

Roadway Pavement Resiliency

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Roadway Pavement Resiliency

Why? The infrastructure between bridges and buildings is also important.

Goal: Explore the issues and best practices involved in pavement design, construction, and repair that will help ensure that repairs can be made quickly when emergencies arise.

Roadway Pavement Resiliency

What will we cover?

- Important fundamentals
- Case studies
- Best practices (what helped in the case studies)
- Areas for further work and research











Roadway Resiliency

- What type of roads do you have?



Roadway Resiliency

- Concrete Roadway Emergency Structural Repair
 - Initial repair will typically be asphalt pavement
 - Following initial repair will be permanent repair



Roadway Resiliency

- Asphalt Roadway Emergency Structural Repair
 - Initial repair will typically be asphalt pavement
 - Following initial repair *might* need permanent repair



Roadway Resiliency

Permanent Repair Construction Time Comparison

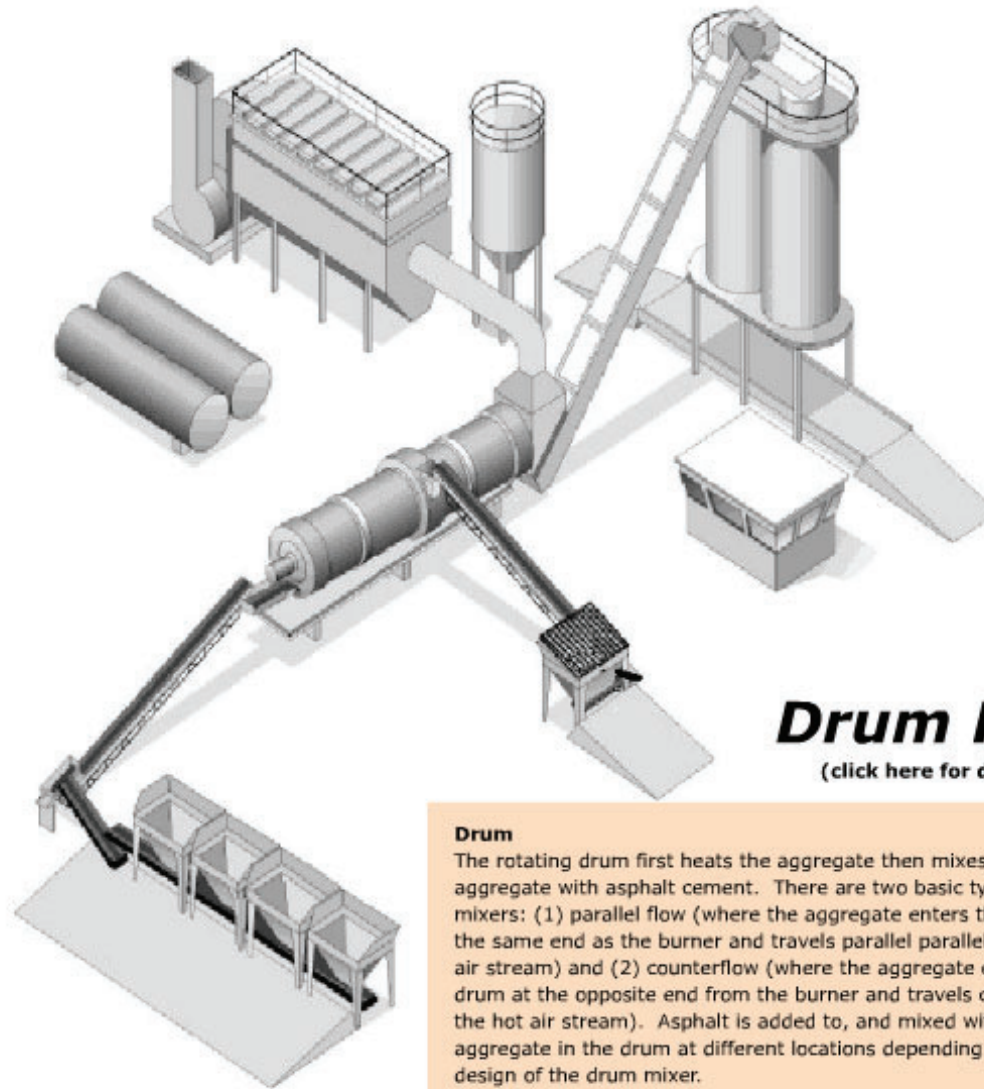
- **Concrete**
 - Rebar: 1,000 feet per shift per lane
 - Cure Time: 15 days +/- unless special cement/design used
- **Asphalt**
 - Emergency repair likely can be used as permanent repair
 - Paving speed typically 250 tons per hour per paver
 - No cure time

Roadway Resiliency

Permanent Repair Construction Time Comparison

12-foot lane at 6 inches in depth, 8-hour shift

- Asphalt: 4,600 feet, immediately open to traffic**



Drum Plant

(click here for directions)

Drum

The rotating drum first heats the aggregate then mixes the hot aggregate with asphalt cement. There are two basic types of drum mixers: (1) parallel flow (where the aggregate enters the drum at the same end as the burner and travels parallel to the hot air stream) and (2) counterflow (where the aggregate enters the drum at the opposite end from the burner and travels counter to the hot air stream). Asphalt is added to, and mixed with, the hot aggregate in the drum at different locations depending upon the design of the drum mixer.











Resiliency Issues for Asphalt Plants

Two Primary Types of Asphalt Plants

- Fixed “Commercial” Plants
- Portable Plants

Typical Age – not exactly new



Resiliency Issues for Asphalt Plants

Fuel for Asphalt Plants

- Natural Gas/Propane (Fixed Plants)
- Recycled Fuel Oil/Propane (Portable Plants)

Why does this matter?

- Some plants aren't set up for back-up fuel
- Most plants are permitted for 1 fuel type
- DEQ air quality regulations may be a problem

Also need electricity

Resiliency Issues for Asphalt Plants

If plant is working, need 2 ingredients

- Aggregates
- Asphalt Binder



Aggregates

- Typically readily available where there are fixed plants
- In rural areas, will need to waive testing requirements if there is an immediate need
- If there are no stockpiles, aggregates will need to be crushed or trucked or brought by rail



Asphalt Binder

- Availability likely not an issue during paving season
- In offseason, must address availability
 - Local pavers won't have any
 - Asphalt binder suppliers may have limited quantities (primarily in urban areas)
 - Trucking will likely be the only means of transport



Resiliency Issues for Asphalt Plants

Two of Oregon's Asphalt Binder Supplier Locations



Resiliency Issues for Repair Work

Trucks needed to haul mix from plant to road

- **Truck/driver shortage throughout Oregon**
- **Where are the trucks and drivers in your area?**
- **Trucks may be needed for debris disposal**
- **Anecdotal stories of exorbitant trucking costs**

Resiliency Issues for Repair Work

Paving equipment & crew

- Oregon pavers have a great record of responding to isolated emergencies, but no experience with widespread emergencies
- Crew expectations – has there been a conversation?
- Case studies show that paving crews will rise to the occasion once work starts

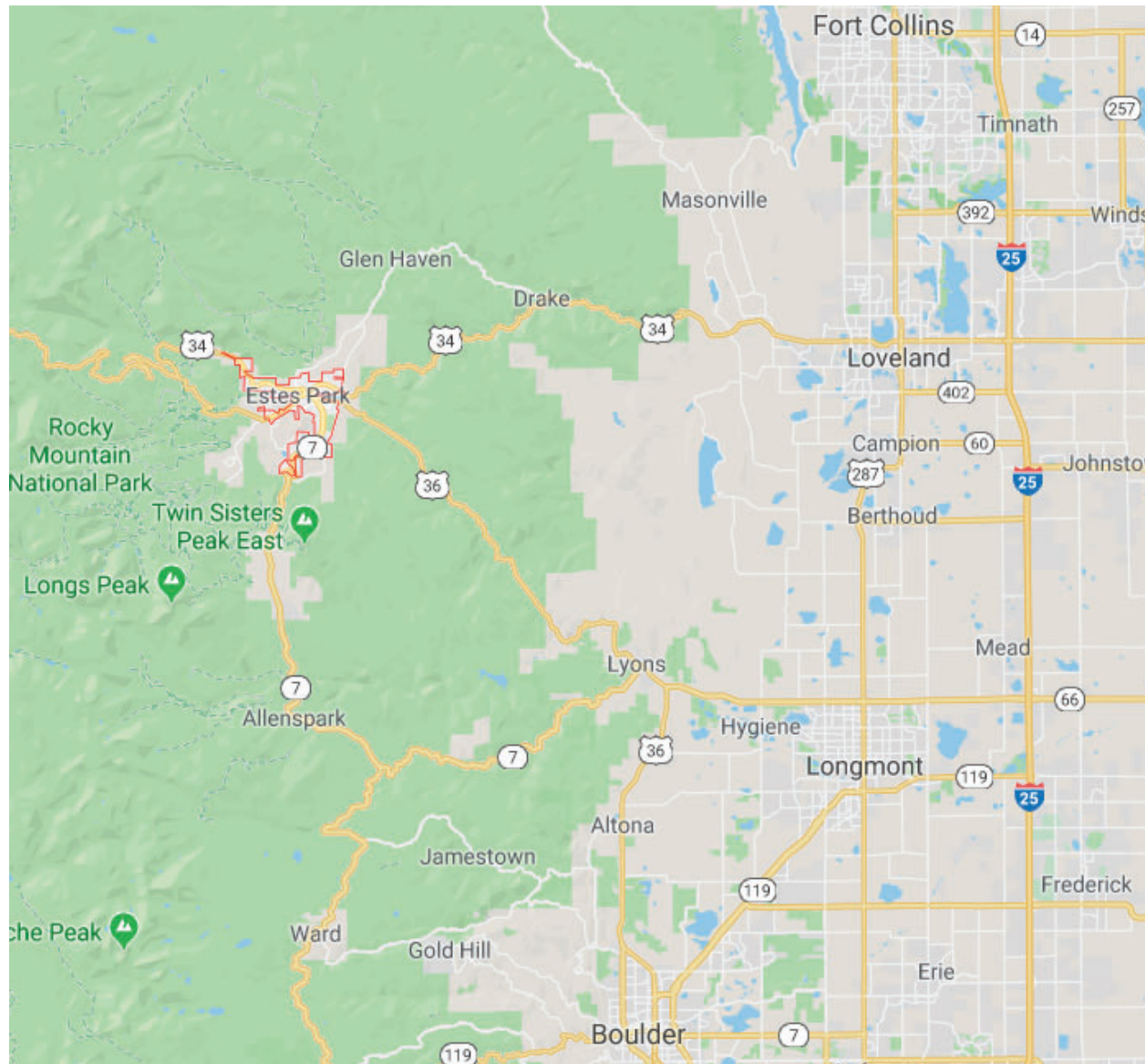
US 34, Colorado 2013



US 34, Colorado 2013

- 17 inches of rain in 4-5 days
- 100 miles of county roads lost
- 4 bridges destroyed
- Estes Park community cut off
- Fixed asphalt plants not working
- Multiple remote areas completely washed away
- No stockpiled aggregates or asphalt binder
- Cold temperatures





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US 34, Colorado 2013

- **CDOT emergency meeting with contractors**
- **Contractor proposals 2 days later**
- **Work was divided based on experience and resources**
- **CDOT partnered with contractors to solve problems
aggregates/binder/temperatures/technology**
- **Extra rock crushing equipment brought to site**
- **Warm mix technology enabled placement in cold temps
with a 3-hour haul**

US 34, Colorado 2013

- **Portable asphalt plant capability critical**
- **Most work performed on force account**
- **CDOT would make more use of bid items and photos in future**
- **Tendency to want to get everything back to normal right away, but need to prioritize routes ahead of time and communicate to contracting industry**

US 34, Colorado 2013, before and after



US 34, Colorado 2013

- **Retired CDOT Regional Director Johnny Olson:**

“Maintaining a partnership with industry is critical. It’s easy to get caught up on every day contract stuff with contractors trying to make money and owners enforcing the specs. You cannot lose sight of building a solid relationship. Without a solid relationship, things fall apart when the unexpected happens.”

Alaska Earthquake November 2018

7.0 earthquake severely damages 8 major Anchorage corridors





Alaska Earthquake November 2018

Alaska Earthquake November 2018



5 Days!

Alaska Earthquake November 2018

- **December in Alaska – temperatures big problem**
- **Alaska has practice in responding to earthquakes and severe weather events**
- **AKDOT has close relationships with local contractors**
- **DOT and contractor personnel know expectations**
- **Warm mix technology and extra rollers enabled placement in frigid temps**
- **All 8 corridors repaired in less than 5 days!**

California Earthquakes July 4 & 5, 2019

- Ridgecrest, CA (125 miles east of LA)
- **Back-to-back earthquakes (6.4 and 7.1) severely damaged SR 178**
- Emergency repairs done within hours
- **Permanent repairs done within 10 days**
- 100-degree weather, so no warm mix needed
- **Contractor and Caltrans worked together**



July 6, 2019

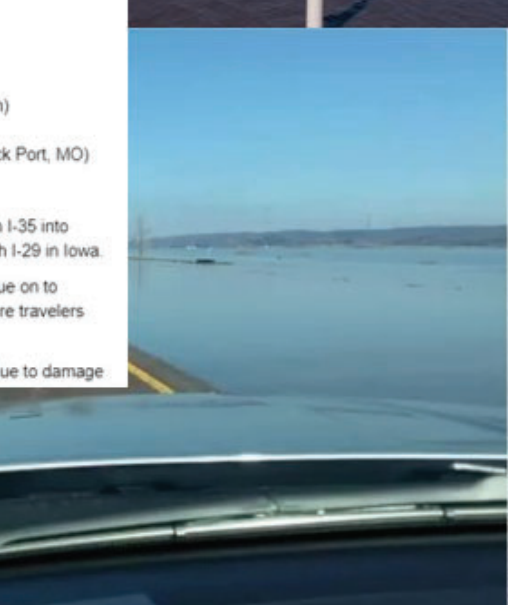

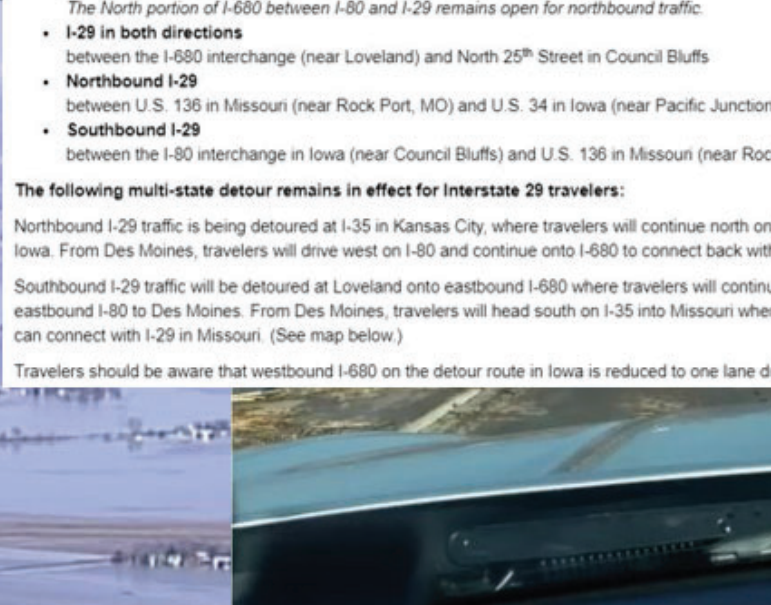





July 7, 2019



July 9, 2019

Iowa Flooding March & April 2019



IOWA DOT NEWS RELEASE

SEVERAL IOWA ROADS INCLUDING INTERSTATES 29 AND 680 REMAIN CLOSED DUE TO FLOODING

POSTED ON: MARCH 16, 2019

AMES, Iowa – March 16, 2019 – 10AM – Multiple flood closures remain in place for Interstates 29 and 680 as well as several surrounding roads and others throughout Iowa. Travel in Missouri and Nebraska is also being impacted by flooding.

Interstate closures include:

- **I-680 in both directions**
between the Nebraska border and I-29 near Crescent (Mormon Bridge)
The North portion of I-680 between I-80 and I-29 remains open for northbound traffic.
- **I-29 in both directions**
between the I-680 interchange (near Loveland) and North 25th Street in Council Bluffs
- **Northbound I-29**
between U.S. 136 in Missouri (near Rock Port, MO) and U.S. 34 in Iowa (near Pacific Junction)
- **Southbound I-29**
between the I-80 interchange in Iowa (near Council Bluffs) and U.S. 136 in Missouri (near Rock Port, MO)





The following multi-state detour remains in effect for Interstate 29 travelers:

Northbound I-29 traffic is being detoured at I-35 in Kansas City, where travelers will continue north on I-35 into Iowa. From Des Moines, travelers will drive west on I-80 and continue onto I-680 to connect back with I-29 in Iowa.

Southbound I-29 traffic will be detoured at Loveland onto eastbound I-680 where travelers will continue on to eastbound I-80 to Des Moines. From Des Moines, travelers will head south on I-35 into Missouri where travelers can connect with I-29 in Missouri. (See map below.)

Travelers should be aware that westbound I-680 on the detour route in Iowa is reduced to one lane due to damage

COURTESY - KHSB
AERIAL FOOTAGE ALONG



Iowa Flooding March & April 2019

- SW IA needs I-29 & I-680 (concrete highways pre-flood)
- March Missouri River flooding severely damaged both
- IA contacted a local contractor and I-680 was open 4 days later with new asphalt pavement
- IA engineer Dr. Scott Schram:

“You spend all those years building relationships with contractors, and when there is an emergency – they answer their phone when you need help. Even when you call them on a Friday afternoon. They bring their expertise to the problem.”

Iowa Flooding March & April 2019

- I-29 major freight corridor, damaged worse than I-680
- I-29 closure cost to SW IA: \$200,000/day
- Plans prepared and proposals received within 10 days



Iowa Flooding March & April 2019

- Asphalt pavement used instead of concrete for rebuilding because of cost and speed of construction (resiliency attributes)
- Portable asphalt plants used
- Trucking was challenging because debris clean up and rail work
- IDOT included significant early completion incentives



Florida Hurricanes

- Debris removal effort bigger than ever anticipated
- Trucks might be unavailable if hauling debris
- Lack of contracting plan delayed permanent repairs



Case Studies – Key Takeaways

- **Contractor relationships crucial (all)**
- **Relationships result in solutions (all)**
- **Contractor ingenuity invaluable (all)**
- **Paving crews rise to the occasion (all)**
- **Warm mix technology important tool (CO, AK, IA)**
- **Force Account work necessary, but assess bid items as quickly as possible and connect photos to work items (CO)**

Case Studies – Key Takeaways

- **Prioritize & communicate ahead of time (CO)**
- **Portable equipment important tool (CO, IA, CA)**
- **Repair time decreased with planning/practice (AK)**
- **Know trucking & contractor capacity (IA, FL)**
- **Asphalt pavement fastest to construct and lower initial cost (CO, IA)**

Case Studies – Key Takeaways

- **Contracting – pricing agreements?**

Permanent Repairs

- **Prioritize & communicate ahead of time**
- **Strong base materials important**
- **Widen shoulders in high priority and/or high risk areas – future equipment access**
- **Lower initial cost important where risk is high and growing (design as if you will need to replace)**

Roadway Pavement Resiliency

Resiliency Includes Climate Change Issues

- Increasing weather extremes may necessitate changing roadway design
- Rising groundwater increases risks of base failures
- Build to withstand the worst or build assuming will replace?
- Quantifying risks and cost over lifecycle tricky

Roadway Pavement Resiliency

FHWA Synthesis

