Investigation of the Use of Recycled Asphalt Pavements (RAP): Development of Design Specifications and Practices

Broad Areas

- Design and Development
- Habitation and Maintenance

Need for the Study in the Context of Future of Cities

Reclaimed asphalt pavement (RAP) is the term given to removed and/or reprocessed pavement materials containing asphalt and aggregates. These materials are generated when asphalt pavements are removed for reconstruction, resurfacing or to obtain access to buried utilities. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement. Asphalt pavement is generally removed either by milling or full-depth removal. Milling entails removal of the pavement surface using a milling machine, which can remove up to 50 mm thickness in a single pass, and transported to a central facility for processing. At this facility, the RAP is processed using a series of operations, including crushing, screening, conveying, and stacking. RAP can be used to a larger extent as a base course; however a limitation of using RAP as fill material is the unknown risk of leaching of pollutants from the aggregate to the environment. RAP can be used as an aggregate substitute material, but in this application it also provides additional asphalt cement binder, thereby reducing the demand for asphalt cement in new or recycled asphalt mixes containing RAP. As far as life cycle assessment of RAP is concerned, the life of the recycled pavement materials starts at breaking up the existing old pavement, followed by transportation to deposit or asphalt/concrete plant, and then followed by crushing, mixing of new pavement material and transportation to the location of the new pavement. In summary, the benefits of RAP include: Reduction in CO_2 emissions due to lower demand of construction materials, Reduction in the asphalt (bitumen) content, Reduction in the overall cost, Almost same if not more of the performance and durability characteristics of a conventional dense graded asphalt concrete materials

Cost is an important factor in terms of recyclability and reuse of material and can be an incentive to use such material. The construction industry will certainly recognize the economic benefits of using recycled materials, such as crushed RAP aggregates for base courses of the pavements. The cost-effectiveness of substituting conventional aggregate with recycled materials is highly dependent on the location, the quality and cost of local aggregates. Recycling versus tipping fees and distances to landfills are other important aspects for the feasibility of recycling. In some urban areas recycling can be more

profitable than in rural areas. In rural areas recycling can be expensive and impractical due to high transportation cost and the lack of nearby materials. On the other hand, if materials are available, reuse of materials that otherwise have to be transported can be very cost effective. Overall, there is a critical need to understand the use of recycling of existing damaged asphalt pavement materials to produce new pavements with considerable savings in materials, energy and cost in the Indian context. In addition, aggregates and binders from old asphalt pavements are still valuable even though the damaged pavements have reached the end of their service lives.

In particular, in the context of "Future of Cities", it may be noted that one of the most significant benefits of recycling of urban asphalt pavements is that road levels can be maintained without raising them each time a maintenance or rehabilitation layer is placed on the existing pavement. It is also to be noted that most often when these streets are rehabilitated the existing condition of the surface requires removal. While removal of the asphalt surface using different excavators is a common practice, cold milling is being routinely being done across the country in a large number of road projects using milling machines of different sizes. Another major concern is where all the removed asphalt material will be placed if not recycled.

Objective and Scope of Work

The main objective of the study is to develop specifications and practices for recycled asphalt pavement (RAP) mixes and to understand the performance characteristics of the asphalt mixes, mainly from the perspectives of materials, energy and costs. The proposed work envisages the following scope of the effort:

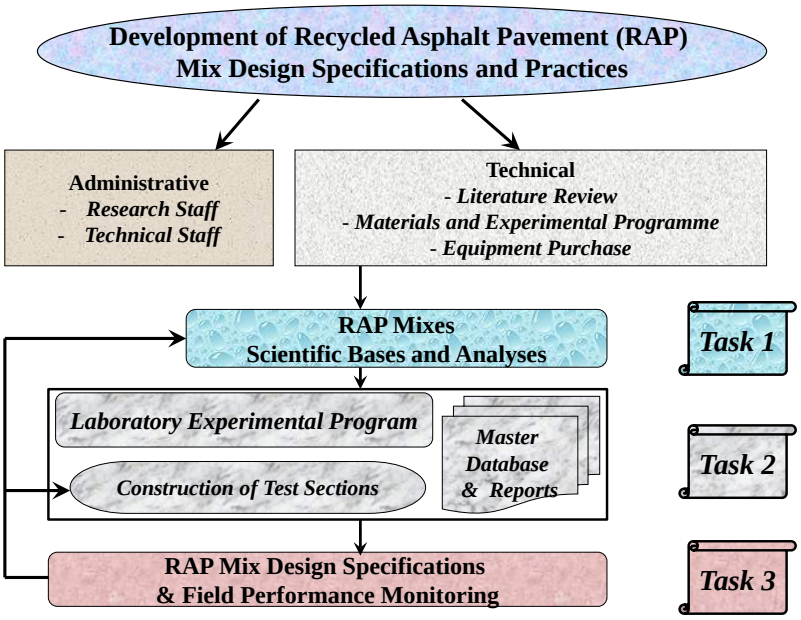
a) Review of the RAP mix design methods practiced worldwide
b) Select appropriate percentage of RAP to be used with new materials which will result in adequate density (and porosity) of the conventional mixes
c) Investigate the use of modifiers (crumb rubber and polymer additives) in the RAP mix designs
d) Conduct material characterization (binders and mixtures) laboratory tests to evaluate for their rutting, cracking and moisture resistance characteristics
e) Compare the test results with the performance of the traditional control conventional asphalt mixes in the laboratory with the RAP (conventional and modified) mixes
f) Develop rutting, cracking and moisture performance criteria and models

g) Construct test sections at the IIT Kharagpur's accelerated pavement test facility and assess performance of the different pavement materials

h) Recommend guidelines to incorporate RAP mix designs in the newly approved Indian Roads Congress (IRC:37, 2012) design guide

i) Prepare draft standards of the conventional and modified RAP mix designs

Methodology



Outcomes/Deliverables

(a) A Comprehensive state-of-the-report on the RAP mix design methods and specifications

(b) Specifications for percent RAP, aggregate gradation, asphalt content, modifier (rubber and polymer) content, air voids to be used in the RAP mixes

(c) Design specifications and standard practice for the use of RAP mixes

(d) Draft guidelines for the design of pavements with RAP layers

Team Composition

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