# Guidelines for Constructing Local Roads in New York's Adirondack Park

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**The Adirondack Park in upstate New York contains more than 23 000 km$^2$ (9000 miles$^2$) of public and private lands. Most state-owned land is designated by the state constitution to remain "forever wild", and development of private land is closely controlled by the Adirondack Park Agency, which is part of the executive branch of the state government and also has jurisdiction over construction of new municipal roads and expansions of existing ones. Guidelines that have been developed for use in lieu of review of individual local road projects by the Adirondack Park Agency are presented and discussed. The guidelines are presented in seven categories: (a) planning, (b), alignment, (c) cross section, (d) roadbed construction, (e) riding surface, (f) bridges and culverts, and (g) general construction. Their objective is to ensure that local roads are constructed or reconstructed so that they fit harmoniously into the natural surroundings and impart the feeling of being in a park. Local road standards issued by the American Association of State Highway and Transportation Officials contained some geometric guidelines that were considered inappropriate for widespread use in the Adirondacks.**

In 1892, the state of New York established the Adirondack Park, which now consists of >2300 km$^2$ (9000 miles$^2$) and is the largest park in the continental United States. About 60 percent of the land is privately owned; the remainder, about 10 000 km$^2$ (3800 miles$^2$) is state land that is primarily under the jurisdiction of the New York State Department of Environmental Conservation as part of the Adirondack Forest Preserve. This mixture of public and private lands posed many problems, so in 1968 Governor Nelson A. Rockefeller appointed the Temporary Study Commission on the Future of the Adirondacks to assess and make recommendations for the future use of all lands in the park. The commission's report resulted in (a) the creation of the Adirondack Park Agency (APA), (b) a Master Plan for State Lands, and (c) a land-use and development plan for all private lands in the park.

The Master Plan for State Lands, issued in 1972 by APA, classified all lands and promulgated extensive guidelines for their care, custody, and control. The guidelines for state lands classified as travel corridors called for "parklike" roads that complement the total Adirondack environment. Although the master plan applied only to state lands and therefore to state highways, it also called for the New York State Department of Transportation (NYSDOT) to use its influence over local governments to try to achieve similar objectives for other highway corridors within the Adirondack Park.

In 1976, NYSDOT issued special design standards for state highways in the park. These called for varying clearing limits, back slopes, and ditch depths and for avoiding wetlands where possible so that highways fit harmoniously into the natural surroundings and impart the feeling of being in a park. For reconstruction projects, these new standards will result in a total roadway width—including pavement, shoulder, ditches, and clear area—of only 28 m (92 ft) compared with 40 m (132 ft) for a similar roadway outside the park. For rehabilitation and preservation projects, the total clear width will be only 16.5 m (54 ft).

The guidelines suggested here present similar goals for local roads but have been modified somewhat because of the lower traffic volumes and speeds on these roads. The objective is to construct and reconstruct roads so as to ensure protection, conservation, and enhancement of the parklands. The guidelines emphasize that aesthetics and engineering are mutually dependent and that roads can be built that will be operationally safe and efficient and easier and cheaper to maintain and yet will blend attractively into the surrounding landscape. Figures 1 and 2 show examples of good construction practices in the park, and Figure 3 shows an example of what should be avoided.

Many researchers have questioned the applicability of the American Association of State Highway and Transportation Officials (AASHTO) Geometric Design Guide for Local Roads and Streets (1) and Highway Design and Operational Practices Related to Highway Safety (2) to low-volume rural roads and have suggested lesser standards (3-8). The AASHTO standards for local roads were generally considered to be too costly for roads in the Adirondack Park and to result in an overly wide road section that would not be parklike. Currently, about 50 percent of the 5900 km (3660 miles) of the park's town and county roads have gravel riding surfaces and are less than 4.3 m (14 ft) wide. It was necessary, therefore, to develop new guidelines in which the emphasis would be on minimal disruption of the area surrounding the roadway. These guidelines are presented here in seven categories: (a) planning, (b) alignment, (c) cross section, (d) roadbed construction, (e) riding surface, (f) bridges and culverts, and (g) general construction.

## PLANNING

Because of increased concern for the environment, extra precautions must be taken in planning to build or reconstruct roads in environmentally sensitive areas such as the Adirondack Park. During the early stages of a project, adequate consideration should be given to all factors that could influence the location, type, and size of the road. Among these factors are the function of the road, its present and future traffic characteristics (speed, volume, and vehicle type), land use of the adjoining property, snow storage, and the safety of those traveling on the road. These engineering requirements must be integrated with environmental and scenic considerations so that no unnecessary damage is done to the surrounding landscape during construction.

On new construction, or in the reconstruction of a new alignment, the Department of Environmental Conservation and APA can assist in determining the existence or the location of particularly sensitive areas, such as wetlands, habitats of rare or endangered species, historic landmarks (see Figure 4), and forest preserve lands.

## ALIGNMENT

The following guidelines are provided for alignment:

1. Alignment between control points should be to as high a standard as is commensurate with the topography, terrain, design traffic, obtainable right-of-way, and preservation and enhancement of the unique character of the park.
2. The road should blend with the terrain. A

Figure 1. Trout Pond Road in Essex County: typical low-volume gravel road with curvilinear alignment and minimal clear distance.

Figure 2. Typical high standard road with adequate lane and shoulder widths and clear distance and revegetated side slopes.

curvilinear alignment (see Figure 5) is visually and functionally preferable to tangents cut through hillsides, which leave unsightly cut slopes or fill slopes (see Figure 6).

3. Wherever possible, alignments should be chosen to bring interesting natural and man-made features into view.

4. Small dips and humps should be avoided in what is actually a uniform grade (see Figure 7), and "broken-back" curves should be avoided in what is actually one long curve (see Figure 8).

5. A sharp horizontal curve should not begin near the top or bottom of a hill. Generally, the horizontal curve should begin before the vertical curve starts and be somewhat longer (see Figure 9).

6. Consideration should be given to providing the best sight distance possible under prevailing conditions of terrain and topography while retaining geometrics appropriate to the park atmosphere. These considerations are of particular importance at intersections, at horizontal curves, at the crest of vertical curves, and especially on paved roads where higher speeds are likely. Opportunities for passing other vehicles should also be provided. The design values for sight distance recommended by AASHTO are given below (1 km = 0.62 mile; 1 m = 3.28 ft):

Figure 3. Example of poor construction practices: excessive clearing, unrelocated utility pole, and no revegetation.

| Average Daily Traffic (no. of vehicles) | Maximum Anticipated Speed (km/h) | Sight Distance (m) | | |
|---|---|---|---|---|
| | | When Stopping | When Passing | At Intersections |
| <100 | 32-48 | 46-61 | NA | 61-92 |
| 100-400 | 48-80 | 61-107 | 336-549 | 92-152 |
| >400 | >80 | 131 | 610 | 168 |

High and low sight distances correspond to respective high and low anticipated speeds; e.g., for an average daily traffic of <100 vehicles, the recommended stopping sight distances are 46 m (150 ft) at 32 km/h (20 miles/h) and 61 m (200 ft) at 48 km/h (30 miles/h).

7. AASHTO recommends the following maximum grades for three types of terrain:

| Average Daily Traffic (no. of vehicles) | Maximum Grade (%) | | |
|---|---|---|---|
| | Flat | Rolling | Mountainous |
| <100 | 7 | 10 | 12 |
| 100-400 | 7 | 9 | 10 |
| >400 | 6 | 7 | 9 |

## CROSS SECTION

Selection of roadway width depends on the type, volume, and speed of anticipated traffic. Safety, environmental protection, and future land use must also be considered. Data for three typical sections (see Figures 10-12) are given in Table 1.

On certain low-volume roads, wider cross sections may be necessary, especially when school buses, recreational vehicles, logging trucks, and other large vehicles will be using the road. At some locations, climbing or passing lanes may be needed or shoulders may have to be wide enough for parking. Widening the riding surface on sharp horizontal curves should be considered wherever it is feasible.

Gravel riding surfaces should have a 4 percent cross slope [4.2 cm/m (0.5 in/ft)] to provide surface drainage. On asphalt surfaces, a 2 percent cross slope [2 cm/m (0.25 in/ft)] is adequate. A 6 percent cross slope [6.35 cm/m (0.75 in/ft)] should be used on shoulders. Cut-and-fill slopes should be 1 percent vertical on 2 percent horizontal or flatter, rock cuts being generally no steeper than 3 percent vertical on 1 percent horizontal.

ROADBED CONSTRUCTION

Ideally, all roads in the Adirondack Park should be constructed with a 1.22-m (4-ft) high compacted embankment on top of existing ground that has been cleared of trees, stumps, and boulders. The top 0.61 m (2 ft) of embankment should be free of stones larger than 0.15 m (6 in). Excavation should be kept to a minimum but, where cuts are necessary, a 1.22-m ditch normally provides adequate subsurface drainage of the subgrade.

Figure 4. Historic Jay Covered Bridge, built in 1857, which carries Essex County Route 22 over the Ausable River.

Figure 5. Curvilinear alignment on low-volume gravel road.

Figure 6. Tangent section of road cut through hillsides.

The top 0.30 m (12 in) of the roadbed should be constructed with a clean, well-graded compacted gravel subbase material [50.8 mm (2 in) top size, 30-65 percent passing the 6.3-mm (0.25-in) sieve and 0-10 percent passing the 0.075-mm (no. 200) sieve]. This material should be used whether it is to be placed beneath a pavement or as the travel surface. In the latter case, the 50.8-mm top size gravel should minimize potholes and washboards. If 50.8-mm top size gravel is not readily available, other granular materials can be used in the lower 0.20 m (8 in) of the subbase, but these should have no particles larger than 0.10 m (4 in) and no more than 10 percent passing the 0.075-mm sieve.

On some town and county highways, where the cost of such construction may be prohibitive, the recommended first stage of construction is raising the roadbed and surfacing with 0.30 m (12 in) of gravel. The gravel should be clean and well-graded and have a gradation

Figure 7. Avoiding small dips and humps in uniform grades.

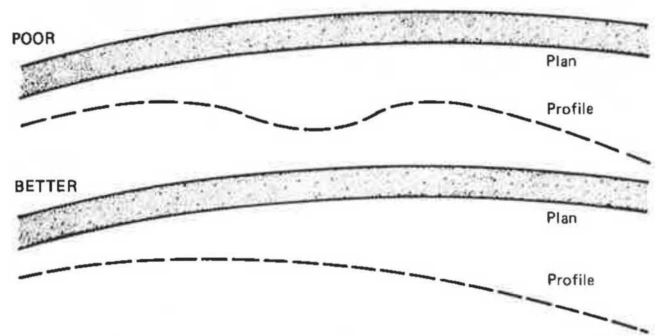



Figure 8. Avoiding broken-back curves.

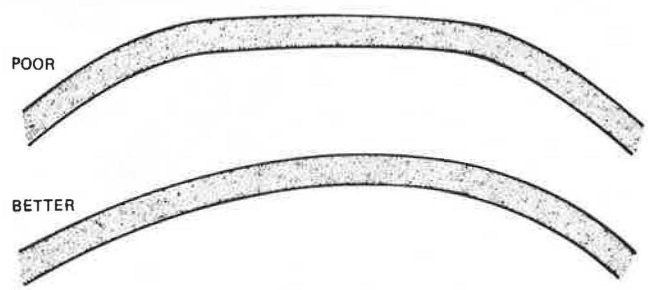



Figure 9. Use of horizontal and vertical curves in combination: Horizontal curve should begin before vertical curve and be longer.

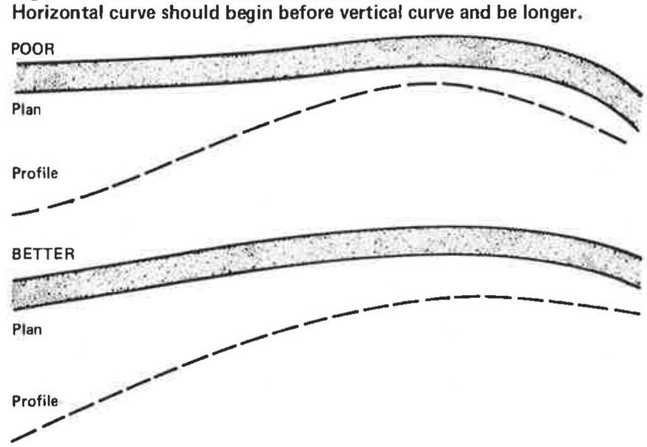


Table 1. Typical cross sections for various road categories.

| Category | Avg Daily Traffic (no. of vehicles) | Maximum Anticipated Speed (km/h) | Width of Riding Surface (m) | Shoulder Width (m) | Clear Distance[a] (m) | Typical Surface Material |
|---|---|---|---|---|---|---|
| 1 | <100 | 32-48 | 4.3-5.5 | 0-0.6 | 3.0 | Gravel |
| 2 | 100-400 | 48-80 | 4.9-6.1 | 0.9-1.5 | 3.7 | Double surface treatment |
| 3 | >400 | >80 | 5.5-7.4 | 1.5-2.4 | 4.3 | Plant mix or road mix |

Note: 1 km = 0.62 mile; 1 m = 3.28 ft.

[a]For reasons of safety, the clear distance may be extended to the edge of the right-of-way.

Figure 10. Redmond Road in Essex County: typical category 1 low-volume gravel road.

Figure 11. Essex County Route 24: typical category 2 road with treated riding surface and gravel shoulders.

similar to that described above for subbase material. When it becomes necessary to upgrade an existing road because of problems related to frost, drainage, soft soils, or increased traffic, the upgrading should follow these guidelines—that is, raise the grade where possible and use 0.30 m of compacted subbase material.

To provide subsurface drainage, there should be ditches at least 0.15 m (6 in) below the bottom of the gravel. The top and bottom of the ditches should be rounded.

When particularly complex problems are encountered that involve foundation soils, earth or rock slopes, or

Figure 12. Herkimer County Route 4: typical category 3 road with paved riding surface and shoulders.

subbase materials, the NYSDOT regional soils engineer can be consulted.

RIDING SURFACE

Low-volume roadways may be left with a gravel riding surface. When necessary, additional gravel with a top size of 0.05 m (2 in) may be added. For dust control on gravel surfaces, an alternative to oil would be calcium chloride. The riding surface can be upgraded by adding a double surface treatment in which an appropriate bituminous material is used (emulsion is preferred) with no. 1 or no. 1A stone. A more substantial riding surface could consist of a minimum 0.08 m (3 in) of a bituminous-stabilized gravel. This should be covered with a double surface treatment for a wearing course. For roadways that are subject to substantial traffic, a plant-mixed asphalt concrete with a minimum thickness of 0.06 m (2.5 in) should be used.

BRIDGES AND CULVERTS

All new bridge structures should be at least 1.22 m (4 ft) wider than the approach riding surface. For drainage structures with spans of 7.6 m (25 ft) or less, the full shoulder width should be carried. Vertical clearances should be at least 4.25 m (14 ft) over the entire roadway width, and a 0.10- to 0.15-m (4- to 6-in) allowance should be made for resurfacing. The recommended minimum design loading for bridges should be MS-18 (HS-20), particularly for spans of more than 7.6 m (25 ft). Use of materials such as treated timbers and controlled-oxidizing steel will result in functional bridges that blend with the surrounding landscape.

Ideally, culverts under the roadway should have a

Figure 13. Poor construction practices: undercut slopes, no revegetation, and piles of debris along shoulders.

Figure 14. Abandoned borrow pit where no restoration effort was made.

minimum diameter of 0.38-0.45 m (15-18 in). This can be reduced to 0.30 m (12 in) under driveways, if necessary. Culvert ends should not protrude unnecessarily beyond the grade of the slope, and wherever possible they should be concealed by stones to give a natural appearance.

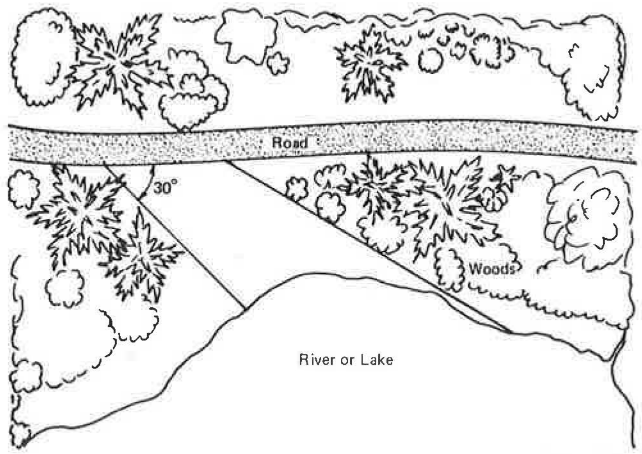
Bridges and culverts should be located along natural drainage channels to be most efficient and to minimize erosion problems. The location of bridges should allow for a smooth approach of horizontal and vertical alignments.

## GENERAL CONSTRUCTION

All areas both within and outside the right-of-way that are disturbed or serve as sources of materials (see Figure 13) should be restored to a pleasing and acceptable condition. This applies to borrow pits (see Figure 14), spoil or waste areas, tops of cut slopes, drainage ditches, haul roads, storage areas, and all similar locations. All debris and waste material should be removed from the right-of-way. The objective is to reduce construction scars and to retain and protect the visual quality of the travel corridor.

Construction projects in any road corridor in the Adirondacks may encounter highly erodible soils that could affect nearby waterways and adjacent properties. Soil areas that have a high potential for erosion and possible sediment production include (a) earth cut slopes and fill slopes without vegetative cover; (b) earth cuts with slopes steeper than the natural angle of repose of the in-place soils; (c) cut-to-fill transitions; (d) ditches that have steep or long continuous grades and no vegetative, stone, or other protection; (e) inadequate systems for controlling surface water (i.e., shallow ditches and infrequent or undersized culverts); and (f) saturated soil conditions in and around the road (silts, clays, and fine sands). Temporary or permanent erosion controls should be used in these areas (9).

Figure 15. Desirable geometrics for moving vistas.




Proper highway design, including rounding the tops and bottoms of earth slopes, encourages vegetation and minimizes erosion. Earth cut slopes and embankment slopes should be seeded and mulched as soon as it is practical to do so during construction to reduce damage by erosion; to minimize sedimentation in nearby streams, lakes, and wetlands; and to minimize damage to adjoining property.

Excessive removal of roadside vegetation should be avoided, but selective thinning should be considered to provide views of bodies of water, streams, wetlands, unique rock formations or landforms (such as mountains), and man-made features. A 30° angle from the direction of travel is the desirable angle for the moving vista (see Figure 15). Trees that are removed should be cut as close to the ground as possible to avoid unsightly stumps along the roadside. In most locations, brush, logs, slash, or other inflammable materials should not be left within 6.1 m (20 ft) of the public right-of-way.

An undulating clearing line for trees (see Figure 16) has a more pleasing appearance than a straight-edged channel. When safety permits, consideration should also be given to preserving important vegetation (such as specimen trees) and landscape features within the limits of construction. However, at intersections and horizontal curves, trees, shrubs, and brush that could obstruct sight lines should be controlled or eliminated if necessary (10).

Wherever possible, utility lines should be one set of poles set on one side of the road. Efforts should be made to locate them so that they will have minimal visual effect. Figure 17 shows the type of placement that should be avoided.

Figure 16. Undulating clearing line along the roadside.

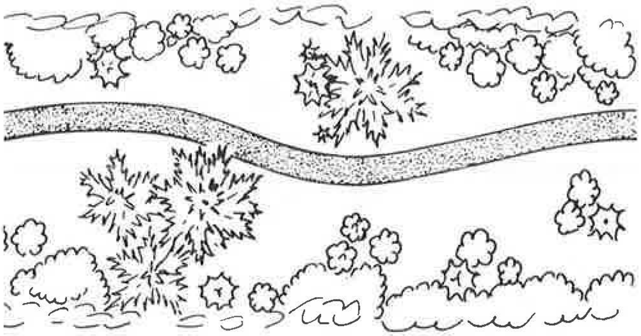
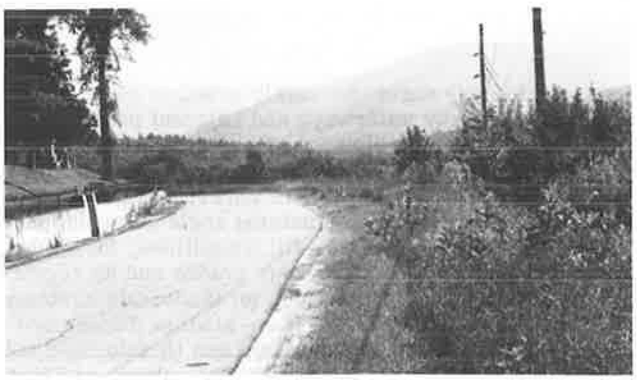


Figure 17. Utility lines and poles obstructing the view along a local road in the high-peaks region.



## SUMMARY

The guidelines discussed in this paper were developed to ensure that roads in the Adirondack Park are constructed or reconstructed so as to protect and enhance the parklands. AASHTO standards for local roads, in relation to sight distances, maximum grades, pavement cross slopes, and bridge design loading and widths, were considered necessary for safety and are incorporated into these guidelines. However, AASHTO pavement and shoulder widths and clear roadside area were not considered parklike or cost-effective for these low-volume roads, and lesser widths were adopted. In addition, it is recommended that special precautions be taken to minimize erosion problems and reduce construction scars and at the same time provide safe and efficient roads.

## ACKNOWLEDGMENT

I wish to thank the members of the Adirondack Highway Council and the highway superintendents in the 12 Adirondack Park counties for their guidance and constructive comments during the preparation of these guidelines. In addition, the assistance of the Soil Mechanics Bureau and Photolog Unit of NYSDOT is gratefully acknowledged. The guidelines were edited for publication by A. D. Emerich, and design and layout were done by Charlotte J. Ronish and Donna L. Noonan, all of the NYSDOT Engineering Research and Development Bureau.

I especially acknowledge the assistance of Robert E. Longfield, Jr., of Northeast Environmental Design, Woodstock, Vermont, author of The Vermont Backroad (7), which served as a model for these guidelines.

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*Publication of this paper sponsored by Committee on Geometric Design.*