Ditch Basics

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Water is the most destructive force in roads. Ditches are the best way to carry water away from roads and to the water table. Ditches catch sediment carried off the road surface. This makes it imperative that road managers keep ditches in good condition. This article will cover the basics of good ditches: inspection, shape, slope, lining, vegetation, and maintenance and repair.

Inspection

The first step to ditch basics is to regularly clean and inspect ditches to keep them working properly. Use the following checklist to help identify needed maintenance.

- ☐ Is the ditch free of obstructions?
- ☐ Does the ditch have a clear outlet?
- ☐ Is the ditch deep enough to drain the subgrade and cut off subsurface water?
- ☐ Is the ditch broad enough?
- ☐ Is the slope uniform; that is, free of high or low points to minimize ponding?
- ☐ Could debris control devices be used?
- ☐ Is there any erosion?
- ☐ Is a lining needed/does the existing lining need repair?
- ☐ Is the slope adequate?

Shapes

Highway crews can construct and maintain ditches in three cross-section shapes: parabolic (round bottom), trapezoidal (flat bottom), or triangular (v-shaped bottom).

- **Parabolic--**This ditch is best in terms of long-term cost and efficiency. It has about the same capacity as the trapezoidal with less erosion. Sides are easily vegetated, further reducing erosion. It is probably the most difficult and expensive to construct.
- **Trapezoidal--**The flat bottom is easier to construct than the round bottom (parabolic) ditch. Compared to the triangular shape, the flat bottom slows water and reduces erosion. It takes more time and expense to construct, but requires less maintenance and greater capacity.
- **Triangular--**The v-shaped bottom ditch is the most easily constructed and requires the least roadside area. Of the three types, it requires more maintenance, has the lowest water-carrying capacity, and is the most susceptible to erosion.

Slope

The lengthwise slope affects the velocity of flow. If the slope is too steep, the swift water flow causes erosion and maintenance problems. If the slope is too flat, water stays in the ditch and can infiltrate the road base. Water in the base deteriorates the road from within. To ensure water flow, the minimum desired lengthwise slope is 1.0%. It should never be less than 0.5%. The maximum for an unlined ditch is 5%. If the slope exceeds 5%, the ditch should be lined as described below to prevent erosion.

Ditches with earth sides should have side slopes from 1:4 or 1:2 (drop to run). To calculate slopes, see page 9 for a copy of "Measuring and Calculating Slopes."

Lining

Erosion creates sediment that is deposited in ditches and water bodies. The greater the erosion, the more maintenance needed. Excessive erosion can weaken the sides of the road itself.

Ditch lining is the most common way to prevent erosion. Linings can be of natural soil, vegetative, or paved. The material used depends on flow velocity. The following table illustrates the types of lining appropriate for various flow velocities.

Engineers use similar tables when designing waterways. Road managers can also use it empirically. If a lined, well-maintained ditch is eroding, then crews should apply a lining for a higher flow. If problems persist, the agency should consult a qualified engineer.

Type of Lining	Maximum Flow Velocity (ft/sec)
Natural Soil Linings	
Rip-rap sides and bottoms	15-18
Clean gravel	6-7
Silty gravel	2-5
Clean sand	1-2
Silty sand, clay	2-3
Clayey sand, silt	3-4
Vegetative Linings	
Average turf, erosion resistant soil	4-5
Average turf, easily eroded soil	3-4
Dense turf, erosion resistant soil	6-8
Gravel bottom, brushy sides	4-5
Dense weeds	5-6
Paved Linings	
Gravel bottom, concrete sides	8-10
Mortared rip-rap	8-10
Concrete or Asphalt	18-20

Vegetation

In addition to minimizing erosion in low-flow ditches, vegetation removes roadway pollutants from runoff water. Here are a few guidelines to remember about vegetation in ditches.

- Vegetative linings should be established BEFORE erosion begins.
- Seed, mulch, and, where necessary, fiber mats should be applied immediately after any ditch maintenance or storm damage.
- Fertilizer often speeds growth, but excessive fertilization can cause groundwater and surface water quality problems.
- Mowing prevents weeds and woody vegetation. Mowing too close will reduce the erosion resistance of the lining.

Maintenance and Repair

Ditch repair should be included in all road repair projects. Road rehabilitation and reconstruction are expensive and some municipalities omit ditch repair to save money. Some ignore ditches in minor projects, too. Inadequate ditches will allow water to infiltrate the road base. This creates inadequate drainage resulting in faster road deterioration than if the time and money was spent on proper ditching.

Periodically maintain all ditches. Schedule routine maintenance every five years. Poorly shaped, sloped, or lined ditches require maintenance more often. To maintain ditches in a five-year cycle, divide municipal roads into five areas. Plan and schedule work on each section in a given year.

Planning begins with inspection. Inspection in the fall enables a clear view of ditch conditions, and allows planning over the winter. Planned maintenance should produce ditches with adequate shape, slope, and linings. The following guidelines should be considered:

- The most efficient and effective ditches have flat or round bottoms. A backhoe or excavator most easily constructs trapezoidal or parabolic shaped ditches. If using a grader, run the wheel the ditch bottom.
- Compact the ditch bottom.
- The lengthwise and side slopes should be uniform.
- Immediately seed, mulch, and use fiber mats to establish vegetation, or immediately apply other necessary lining.

Ditches should be an appropriate depth. To keep water out of the base material, the ditch bottom should be below the base course. A depth of 18 inches is usually sufficient, but it may have to be deeper if water flows in from hillsides. The distance between cross culverts or ditch outlets influence depth. Inspection will indicate if depth is adequate, or if culverts or outlets should be installed.

Ditches are often constructed too deep. Lining is more difficult, and the added depth increases ditch erosion. Deep ditches can create a safety hazard to motorists, especially on roads with narrow shoulders.

Ditches are necessary to carry water off and away from roads and must be regularly maintained. They must have the proper shape, slope, and lining. Water flow, road surface sediment, and growing vegetation attack these features.

Sources:

Basics of a Good Road. UNH Technology Transfer Center. Durham, NH. June 2000.

"Ditch/Channel Construction & Maintenance." *A Series of Quick Guides for New Hampshire Towns.* UNH Technology Transfer Center. Durham, NH.

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