



PART TWO

**Regulatory Approval of
Keyhole Coring and Reinstatement
Process**

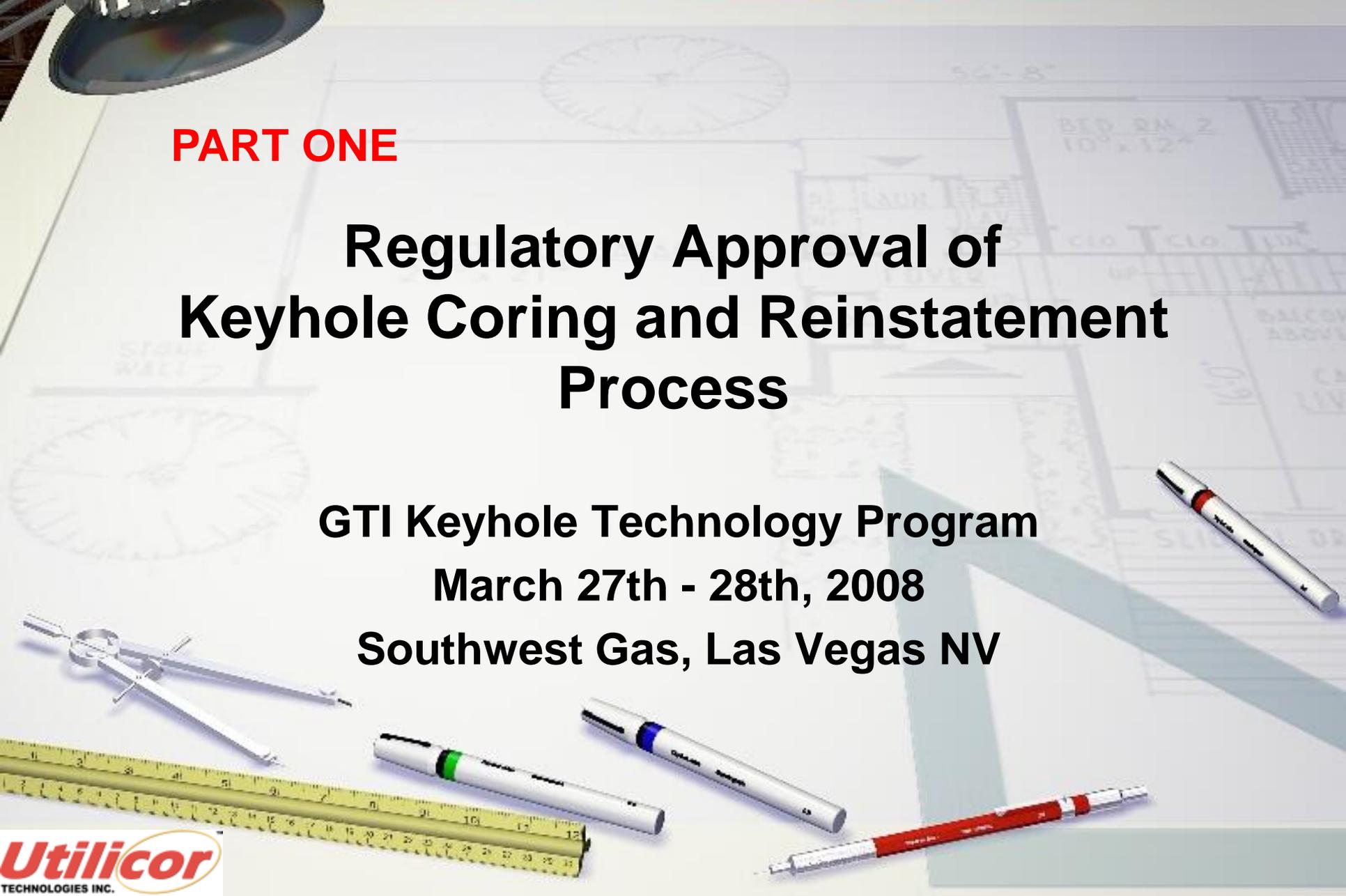
Tools to Push Back With

**GTI Keyhole Technology Program
November 13th – 14th, 2013**

National Grid, Worcester, MA



PART ONE



**Regulatory Approval of
Keyhole Coring and Reinstatement
Process**

**GTI Keyhole Technology Program
March 27th - 28th, 2008
Southwest Gas, Las Vegas NV**



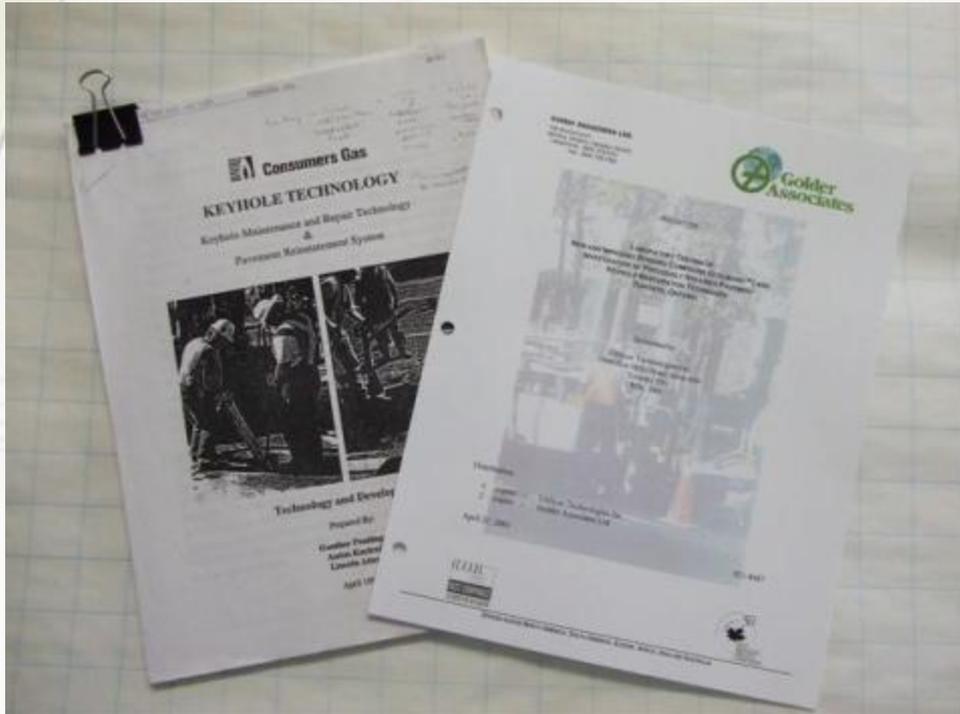


PART ONE

Outline

- In the beginning ...
 - Evolution of Coring Units **1988-2013**
 - Proof of Process: Golder Report **10 Year Study**
 - Evolution and Testing of Bonding Compounds **Independent Testing**
 - Different Approaches:
 1. *Show and Tell (demonstrations and test data)*
 2. *Just Do It! (and guarantee performance)*
 3. *Pilot Project (monitor limited program)*
 - Towards a Standard
 - AASHTO H-25
 - Types of Approvals:
 1. *Unwritten -- Go Ahead!*
 2. *Approve Specific Process or Method*
 3. *Approve Pilot Project*
 4. *General Approval*
 5. *Specification and Standards*
 - Toronto Standard
- Golder 1992-2002
 - GTI Bond Testing 2003
 - GTI “No Bottom” 2003
 - University of Illinois 2003
 - USACE & NRC 2004
 - Penn DOT (Core-Bore) 2004
 - CTL for IDOT 2009
- ### Development of Standards
- Toronto 2007
 - Montgomery Cty, MD 2009
 - MAG (Phoenix, AZ) 2010
 - Las Vegas, NV 2011

Proof of Process



- **Golder Associates:** 10 year Engineering study (1992-2002):
- *“Based on trials carried out at our testing laboratory and our in-field performance observations, we are satisfied that the equipment, procedures and materials developed and used by Enbridge Gas Distribution over the last 10 years will ensure satisfactory long term performance of the pavement reinstatement.”*

Golder Associates Engineering Reports 1996 and 2003

Metro Toronto Requirements

TRANSPORTATION DEPARTMENT



Metropolitan Toronto Requirements of Permanent Pavement Restoration

Load Transfer: Reinstated core must effectively transfer traffic loads from patched area to undisturbed pavement.

No Voids: The proposed system would have to effectively fill any voids beneath the slab that may have been produced during the repair of the service

Waterproof: Bonded joint needs to be impervious to ground water penetration.

Strong and Fast: Bonded joint must be strong (exceed AASHTO) and have fast-strength gain to minimize road closure time.

Simple Process: Procedure uses readily available materials of known quality and a non-hazardous nature.

Replicable: Consistent process quality. Easily and reliably replicated by typical work crews.

Results must be permanent and capable of performance through repeated freeze-thaw cycles.

Utility responsible to repair failures.

Unshrinkable Fill Material: All utility cuts are required to be backfilled with Unshrinkable Fill Material. There may be exemptions to this requirement, whereby the applicant has been permitted to use Granular Fill.

W.J. Mason, P.Eng.
Maintenance Engineer

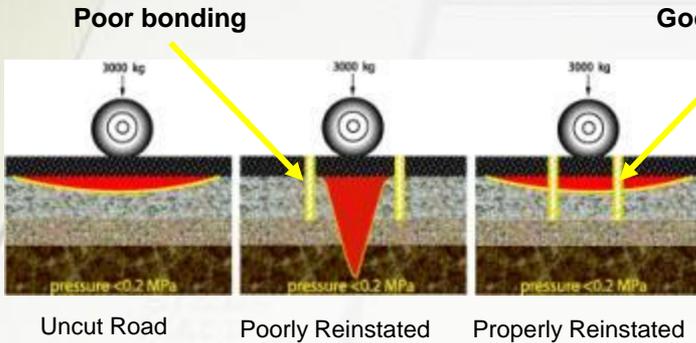
1992



- ✓ **Transfers Load across**
- ✓ **joint**
- ✓ **Fills all voids**
- ✓ **Waterproof -- low**
- ✓ **shrink**
- ✓ **Strong and Fast Bond**
- ✓ **Simple, Non-hazardous**
- ✓ **Process**
- ✓ **Consistent &**
- ✓ **Repeatable thru' Freeze-Thaw**
- ✓ **Cycles**
- ✓ **Works with Unshrinkable & Granular**
- ✓ **Fills**

Regulatory Requirements

Golder Report Essentials



Uncut Road Poorly Reinstated Properly Reinstated

Effective Load Transfer



Sep. 1995



Dec. 2002

Long Term Performance through freeze-thaw cycles



**Mechanical Bond
No Voids**

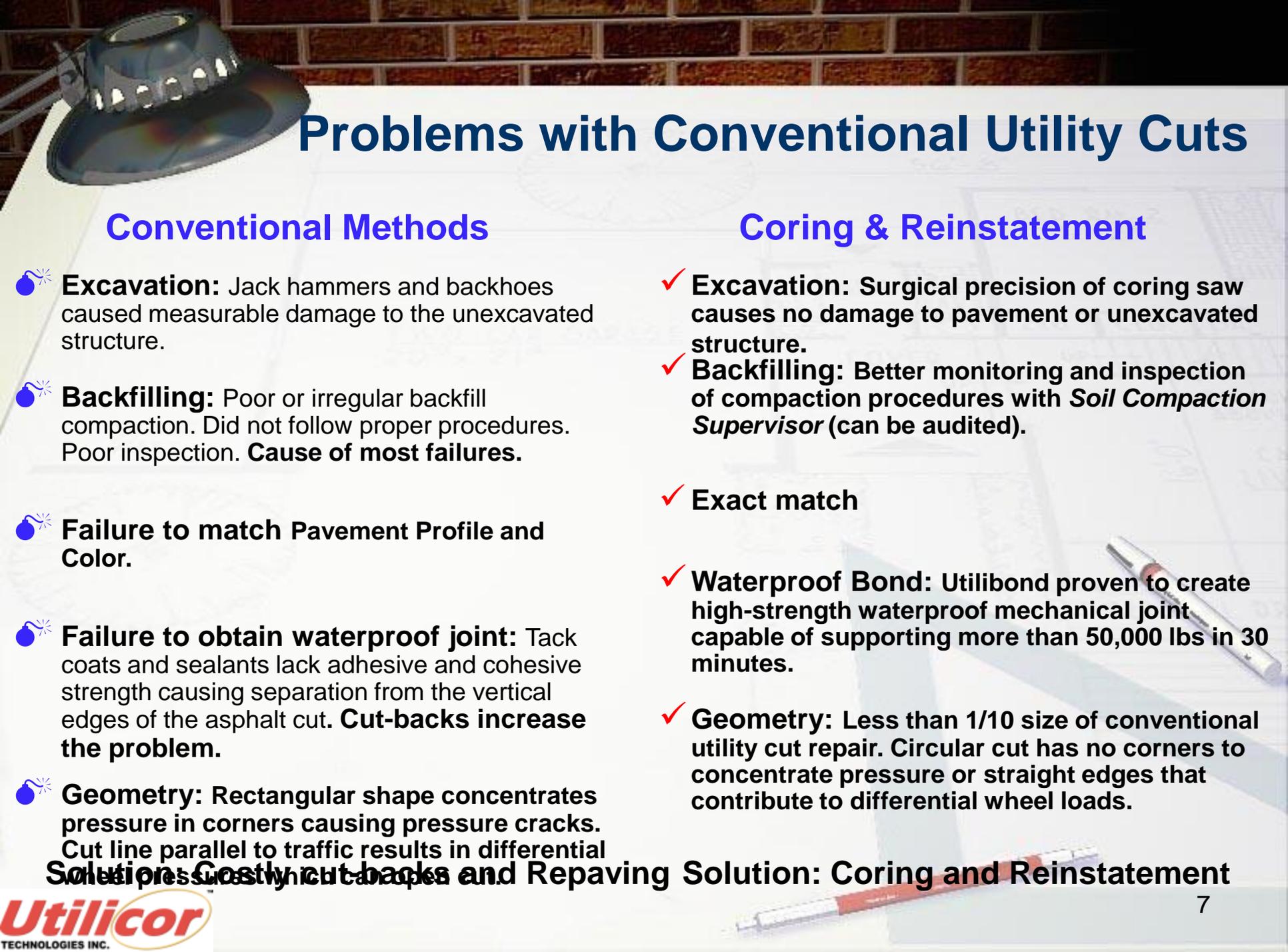


**Fast Setting, Rapid Strength Gain
Convenient, Consistent, Replicable**



Comprehensive Laboratory Testing





Problems with Conventional Utility Cuts

Conventional Methods

-  **Excavation:** Jack hammers and backhoes caused measurable damage to the unexcavated structure.
-  **Backfilling:** Poor or irregular backfill compaction. Did not follow proper procedures. Poor inspection. **Cause of most failures.**
-  **Failure to match Pavement Profile and Color.**
-  **Failure to obtain waterproof joint:** Tack coats and sealants lack adhesive and cohesive strength causing separation from the vertical edges of the asphalt cut. **Cut-backs increase the problem.**
-  **Geometry:** Rectangular shape concentrates pressure in corners causing pressure cracks. Cut line parallel to traffic results in differential settlements. **Costly cut-backs and Repaving**

Coring & Reinstatement

- ✓ **Excavation:** Surgical precision of coring saw causes no damage to pavement or unexcavated structure.
- ✓ **Backfilling:** Better monitoring and inspection of compaction procedures with *Soil Compaction Supervisor* (can be audited).
- ✓ **Exact match**
- ✓ **Waterproof Bond:** Utilibond proven to create high-strength waterproof mechanical joint capable of supporting more than 50,000 lbs in 30 minutes.
- ✓ **Geometry:** Less than 1/10 size of conventional utility cut repair. Circular cut has no corners to concentrate pressure or straight edges that contribute to differential wheel loads.

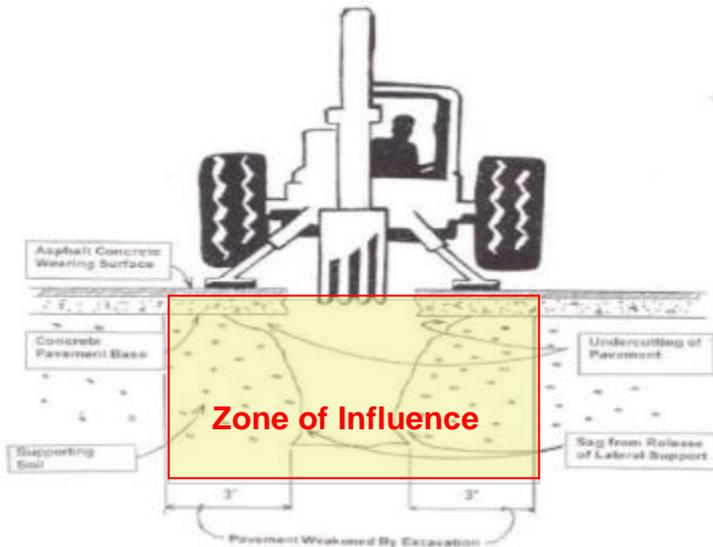
Solution: Costly cut-backs and Repaving Solution: Coring and Reinstatement



Coring & Reinstatement is Different

- 1. No Excavation Damage to Sub Base**
 - 2. Reinstates Pavement to Pre-Excavation Performance**
 - 3. Water-Proof Joint – Reduces Deterioration & Potholes**
 - 4. Circular – No Corner Pressure Cracks**
 - 5. Reduced Public Inconvenience**
 - 6. Better Aesthetics**
 - 7. More Environmentally Friendly**
 - 8. Documented Field and Laboratory Proven Process**
- 
- 

1. No Excavation Damage to Sub Base



Zone of influence is the area around the excavation that is susceptible to slippage or collapse resulting from external surface load, from vehicles, plant, or excavated material at or near the excavation.



The precise coring process when combined with vacuum excavation reduces loading adjacent to the excavation and **minimizes or eliminates any zone of influence.**

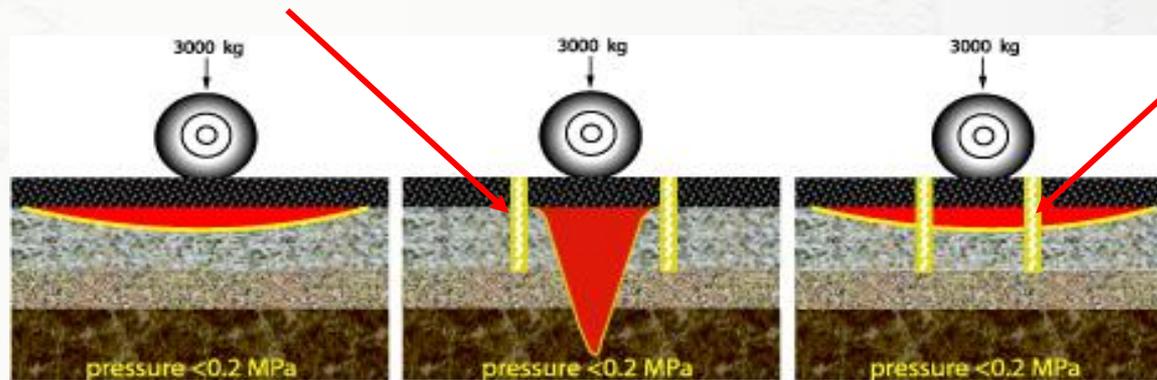
2. Reinstates Pavement to Pre-Excavation Performance

Restores Load Transfer Capacity to Repaired Roadway

- **Mechanical Joint:** Utilibond bonding compound creates a mechanical waterproof joint with the remaining pavement to restore its load transfer capability to what it was prior to the excavation.

Conventional Pavement Repair

Reinstated Core



Uncut Road

Conventional Repair

Bonded Core

Effective

Zero Load Transfer

Effective



3. Water-Proof Joint – Reduces Deterioration and NO Potholes



US Army Corps
of Engineers



National Research
Council Canada

Restoration of Utility Cut Study: Toronto Field Experiment
2001-03

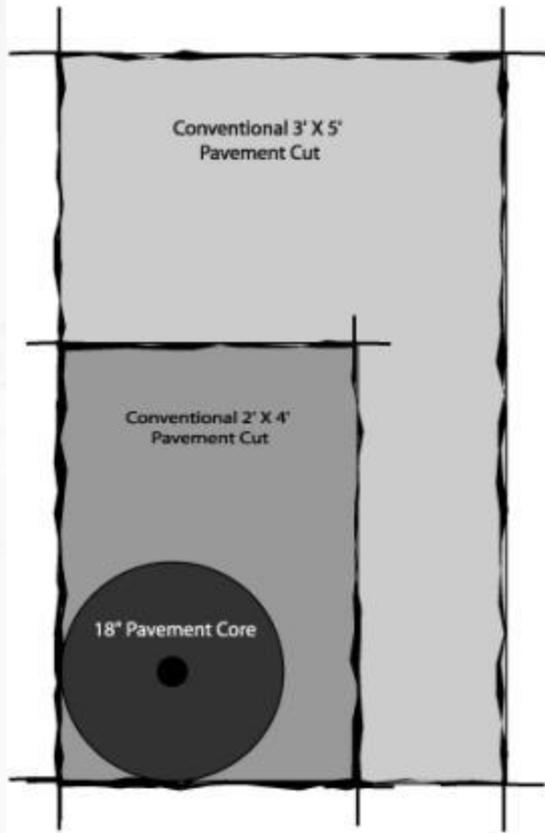
CONVENTIONAL TRENCH

- Noticeable failures in conventional cut.
- Joint between road and cut opened.
- Settlement in trench along wheel path
- Joint seal was lost because of traffic.
- **Higher levels of moisture (compared with keyhole).**

ROTARY CUT KEYHOLE

- No defects.
 - Performed well throughout life of project.
 - Core remained level with the road.
 - The bonding material remained intact
 - **Waterproof bond.**
- 

4. Circular – No Corner Pressure Cracks or Over-Cuts



**Waterproof
No Corner Cracks**

5. Reduced Public Inconvenience



- No noisy jack-hammers
- No dust or debris
- Fewer & Shorter Road Closings
- Reduced Traffic Congestion and Delay



6. Better Aesthetics

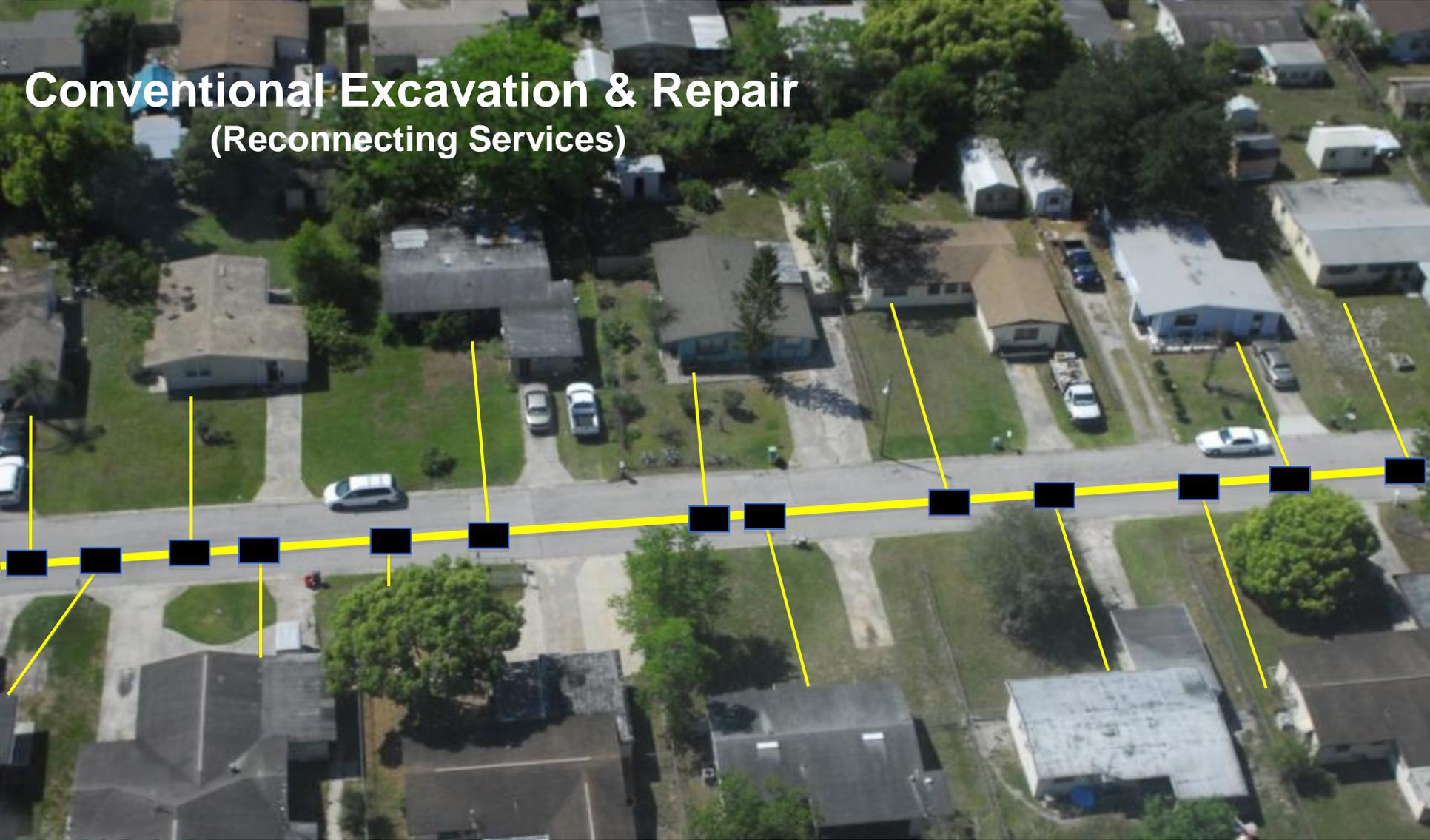
- Exact Pavement Match
- Almost Invisible
- Safer: Flush and Level
- 1/10 size of Conventional Cut
- Truly a Trenchless Alternative





Conventional Trenchless

Conventional Excavation & Repair
(Reconnecting Services)



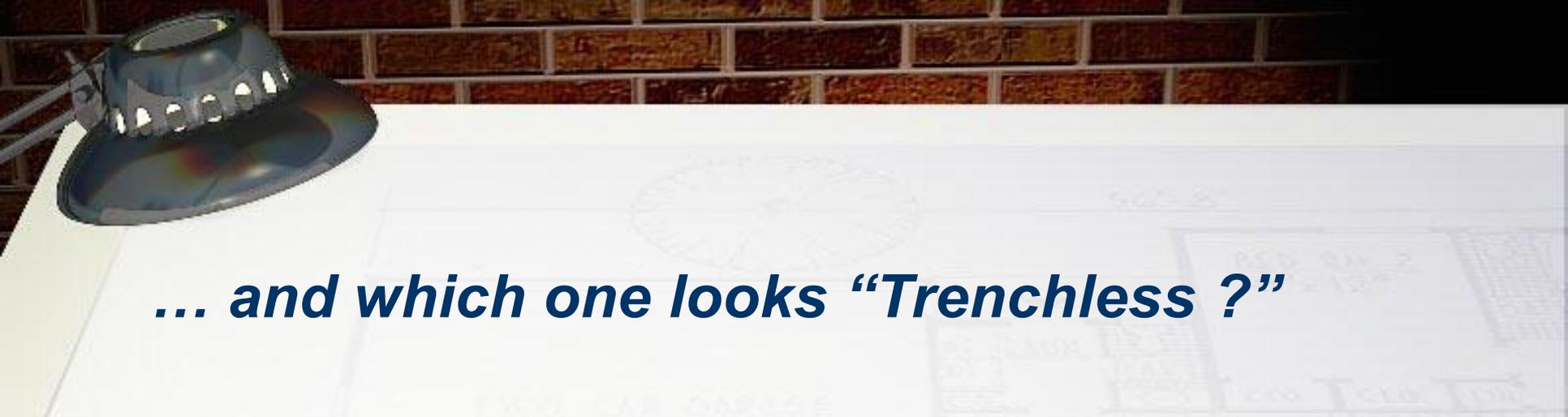


Keyhole Trenchless

Keyhole Technology
(Reconnecting Services)

Pavement Restoration Cost Savings
\$250,000 per mile of main

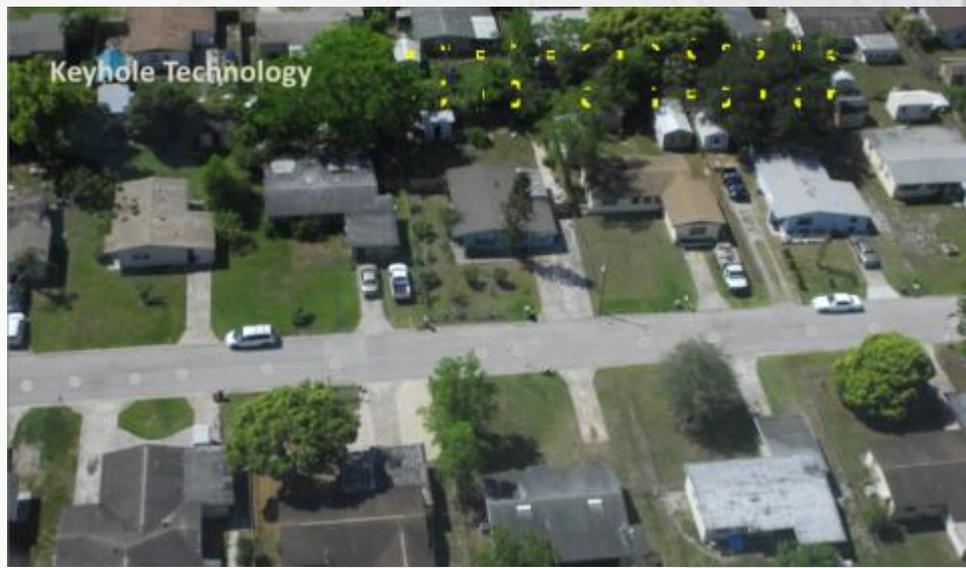




... and which one looks “Trenchless ?”



Conventional Excavation & Repair



Keyhole Technology



7. More Environmentally Friendly

Excavation

Restoration

1



Coring



Core



Vacuum

Same Day



Reinstate

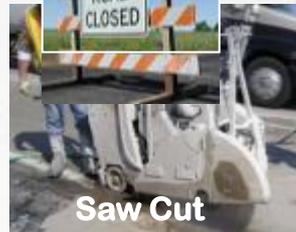


Finished Repair

1



Conventional



Saw Cut



Excavate Pavement



Dump Spoil



Vacuum



Temporary Asphalt Patch



Compact Patch

Months Later



2



Excavate Patch



Dump Spoil



Concrete Base



Asphalt Surface



Compact Surface

Advantages for the Environment



- **Environmentally Friendly.** No noisy and dusty pavement breaking machines. No temporary patching compounds with volatile organic compounds (VOCs) to escape into the atmosphere, and no wasteful T-section cutbacks needed.
- **Reduce, Reuse and Recycle.** No new asphalt or concrete paving materials required. No pavement spoil to be disposed of in dumps.
- **Reduced Carbon Footprint.** Less than 1/6 the amount of carbon emissions than from conventional pavement excavation and restoration. Only two pieces of mechanized equipment vs. up to 10 (5 x 2) for conventional method.
- **Fewer and Shorter Road Closings** result in less traffic disruption, and fuel wastage and increased pollution from idling engines.



Summary of Advantages for the Municipality and Public



- **Improved Appearance.** Neat, almost invisible 18-inch diameter, circular core (less than 1/10 the size of conventional road cut), means less scarring of the landscape and an exact pavement match.
- **Improved Pavement Performance Saves Tax Dollars .** Road restored to original design specification. No unsightly road cuts, sunken patches or weakened or failed roads. **No Potholes.**
- **Cleaner, Safer, Less Intrusive Worksite:** No jack-hammers or large excavation equipment means less noise and mess during and after excavation and reduced disruption for neighbors. No spoil trucked through city.
- **Fewer Complaints from Public.**
- **Reduced delay** and no unsightly road cuts or potholes.
- **Reduced Traffic Disruption** with fewer and shorter road closings and no repeat visits for

- **Improved Logistics:** Restoration can be completed even if no Asphalt plants in operation.

8. Documented Field & Laboratory Proven Process

- Golder Associates monitored the process for 10 Years: 1992-2002

Failure FREE !



Sep. 1995

Core Reinstated in 1995.
Small satellite cores cut through kerf.



Dec. 2002

Same core 7 years later in 2002.
Perfectly level and watertight.



Cuts through kerf showing mechanical bond and no voids



Documented Proof of Process

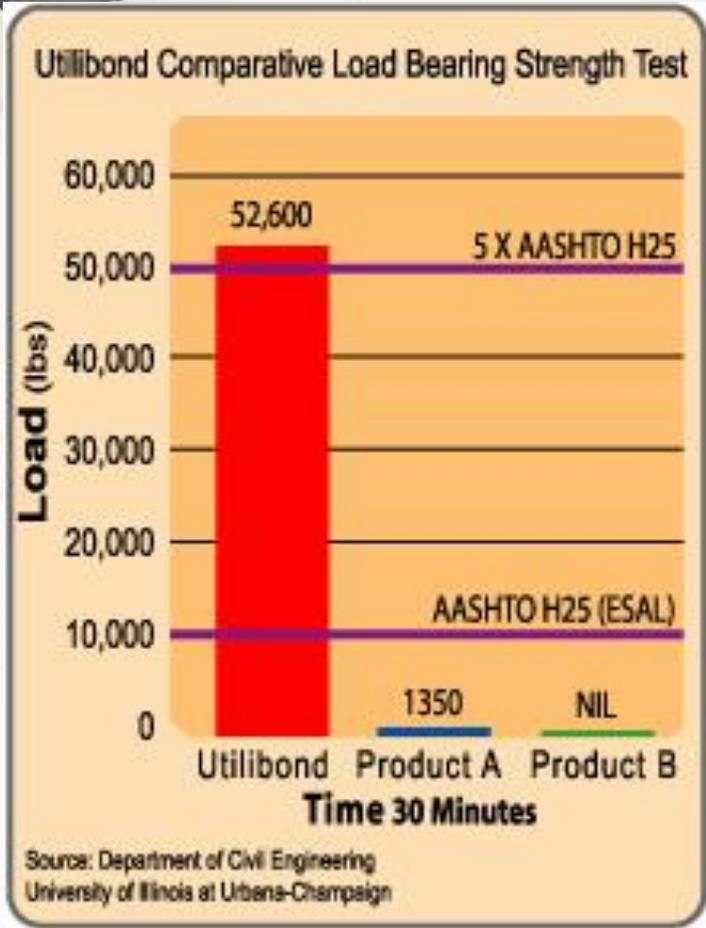
Independent Testing (Over 17 Years)

- Golder Associates 1992-2002
- GTI Bond Testing 2003
- University of Illinois 2003
- GTI “No Bottom” Test 2003
- US Army Corps of Engineers & NRC : “Utility Cut Study” 2004
- AASHTO Construction Testing Laboratory for IDOT 2009
- And more ...

Standards

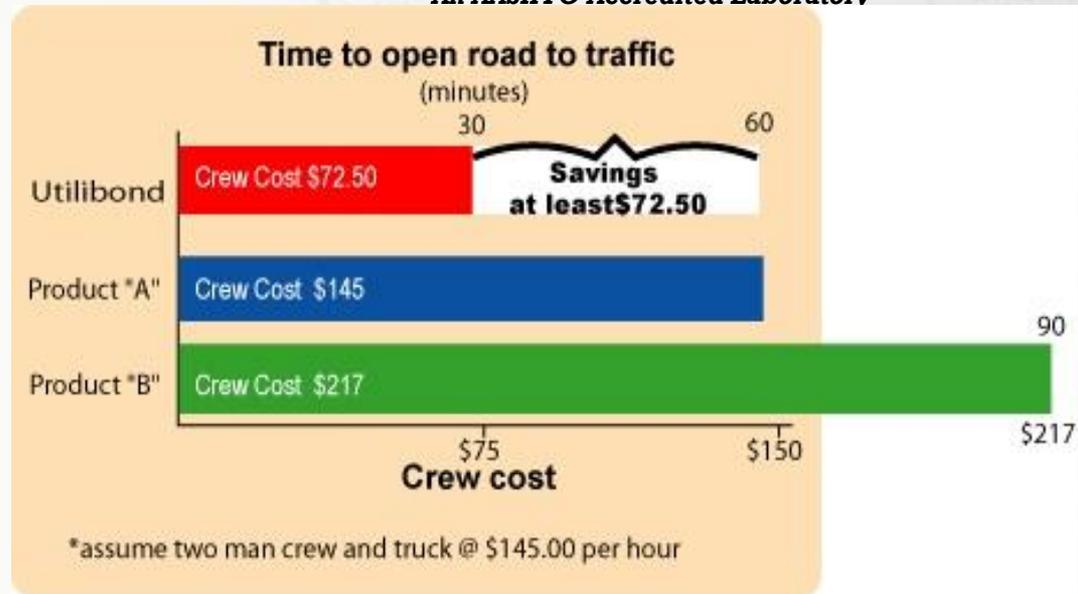
- Penn DOT (Core-Bore) Process 2004
- Toronto 2007
- Montgomery County, MD 2009
- MAG (Phoenix, AZ) 2010
- Las Vegas, NV 2011

Bond Strength



- Utilibond is the **ONLY** bonding compound that gains full strength in 30 minutes and is stronger than the pavement.

* Construction Technology Laboratories
An AASHTO Accredited Laboratory



University of Illinois
Urbana-Champaign

Time is money!

GTI "No Bottom" Trial



Core 8"



Vacuum down 6"



Suspend false bottom



Pour in Pea stone



Pour in Utilibond



Replace core



Loading machine



Wheel Track



10,000 lb Load



**43,378
Passes
Later ...**



Minor 3 mm deflection on exit edge

Subsequent investigation revealed that cause of torquing was likely due to lack of agitation during installation resulting in gaps or voids in

Discussion

