

INTERCHANGE

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Photo by Karen Dodge

An existing culvert, downstream of a dam on Amherst Road in Pelham, is replaced with a 10' precast box culvert. What happened to the road?

A Quick Guide to Culvert Installation & Maintenance

Potential Problems

- Sediment problems can develop in waterways downstream of road crossings due to excavation or backfilling operations during installation of culverts.
- Damaged culverts or culverts filled with sediment can't carry the designed quantity of flow, so water may overtop the roadway, causing safety problems.
- Improperly sized culverts can cause upstream flood problems from water backing up at the road crossing.
- Water quality problems can be created from improper grade control during culvert installation.

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Local Technical Assistance/Technology Transfer Center
(800) 374-ROAD or (413) 545-2604

Culverts . . . from Page 1

○ Significant erosion problems can develop at the outlet of culverts if they are not properly designed or installed.

For example, a culvert draining 13 acres of land would need to be at least 21 inches in diameter.

○ Refer the design of culverts for watersheds larger than 20 acres to a professional trained in hydrology and hydraulics.

○ Place at least 1 foot of fill over a culvert.

○ Make the bottom width of a trench for installing the culvert twice the width of the culvert. Make the trench side wall at a 1:1 slope or flatter.

Guidelines

○ Design culverts with adequate capacity to carry the 10% chance or 10-year frequency storm runoff, or size them to handle the rates used to design upstream structures.

○ Space culverts draining water from road ditches, areas adjacent to the road, and the road surface itself no greater than 500 feet apart.

○ Properly compact the soil around and over the culvert pipe in small layers to prevent seepage along the pipe and reduce settlement of the road over the culvert. Use the excavated material for the backfill.

○ For small watersheds (less than 20 acres), size culverts using the following rule of thumb:
Culvert diameter (inches) = 8 + Number of acres of drainage.

○ Make all culverts at least 12 inches in diameter, or 18 inches if freezing is a major problem.

○ Provide needed erosion and sediment control in accordance with specs.

○ To avoid frost heaving problems, install culverts below the frost depth (at least 36 inches).

○ Stabilize the inlet and outlet to protect from erosion.

Culvert Design by Approximate Method

Drainage Area	Culvert Diameter
0 - 5 Acres	12"
5 - 10 Acres	18"
10 - 15 Acres	24"
15 - 20 Acres	30"
>20 Acres	Detail Design

○ Install or conduct maintenance operations during the summer months when streams and brooks are at low flows and when erosion and sedimentation problems are minimal and can be easily solved.

○ Protect the outlet of all culverts against erosion and undermining. One method of protection is a stoned outlet or plunge pool. For culvert sizes of 30-inch diameter or less, an outlet pool lined with 6:12-inch stone constructed 1 diameter deep, 2 pipe diameters wide, and 4 pipe diameters long will provide adequate outlet protection. Outlet protection for all culverts larger than 30 inches in diameter should be designed by a professional engineer.

...continued on Page 6

Spray Injection Machines to Patch Potholes

The Spray Injection machines are blower type machines that employ a three-stage repair method to patch potholes: A hand-held or boom-mounted nozzle first blows any loose debris and water out of the pothole. It then applies a tack coat of emulsion. In some cases it heats the pothole. The aggregate is coated with emulsion as it leaves the delivery hose, and sprayed into the hole layer by layer. The high velocity of spray provides compaction from the bottom up.



This step in the automated pothole repair process applies a dust coat of aggregate that allows immediate traffic flow.

Photo descriptions are from the Michigan T2 Center publication, *The Bridge*, Summer 1994.



Aggregate and hot emulsion are combined with forced air and then shot into the pothole -- all from an enclosed distance of 20 feet (6m).

Two variations are available in this type of machine: the truck mounted, and the trailer mounted. However, all employ the basic three stages to repair the pothole, and all place patches effectively. The truck mounted unit can be operated by a single operator from within the truck cab. The trailer unit is operated from outside. In this respect, the former provides more safety than the latter.

The cost of these machines can vary anywhere from a low of \$20,000 for trailer mounted units, to as high as \$125,000 for self contained truck mounted ones.

Call us for the two page description, which includes a list of manufacturers.

in this
issue

A Quick Guide to Culvert

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Calibrate Spreaders to Control Spreading of Deicing Materials

Spreading accurate amounts of deicing salts to roads and streets during winter storms saves materials and money. To keep spreaders in peak condition, they should be calibrated at least once a year or anytime repair work on the hydraulic system is performed.

Even identical models of spreaders can vary greatly, so every spreader must be calibrated individually. Also, since different materials will spread at different rates using the same spreader setting, the spreader must be calibrated for each type of material you intend to use.

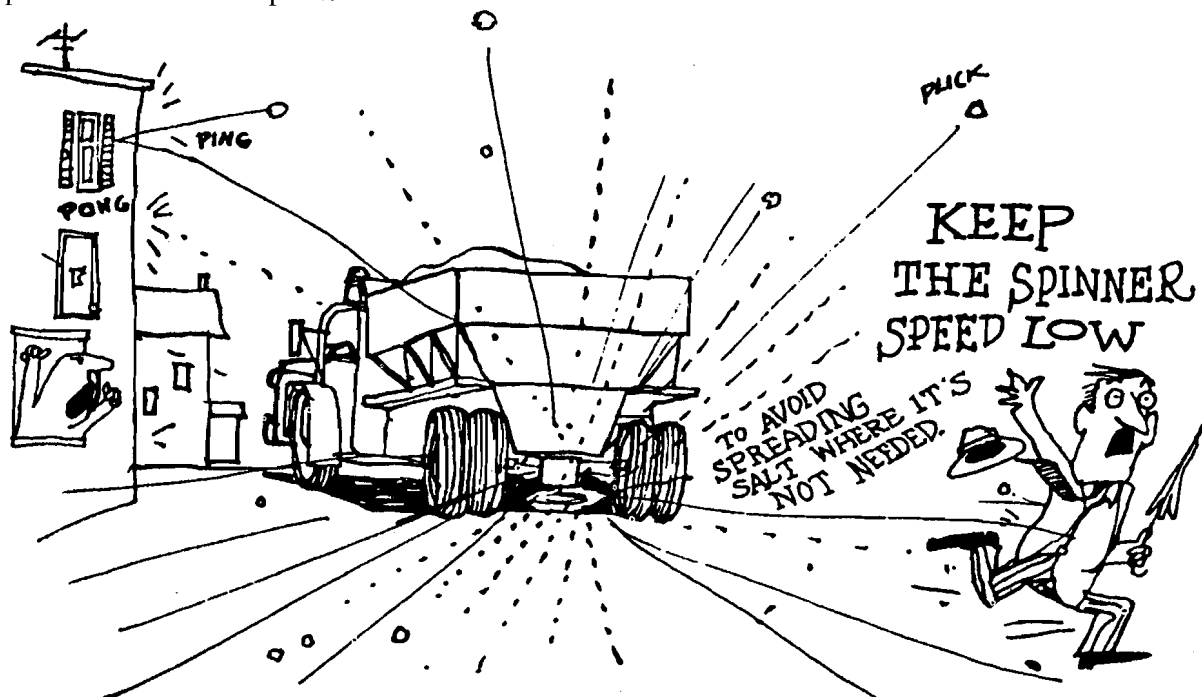
Spreader calibration is the calculation of the pounds of material discharged per mile at varying truck speeds for each spreader control setting. Using the chart on page 5, follow these steps to calibrate a spreader with non-automatic controls:

- Remove the spinner.
- Mark the shaft end of the auger or conveyor.
- Put a partial load of the material being tested on the truck.
- Warm the truck's hydraulic oil to a normal operating temperature with the spreader system operating empty.
- Dump material into the spreader.

- Rev the engine to a normal operating RPM.
- Count the number of shaft revolutions per minute for each spreader control setting in Column A, and record in Column B.
- Place a container under the spreader discharge chute, or tie a heavy sack to it.
- Collect material for one revolution at a low setting and weigh it, deducting the weight of the container. For greater accuracy, collect material for several revolutions; weigh it, deducting the weight of the container; then divide the weight of the material by the number of turns to find the material discharged for one revolution. Record the result in Column C.
- Multiply the shaft RPM (Column B) by the discharge per revolution (Column C) and record in Column D (discharge rate in pounds per minute). Now, multiply Column D by the conversion factor (E) for the desired truck speed and record. For example, at 20 mph with a 30 shaft RPM and 7 lbs/revolution discharge, the calculation would be:

$$30 \text{ rev/min} \times 7 \text{ lbs/rev} = 210 \text{ lbs/min.}$$

$$210 \text{ lbs/min} \times 3 \text{ min/mi} = 630 \text{ lbs/mi.}$$



Finally, spinner speeds should be checked. A spinner that revolves too quickly will throw material over a wide area, causing waste. Adjust the drop location on the spinner or use the directional baffles to correct this "overthrow."

Information for this article was obtained from Technology Transfer, The University of Connecticut, and HERPICC Pothole Gazette, Purdue University. The graphic is from The Bridge, Michigan Technology Transfer Center.

Material tested: _____		Truck No.: _____		Spreader No.: _____						
Hopper Gate Opening: _____		Date: _____		Tested By: _____						
Equipment Location: _____		Agency: _____								
Pounds Discharged Per Mile										
(A)	(B)	(C)	(D)	(E)						
Control Setting	Shaft RPM (loaded)	Discharge Per Revolution (lbs/rev)*	Discharge (lbs/min)	Conversion Factor (min/mile) (Truck Speed, mph)						
				x 4.00 (15 mph)	x 3.00 (20 mph)	x 2.40 (25 mph)	x 2.00 (30 mph)	x 1.71 (35 mph)	x 1.50 (40 mph)	x 1.33 (45 mph)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

*This weight is constant for each material tested.



The Underground Safety Series

This is a set of six short (10 minute) videos on the following topics: Personal Protection, Confined Space Entry, Heavy Equipment Operation, Jobsite Hazards, Trench Shoring, and Trench Shields. Each video comes with a short booklet that covers the highlights (for future reference). These videos are available as a set for a two week loan.

Snowfighting from A to Z (MO-190)

This 73 minute video from the Salt Institute takes a practical and comprehensive look at snow and ice control on our streets and highways. This tape has three sections: The Snowfighters (our current video MO-137), Salt: The Best Deicer, and Salt: The Essence of Life. The last two sections are new to our library. Consider supplementing this video with some free snow & salt publications from Baystate Roads Program. Call us for details.

How to Inspect Your Culverts

Use the acronym **R-WEB** to remember how to inspect your culverts.

For inspection, remember **R-WEB: Road Waterway Ends Barrel.**

Road: Any change at all? A sag? Crack? Sideslope failure? Excessive patching?

Waterway: Any scouring? In-filling? Catching of debris? Is the culvert still lined up right? What about high water marks and changes in the drainage area? Is the culvert still the right size?

Ends: Have they moved? Settled? Cracked? Has the water undermined them? Scoured into the streambed? Seeped along the outside? Created holes by removing soil?

Barrel: Has the shape changed? What about joints and seams? Rips and tears? Pitting? Cracking? Spalling?

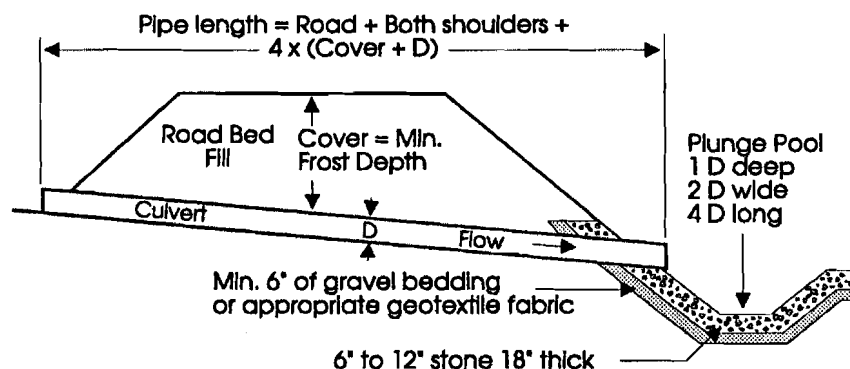
For records, keep at least a file card containing this information:

- ID number
- location
- type
- age
- description
- repair history

And when in doubt, take a photo.

Plunge Pool Design

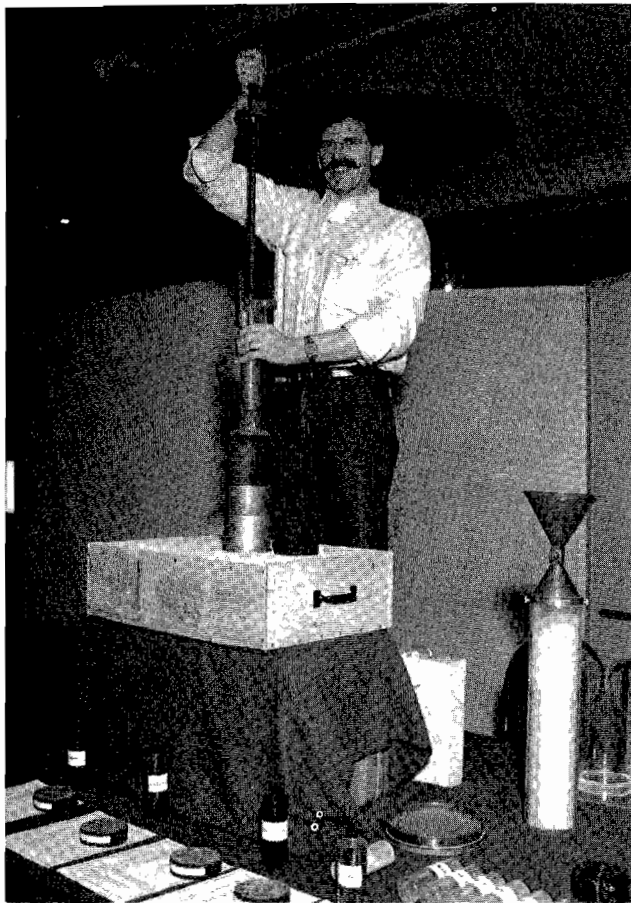
Culvert Diam. (Ft.)	Depth (Ft.)	Width (Ft.)	Length (Ft.)
1.0	1.0	2.0	4.0
1.5	1.5	3.0	6.0
2.0	2.0	4.0	8.0
2.5	2.5	5.0	10.0
>2.5	Need Detailed Engineering Design		



This article was reprinted from the Summer 1994 issue of *The Roadster*, a publication of the Virginia Transportation Research Council. It was originally adapted from "Culvert Installation and Maintenance: A Quick Guide for New Hampshire Towns," No. 1, University of New Hampshire Technology Transfer Center.

The R-WEB box was also reprinted from the Summer 1994 issue of *The Roadster*. It was originally from *Vermont Local Roads News*, Saint Michael's College, June 1993.

Photo by Karen Dodge



What is this man doing?

Bob Christman, Director of Pavement Services for Vanasse, Hangen, Brustlin, Inc., beats a pavement sample senseless with a drop hammer while teaching pavement testing methods. This demonstration was held at last March's *Pavement Quality Control & Management* workshop.

Watch for these and other upcoming workshops:

Pesticide Applicator License Exam Preparation

December 6	UMass/Amherst
December 8	Holiday Inn, Taunton
January 5	Andover Inn, Andover

Confined Space Safety	March 1995
Excavation Safety	April 1995
Basic Surveying	May 1995
Introduction to the Metric System	Winter 1995

calendar

The following courses are being offered by the OSHA Training Institute Educational Center in Region 1 (New England):

- Machinery and Machine Guarding Standards**
- Basic Instructor Course in Occupational Safety & Health Standards for the Construction Industry**
- A Guide to Voluntary Compliance in Safety and Health**
- Occupational Safety and Health Standards for the Construction Industry**
- OSHA Guide to Voluntary Compliance in the Industrial Hygiene Area**
- Collateral Duty Course for Other Federal Agencies**

These courses will be offered at several times throughout the rest of 1994 and in 1995. They will be held at UNH - Manchester, N.H. and at other sites in New England. For more information, call (800) 449 - OSHA.

26th Annual Conference and Trade Exposition

February 28 - March 3, 1995
Sponsor: International Erosion Control Association
Location: Atlanta, Georgia
Contact: John T. Price
(616) 530-8230

And More:

Baystate Roads Program has a new publication, *Concrete Pavement Repair Manuals of Practice*. This booklet contains two pavement maintenance manuals. One manual describes good practices for portland cement concrete (PCC) joint resealing, and the other focuses on partial-depth spall repair. Call us if you would like a copy. For loan only.

Buckland Highway Department replies:

"It may be old, but it's all we have"

Photo by Karen Dodge



Shortly after we mailed our last newsletter, we received a letter from Erwin Reynolds, Superintendent for the Buckland Highway Department. Erwin said that if we wanted to see an old road grader, we should visit Buckland. We took him up on his invitation, and found a #33 Husky Model road grader, dubbed "Brahman Bull." Rather than keep horses, the highway crew now attaches it to their payload and uses it twice a year on Buckland roads. As Mr. Reynolds said, "It may be old, but it's all we have." The grader is pictured to the left.

Our hats off to the crew in Buckland for their ingenuity.

On the other hand . . . I don't know guys . . . it may be time to upgrade.

Pictured here are John Tatro on the grader, and Erwin Reynolds on the payload. Our thanks to everyone in Buckland for their feedback and support.

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.

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

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MASS INTERCHANGE

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