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Thesis title: **Recycling of Bituminous Mix**

Introduction:

Rehabilitation and maintenance of pavement structure is costly, time consuming and material intensive. Various types of rehabilitation methods like reconstruction, overlaying and recycling are in use all over the world. In India overlaying is the most commonly adopted technique of pavement rehabilitation. Recycling or reuse of the pavement materials for rehabilitation purposes offers several advantages over the other methods of rehabilitation. The major benefits may include conservation of aggregates, binder, existing highway geometrics etc.

Types of recycling:

Recycling can be broadly classified into two major groups.

1. Hot mix recycling

2. Cold in place recycling

The present work deals with hot mix recycling only.

Objective:

1. To develop a step by step mix design procedure for recycling process to satisfy the Marshall mix design criteria as per MORT & H specification..

2. To find out the amount of old mix which can be recycled?

Proposed design process for recycling:

The proposed design procedure consists of two parts. The first part of the design procedure is to find out the optimum bitumen content for the recycled mix using the uncoated recovered aggregates obtained from the bitumen extraction test. The second part of the design procedure is to find out the percentage of RAP (old mix) which can be recycled without extracting the bitumen. The two flow charts of the proposed design process are given in Fig.1 and Fig.2. The second part of the design procedure is explained with the help of the following example.

Determination of RAP:

Let us consider the optimum bitumen content (OBC) is found to be 5% by weight of the mix obtained from Marshall test while using the uncoated aggregates for the recycled mix.

Hence OBC = 5% = Desired bitumen content for the recycled mix while using the RAP.

Bitumen content in old mix by weight of mix = 3%. This can be found from the bitumen extraction test.

Proportion of old binder and new binder in recycled mix = 20:80. The binder proportion can be found out from the viscosity blending chart or rutting factor ($G^*/\sin\partial$) blending chart.

Hence percentage of new binder in recycled mix = $0.8 \times 5\% = 4\%$

Old binder in the recycled mix = (5-4) % = 1%

Now 100% of recycled mix = 4% new binder + 96% old mix and fresh aggregate

Let's say we are using X% of old mix for 100% of recycled mix.

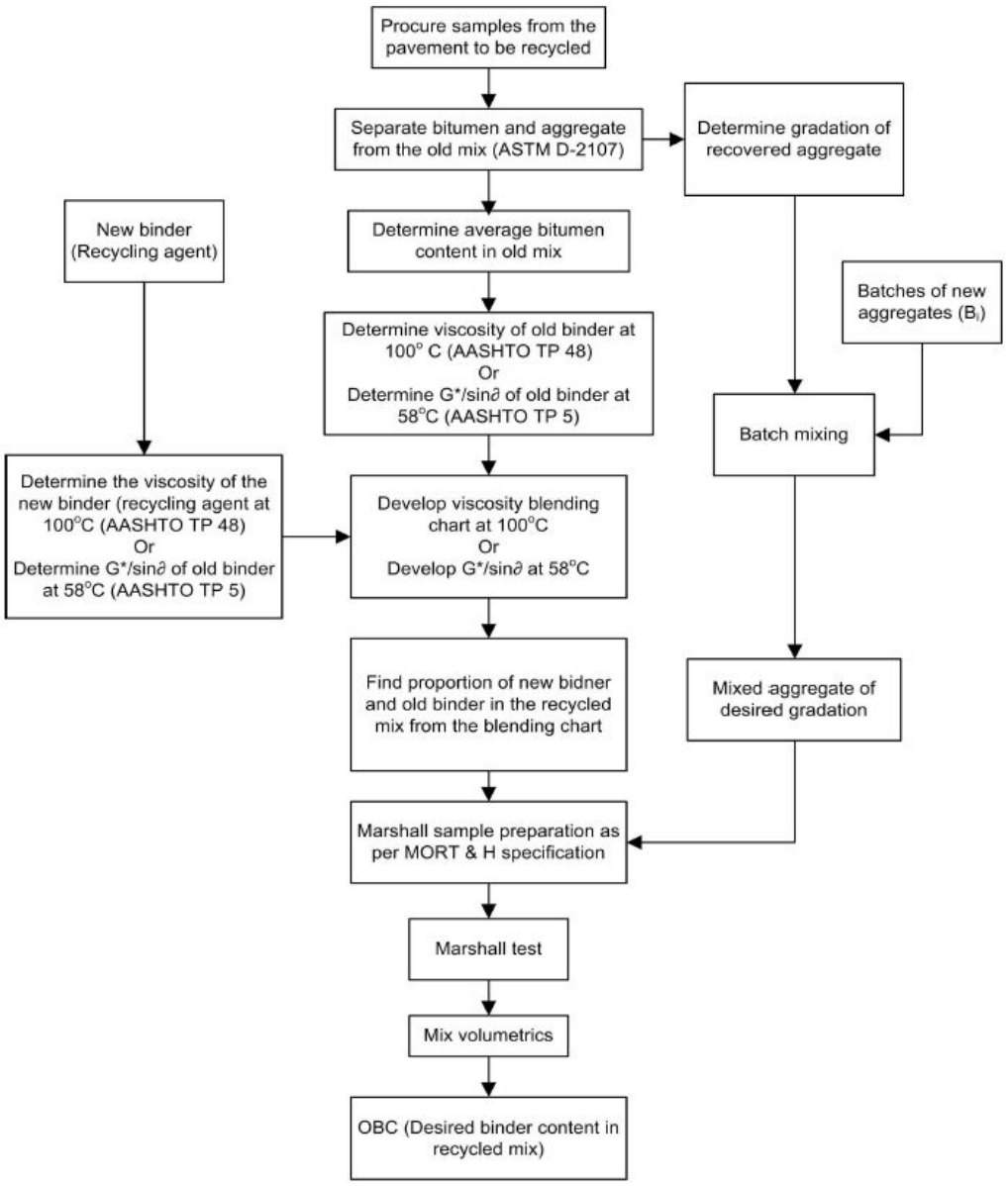
Hence old mix in 96% of aggregate portion = $0.96 \times X\%$

Now binder content in the old mix = $0.96 \times X \times 0.03 = 1\%$

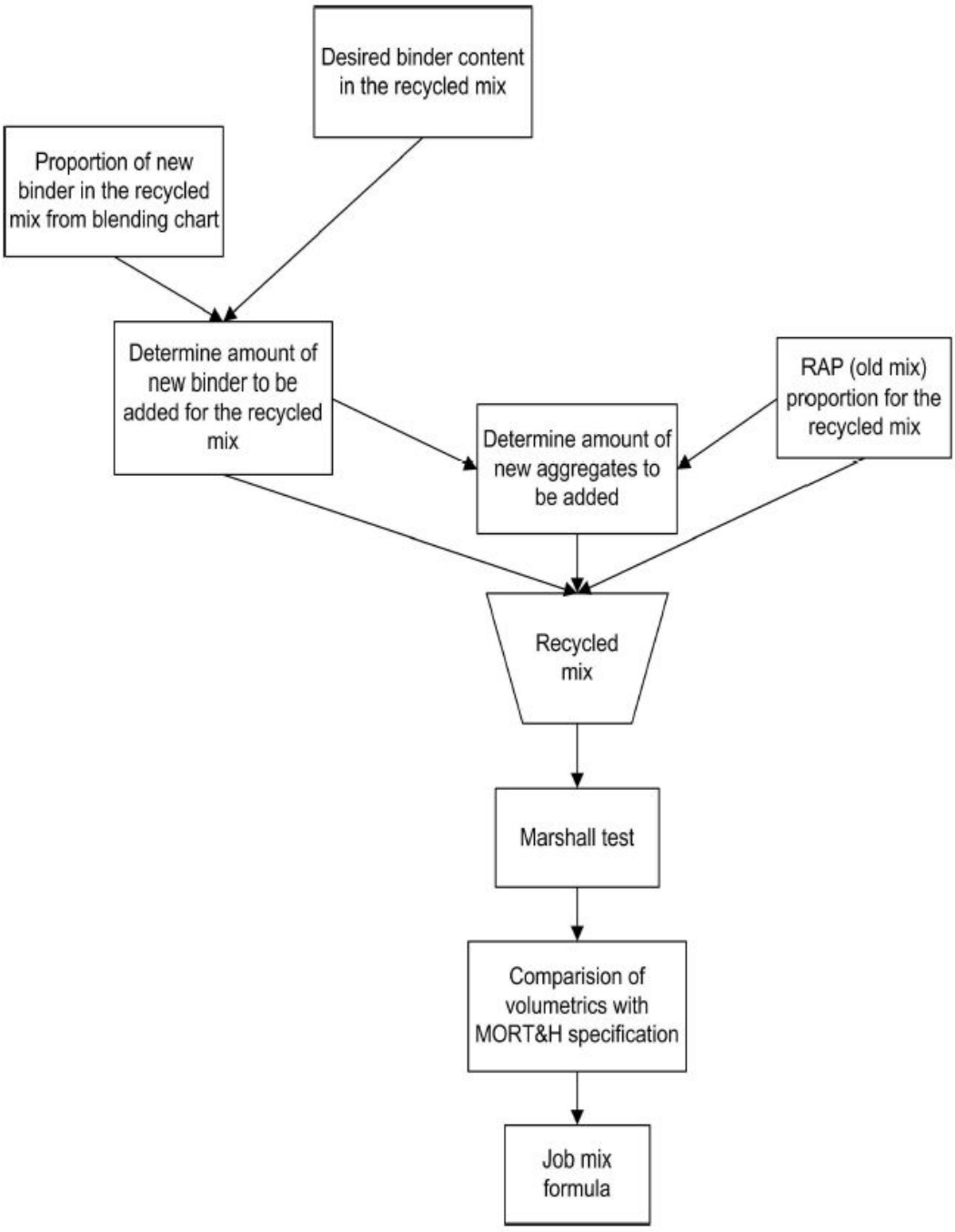
Hence X = 35% (approximately)

Experimentation program:

The experiments were conducted in the lab as per the proposed design procedure and the proportions of new binder; new aggregate and RAP were found out for the recycled mix.



Part I of design procedure for recycling



Part II of design procedure for recycling

Results:

Table 1. shows the desired bitumen content for the recycled mix for the three roads chosen for the project. Table 2. shows the job mix formula for the three roads chosen for the project. All the results are from viscosity consideration only.

Table 1. Desired bitumen content for recycled mix

Name of the road	Desired bitumen content
IITK	5.25
GT	5.20
KDA	5.60

Table 2. Job mix formula

Name of the road	RAP (%)	New binder (%)	New aggregate (%)
IITK	31.0	3.9	65.1
GT	21.0	4.0	75.0
KDA	43.0	3.2	52.8