

# Ohio Department of Transportation ORIL Research Project Fact Sheet



## Optimizing the Performance of Item 404-Low Volume Traffic Mixes

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### The Problem

Most local public agencies (LPAs) in Ohio follow the Ohio Department of Transportation (ODOT) specifications for designing asphalt mixtures placed on low-volume roads. As an alternative, some LPAs use a mix known as 404LVT, which is a recipe mix that was used by ODOT for several decades before being removed from ODOT's Construction and Material Specifications (CMS). This mix is rich in asphalt binder, fine textured, and nonrestrictive in aggregate shape and type that is intended for use on low-volume roads with a maximum average daily traffic (ADT) of 2,500 vehicles per day. The higher asphalt binder content in this mix makes the mix more durable and more resistant to cracking. Another advantage of this mix is that it contains smaller aggregate particles, which would allow placing an asphalt overlay at a thickness of 1 inch (as compared to 1.25 inches or 1.5 inches, which are typically used for ODOT Type 1 surface mixes).

Several LPAs in Ohio currently use 404LVT mixes, including Fayette County, Miami County, and Darke County, and are generally satisfied with the mix performance. The LPAs in these counties have made significant efforts to select a material combination for this mix that will provide good cracking resistance for asphalt overlays on their low-volume roads. However, it is recognized that the specification could be improved through a more comprehensive effort to optimize the 404LVT material selection and mix design. The optimization of this mix is expected to not only result in more cost-effective, longer lasting low-volume roads but also provide the data needed to support the wider use of 404LVT mixes on low-volume local roads across Ohio.

### Research Approach

This research project involved the following:

- **Online survey:** An online survey was conducted in this study to document the current state-of-the-practice by Ohio LPAs regarding the use of 404LVT asphalt mix design specifications.
- **Laboratory study:** A laboratory testing plan was designed and implemented in this study to examine the effects of various mix design factors - such as asphalt binder type, asphalt binder content, reclaimed asphalt pavement (RAP) content, coarse aggregate type, fine aggregate type, and aggregate source - on the performance and durability of 404LVT mixes. Balanced mix design concepts were utilized in evaluating the effect of different modifications to the 404LVT mix design. Several laboratory tests were used for this purpose, including the indirect tension asphalt cracking test, the modified Lottman test (AASHTO T 283), the Hamburg wheel tracking device, and the asphalt concrete cracking device.
- **Field condition evaluation:** The research team evaluated the field condition of different pavement sections constructed using 404LVT mixes in Fayette County, Darke County, and Miami County in order to identify the most common types of distresses encountered for 404LVT mixes in the field. The pavement condition evaluations were supplemented with information about the 404LVT mix designs used in construction and traffic information for the different pavement sections.

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*This research was sponsored through Ohio's Research Initiative for Locals, the Ohio Department of Transportation and the Federal Highway Administration.*

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### Findings

Below are the main findings of this study:

- **Binder type:** The current 404LVT specifications allow using either PG 58-28 or PG 64-22 asphalt binders. The laboratory test results for 404LVT mixes prepared using PG 58-28 showed better resistance to low-temperature cracking and fatigue cracking than those prepared with PG 64-22, while 404LVT mixes prepared using PG 64-22 showed better resistance to rutting. Therefore, it is recommended to use PG 58-28 asphalt binders for 404LVT mixes rather than PG 64-22.
- **Binder content:** The current 404LVT specifications allow a total asphalt binder content of 6.8% when using limestone coarse aggregates, 6.6% when using gravel coarse aggregates, and 6.7% when using gravel/limestone coarse aggregate blends. The laboratory test results revealed that the total asphalt binder contents in the current 404LVT specifications are relatively close to the optimum for fatigue cracking and are slightly higher than the optimum for rutting for some of the mixes. Since this mix is designed for use on low-volume roads where rutting is less of a concern, it is recommended to continue to use the same total asphalt binder contents. In addition, it is recommended that this mix be used at locations where truck traffic does not exceed 100 trucks per day.
- **Coarse aggregate type:** Limestone and gravel are the two most commonly available coarse aggregates in Ohio. Comparable laboratory test results were obtained for 404LVT mixes prepared using limestone No. 8, gravel No. 8, and a blend of gravel No. 8 and limestone No. 8 coarse aggregates. However, pavement sections constructed using 404LVT mixes in Fayette County, Darke County, and Miami County showed better performance with regard to raveling and transverse cracking for 404LVT mixes produced using limestone coarse aggregates as compared to those produced using gravel coarse aggregates or gravel/limestone coarse aggregate blends. Therefore, it is recommended to consider using limestone coarse aggregates when available in the production of 404LVT mixes.
- **Fine aggregate type:** In the current specifications, a minimum of 50% of the virgin fine aggregates must consist of natural sand. Incorporating limestone sand or slag sand along with natural sand in 404LVT mixes was found to improve their resistance to fatigue cracking and rutting. Therefore, it is recommended to use limestone sand or slag sand in addition to natural sand in this mix.
- **RAP content:** The current 404LVT specifications allow for using 20% RAP with PG 58-28 and 10% RAP with PG 64-22. The laboratory testing plan evaluated the effect of increasing the RAP content by 5% for PG 58-28 and by 10% for PG 64-22. The higher RAP content did not seem to negatively impact the performance of the resulting asphalt mixtures. Therefore, along with using PG 58-28 for 404LVT mixes, it is recommended to use a maximum allowable RAP content of 20% for Method 1 RAP and 25% for Method 2 RAP (similar to ODOT CMS Item 441 Type 1 surface mixes).
- **Aggregate gradation:** Minor changes to the aggregate gradation were made to make the mix strictly finer.

### Recommendations

Revised 404LVT specifications were provided as part of this research project to reflect the findings mentioned above. It is emphasized that 404LVT asphalt mixes should only be used for low-volume roads with low truck traffic where heavy, slow-moving trucks are not commonly encountered. The 404LVT mix is intended for use in rehabilitating low-volume roads where the ride quality has been compromised. It should not be used for roads that do not have sufficient remaining structural capacity to last for the service life of the 404LVT application. In addition, it is not recommended to use 404LVT mixes for roads with excessive fatigue cracking, roads with rutting that exceeds  $\frac{1}{4}$  inch in depth, or roads where the base of the pavement has failed. Roads that may benefit from the use of 404LVT mixes include pavements with raveling, where the loss of surface aggregates can lead to reduced skid resistance and a rougher road surface. Roads with cracks that may be too small for crack sealing applications or have already been treated using chip seals/cape seals but are losing aggregate or exhibiting surface delamination are also good candidates for treatment with 404LVT mixes.

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