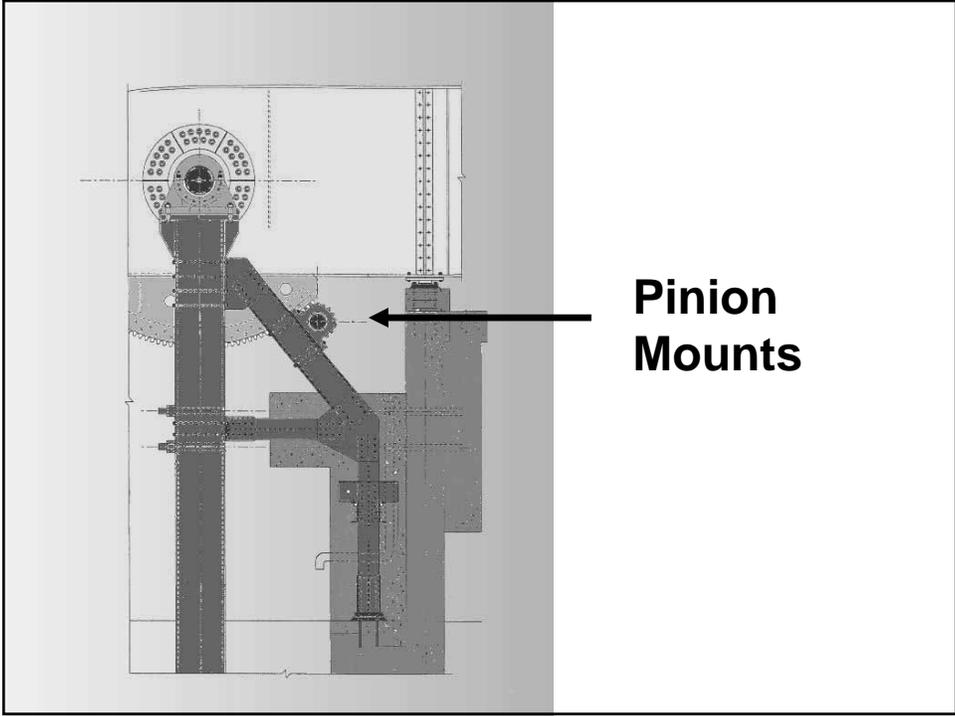
40% of Bore



Pinion Bearings

**Mount bearings and supports
in horizontal position only,
along both the axes**

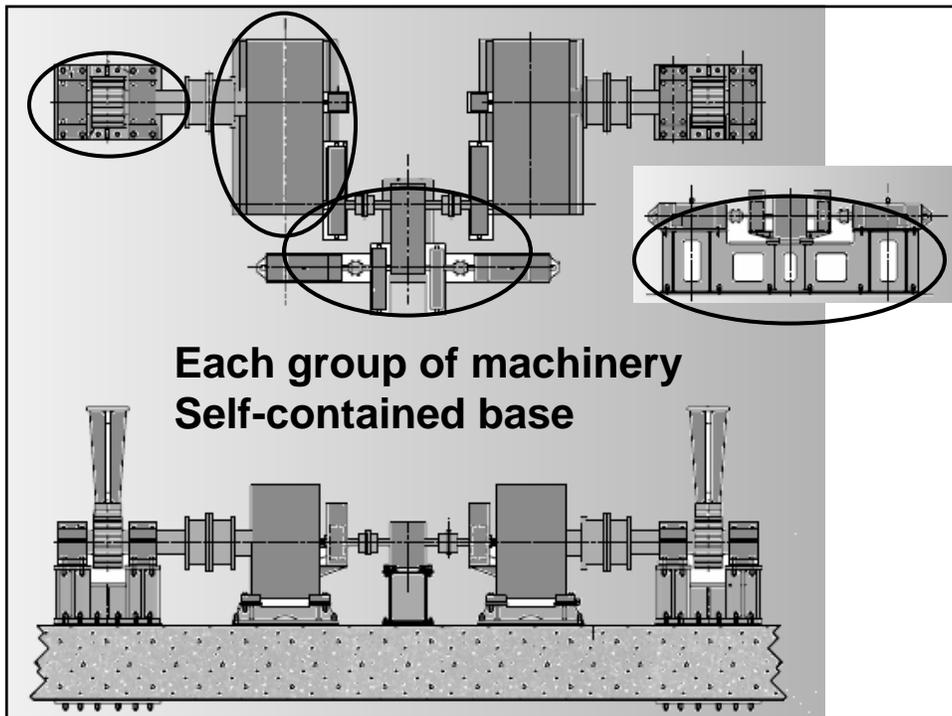






AASHTO 6.4.1.4

Each group of machinery shall be mounted on a self-contained steel frame, base, or bedplate



AASHTO 6.4.1.4

~~Where practical,~~

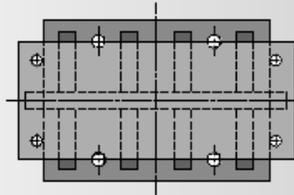
Each group of machinery shall be mounted on a self-contained steel frame, base, or bedplate or other rigid structural steel support.

Machinery Supports

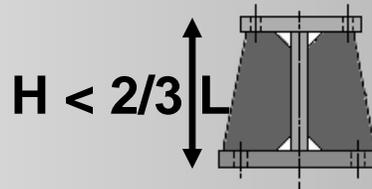
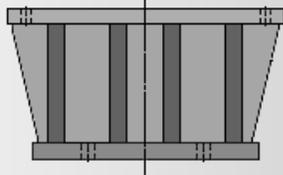


Height shall not exceed 2/3rd the length at the top

Machinery Supports



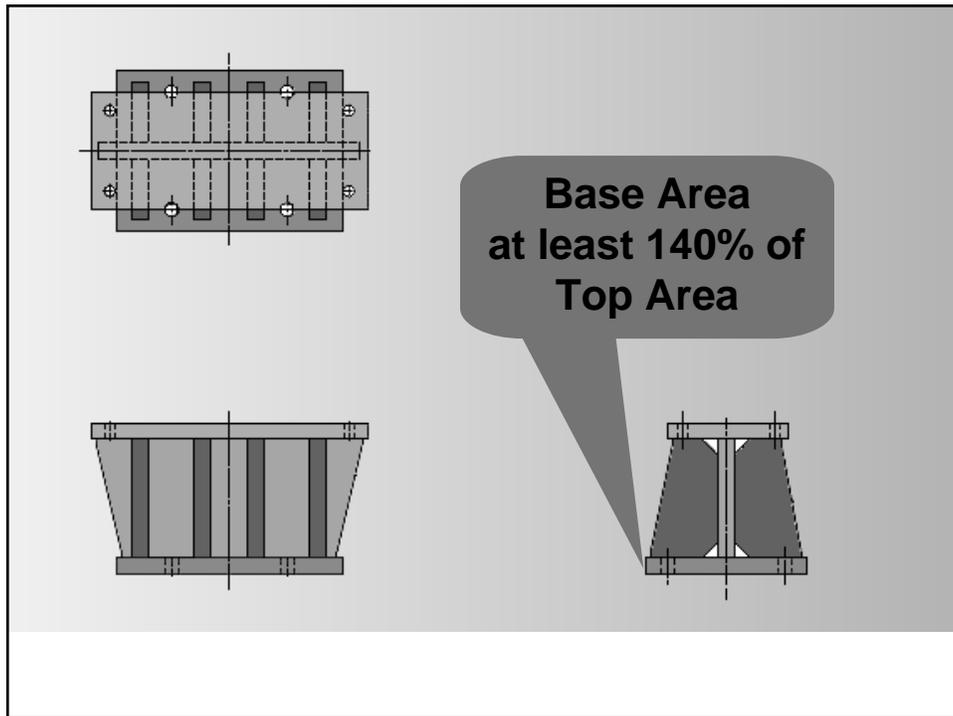
← Length →



Machinery Supports



**Design the footprint at least 40%
larger than top bearing area**



Machinery Supports



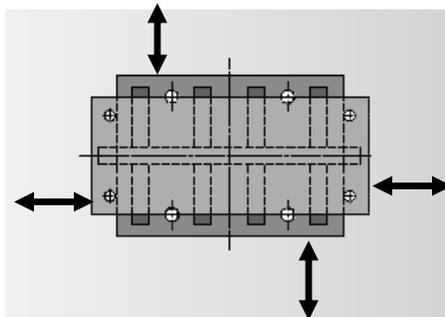
Installation Tolerances -

- | | |
|-------------|----------------|
| Position | - x, y, z axes |
| Orientation | - x, y axes |
| Levelness | - x, y axes |

Service Accessibility

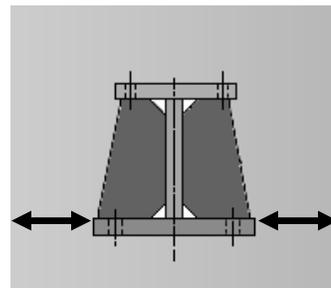


**Service area
not less than 30 inches wide
around drive components**



Service Clearance

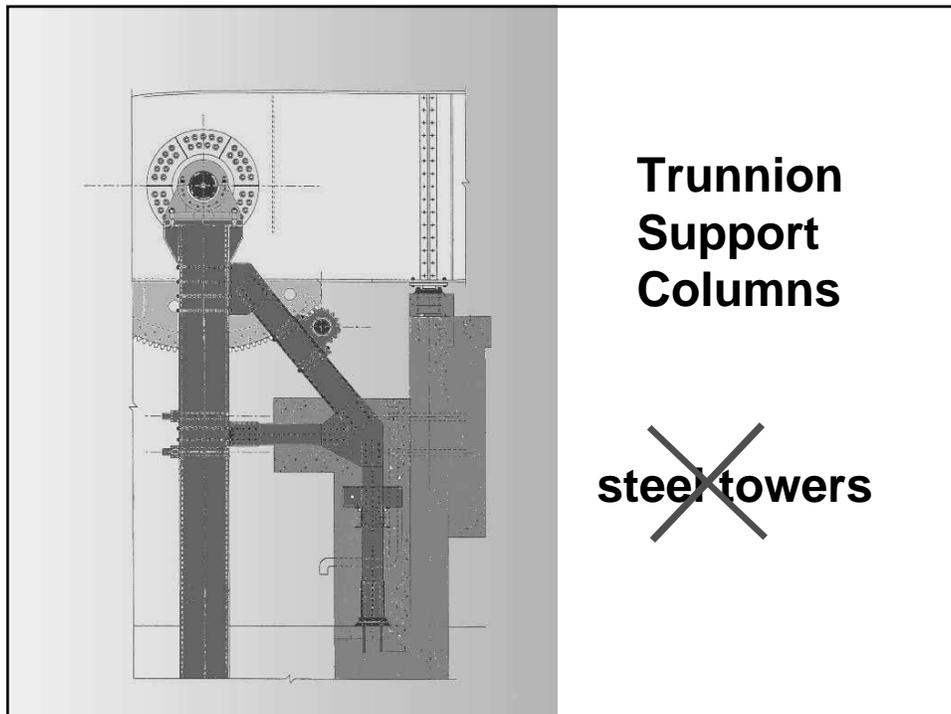
**30 inches wide
around machinery**

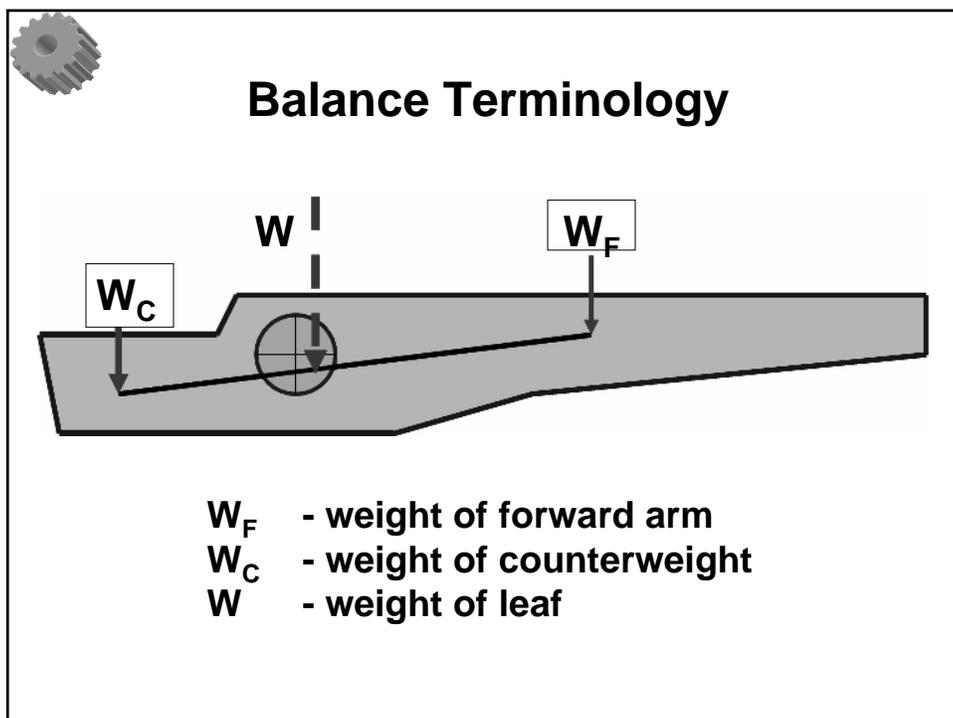
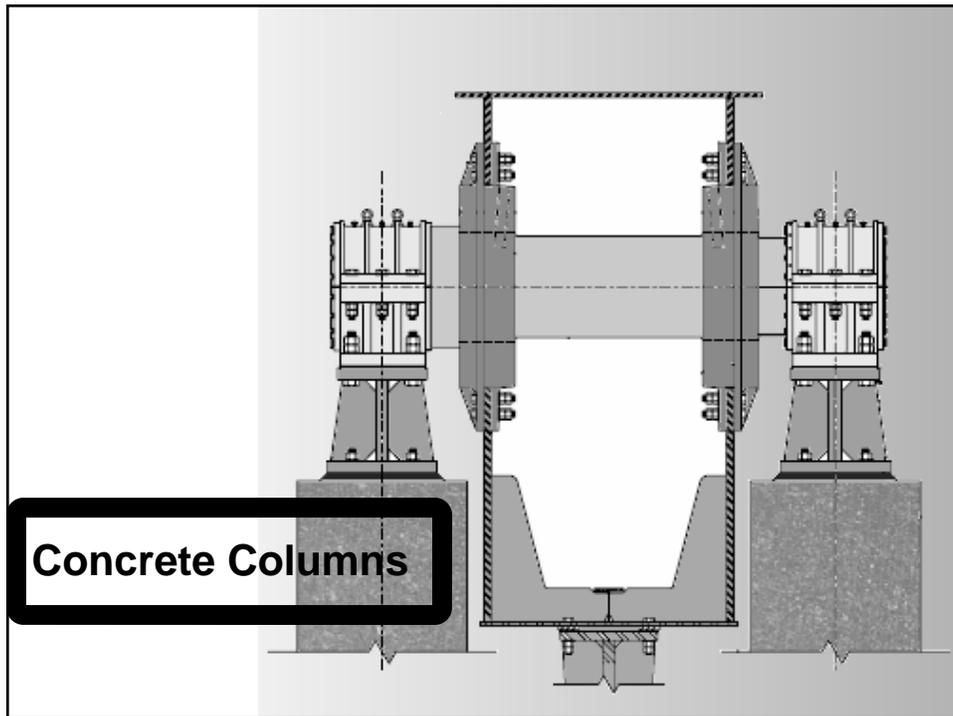




Trunnion Support Columns

Provide concrete trunnion columns
Do not use steel towers





Balance Specifications

Unbalance Condition	Specifications
Weight applied at the tip of leaf	2000 to 4000 lb
Leaf closed unbalance moment	200 to 600 kip-ft
Reaction at the live load shoes	Unbalanced moment is translated to the reaction

Balance Specifications

**Controlled
Unbalance**

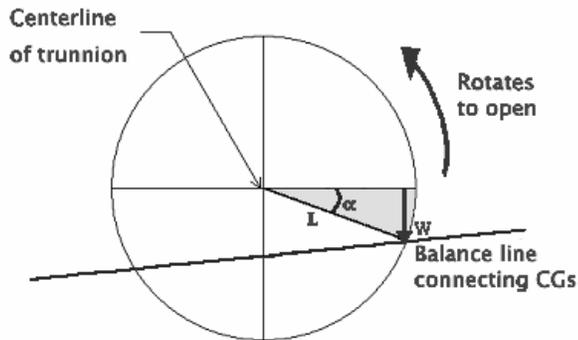


**$W \times L \times \cos \alpha$
in leaf closed position**



**Angle α of CG
with horizontal specified**

Balance Symbols



**Closed position
Unbalance torque**

$$T = W \times L \times \cos \alpha$$

W	Weight of leaf, lb or N
L	Radial distance of CG of leaf from trunnion axis
α	Angle of CG with the horizontal at the trunnion axis

Balance Symbols

Symbol	Description	Sign Convention
W	Weight of leaf, lb or N	
L	Radial distance of CG of leaf from trunnion axis	
α	Angle of CG with the horizontal at the trunnion axis	+ in direction of rotation
θ	Leaf opening angle	+ in direction of rotation
x	Horizontal distance of CG of components or leaf	+ forward of trunnion axis
y	Vertical distance of CG of components or leaf	+ upward of trunnion axis



FDOT Standard Specifications

Mechanical Systems Engineer -

**Ten years
supervisory experience
in movable bridge construction**

FDOT Standard Specifications

Mechanical Systems Engineer -

**At least three bridges in ten years
At least one in last three years
At least one has same type of
machinery**



Recap

**Mechanical Systems Engineer -
Qualifications
Experience**



**Each group of machinery
shall be mounted
on a self-contained
base/bedplate**

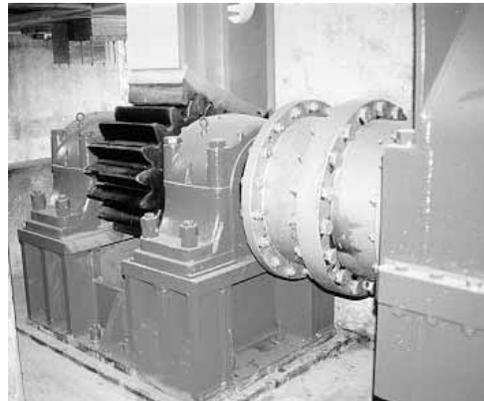
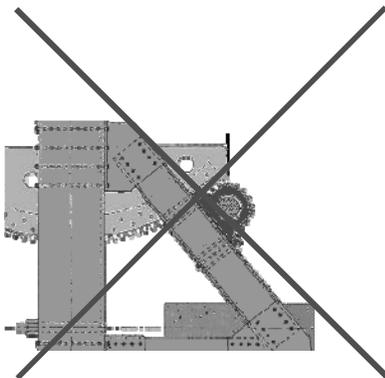
Controlled Unbalance

$W \times L \times \cos \alpha$

and

Angle α

Pinion Bearings/Supports -

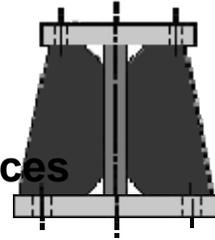


Machinery Supports -

Expanding base

Height limitation

Installation tolerances



Radial Hub Thickness

~~20% of Bore~~

40% of Bore

**Provide
concrete
columns**



**Steel
Trunnion Towers**

