Western Bridge Engineers' seminar

McLoughlin Boulevard Pedestrian Bridge

Springwater Trail Three Bridges

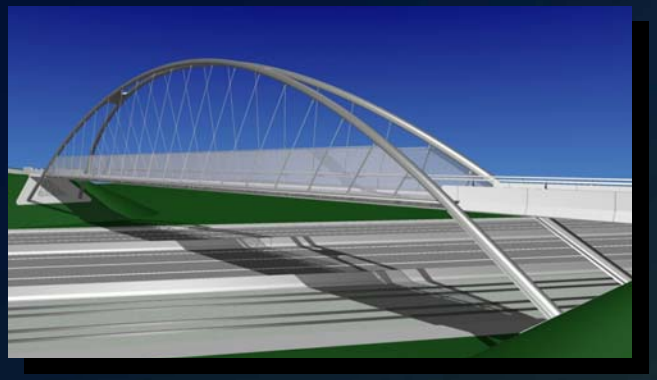
Gary Rayor, PE, SE – OBEC Consulting Engineers

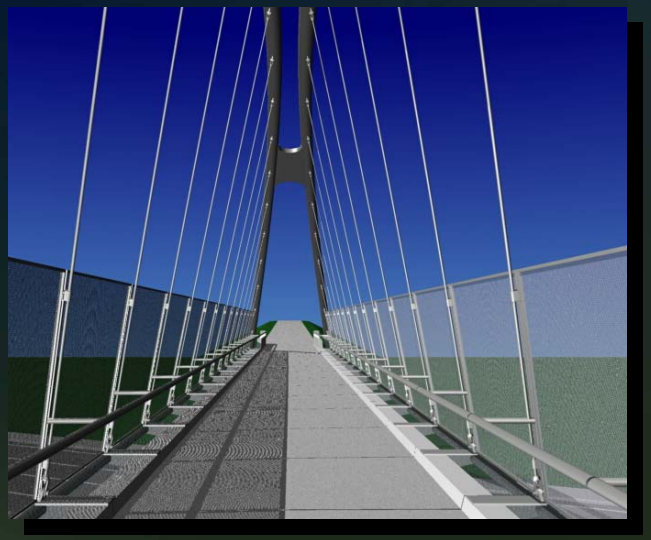
Dr. Jiri Strasky, PE – Consulting Engineer

Western Bridge Engineers' Seminar

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge





- Owner: City of Portland
- Contractor: Mowat Construction Company
- Concrete Producer: Glacier NW
- 241-foot main span
- 320 feet overall
- 27 – 10-foot x 15.5-foot precast concrete deck panels
- 44’ high arch
- PT Contractor: AVAR
- Steel Fabrication: Fought Steel

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Dr. Jiri Strasky, PE
Consulting Engineer,
Greenbrae, CA &
Brno, Czech Republic

Gary E. Rayor, PE, SE
OBEC Consulting Engineers,
Eugene, Oregon

OBEC CONSULTING ENGINEERS

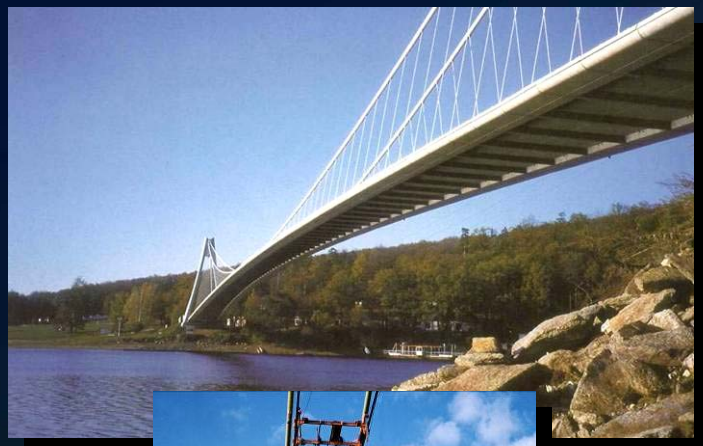
Background of Design – Dr. Jiri Strasky

Background of Design:

Dr. Jiri Strasky, PE
Stress Ribbon Bridges
1970's
Czechoslovakia

OBEC CONSULTING ENGINEERS

Background of Design – Lake Varnov Bridge



Dr. Jiri Strasky, PE

Precast, Post-tensioned Concrete Suspension Bridge

- **1989**
- **820-foot span**
- **Erection via Erection Cables**

OBEC CONSULTING ENGINEERS

Background of Design – Sacramento River Bridge

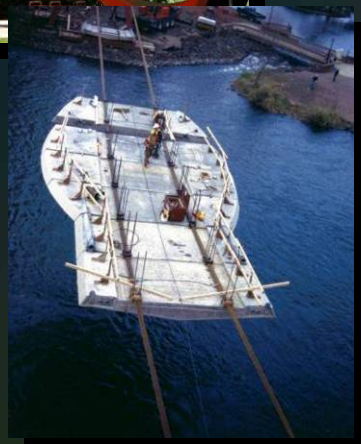
Dr. Jiri Strasky, PE
Charles Redfield, PE

Precast, Post-tensioned Concrete Stress Ribbon Bridge

- **1990**
- **420-foot span**
- **Erection Via Bearing Cables**
- **PT Contractor: DSI**

OBEC CONSULTING ENGINEERS

Background of Design – Willamette River (DeFazio) Bridge



Dr. Jiri Strasky, PE
Gary E. Rayor, PE

Precast, Post-tensioned Concrete Suspension Bridge with cable-stayed technology

- **1996**
- **Owner: City of Eugene**
- **Contractor: Mowat Construction Company**
- **340-foot main span**
- **640 feet overall**
- **Erection via Erection Cables**
- **PT Contractor: DSI**

OBEC CONSULTING ENGINEERS

Background of Design – Grants Pass, (Rogue River) Bridge

Gary E. Rayor, PE
Dr. Jiri Strasky, PE

Precast, Post-tensioned, Multi-span Concrete Stress Ribbon Bridge

- 2000
- Owner: City of Grants Pass
- Contractor: Holm II
- 278-foot main span
- 640 feet overall
- Erection via Bearing Cables
- PT Contractor: AVAR

OBEC CONSULTING ENGINEERS

Background of Design – McKenzie River Bridge

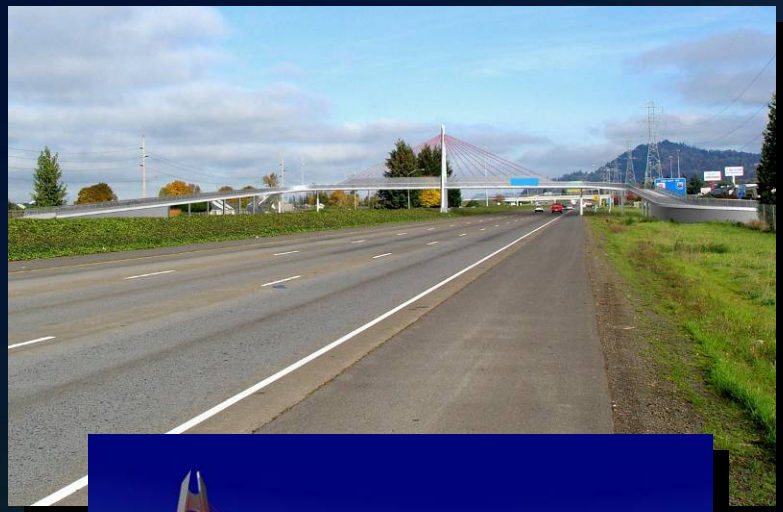
Dr. Jiri Strasky, PE
Gary E. Rayor, PE

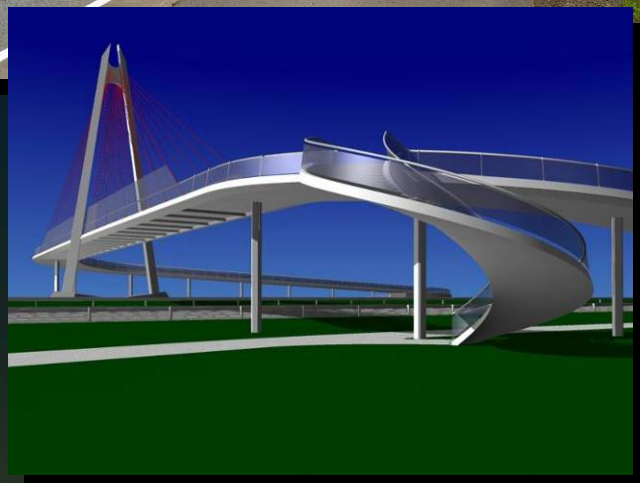
Precast, Post-tensioned Concrete Suspension Bridge

- 2002
- 430-foot main span
- 670 feet overall
- 67 – 10-foot x 24.5-foot precast concrete deck panels
- Out-to-out deck width – 20’
- 82,000 pounds PT strand
- 4,000 pounds PT rods
- 74’ high towers
- PT Contractor: DSI

OBEC CONSULTING ENGINEERS

Background of Design – I-5 Pedestrian Bridge





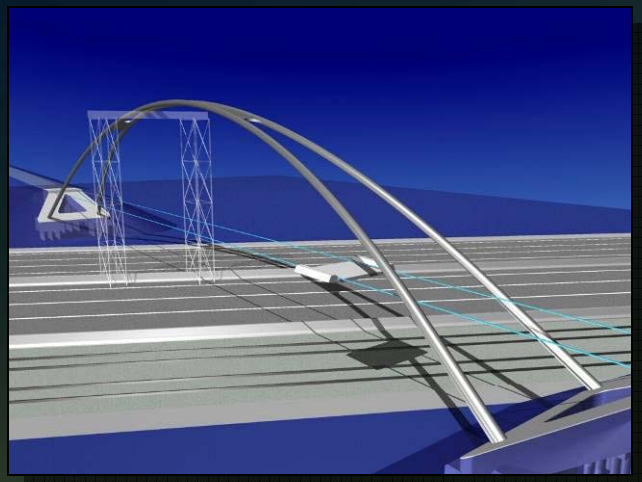
Dr. Jiri Strasky, PE
Precast, Post-tensioned
Gary E. Rayor, PE

Symmetrical Cable Stayed Bridge w/ Precast, Post-tensioned Deck

- **2008**
- **Owner: ODOT**
- **Contractor: Mowat Construction Company**
- **208-foot main span**
- **530 feet overall**
- **Erection via Erection Cables**
- **PT Contractor: Schwager-Davis**

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge



Dr. Jiri Strasky, PE
Precast, Post-tensioned
Gary E. Rayor, PE

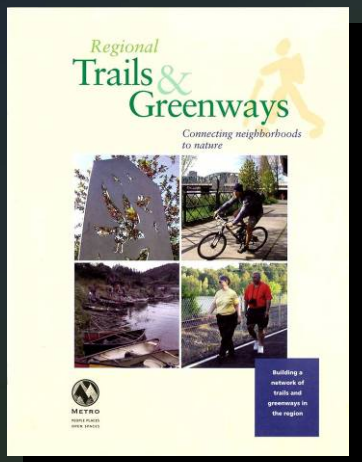
Through Basket Handle Arch Bridge w/ Precast, Post-tensioned Deck

- **2006**
- **Owner: City of Portland**
- **Contractor: Mowat Construction Company**
- **241-foot main span**
- **320 feet overall**
- **Erection via Erection Cables**
- **PT Contractor: AVAR**

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Site Prior to Construction



Three Bridges: McLoughlin span 'gateway' between cities

Springwater Corridor bridge connections

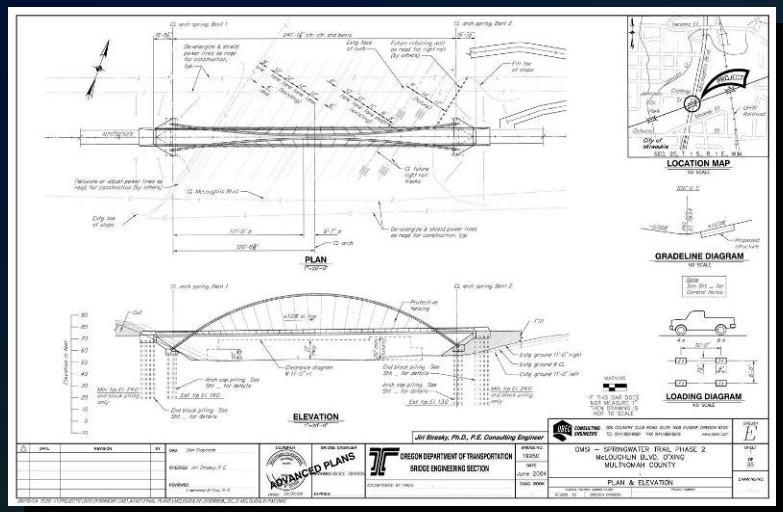
With arches in place, Springwater Corridor heads into home stretch

Trail: New spans, to be completed in September, will bridge gaps in the popular path for bicyclists and pedestrians

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

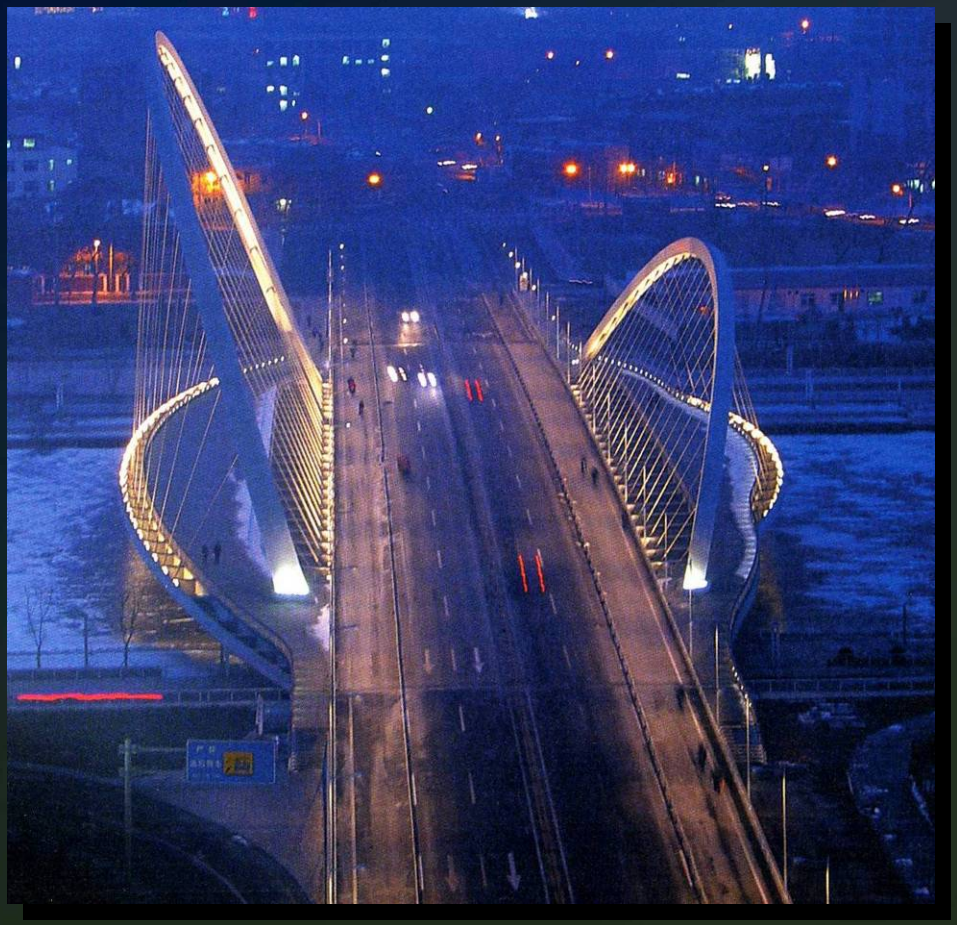
Innovations



- **Precast Post-tensioned Concrete Steel Arch Bridge**
- **Innovations:**
  1. **Post-tensioned/Precast Deck**
  2. **Post-tensioned/Deck Tied Arch**
  3. **Composite Deck/Arch**
- **Span/Depth Ratio of Deck of L/188**
- **Span/Depth Ratio of Arch of L/160**
- **Self Stiffened (deck in compression from abutments)**
- **It's Cool!**

OBEC CONSULTING ENGINEERS

Arch Bridge Form



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Alternatives

OBEC CONSULTING ENGINEERS

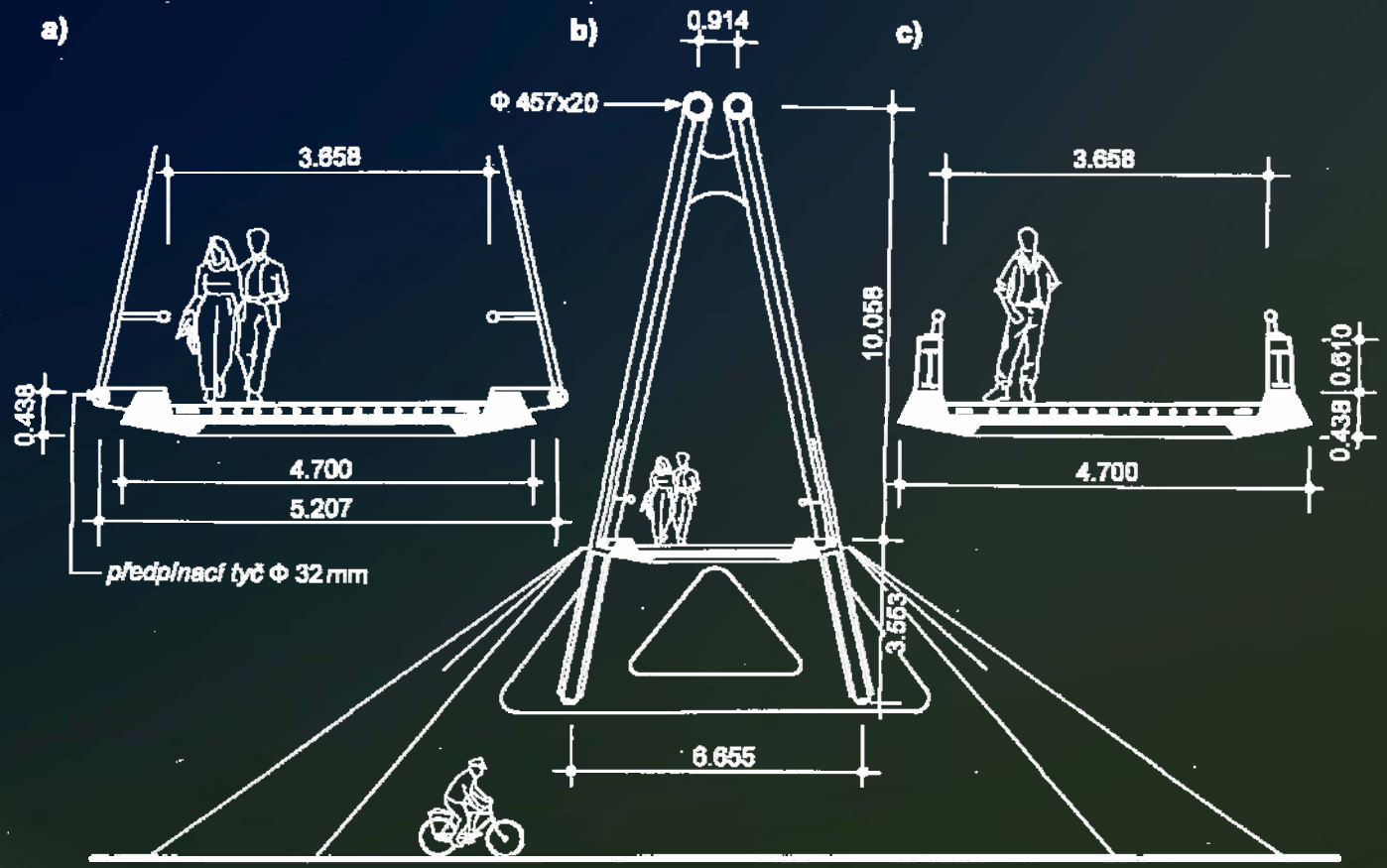
McLoughlin Boulevard Pedestrian Bridge

Preferred Alternative

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

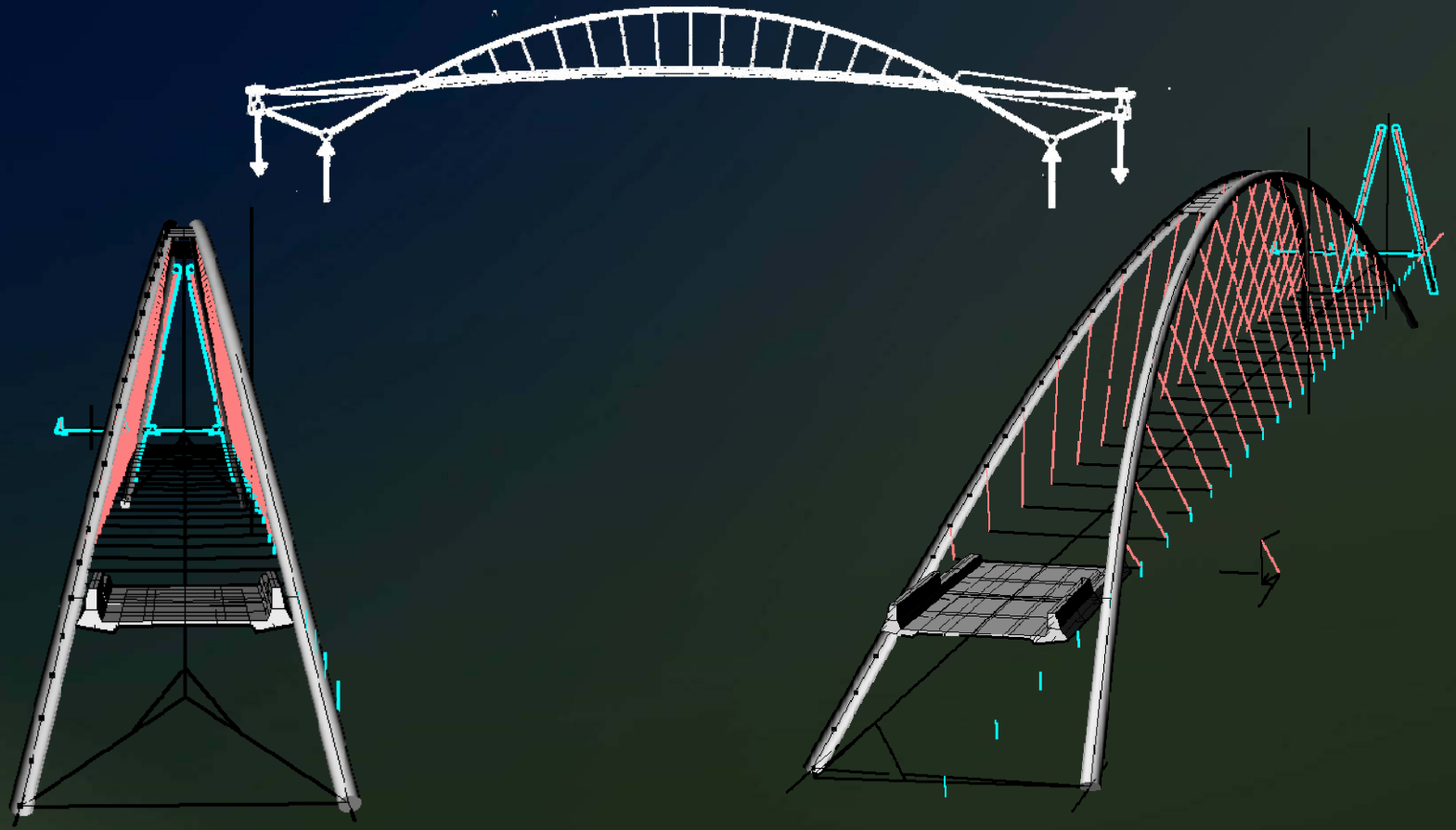
Concept Development



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

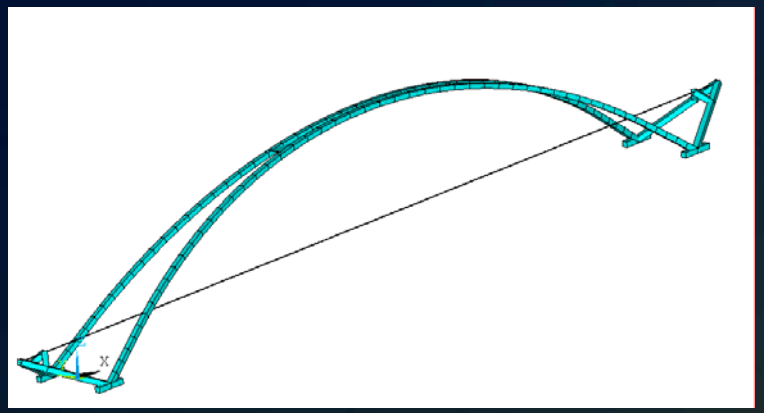
Modeling

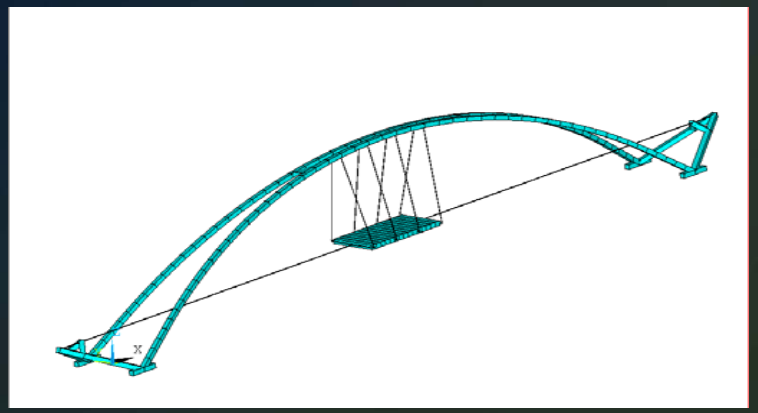


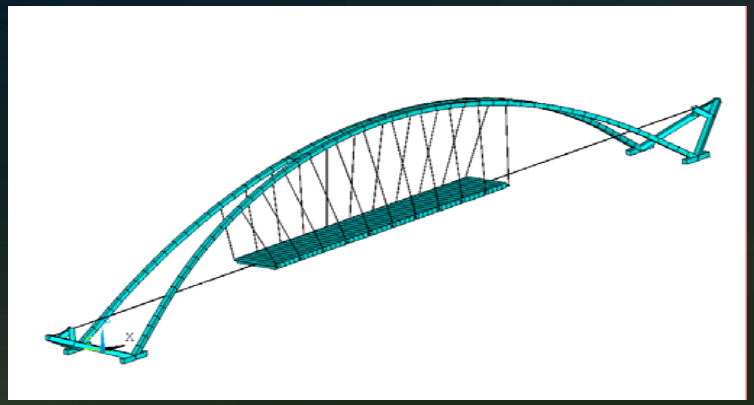
OBEC CONSULTING ENGINEERS

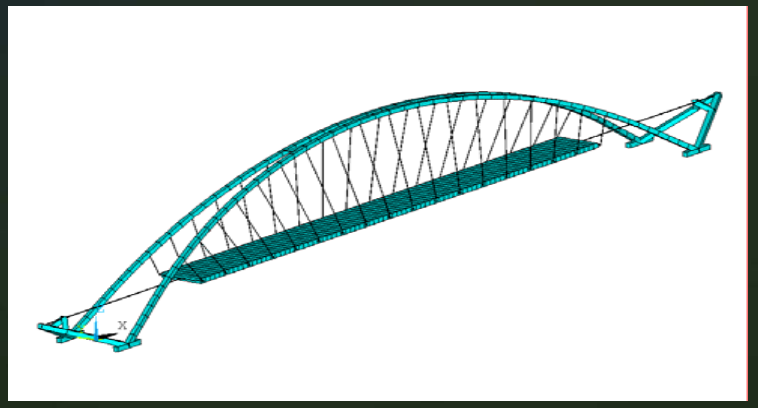
McLoughlin Boulevard Pedestrian Bridge

Development of Erection





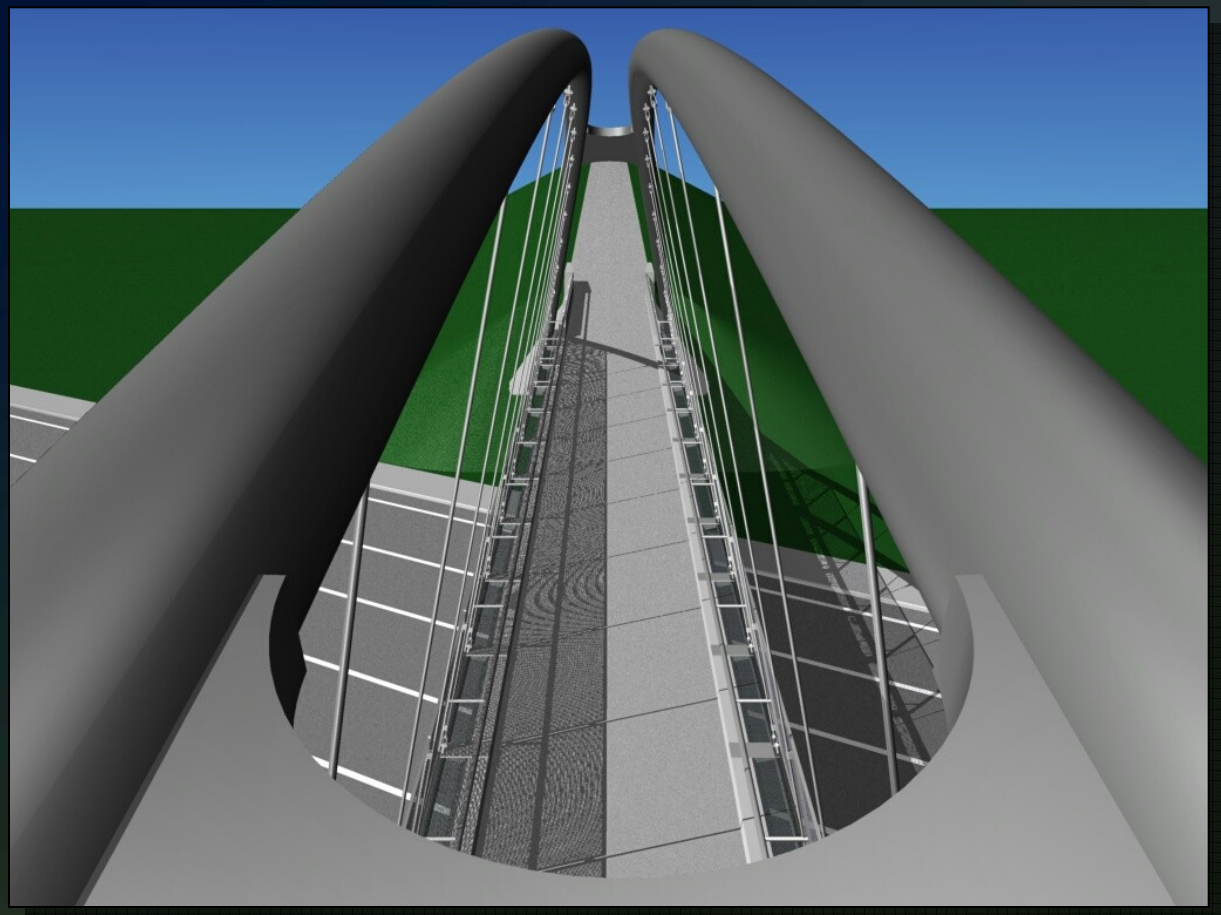




OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

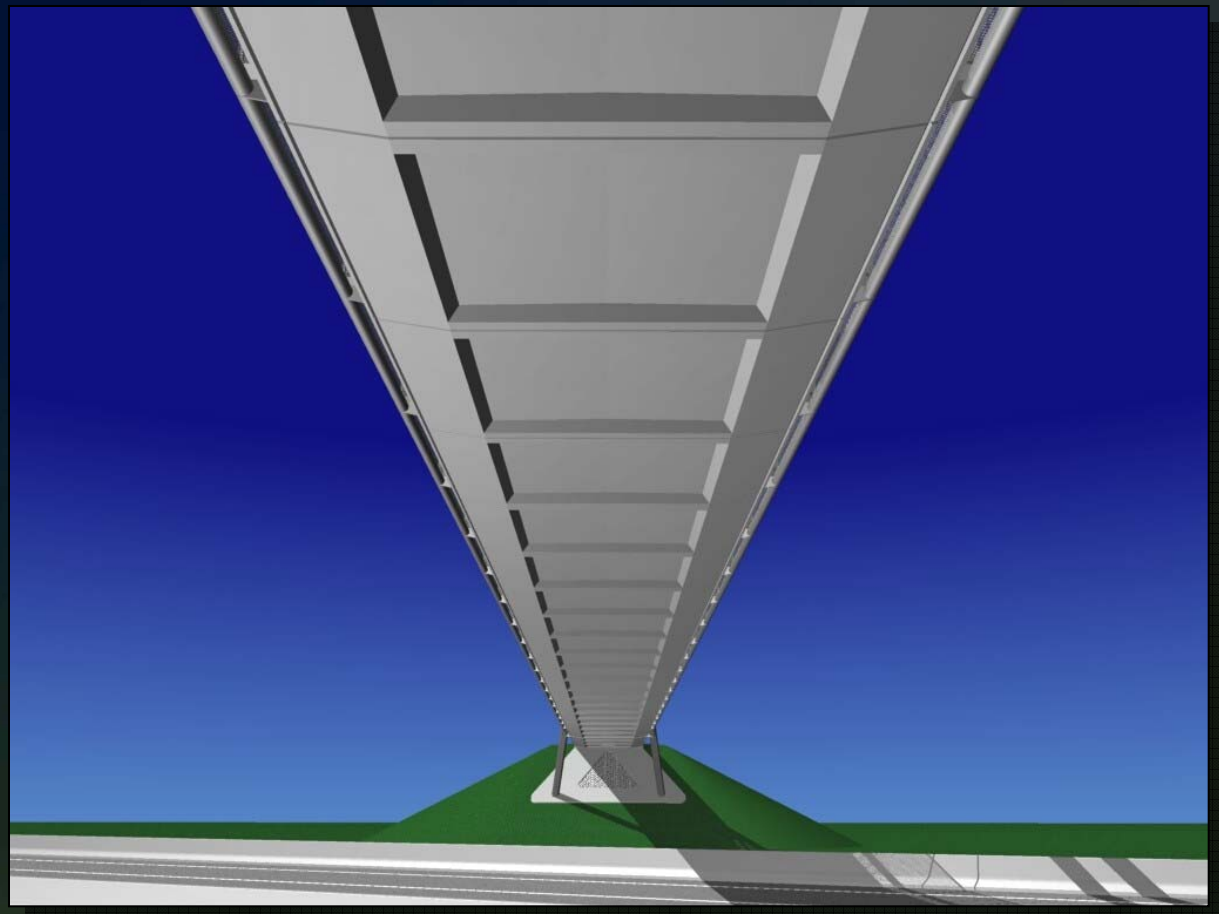
Conceptual Details



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

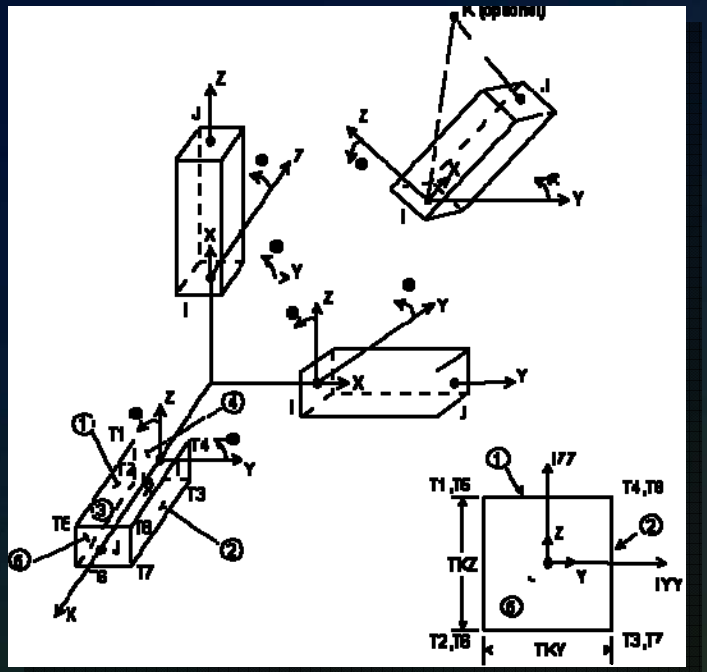
Conceptual Details

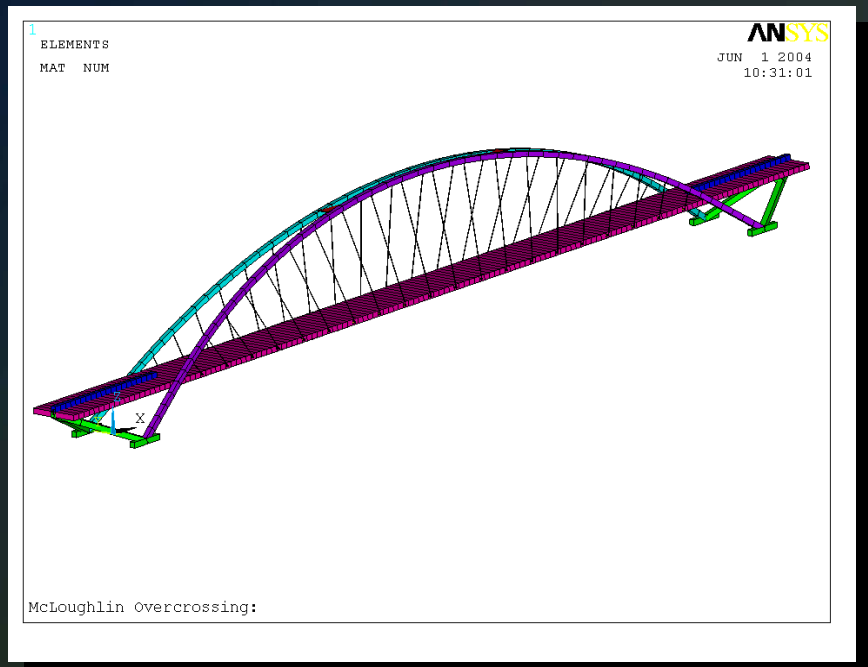


OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Model Development

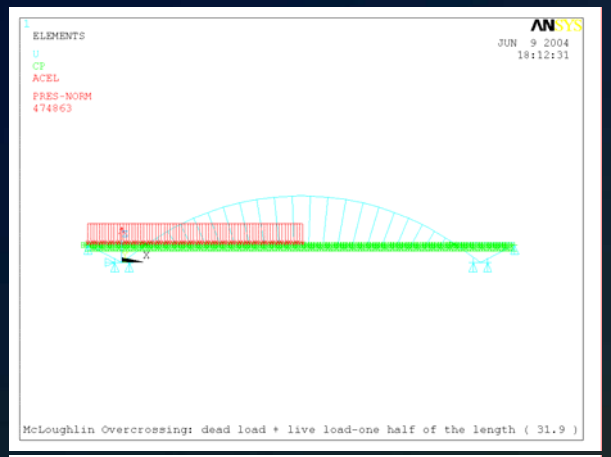


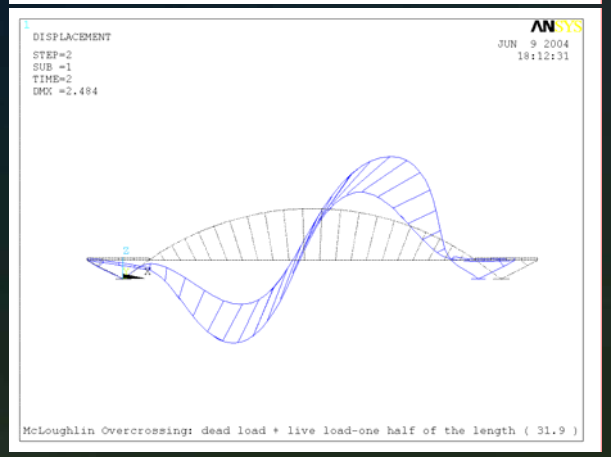


McLoughlin Boulevard Pedestrian Bridge

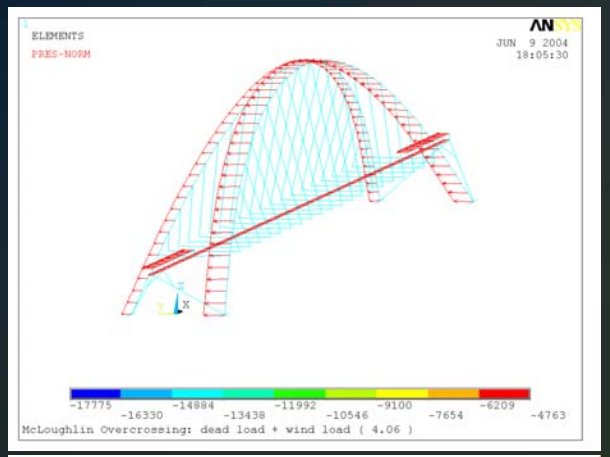
Verification of Member Sizes

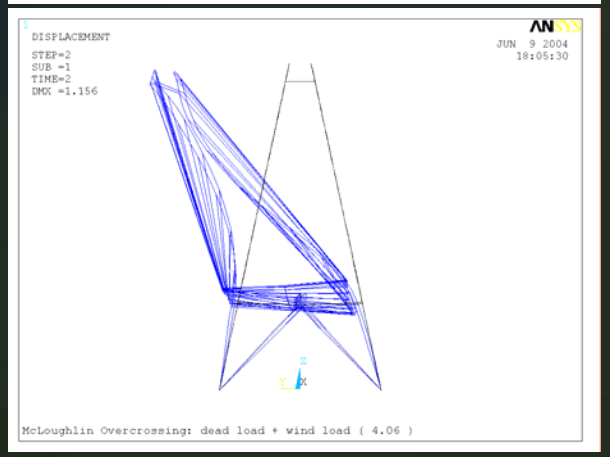
γ = 31.9 p





γ = 4.06 w



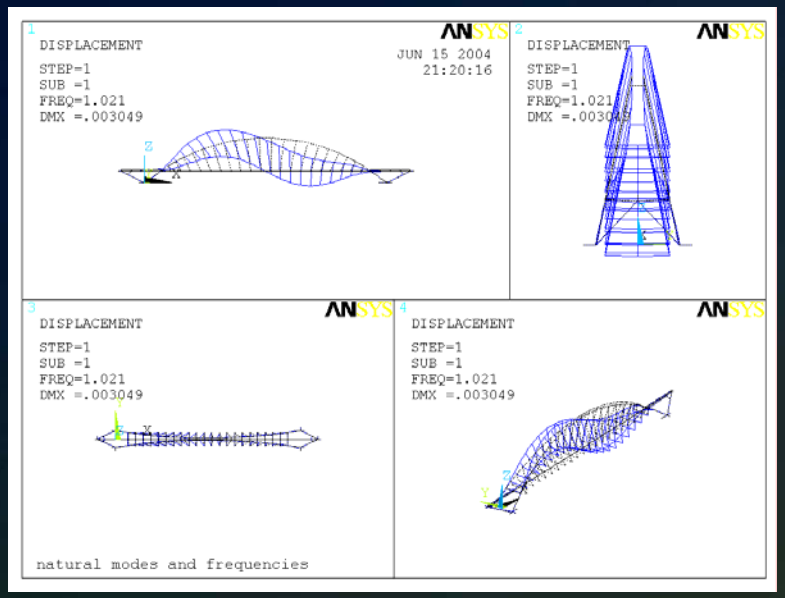


OBEC CONSULTING ENGINEERS

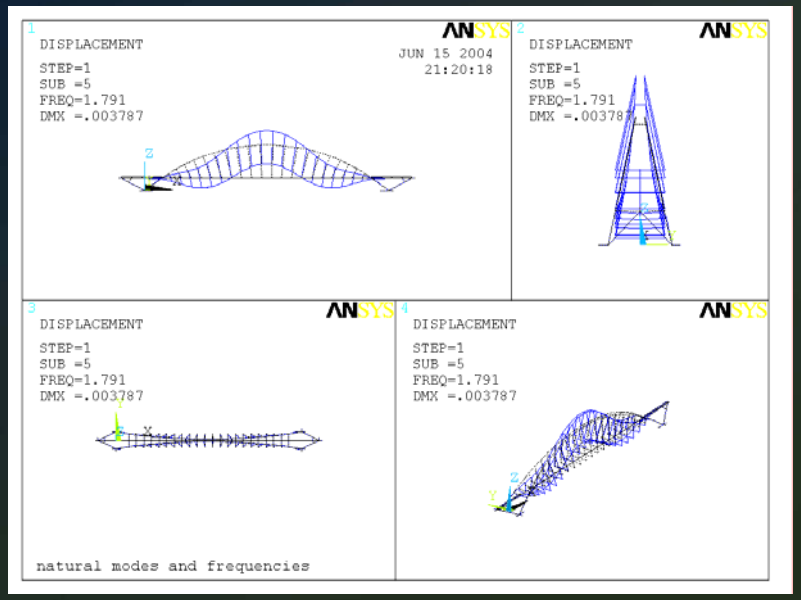
McLoughlin Boulevard Pedestrian Bridge

Verification of Seismic Performance

Mode 1 - f_1 = 1.021 Hz



Mode 5 - f_5 = 1.791 Hz



The maximum forced acceleration

$a = 0.104\ m/s^2$

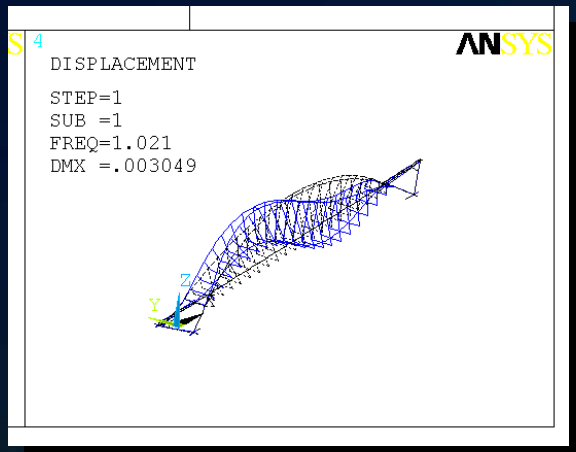
$f_0 = f_1 = 1.021$ Hz

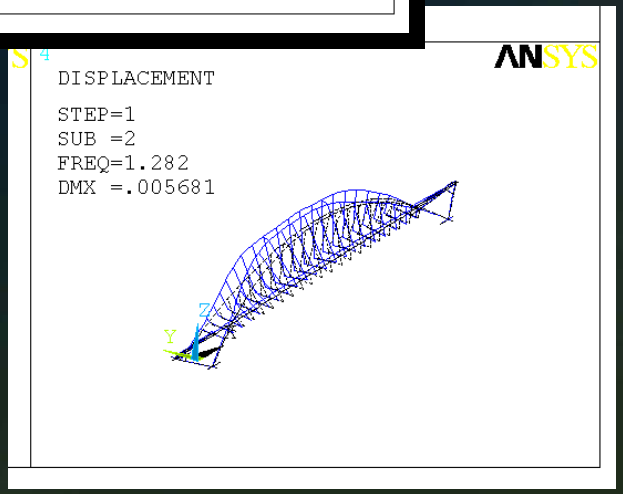
$a_{lim} = 0.5\ (1.021)^{1/2} = 0.505\ m/s^2$

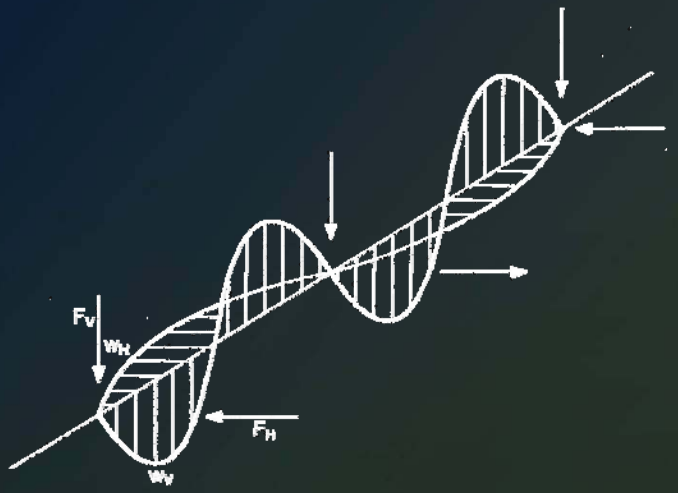
OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Verification of User Vibration







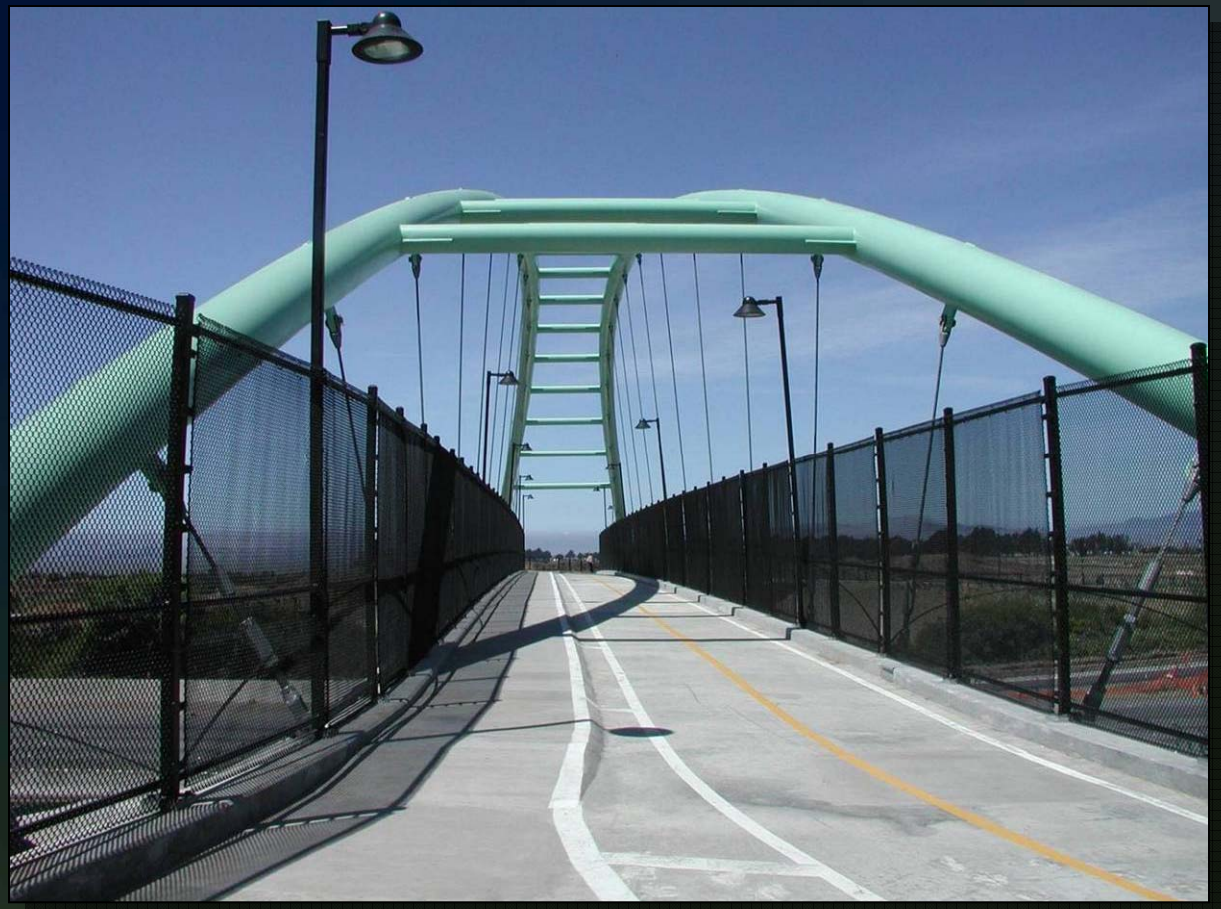
Vertical $f_V = f_1 = 1.021$ Hz

Horizontal $f_H = f_2 = 1.282$ Hz

$f_V = 1.021 \text{ Hz} < 2 f_H = 2.564 \text{ Hz}$

OBEC CONSULTING ENGINEERS

Fence Study – Ugly Fence



OBEC CONSULTING ENGINEERS

Fence Styles

Vertical Fence

Inclined Fence

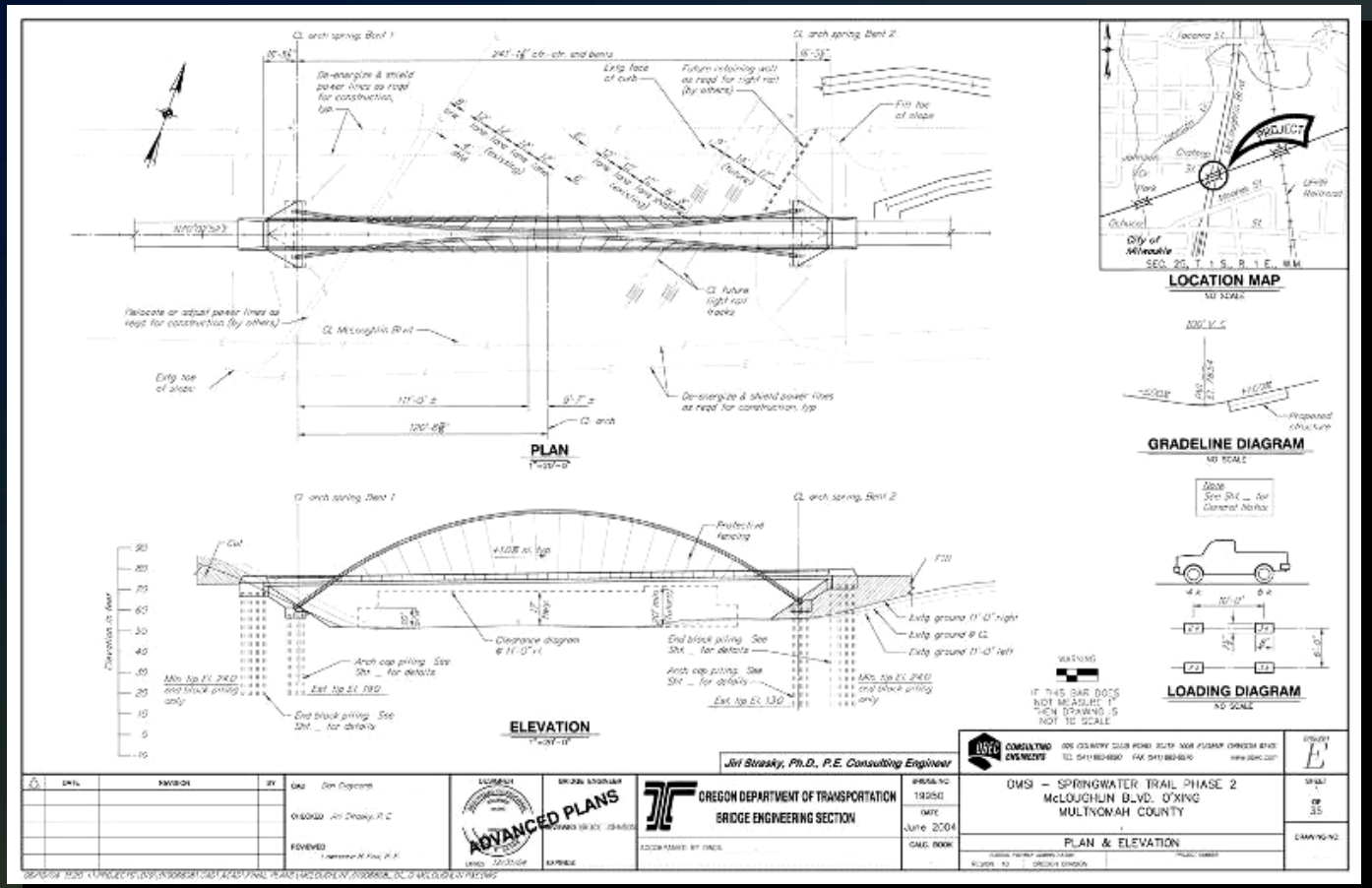
OBEC CONSULTING ENGINEERS

Colors Study

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Final Plans



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Precast Deck Panel Fabrication

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Precast Deck Panel

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes & Structural Steel

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes & Structural Steel

OBEC CONSULTING ENGINEERS

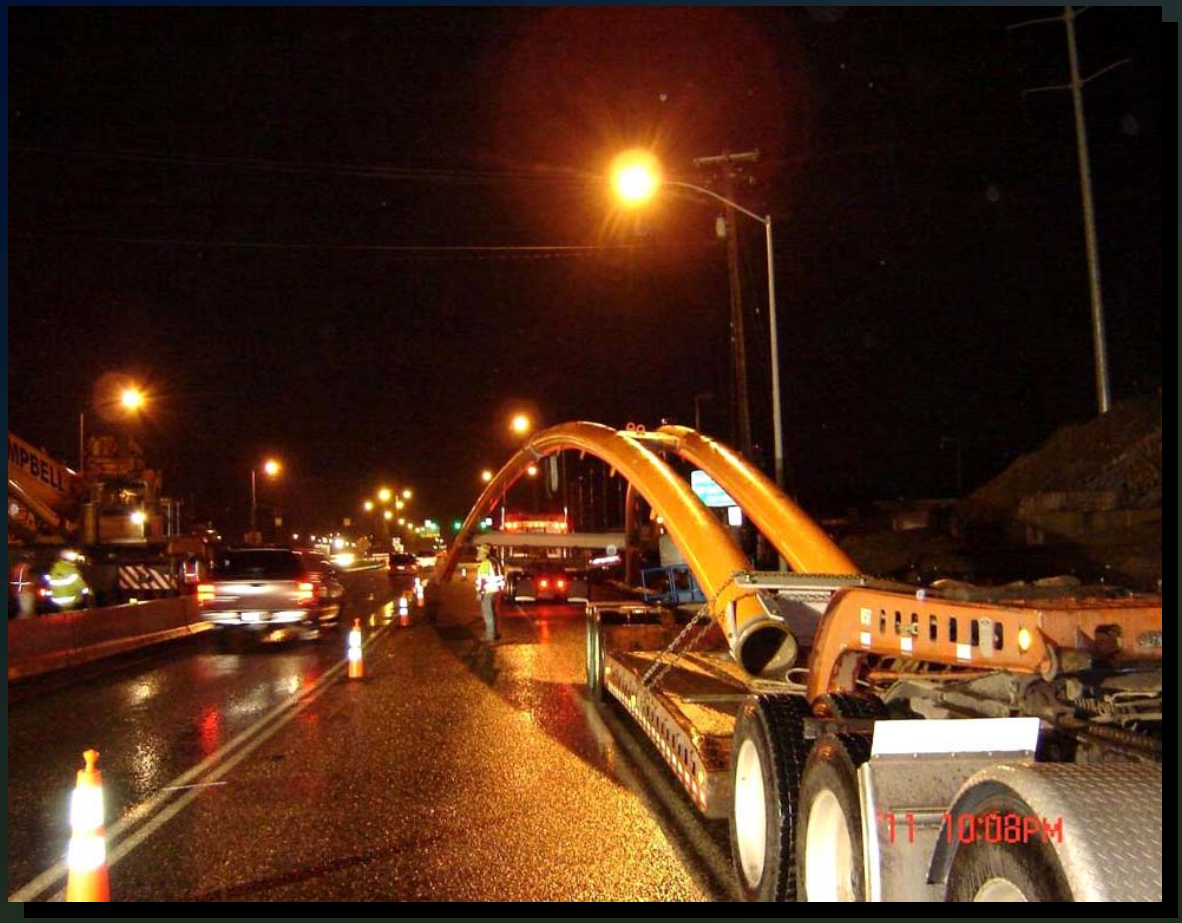
McLoughlin Boulevard Pedestrian Bridge

Arch Pipes & Structural Steel

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes at Site



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes Erection

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes in Place

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Arch Pipes in Place

OBEC CONSULTING ENGINEERS

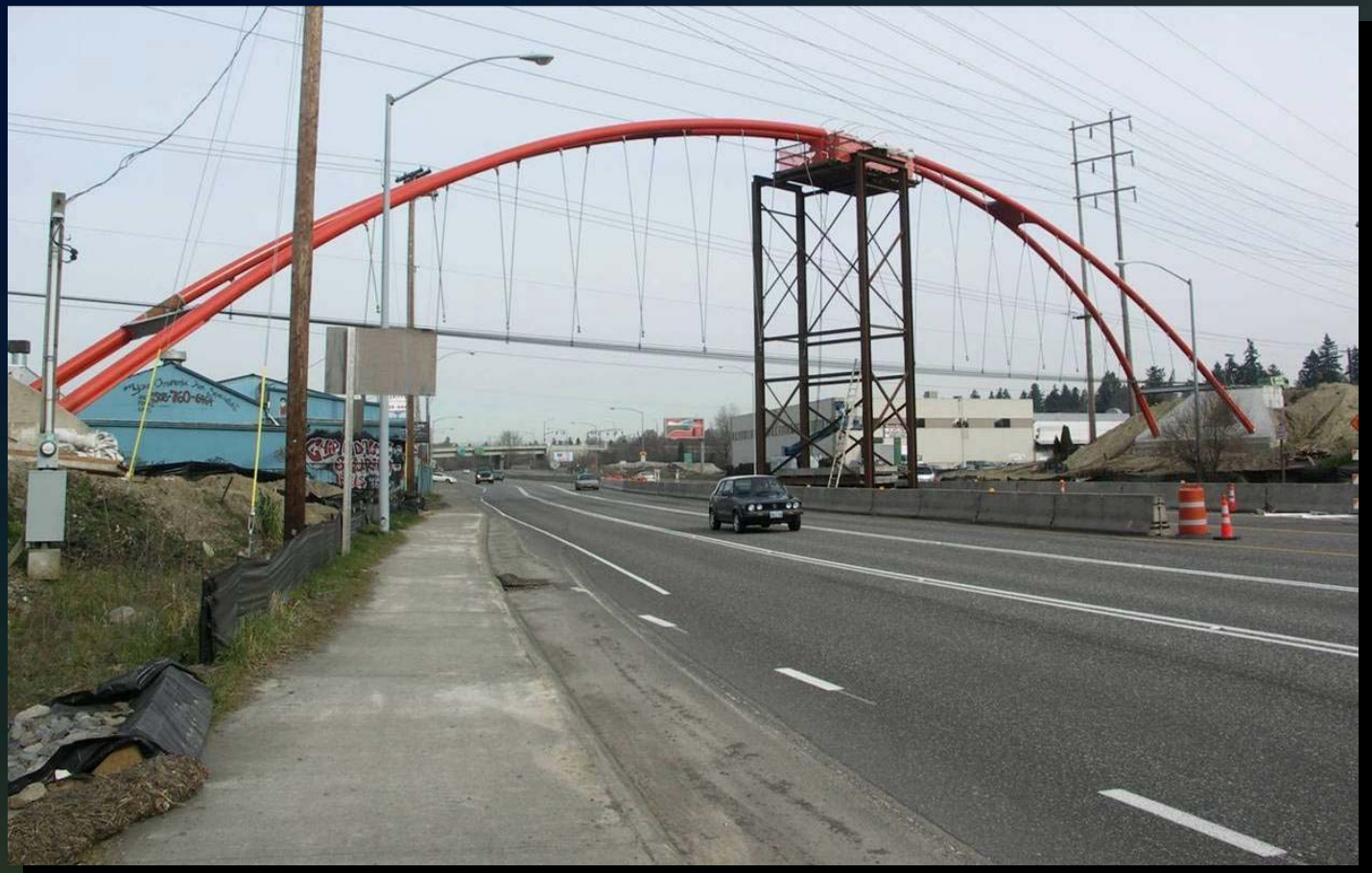
McLoughlin Boulevard Pedestrian Bridge

Arch Pipes End Bents

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Suspenders & Bearing Cables



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Panel Setting

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Panel Setting

OBEC CONSULTING ENGINEERS

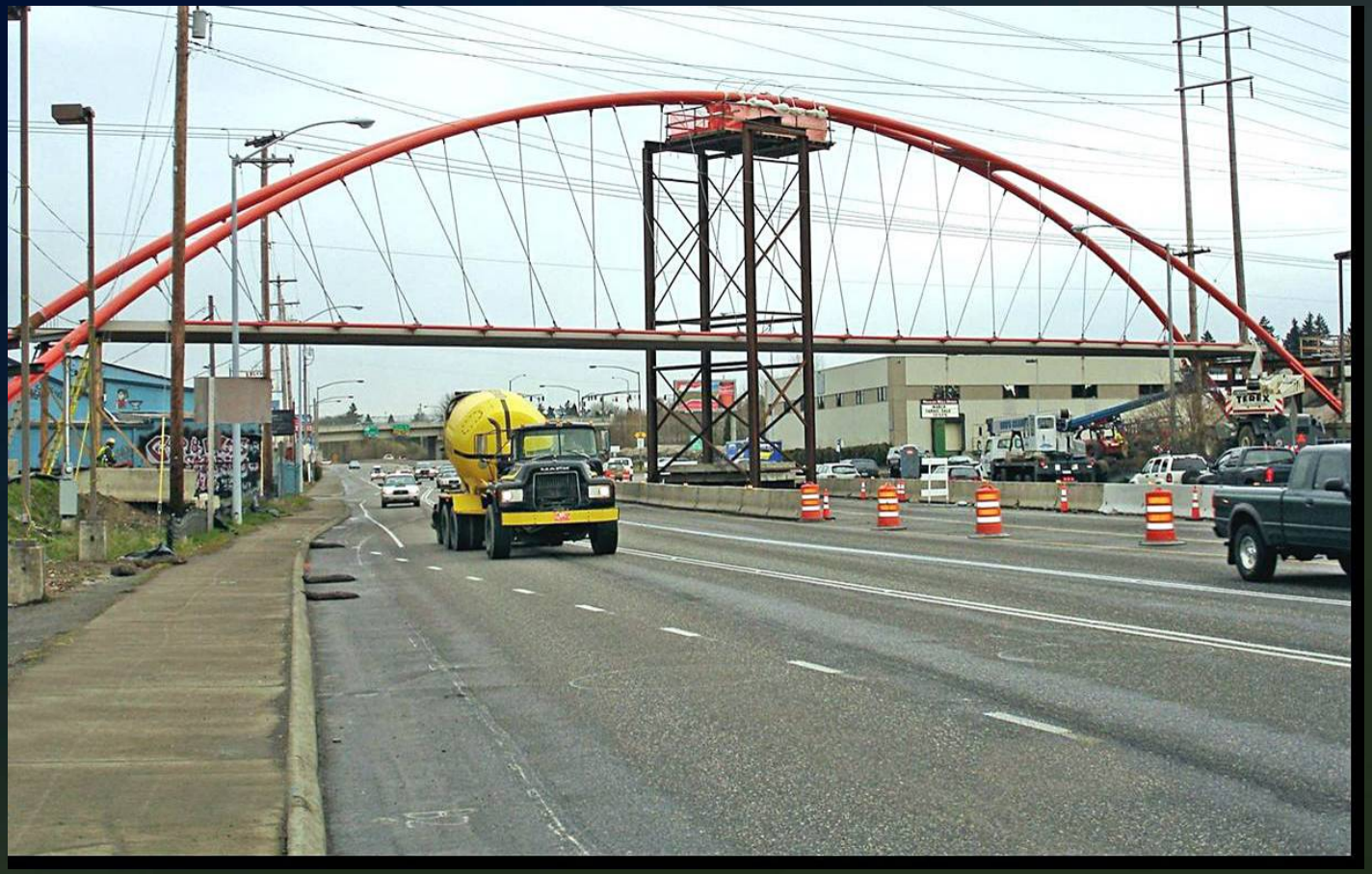
McLoughlin Boulevard Pedestrian Bridge

Panel Setting

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Panel Setting



OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Deck Pour

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Nearly Finished

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Finished Bridge

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Finished Bridge

OBEC CONSULTING ENGINEERS

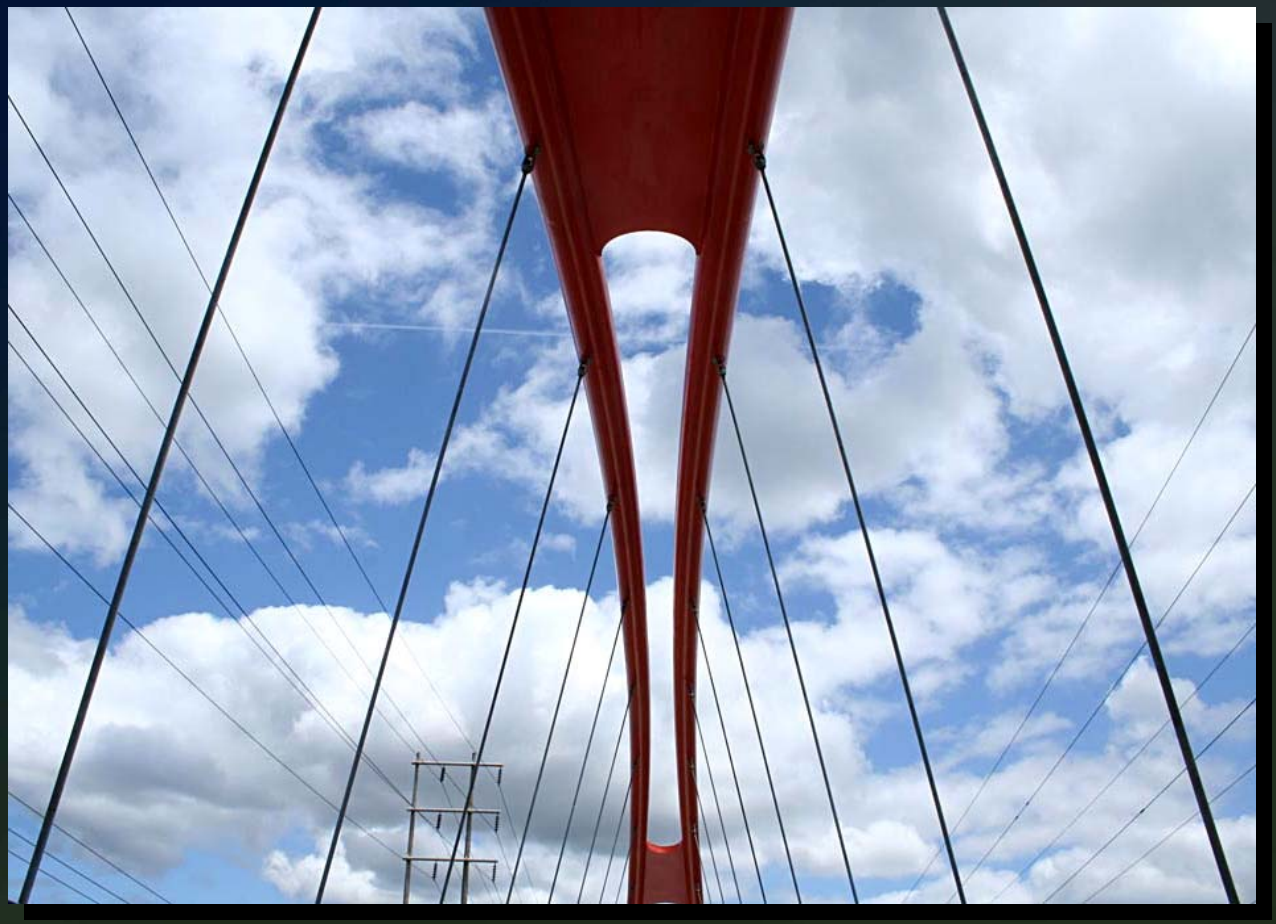
McLoughlin Boulevard Pedestrian Bridge

Finished Bridge

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Finished Bridge



OBEC CONSULTING ENGINEERS

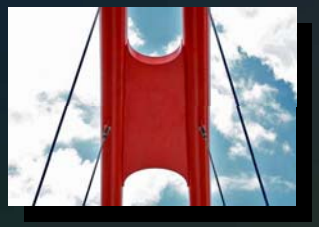
McLoughlin Boulevard Pedestrian Bridge

Finished Bridge

OBEC CONSULTING ENGINEERS

McLoughlin Boulevard Pedestrian Bridge

Questions



Western Bridge Engineers' Seminar

OBEC CONSULTING ENGINEERS