MASS INTERCHANGE

Volume 12, Number 1 Fall 1997

Covet your Culverts

Build Your Own Culvert Pipe End Reshaper

A common problem that restricts drainage in rural areas is the crushed ends of metal culvert pipes. Replacing the whole pipe just to eliminate the crushed end is expensive and a waste of taxpayer money. Yet anyone who has tried to fix them using a standard jack knows how ineffective that method is.

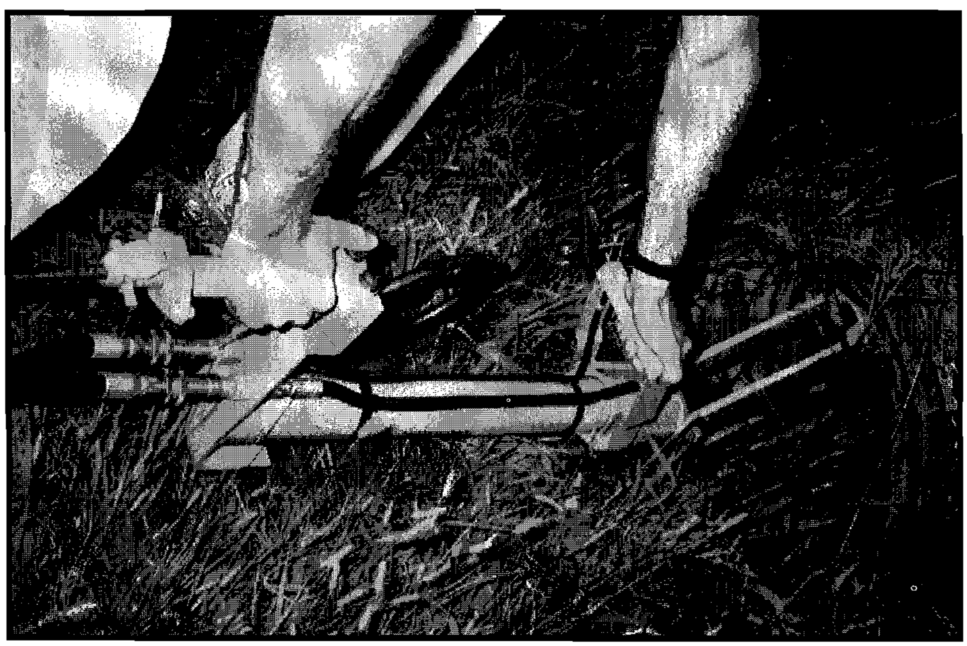
Shop Built Reshaper Does the Job

A great solution is this hydraulic reshaper, designed by Douglass Wright at The Center for Local Government Technology in Oklahoma. It was designed to be made from common off-the-shelf components with a minimum amount of machining and welding involved. Several have been built by people working in maintenance shops for around $270.

The collapsed jack is placed in the end of the crushed pipe. As the cylinder is retracted, the jack expands and the pipe is reshaped. According to Wright, this process takes about as long as it takes to read this paragraph.

A materials list and complete set of plans are available from Baystate Roads by calling (413) 545-2604 to request your set.

Reprinted with permission from Oklahoma LTAP Center from the Fall 1993 Oklahoma Local Government News.



This device was designed for use with a solenoid controlled, 12 or 24 volt, DC, hydraulic power unit.

Design, Monitoring, Evaluation & Repair of Culverts

An Ohio Department of Transportation study of durability problems with precast reinforced concrete box culverts resulted in the following recommendations:

1. External joint wrap should be required on the tops and sides of precast reinforced concrete box culvert joints. If full membrane waterproofing of the top is provided, it need only extend 1 foot down the sides of the culvert.

2. Surface sealer (either full membrane waterproofing or clear sealant) should be required on the external top slab of precast reinforced concrete box culverts, especially those with less than 3 feet of cover. The sealer should extend approximately 1 foot down the sides of the culvert.

3. A minimum cover of 1/2 inch over both circumferential and longitudinal reinforcement should be required at the mating surfaces of precast reinforced concrete box culvert joints.

4. Lift holes should not be permitted unless full membrane waterproofing is provided over the precast box sections or approved joint wrap material is applied over the lift hole.

5. Where guardrail posts must be mounted to the precast box culvert tops, through-bolting should not be permitted.

6. Additional joint material should not be placed in the inside of the joint on the top and sides of the box culvert.

7. The manufacturer's name and required product information should be placed on the inside of the precast box culvert section within the top half of the culvert.

Reprinted with permission from Oregon LTAP Center from the Fall 1993 issue of Oregon Roads newsletter and originally excerpted from an article on "Field Performance of Precast Reinforced Concrete Box Culverts" by John Owen Hurd, Ohio Department of Transportation, published in the Transportation Research Record 1315, Washington, DC, 1991.

Culvert Publications and Videos

Baystate Roads Library

VIDEO

MO-147
Cleaning of Lined Ditches, Culverts and Catch Basins

DC-110
The Importance of Roadway Drainage

ST-102
Safety Features for Local Roads & Streets, Part 1

PUBLICATION

DRA-07
Culvert Inspection Manual - Supplemental to the Bridge Inspector's Manual

DRA-18
Class Handout for a Course on Culvert Inspection

DRA-21
Concrete Culverts and Conduits

D&C-57
Culvert Design Aids

CDROM-6
Hydraulic Design of Highway Culverts - Version 1 (with user's manual)

MTAP
Culvert Design - An Engineering Training Course

Wayland Utilizes a Two-Paver Method...

Why didn't we think of this before?

Toma Duhani, Superintendent of the Highway Department, is now utilizing a two-paver method of laying asphalt in the Town of Wayland. This process, mainly used on primary arterial roads, paves the entire width of the road utilizing two pavers at once. This process eliminates cold joints and allows pavers to do the job correctly, utilizing ample time to pave and roll at the proper speed. The process also prohibits traffic prematurely on the road, thus ensuring quality and a long lasting road.

Trucks wait their turn at the paver.

An additional benefit, which made the town especially happy, is the cost-effectiveness of the process. By utilizing this method, the average 3-day job can be done in a single day, eliminating extra costs for police details and traffic control. This method is also beneficial to the contractor because he can place down a large volume in a single day. As he gets paid on a per ton basis, the method increases his productivity and lowers his costs.

Two pavers eliminate cold joints.

Review of some benefits with uitilization of the two-paver sytem for laying asphalt:

- Minimizes traffic distributions.
- Lowers traffic control costs.
- Increases quality of paving.
- Provides large area for queuing trucks which minimizes wait time for loading pavers.
- Increases construction productivity which may result in lower unit cost for the municipalities.

-Danielle Carriveau
(edited by Toma Duhani)

How Long Should the Culvert Be?

When you plan to replace a culvert, use the following formula to calculate how long a culvert to order:

$$L = (2 \times S \times D) + W$$

Length (L) of culvert = 2 times the Slope (S) times (D). Add the product to the Width (W) of the road including the shoulders.

For example:
S Slope (no. of feet horizontal run per one foot drop) is 4:1.
W Width (with shoulders) is 26 feet.
D Culvert depth (from shoulder edge to flow line of culvert) is 4 feet.

L= (2x4x4ft.)+ 26ft. L= 32ft.+ 26ft. or L= 58 ft.

--or--

for a slope of 4:1 (the minimum acceptable for safety without guardrails) use this table

Width of road at culvert location "W" (ft.)

16	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**Depth of culvert (ft.)**
40	42	44	46	48	50	52	54	**3**
48	50	52	54	56	58	60	62	**4**
56	58	60	62	64	66	68	70	**5**
64	66	68	70	72	74	76	78	**6**
72	74	76	78	80	82	84	86	**7**
80	82	84	86	88	90	92	94	**8**
88	90	92	94	96	98	100	102	**9**
96	98	100	102	104	106	108	110	**10**

The number where width and depth intersect indicates the length of the culvert.

Culvert Capacities

If a 15" diameter culvert is considered to have a capacity of 1, then other sizes have a relative capacity, as shown below:

12"	0.64
15"	1.00
18"	1.44
21"	1.96
24"	2.56
30"	4.00
36"	5.75
42"	7.83
48"	10.23
54"	12.95
60"	15.98

For example, a 24" pipe will carry *four times* the capacity of a 12" pipe.

Remember:
For the same type of pipe, CAPACITY QUADRUPLES each time the pipe DIAMETER DOUBLES.

Source: Georgia Roads, Georgia Technology Center, Spring 1993

Remove old culvert headwalls for safety

Many old-style culvert headwalls still exist on local roads. They are rigid and strong and could abruptly stop or roll a vehicle. Simply breaking them off at ground level will make them much safer. New culverts should be made so vehicles can run over them (traversable) by shaping the ground around the culvert.

For old headwalls remove the headwall and extend the culvert, or use a traversable opening such as a grate. To achieve a safe grade on the sideslope around the culvert, you may have to lengthen the culvert and fill around it. The culvert end slope should match the embankment slope.

If there will be no guardrail along the slope it should be no steeper than 4:1 which is considered nonrecoverable but transversable. This means the vehicle is not likely to overturn but most motorists will be unable to stop or return to the road easily. Ideally slopes should be flatter than 4:1 and without obstacles that can interfere with the vehicle such as trees or erosion.

This article was reprinted with permission from the Wisconsin LTAP Center.

Two 12" culverts must carry more than one 18"...Right?

As intuitive as this seems, it is wrong. In fact, it would take three12" concrete pipes to equal one 18" diameter culvert.

Here's the calculation:

$$Q = \frac{1.486/n\ D^{\frac{8}{3}}\ S^{\frac{1}{2}}}{n}$$

where:

Q= Flow in cubic feet per minute

n = roughness coefficient (assumed to be 0.010 for this calculation)

D = inside diameter of the pipe in feet

S = Slope of the pipe (assumed to be 2% for this case)

12" concrete culvert @ 2% slope, full flow

1 Pipe
$Q=6.55\ ft^3/min$

2 Pipes
$Q = 13.10\ ft^3/min$

3 Pipes
$Q = 19.65\ ft^3/min$

18" concrete culvert @ 2% slope, full flow

1 Pipe
$Q = 19.59\ ft^3/min$

Williamstown uses 60" HDPE pipe

PROJECT:
Forty feet of 60" annular corregated high density polyethylene pipe (HDPE) to replace 60" corroded "boiler shell" culvert under high traffic primary gravel road in Williamstown, MA.

CONDITIONS:
Trench installation with shallow burial depths of one to two feet. Stone bedding and backfill was placed immediately around pipe to springline. Processed gravel with recycled asphalt content used from springline to grade. Rammer-type compactors achieved Std. Proctor densities near ninety percent.

RESULT:
According to Fran Bush, Williamstown highway crew completed the HDPE pipe installation in one day, with traffic passing on the road by the end of the day. The town's maintenance shop constructed a 20' spreader to keep the lifting points 20" apart, and old headwalls were rammed out to prepare the bed for the HDPE pipe. The pipe was lifted by the town's JD 495 rubber tire excavator and set in the trench.

"We were pleased with the installation; this job went extrememely well with everyone working together. The road supports heavy farm traffic and also high vehicular loading for a gravel road."

-Fran Bush

Our thanks to Fran Bush, Highway and Landfill Superintendent for Town of Williamstown and Frank Mailhot, formerly of Hancor. If you would like a copy of the complete article on this installation, please contact Baystate Roads Program.

CALENDAR

TRAFFIC SIGNALS

November 25, 1997	Hotel Northampton, Northampton
December 11, 1997	Holiday Inn, Taunton
January 15, 1998	Nichols College, Southborough

SNOW AND ICE

October 31, 1997	Hotel Northampton, Northampton
November 19, 1997	Holiday Inn, Taunton
November 20, 1997	Wyndham Garden, Burlington

STORMWATER MANAGEMENT

December 9, 1997	Hotel Northampton, Northampton
December 10, 1997	Crowne Plaza Hotel, Worcester
December 16, 1997	Westford Regency, Westford
December 17, 1997	Holiday Inn, Taunton

MASSACHUSETTS HIGHWAY ENVIRONMENTAL TRAINING

November 5-6, 1997	Sheraton Springfield Monarch Place, Springfield
November 12-13, 1997	Bank of Boston Conference Center, Boston

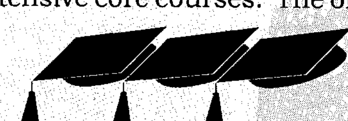
YAHOO!

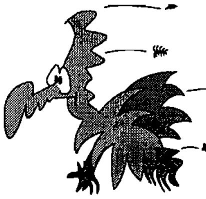
Congratulations!!

to our newest grads in the Baystate Roads Program!!

Thomas Allan	*MA Highway Department*
Michael Ball	*Town of Great Barrington*
Roger A. Bisbee	*Town of Williamsburg*
Paul Corrieri	*Town of Bedford*
F. Thom Donahue	*Town of Somerville*
Fred LaPiana	*Town of Vineyard Haven*
John C. Modzelewski	*Town of Holden*
John W. Moultrie	*Town of Georgetown*
Kati Murphy	*Town of Douglas*
James Riccio	*Town of Watertown*
Paul Riccio	*Town of Watertown*
Stephen Seymour	*Town of Barnstable*
David Small	*MDC Watershed Mgt.*
Charles Souza	*MA Highway Department*
Robert Weeks	*Town of Bourne*

Congratulations to this class of Massachusetts Roads Scholars whose names and town affiliations are listed above. These fifteen dedicated employees attended a minimum of seven training workshops, five of which had to be intensive core courses. The one-day seminars allowed the scholars to improve their skills and knowledge with recognized experts who provided practical, up-to-date and innovative instruction.





Amy leaves the nest.

After 5 years as a civil engineering undergraduate working at Baystate Roads, Chris has pushed me out of the nest. On September 22, I became a proud member of the engineering staff at a Connecticut engineering firm. Amy Bisbee, Pavement Support Engineer; I like the sound of that.

So here I am on my last day at work (a day for which I actually showed up *on time*) and what does Chris say? He expects me to work! "Write an article about yourself for the newsletter," he demands. And he thinks I'll miss this place. Who am I kidding, I was the luckiest student on campus to have the opportunity to work for the Baystate Roads Program. It's been a great job. I got to work with fun, interesting, and knowledgeable people, and every *now and then* Chris would let me out of the office...

But as much as I will miss everyone here, I am really excited to move on. Thanks to everyone and look out Connecticut, here I come!

Amy Bisbee

in this issue

The Baystate Roads Program, which publishes *Mass Interchange* each quarter, is a Technology Transfer (T2) Center created under the Federal Highway Administration's (FHWA) Local Technical Assistance Program (LTAP). FHWA is joined by the Massachusetts Highway Department, the Department of Civil and Environmental Engineering at the University of Massachusetts/Amherst, and local public works departments in an effort to share and apply the best in transportation technologies.

In addition to publishing *Mass Interchange*, the Baystate Roads Program facilitates information exchange by conducting workshops, providing reports and publications and videotapes on request, and offering one-to-one technical assistance on specific roadway issues. Because the program relies on input from many sources, inquiries, articles, and ideas are encouraged.

Local Technical Assistance/Technology Transfer Center

To contact the Baystate Roads Program, call (800) 374-ROAD (in state) or (413) 545-2604.

BAYSTATE ROADS PROGRAM
Department of
Civil & Environmental Engineering
University of Massachusetts
214 Marston Hall
Amherst, MA 01003-5205

Non-Profit Organization
U.S. Postage Paid
Permit No. 2
Amherst, MA
01002

MASS HIGHWAY
Massachusetts Highway Department
Federal Highway Administration
University of Massachusetts/Amherst