Street Design and Layout

Important Factors in Road Maintenance

by Todd N. McLeod, P.E.

Does it seem that your association spends significant time and money repaving and repairing problematic portions of your community's streets while other areas of the community require little to no maintenance? In addition to more obvious factors, such as the quality of materials and workmanship used in the original roadway construction, the actual design and layout of the street and its drainage system can greatly affect the long-term maintenance requirements of the roadway. Factors such as how the street slopes, where curbs or gutters are located, and which type of drainage inlets are used impact the service life of the pavement and often result in different maintenance schedules for sections of the same community.

In Florida, where deep freezes are rare or non-existent, the main enemy of roadway pavements is water. In an asphalt roadway, water from rainfall

can contribute to oxidation of the asphalt, resulting in a more rigid pavement that eventually cracks or buckles under the constant traffic loads. According to the Federal Highway Administration (FHWA), most aging of asphalt pavements occurs within the first two to four years of service life and mainly impacts the first half inch of pavement (A typical asphalt layer is 1.5 to 2-inches thick for local, residential roads.) Water can also severely damage the underlying base material, often a limerock or shellrock layer, which is sensitive to water intrusion. Erosion of the base material usually results in potholes, settlement, and depressions in the surface pavement. In a concrete roadway, water can infiltrate the joints and cracks within the pavement to reach and erode the underlying base material, which may be a baserock layer or simply a layer of compacted soils. This eventually leads to settling, shifting, and further cracking of the concrete slabs. For these reasons, most roadway maintenance is concerned with sealing, overlaying, or patching the roadway surface to prevent water from reaching the underlying layers.

If water can have such a great impact on the condition of roadway pavements, then street designs, which minimize the contact between water and the pavement, will typically result in a longer service life for the roadway. There are two general roadway designs, or cross sections, which are found in the majority of Florida's residential communities. The first is what engineers call a crowned or standard crowned roadway. The cross section of a crowned roadway typically includes the center of the street as the highest part of the road with each lane sloping out toward the outside edge of pavement or curb. When rain falls on the roadway, the water runs off of the pavement toward the outside lanes and typically into a concrete gutter or a roadside ditch or swale. If the system is functioning correctly, water contact with the pavement is minimal as the runoff flows away from the roadway and into a drainage system.

The second common type of residential roadway cross section is what is often called an inverted crown section. In an inverted crown section, the center of the street is the lowest part of the roadway, and the outside lanes slopes inward toward the center of the street. When rain falls on an inverted crown roadway, the runoff flows toward the center of the road and is then channeled along the road centerline to an inlet located in the center of the street. In this configuration, the roadway centerline is used in place of gutters or swales as the roadway pavement is actually collecting and conveying the rainwater to the drainage system. However, constructing the asphalt and underlying base around the center inlets is sometimes difficult and may result in an uneven surface, which often causes water to puddle around the inlet grates after a storm. Greater contact between the water and pavement can cause the pavement to oxidize quicker or can allow water to infiltrate the underlying base layers.

Although it may appear that the crowned roadway is superior to an inverted crown section, there are many instances where a crowned roadway is either not appropriate or impractical for a community. Crowned roadways typically require more right-of-way, more drainage inlets and piping, and more curbing or gutters than a comparable inverted crown section. In portions of a community where street right-of-way is limited or budgets won't allow the construction of a more extensive drainage system needed for a crowned roadway, developers and engineers may choose an inverted crown design.

To help plan for a successful maintenance and rehabilitation program that prolongs the life of your community's streets, start by looking at the different types of roadway designs within the community. Are there portions of roadway that appear to channel water toward the pavement rather than into outside swales or gutters? If so, these areas may show noticeably faster deterioration than your crowned roadways and may require more frequent maintenance. Are there areas around centerline inlets that are settling, cracking, or puddling? If so, there's a good chance that water may be infiltrating the underlying base material and eroding the roadway foundation. Once water penetrates the surface pavement layer, subsurface damage can happen quickly and can be expensive to repair. By focusing your maintenance efforts on sealing joints and cracks, overlaying aged pavements, and eliminating ruts or potholes before water begins to infiltrate the base layers, you may eliminate costly repairs needed to the base material.

To develop a prioritized maintenance plan, contact your association's engineer or an engineering firm familiar with rehabilitation of residential roadways to have an assessment of your development's streets prepared along with a preliminary cost estimate of the recommended repairs. Your association's engineer should rank the priority of needed maintenance and repairs and assist you with evaluating the cost implications of phasing the repair work.

Todd N. McLeod is the Vice President of One Evergreen, a civil engineering and development consulting firm with offices in West Palm Beach and Zephyrhills, Florida. For more information, visit ***www.oneevergreen.net****.* ■