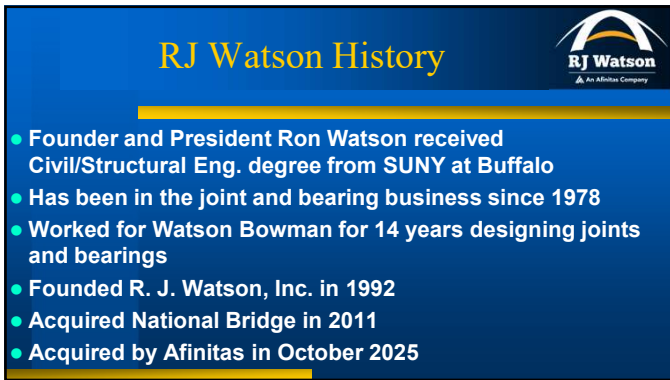


1



2



3



4



5



6



7



8



9



10



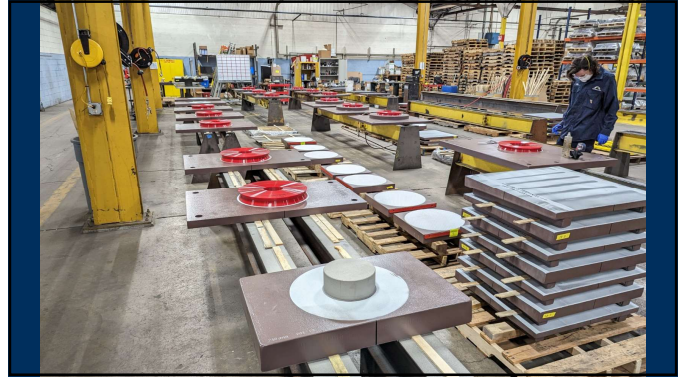
11



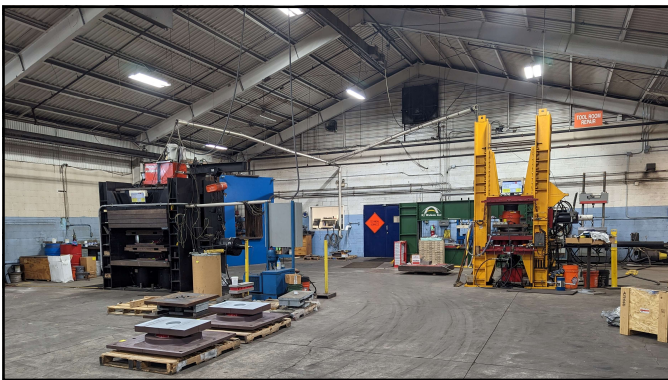
12



13



14




15



16

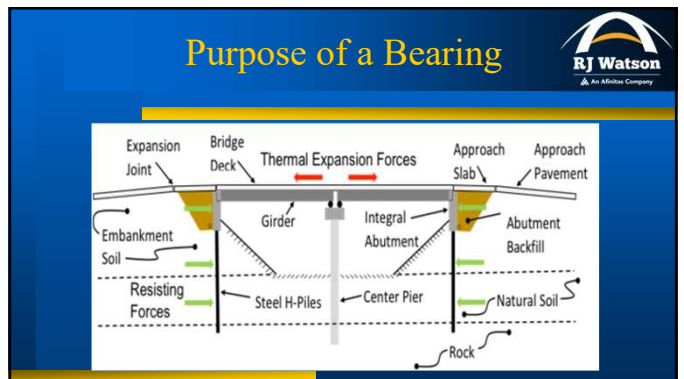
Purpose of a Bearing


An Albialex Company

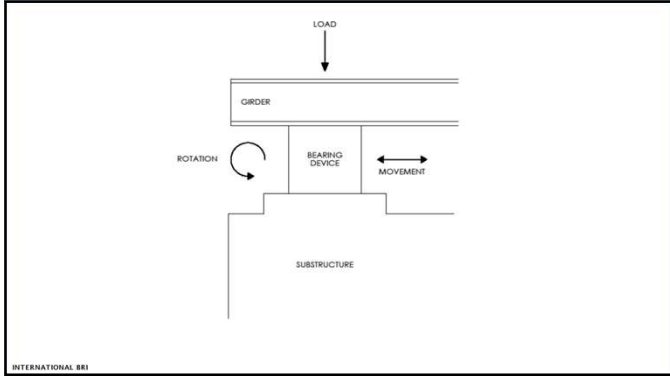
Bridges move (expand, contract, rotate, sway) for many reasons, among them are temperature changes, traffic driving over them, wind, and earthquakes. Bearings are used:

- To allow rotation
- To allow expansion/contraction (thermal)
- To transfer load from superstructure to substructure

17



18



19

Think of your statics & structures classes!

RJ Watson
An Alstom Company

4. A simple beam subjected to a linearly increasing distributed load is shown below. Draw the shear-force and bending-moment diagrams for the beam.

20

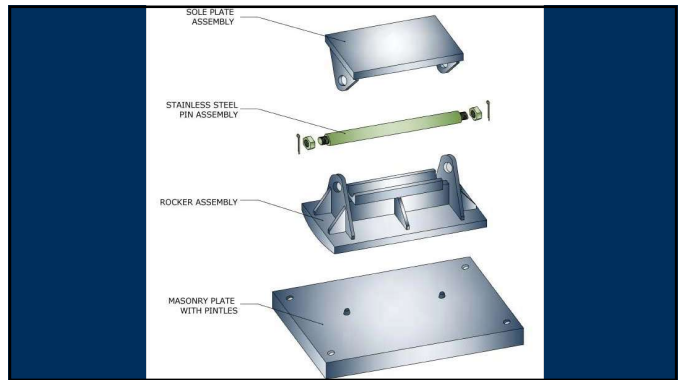
Old Bearing Tech

RJ Watson
An Alstom Company

Rocker Bearings

Pot Bearings

21



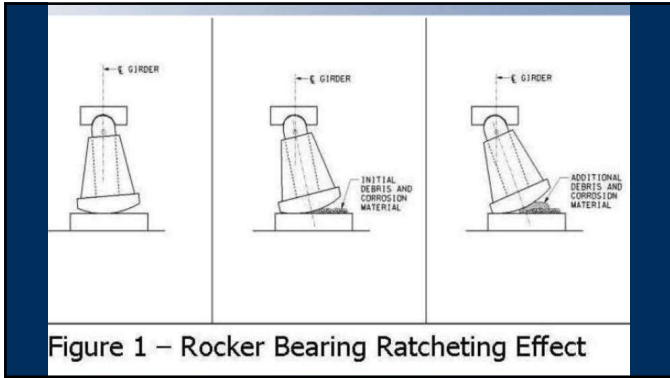
22



23



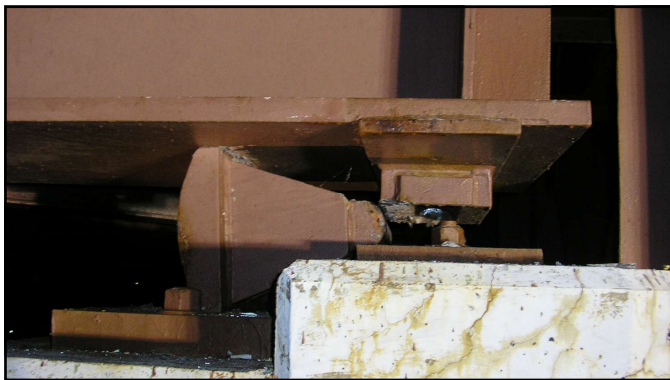
24



25



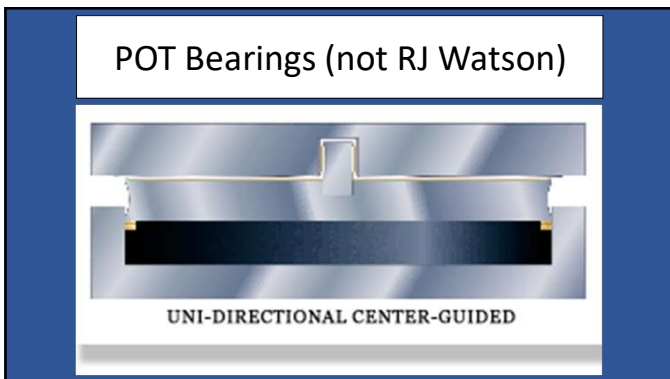
26



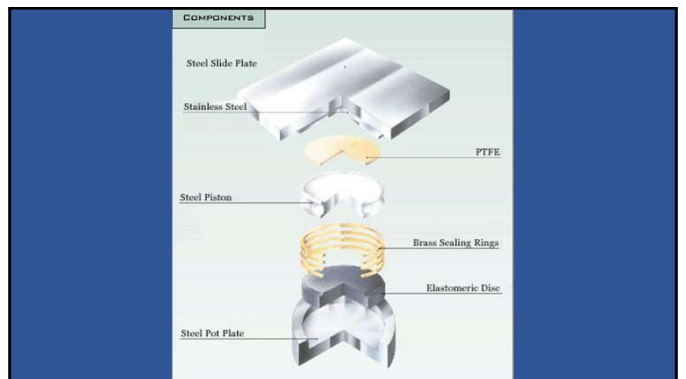
27



28



29



30

Typical Failure Mode of a Pot Bearing



Brass ring fails and the elastomer pushes out of the pot. The bearing now has a greatly reduced load and rotational capacity and requires replacement.

31



32



33

Elastomeric Bearings



34



35

Shear Strains



Bearing overloaded in compression and rotation. Elastomer has torn in shear.

36



37

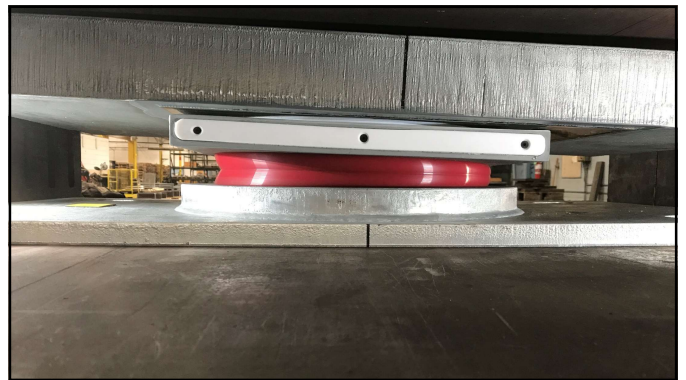
RJ Watson Disktron Bearing System

- 1 Polytron Disc**
By utilizing a polyether urethane load element, the Disktron Bearing accommodates vertical design loads of 10 - 15,000 kips or more while maintaining its ability to provide rotation in all directions.
- 2 SRM (Shear Resisting Mechanism)**
A high strength machined shear pin transfers horizontal loads from the upper bearing plate to the lower bearing plate and isolates shear loads from the Polytron Disc while allowing rotation.
- 3 PTFE/Polished Stainless Steel**
PTFE mated with polished stainless steel results in a sliding interface with a very low coefficient of friction. Wear resistant alternatives to PTFE are also available.

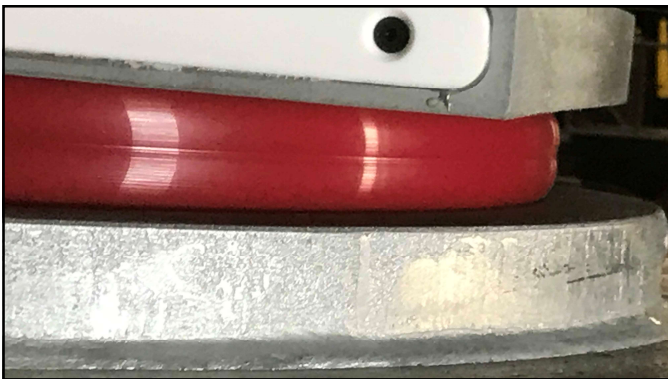
38

How does it work? - Compression

39



40



41

Fixed

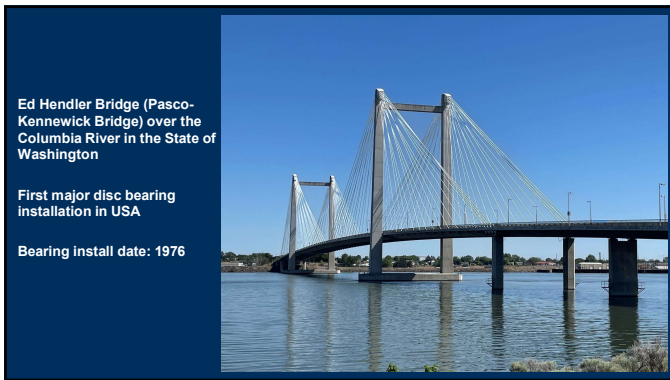
42



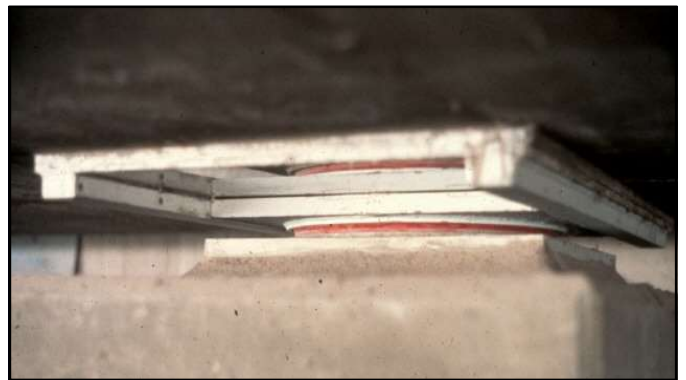
43



44



45



46



47



48



49



50



51



52



53

Selmon Expressway Project 

- Owner: Tampa Hillsborough Expressway Authority
- Engineer: AECOM
- Contractor: Kiewit
- Location: Tampa, FL
- Installation date: 2018-2020

54




55



56



57

Honolulu Light Rail 

- Owner: Honolulu Authority for Rapid Transportation
- Engineer: Parsons/IBT
- Contractor: Shimmick/Traylor/Granite JV
- Location: Honolulu, HI
- Bearings: 175
- Capacity: 650 – 2000 kips (plus uplift)
- Installation date: 2018-2020

58



59



60

LAX Automated People Mover



- Owner: Los Angeles World Airports
- Engineer: HDR
- Contractor: LINXS
- Location: Inglewood, CA
- Bearings: 98
- Type: fixed, guided, uplift, service uplift
- Installation date: 2020-2021

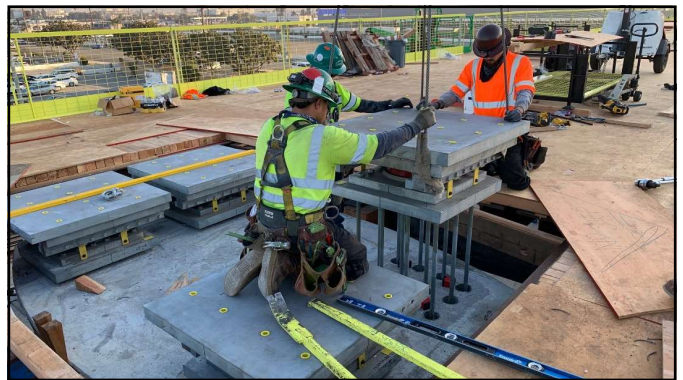
61



62



63



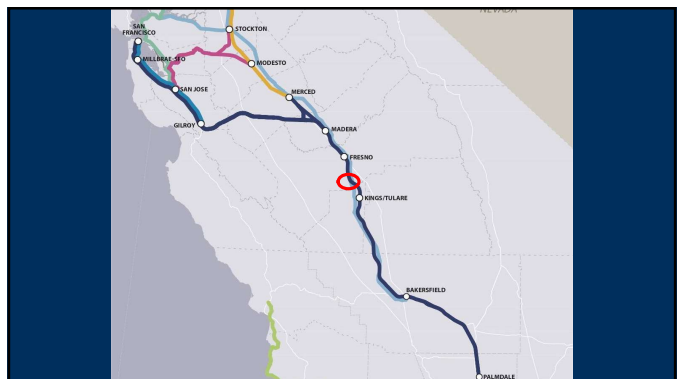
64

California High Speed Rail CP2-3: Hanford Viaduct



- Owner: CAHSR
- Engineer: Jacobs
- Contractor: Dragados-Flatiron JV
- Location: California Central Valley
- Bearings: 365
- Type: standard fixed and expansion
- Capacity: 1320 – 3280 kips
- Installation date: 2021-2025

65



66



67



68



69



70



71



72



73



74



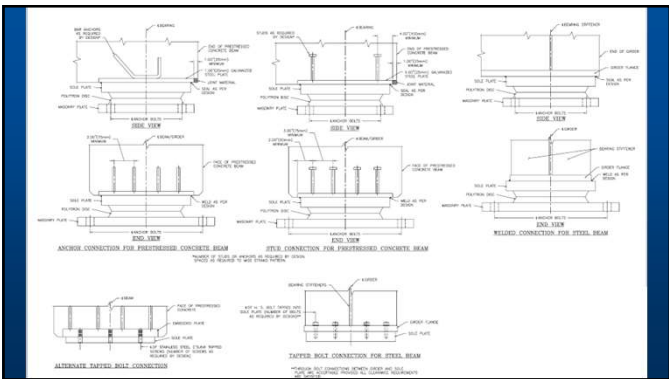
75

Bearing Connection Methods

RJ Watson
An Alstria Company

- Anchors
- Field welding
- Thru-bolts
- Threaded bolts
- Embed plates (studs, pintles)
- Always keeping replaceability in mind

76




77



78

Dulles Metrorail Project



- Owner: MWAA
- Engineer: URS
- Consultant: Corven Engineering
- Contractor: Dulles Transit Partners (Bechtel)
- Location: Northern Virginia
- Bearings: 1594
- Capacity: 115-610 kips (512-2714 kN)
- Installation date: 2010-2016

79



80



81

Goethals Bridge



- Owner: Port Authority of NY & NJ
- Engineer: Parsons Transportation Group
- Consultant: International Bridge Technologies
- Contractor: Kiewit-Weeks-Massman JV
- Location: Elizabeth, NJ – Staten Island, NY
- Bearings: 252 Disktron
- Capacity: 340-1050 kips

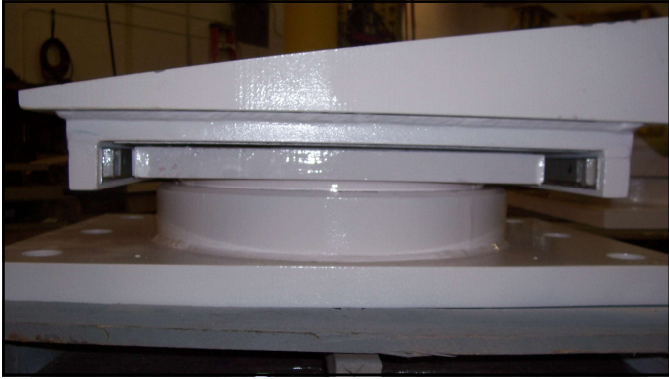
82



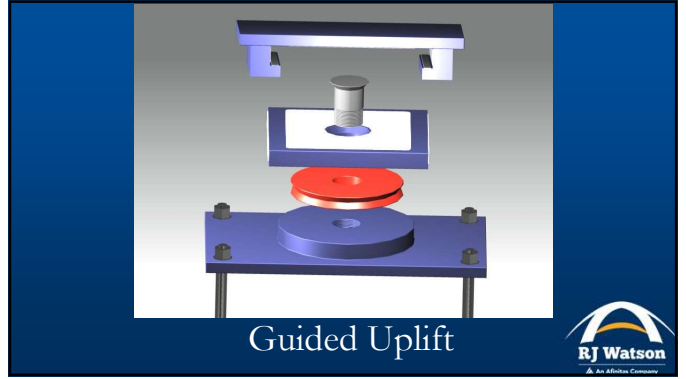
83



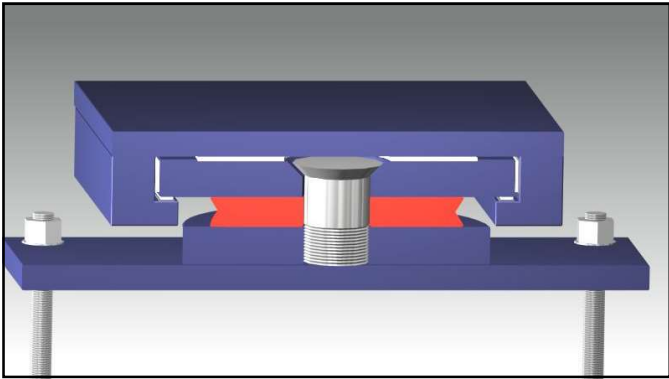
84



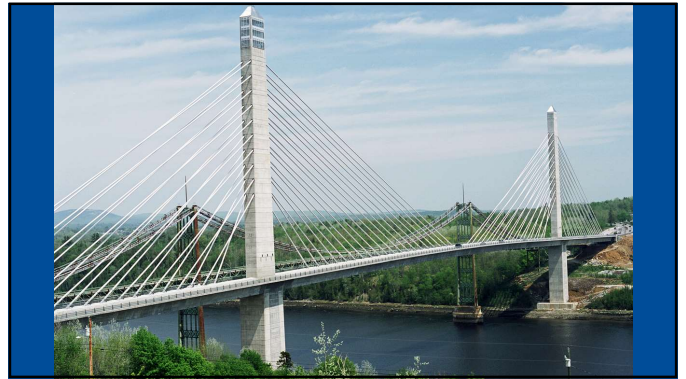
85



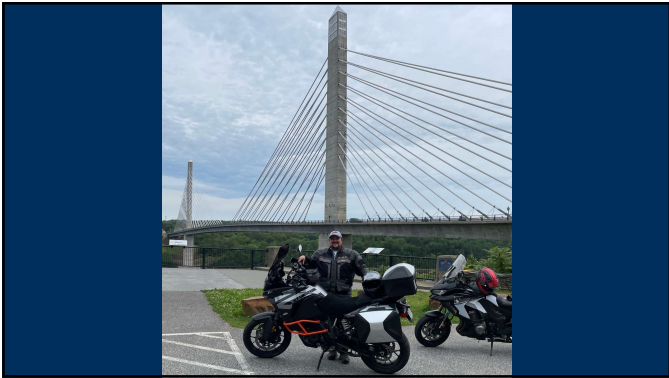
86



87



88



89





90



91

Schuylkill River Pedestrian Bridge

92



93

Atlantic Avenue Viaduct



- Owner: MTA – Long Island Railroad
- Engineer: HNTB
- Contractor: Kiewit
- Location: Brooklyn, NY
- Bearings: 356 (mix of uni and fixed)
- Capacity: 160 kips (712 kN) with uplift
- Installation Date: October 2008

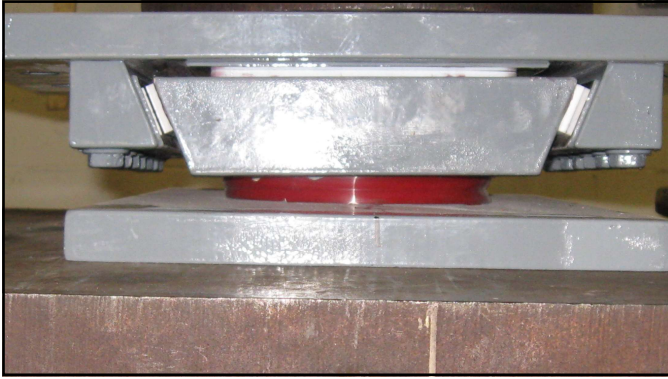
94



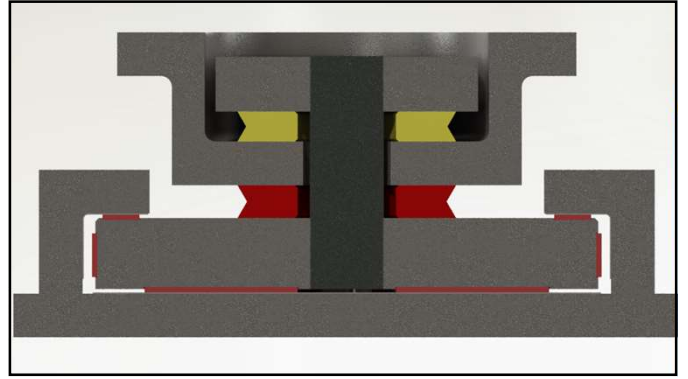
95



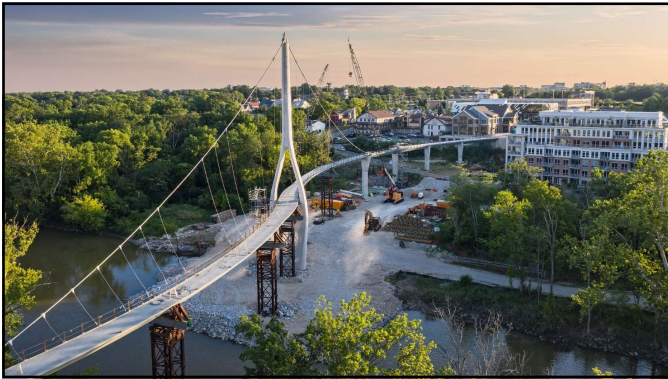
96



97



98




99



100

R. J. Watson Testing Capabilities



- 9500 kip test frame
- +/- 24 Inch Movement Actuator
- Smaller test frames available for component and prototype testing
- SUNYAB connection for dynamic testing

101



102



103



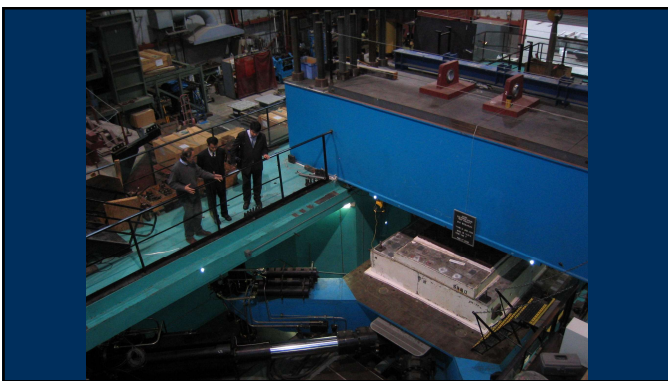
104



105



106



107



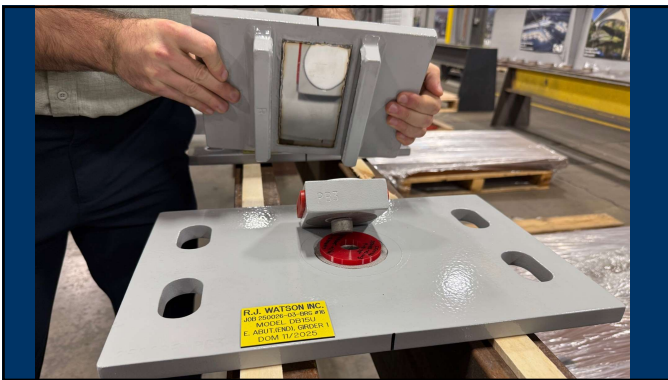
108



109



110



111

RJW Disktron Bearing System
Reliability and Performance

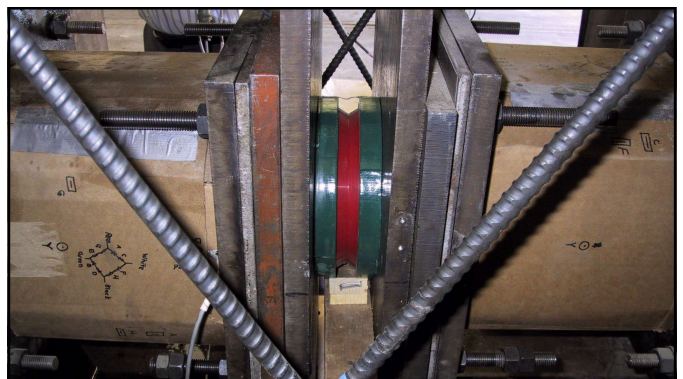
RJ Watson
 An Alfabeta Company

- Ron Watson (Owner and President) has been involved with disc bearings since 1978 and has not experienced a field failure to date.
- Built to last the lifespan of the structure, but can be built with replaceability in mind
- No containment structure necessary for the polyether urethane load element (disc) allows for easy inspection of the bearing
- See installation list for complete breakdown of all jobs dating back to 1995

112



113



114



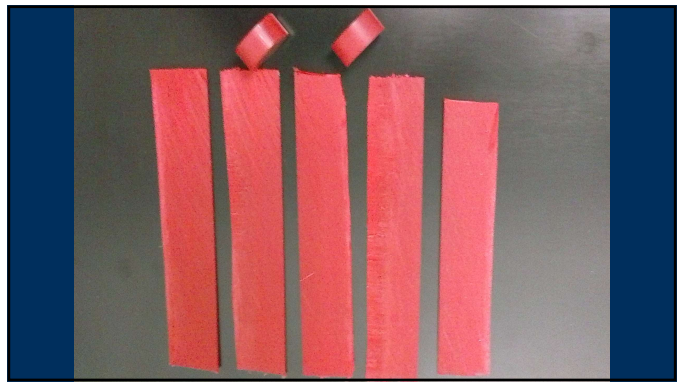
115



116



117



118

	R. J. Watson Material Certification	32 year old disk from Citicore
Durometer (Shore D)	61 D	60 D
Tensile Strength (psi)	5730 +/- 87	5175 +/- 105
Elongation (%)	270 +/- 3.7	270 +/- 3.5
Modulus 50% (psi)	2577 +/- 49	2241 +/- 26
Modulus 100% (psi)	3113 +/- 54	2746 +/- 35
Modulus 200% (psi)	4353 +/- 58	3950 +/- 52
Compression Set (%)	32 +/- 3	38 +/- 1


119


 RJ Watson
 An Alltelus Company

What's New?

120


Current Sliding Surfaces: PTFE





- Main sliding component for HLMR and elastomeric bearings
- Used by RJ Watson on over 35,000 bearings dating back to 1992
- Used by earlier manufacturers on disk bearings dating back to 1976

121


Proposed Sliding Surface: Nylon



122


Properties Comparison



Material	Lubrication	Coefficient of Friction	Design Pressure	Wear	Compression Deflection	Cost		
						Initial	Maintenance	Availability
PTFE	Dry	Low 0.03 to 0.10	Low 3.0 ksi	Highest	Low	Moderate	Moderate	High
	Lube	Lowest 0.01 to 0.06	Low 3.0 ksi	Low	Low	Moderate	Low	High
Bronze	Dry	Highest 0.20 to 0.40	Lowest 2.0 ksi	Moderate	Low	High	Highest	Low
	Lube	Moderate 0.07 to 0.20	Lowest 2.0 ksi	Moderate	Low	Highest	High	Low
Nylon	Dry	Moderate 0.08 to 0.20	Highest 10.0 ksi	Low	Lowest	Lowest	Low	High
	Lube	Low 0.02 to 0.08	Highest 10.0 ksi	Lowest	Lowest	Low	Low	High

123


Current Projects with Nylon Sliding Surfaces



- RJ Watson has used Nylon sliding surfaces on 10+ railroad projects dating back to 202, mostly as side sliding surface material (mating with guide bars)
 - Merchant's Bridge, BNSF Victorville bridge, Portal Bridge
 - 1 project as main sliding surface: Zoo Interchange in Wisconsin
- RJ Watson has also used Nylon sliding surfaces on 75+ highway (AASHTO) structures, dating back to 2014

124

Main Advantages of Nylon in Bearings



- Allowable pressure on the polyether urethane disk is 5000 psi, which makes PTFE (3000 psi) and Bronze (2000 psi) a major factor in bearing sizing
 - Not as big of a deal on the main sliding surface, as a lot of area is available – bigger deal on guide bars
 - When guide bars have to increase in size, the upper bearing plate gets thicker to match, adding a lot of extra cost into the bearing
- Superior wear properties compared to PTFE and Bronze

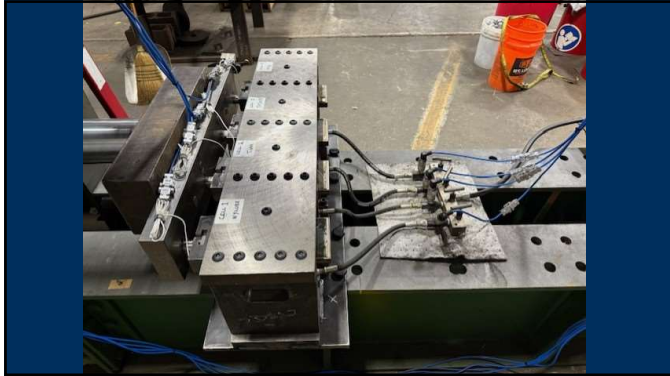
125

What's Next?



- Long-term deterioration testing for a direct comparison between PTFE, Nylon, and other sliding surfaces.
 - In process now with data expected mid-April!
 - 10 km minimum
- Specifications (AREMA, AASHTO)

126




127



128

Seismic Isolation



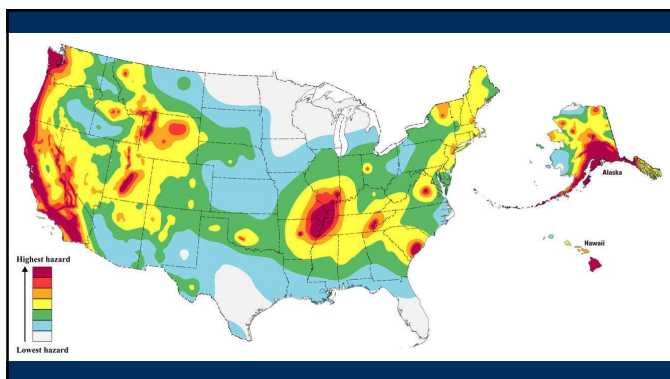
A design approach in which a structure is constructed on flexible supports which are designed to decouple the structure from the harmful effects of strong ground motions typically experienced during an earthquake

129

Why Isolation?

- To protect our structures!
- Reduce seismic forces transferred to bridge substructures
- Reduction of displacements
- Provide designer ability to direct seismic loads to elements of the substructure most capable of resisting them
- Reduction of substructure cost!

130



131

How do we Isolate?

Decouple the superstructure from the substructure through use of bearings

132

Types of Isolation Bearings

- Lead core rubber
- Friction Pendulum
- Flat sliding friction isolation

133



134



135



136

Friction Pendulum

Single Pendulum Isolator

Triple Pendulum™ Isolator

The image shows two types of friction pendulum isolators. The top one is a 'Single Pendulum Isolator', which consists of a blue metal frame with a single curved pendulum arm. The bottom one is a 'Triple Pendulum™ Isolator', which has a similar blue metal frame but with three curved pendulum arms. A small text 'Triple Center to Massing' is visible near the bottom left of the triple pendulum diagram.

137



138

**RJW Solution:
EradiQuake Bearing System**



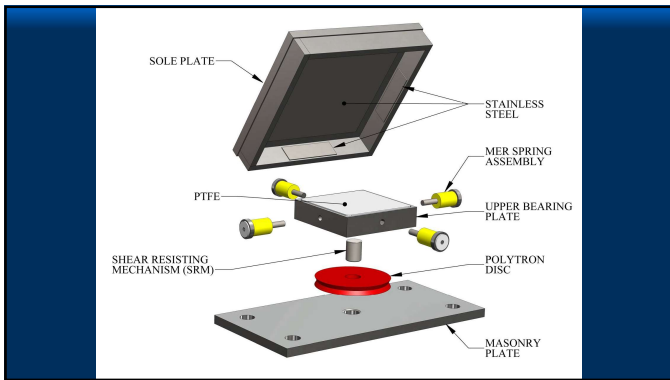
1. SLIDE PLATE
2. MASS ENERGY REGULATOR (MER)
3. UPPER BEARING BLOCK
4. SLIDING MATERIAL
5. POLYTRON DISC
6. SHEAR RESISTING MECHANISM (SRM)
7. LOWER BEARING PLATE



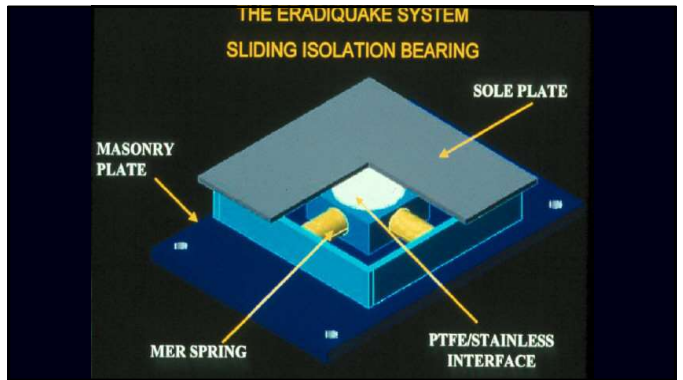
139



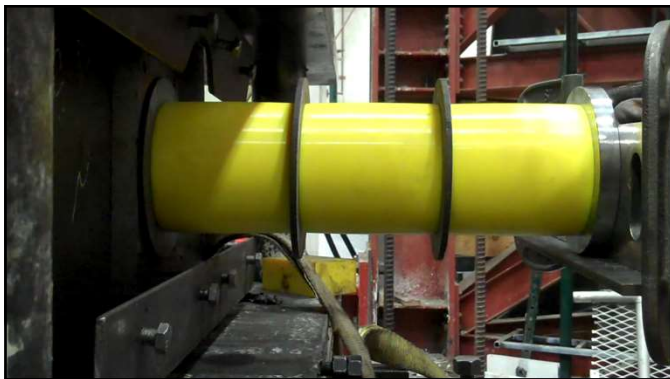
140



141



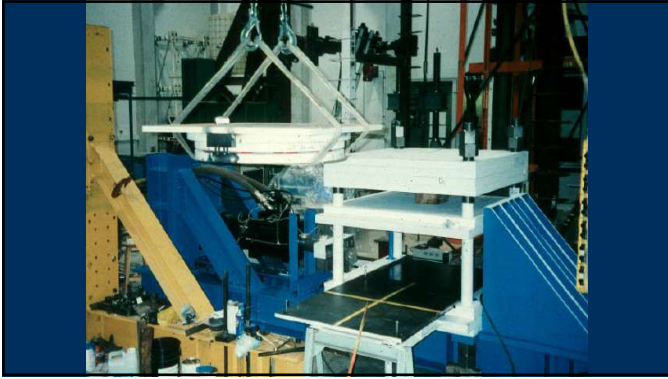
142



143



144



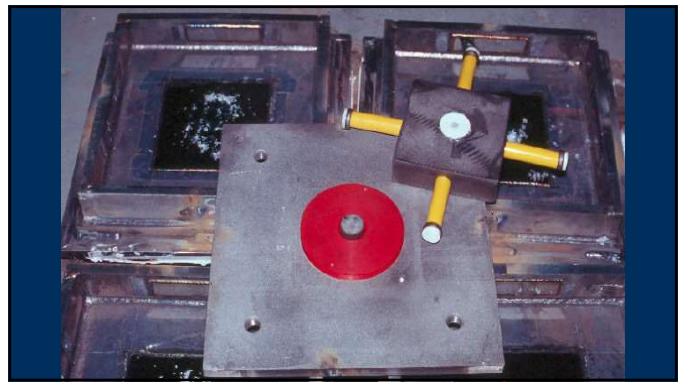
145



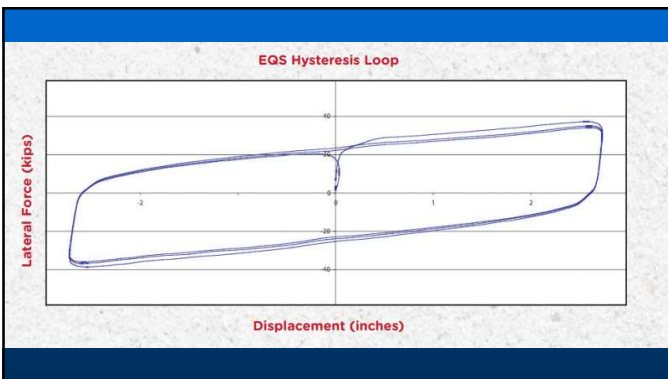
146




147



148



149

I-8 over Union Pacific Railroad 

- Owner: Arizona DOT
- Contractor: Royden Construction
- Engineer: Arizona DOT
- Location: Yuma, Arizona

150



151



152



153

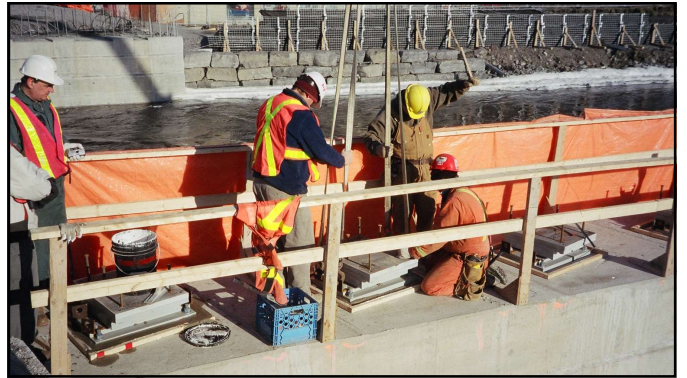
Bytown Bridges 

- Owner: City of Ottawa
- Engineer: Delcan Engineering
- Contractor: Tomlinson Construction
- Location: Ottawa, Ontario

154




155



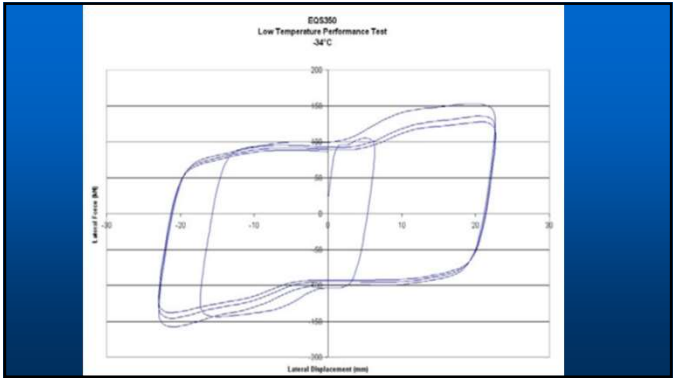
156

Isolation Features and Savings



- Reduced equivalent static earthquake load from 126.8 kn/m to 40.9 kn/m (~1120 kips to ~360 kips)
- Resulted in the use of 30 rock anchors imbedded 3.0 meters (~10 feet) compared to 82 anchors imbedded 8.1 (~27 feet) meters in the foundation design

157



158

Buffalo Airport



- Owner: Niagara Frontier Transportation Authority
- Engineer: Lu Engineers
- Contractor: New Construction
- Location: Buffalo, NY
- Bearings: 34 EQS
- Capacity: 300-1100 kips (1335-4893 kN)
- Installation date: June 1997

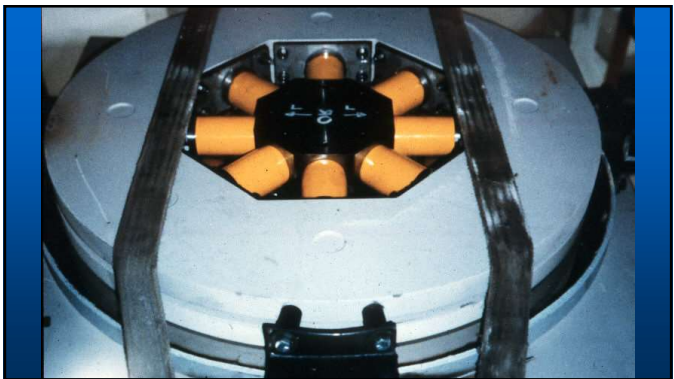
159



160



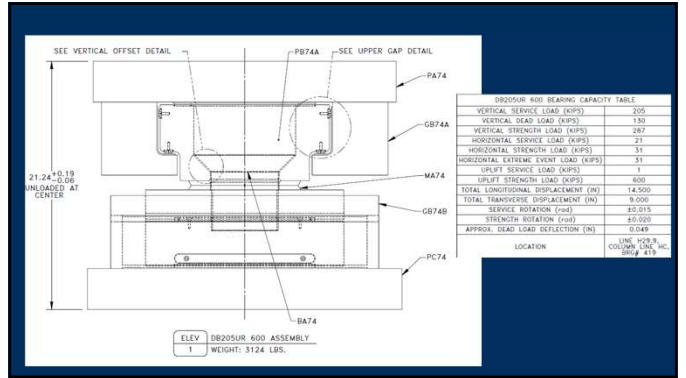
161



162



163



164



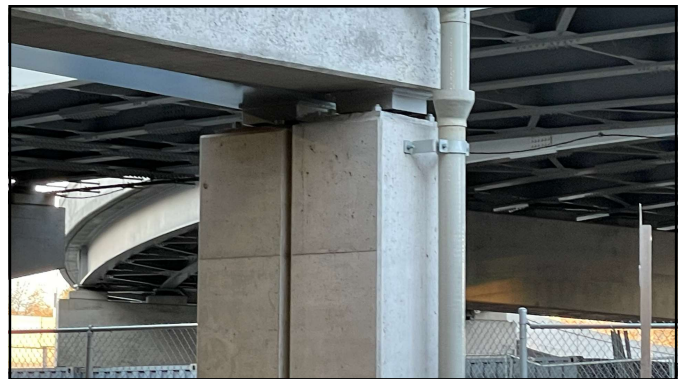
165



166



167



168



169

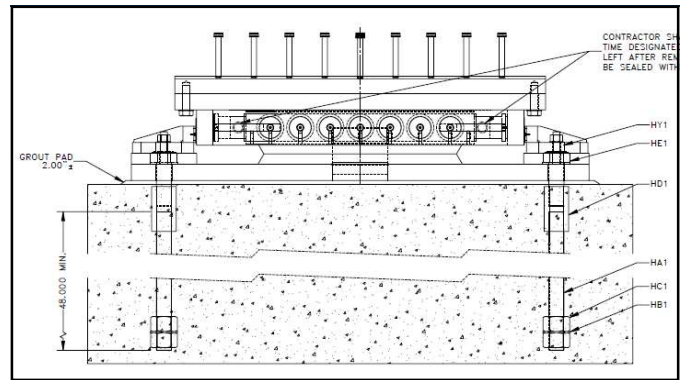
SR 43 Tied Arch Bridge

- Owner: California High Speed Rail Authority
- Engineer: Jacobs
- Contractor: Dragados-Flatiron JV
- Location: Fresno County, CA
- Bearings: 4 EQS
- Capacity: 5070 kips vertical service
- Installation date: 2022 (Projected)

170



171

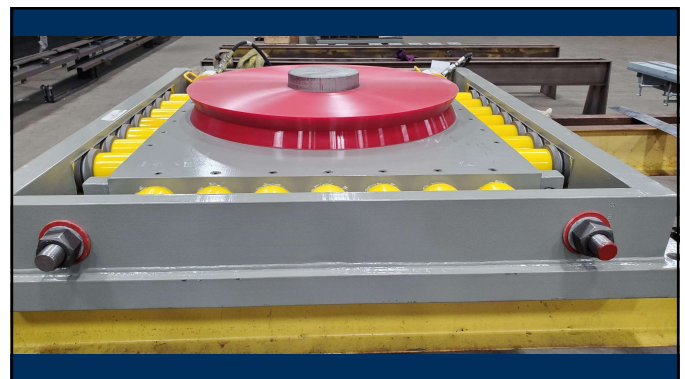


172

EQS Bearing Features

- 5070 kip vertical service load capacity
- 1100 kip horizontal service load capacity
- 1246 kip horizontal extreme event capacity – fuse load
- +/- 2.13" longitudinal seismic displacement
- +/- 1.63" transverse seismic displacement
- +/- 0.020 radian extreme event rotation

173



174



175



176



177



178



179



180




181



182


Conclusions



RJ Watson
An Allflex Company

- Cost effective method of accommodating structural translations and rotations
- 45 years of field inspections and factory tests have revealed long-term maintenance-free performance
- R.J. Watson, Inc. has the knowledge and experience to modify disc bearings to fit any application, including to provide structural isolation for seismic or force control applications

183



Disktron Bearing System
Design Questionnaire

For a fillable version online, please visit www.rjwatson.com, hover over the Services tab at the top, and click on Design Services.

Project

Client: _____
 Consultant: _____
 Project: _____
 Email: _____
 Disktron Bearing Quantity: _____
 Estimated Project Start Date: _____

Superstructure Information

Face of Column or Concrete: _____
 Strength (Nominal Compressive Stress): _____
 Bearing Plate/Flange Dimensions: _____
 Steel Grade: _____
 Size of Bearing Location: _____
 Clear Height Above Column or Concrete: _____

Substructure Information

Face of Column or Concrete: _____
 Strength (Nominal Compressive Stress): _____
 Bearing Plate/Flange Dimensions: _____
 Bearing Dimensions: _____
 Material: _____
 Diameter: _____
 Embedment Depth: _____
 Disktron Bearing Height (if Required to Meet Height): _____

32201 Watson Ave., Dallas, TX 75244 | 714.661.7023 | www.rjwatson.com
 Rev. 11/2017 | 606-004-0001

184

Essential Bearing Design Info



RJ Watson
An Allflex Company

- Bearing Type – Fixed, Guided Expansion (Unidirectional), OR Non-Guided Expansion (Multidirectional)
- Vertical loads
- Net Uplift loads (if applicable)
- Horizontal loads – Longitudinal and Transverse
- Rotations
- Movements (+/-) – Longitudinal and Transverse
- Superstructure – material and strength
- Substructure – material and strength

185



RJ Watson

Silicoflex:
A High-Performance Joint Sealing System for the 21st Century



186

SILICOFLEX
JOINT SEALING SYSTEM

A PREFORMED SILICONE JOINT SEAL

RJ Watson
An Affiliates Company

187

SILICOFLEX
JOINT SEALING SYSTEM

Case Histories

RJ Watson
An Affiliates Company

Owner: New York State Thruway Authority – I-90
Location: Exit 39 Ramp Bridge near Syracuse, NY
Installation: October 1996
Last Inspection: Performing Satisfactorily

188

SILICOFLEX
JOINT SEALING SYSTEM

Case Histories

RJ Watson
An Affiliates Company

JFK Airport AirTrain

Owner: Port Authority of New York and New Jersey
Location: JFK Airport, NYC to Jamaica, Queens
Installation: Year 2000
Last Inspected: April 2022 – Performing Satisfactorily

189

SILICOFLEX
JOINT SEALING SYSTEM

ASTM SPECIFICATION
D8138-18

RJ Watson
An Affiliates Company

190

RJ Watson, Inc.

Poly-Tron Elastomeric Concrete

RJ Watson Inc
Making Bridges Better

191

RJ Watson

Finger Joints for Large Movement Expansion Joints

RJ Watson Inc
Making Bridges Better

192

RJ Watson
RJ Watson
An Alfiere Company

Thank you!

Presented by:
Zachary T. Searer
zachary.searer@afinitas.com
(716) 548-6206

193