

STUDY ON THE USE OF RECLAIMED ASPHALT PAVEMENT (RAP) IN HOT MIX ASPHALT

Economic and environmental considerations have prompted the recycling of steel, aluminum, plastic and many other materials. One of these recyclable materials is Reclaimed Asphalt Pavement (RAP). RAP is described as the asphalt removed from the old pavement and used as raw material in the manufacture of new asphalt paving mixtures. The increasing costs of asphalt materials and the depleting supply of natural resources such as quality aggregates have driven the demand of asphalt recycling. Asphalt recycling is described as the re-use of old asphalt pavement by returning the old asphalt to a new wearing surface and base course in a cost-effective and environment-friendly manner.

DPWH-BRS in conjunction with TRL Consultants conducted a couple of test and study (Marshall Stability Method and Rut Measurement Test) to determine the performance of the said product in a laboratory setting. They performed the tests on two (2) variations of RAP content; one (1) is 40% RAP and the other is 25% RAP content. They concluded that both are comparable to the conventional asphalt pavement and that they both passed the maximum rut depth for an asphalt pavement based on British Standards.

The main objective of this pilot research project is to develop practical guidelines and specifications that will optimize the use of reclaimed asphaltic materials. Specifically, it aims to establish mix design and specifications for the use of recycled/reclaimed asphalt pavement in hot mixed asphalt road construction, to determine the effects of different ratios and sizes of virgin aggregate blend materials in reclaimed asphalt pavement, and to determine the effects on the performance of reclaimed asphalt pavement and note any significant differences with the conventional asphalt pavement.

When RAP is added to hot mix asphalt, measures must be taken to avoid exposing the RAP to temperatures in excess of 427°C (800°F). Exposure of the RAP to temperatures above this limit can result in excessive hydrocarbon emissions (blue smoke). To reduce this problem, hot mix asphalt plants have been modified to permit the recycling of RAP.

In a batch plant operation, the RAP is usually added to superheated new aggregate at the pug mill. In drum-mix plants, RAP is usually introduced with new aggregate into the drum using a dual feed system. The new aggregate is typically introduced at the hot end of the drum (normally the front end of the drum), while the RAP is introduced at the middle or rear of the drum to prevent overheating damage to the RAP.

To produce consistently high-quality recycled hot mix asphalt, the need for systematic quality control of the RAP is essential. The process should be monitored for processed RAP moisture content, gradation, and asphalt cement content. Controlled plant operations have been developed to produce a consistent (homogeneous) RAP. Extraction tests to monitor the RAP gradation and asphalt cement content, and penetration and viscosity tests on the recovered asphalt cement, should be performed regularly to monitor the RAP characteristics for comparison with the job mix formula and enable appropriate adjustments to the mix.

The same field testing procedures used for conventional hot mix asphalt mixes should be used for mixes containing reclaimed asphalt pavement. Mixes should be sampled

in accordance with AASHTO T168, (Sampling Bituminous Paving Mixtures), and tested for specific gravity in accordance with ASTM D2726, (Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures) and in-place density in accordance with ASTM D2950, (Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method).

To further verify the results of the laboratory study, the BRS, in coordination with concerned District Engineering Offices, conducted three (3) pilot trials in different locations in Metro Manila. Like the laboratory trials, each pilot project contains three (3) sections: conventional, 40% RAP content and 25% RAP content. These pilot road research projects were monitored regularly through the conduct of skid resistance and sand patch tests and the average values obtained from the mentioned tests on all the sections of every trial are satisfactory. Furthermore, the measured rut depth on each section is also satisfactory.

With the constructed three (3) pilot trials, surface defects were most observed / visible at third pilot trial. It was lately noted that the section has a slightly lower elevation that caused flooding during rainy season. Defects such as minor raveling, major raveling, transverse/longitudinal cracks, potholes, minor rutting and etc. appeared on three (3) sections of the third project. Hence, the 25% RAP with Item 310-Grading D and 40% RAP with Item 310-Grading B are comparable at par with the conventional at the three (3) pilot trials.

Based on the promising results of the preliminary laboratory investigation carried out jointly by the Bureau of Research and Standards-Department of Public Works and Highways and the Transport Research Laboratory of the United Kingdom which compared recycled asphalt mix test properties and field behavior using two(2) different Reclaimed Asphalt Pavement(RAP) contents, 25% and 40% and the satisfactory performance/behavior of the pilot road projects constructed within Metro Manila and monitored for different number of years, asphalt recycling can be used effectively in road maintenance and construction. In the performance record, RAP is now routinely accepted in asphalt paving mixtures as an aggregate substitute and as a portion of the binder at a substitution rate of 10 to 50 percent. Properly designed recycled asphalt mixes are equivalent in quality and structural performance to conventional asphalt in terms of rutting, raveling, weathering and fatigue cracking. Aside from specialized asphalt plants and allow for the mixing of RAP, laying, compacting and testing of the recycled asphalt can be performed using the conventional equipment and methods as was use in the construction of the pilot projects.

In view of the satisfactory performance of the constructed pilot road projects, the use of 25% and 40% RAP with Item 310-Grading D and Item 310-Grading B, respectively, to produce conventional recycled asphalt maybe adopted for DPWH projects provided that proper design/recipe for the particular RAP and conventional materials be established, proper site selection/identification applicable for asphalt pavement construction and the quality of each material used passed specification requirements and that proper construction procedures be strictly adhered to.