Appendix C

Anyone aspiring to become a county road supervisor in 1913 must pass the "Examination for County Road Supervisors" shown below. The correct answers are listed starting on the next page.

STATE DEPARTMENT OF PUBLIC ROADS
EXAMINATION FOR COUNTY ROAD SUPERVISOR
October 22, 1913

1. In what character of soil is underdrainage necessary? Give as many different methods of constructing under- or sub-soil drains as you can.

2. What points are of particular importance to be considered in locating a macadam or gravel road? (Answer as fully as possible.)

3. What effect has water on a macadam, gravel, or earth road? Tell how it may be removed in each case.

4. What is to be considered in the selection of stone for a macadam road? (b) What methods are employed to ascertain the quality of the broken stone?

5. Give in detail your method of constructing a broken stone road? Give due consideration to subgrades, drainage, character and class of stone, number of courses, and detail with reference to placing same. (b) Give in detail your method of constructing a gravel road.

6. What implements would you use for the construction and what implements for the maintenance of an earth road? Discuss fully.

7. Upon what does the thickness of the broken stone or gravel depend? (b) Upon what does the width depend?

8. How would you repair a hole in a macadam or gravel road? (b) How would you get rid of a mud hole in an earth road that is 10-feet long and 14-inches deep? Discuss fully.

9. Given a straight road, one-quarter of a mile long (1320 ft.), with a 9% grade, what would be a length of a circuitous route that would develop distance enough to reach the same elevation on a 5% grade?

10. What are your views of the advantages and disadvantages of the militia system of working roads? (b) Discuss briefly your distribution of funds and your methods of handling 400 miles of road, assuming that 100 miles are either macadam or gravel, and you had $16,000 to spend annually. Also, state what machinery you would require and how you would distribute your funds to purchase same.
1. In any soil that has a natural tendency to retain moisture or a stratified formation in which a substrata holds water which passes through the surface, underdrains may be constructed along the roadsides under the gutter line or under the center of the road with lateral stubs at frequent intervals. Clay pipe is the best material for their construction, but where this is not available, broken stone filled trenches make a fairly satisfactory substitute. Where pipe is used, it should be surrounded by broken stone on both sides and on top to a thickness of at least six inches. The grade of these drains should be steep enough to prevent their becoming clogged and should be carefully established and followed.

2. The probable quantity and character of traffic that will be imposed upon the road after its construction, taking into consideration the funds available for construction -- whether they are or are not sufficient to build a road that will meet all future demands as nearly as they can be foreseen; the population served; consider the convenience of the inhabitants along the route as well as towns along the road or at its ends where residents use it, together with the traveling public at large, as a through highway.
   (b) Value of beauty.
   (c) Economy of construction, grades, drainage surfacing material will affect the general route followed.

3. A certain amount is necessary to each but an excess causes their destruction by scour or by softening the subgrade of the surface. It is removed from macadam and gravel roads by shaping the surface of the roadway so that rain water will be quickly shed into the gutters which should have sufficient fall to carry it away. Underdrains are frequently placed to facilitate its flow. In the case of macadam roads the material composing the wearing surface is sometimes made waterproof with artificial binders which helps in keeping the subgrade dry. Culverts or bridges are to be provided at all points where the natural surface drains across the road. Earth roads are seldom underdrained but otherwise receive the same treatment outlined above; Oil being used on them in some instances, but the use of the split log drag is the only logical way of protecting the surface from water.

4. Cost, freedom in quarry from clay that cannot be easily removed, hardness, cementing value and grain. The crushed product should be properly screened in sizes to comply with the specifications that will vary with the type of construction.
   (b) Laboratory tests will be made by the U.S. Department of
Roads, upon application, free of charge and their information would be of much value under certain circumstances, but as a general rule, the hardness and uniformity of grain that may be observed by inspection and the blows of a hammer are sufficient. The performance of stone in use in other roads is an excellent indication of what merits it possesses.

5. The location of a new road is, of course, the first step, but in the reconstruction of an old road the revision of the location is generally necessary if the improvement is to be of great value. This will frequently reduce the cost of construction materially and in many instances will make maintenance possible at a reasonable cost. Whatever the material of the hard wearing surface the subgrade must be properly drained and compacted and graded before anything else is done. The macadam surface should be built of stone best adapted to be met. Select the best rock available in the vicinity or, if necessary, have it shipped in from a distance and see that the sizes are in accordance with the specifications. The average road that does not require a greater width than 12 feet of rock surface should be built of at least two courses, the subgrade being shaped to receive the first course by throwing up an earth shoulder along the sides. This course should be not less than eight inches before rolling and, if of greater depth, should be retained on a 1' ring and passing a 2.5" or 3" ring. It should be rolled until hard and solid when the top course, composed of all stone passing the 1' ring, is evenly spread upon it with shovels. The use of water sprinkled upon it is essential as the life of the road depends upon its bond, which is produced by the cementing properties in the stone. Do not begin this course until you have provided a plentiful supply of water and adequate means for spreading it. Keep the screening as wet as possible and follow the sprinkler with roller before the water has time to seep through beneath the surface and soften the foundation.

Sufficient screening should be used to fill all voids in the surface of the first course and cover the road about 1/4' deep after finishing. Gravel may be placed on the crowned subgrade, without shoulders, crowned a little more than macadam, say 1" to 1' of cross slope, and always rolled when possible. It must have enough clay and sand or other cementing materials in the aggregate to form a bond. Washed river gravel is worthless when used alone as it remains loose always.

6. Small tools such as picks, shovels, mattocks, etc., plows, slip scrapers, wheel scrapers, road graders, wagons for construction. For maintenance the grading machines are of value when the condition of the road is very bad, but the split log drag is the one best implement for keeping a good road good. The cost is negligible, and the farmer should use it as religiously as he votes, while the hard crust created by its mudpie-making proclivities
sheds the water of the next shower. The ruts are filled by it and these ruts never get big or deep when the drag is used regularly.

7. Upon the weight of traffic which it carries and sometimes the nature of the subsoil. More often upon the money available. (b) Upon the numbers of vehicles using the road and to some extent their character. The tonnage also is distributed over a given area according to the width. Property owners who won't give right-of-way will also determine width.

8. By first picking out the edges of the hole making them vertical and, if necessary, deepening the hole itself enough to admit the addition of new material of the proper size. Rock or gravel is then added and wet and thoroughly tamped in thin courses and the surface of rock covered with screening that is wet and tamped. (b) The appearance of such a hole should first be taken to correct this. Then remove the mud from the hole and replace it with good dry clay, tamping it hard in courses not over four inches thick until it is brought up to grade.

9. 5280 ft./4 x 9%/5% = 2376 ft. length of circuitous route. A 95 grade means 9-foot rise or fall each 100 feet of roadway; 1320 feet would equal a vertical distance of 118.8 feet; to attain this with a 5% grade would require a length of 2376 feet.

10. The militia system for working roads must have been devised in the remote past where necessity was the mother of invention and was used to compel recalcitrant neighbors to do their share providing an outlet at some seasons for remote inhabitants from their farms to the county seat where each inhabitant is probably compelled to visit at least once a year, but it could hardly have been devised as a sane or suitable method of maintaining a system of highways. In practice, it has proven to be absolutely worthless and while some counties pretend to enforce the system, there is usually more yarn spinning, tobacco chewing, and resting done than work on roads. As a business proposition, it is foolish to believe that a disorganized gang could be collected from all sections of a county and, in the short space of 3 to 4 days, organized into any semblance of systematic road gangs and started to work, even aside from the fact that their services are too often placed at the disposal of an underpaid overseer who understands absolutely nothing of the first principles of road building. My opinion of the system is that it is a dismal failure. (b) In discussing the distribution of $16,000 annually to construct and maintain 400 miles of road, I will assume the country is blessed with an abundance of road making material, either of local rock or gravel, and also the material can be found in locations that do not require other than one handling from quarry or gravel bed to the road which would contemplate not more than a 3.5 to 4 mile haul. As 100 miles are constructed, it is fair to assume that
crushing plants are in existence and this eliminates, for the first year, the initial expense of a crushing plant.

I would endeavor to so distribute the funds as to maintain what I have on hand and also to constantly increase my macadam mileage. Dirt roads can be maintained with a split log drag at a maximum cost of $5.00 per mile per year; miles of earth roads would total $1,500.00.

With the use of modern road machinery, macadam or gravel roads can be maintained at a cost of $250.00 per mile per year. Machinery sufficient to properly undertake this work would have to be purchased from the first year's money. Road roller, one grader, scrapers, plows, water wagon, scarifiers, harrows, shovels, etc., would cost approximately $3,500.00 for machinery, and $1,500.00 for maintaining earth roads would leave $11,000.00 to maintain 100 miles of macadam and construct new roads. Estimating the cost of new construction at a minimum price of $3,200.00 per mile, I would apportion the funds as follows: from the balance of $11,000.00, I would set aside $6,250.00 for maintaining 25 miles of macadam, taking up the succeeding 25 miles the following year endeavoring to make the repairs good enough and sufficient to last over a period of three years, where it could not be worked with the revenue at hand and, using the balance to construct one mile of new road, any saving on the balance of $3,750.00 being reserved for emergencies, which in the end would result in about half the dirt roads being macadamized, or until one-fourth of all the macadam roads would require the total revenue to maintain them. As no work on a macadam road could reasonably be expected to last more than four years.