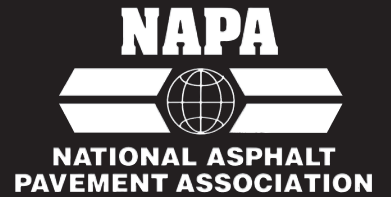
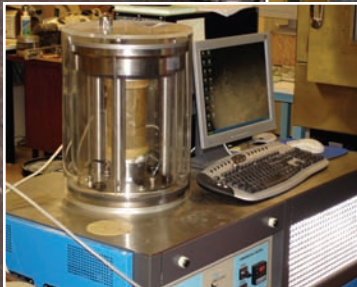
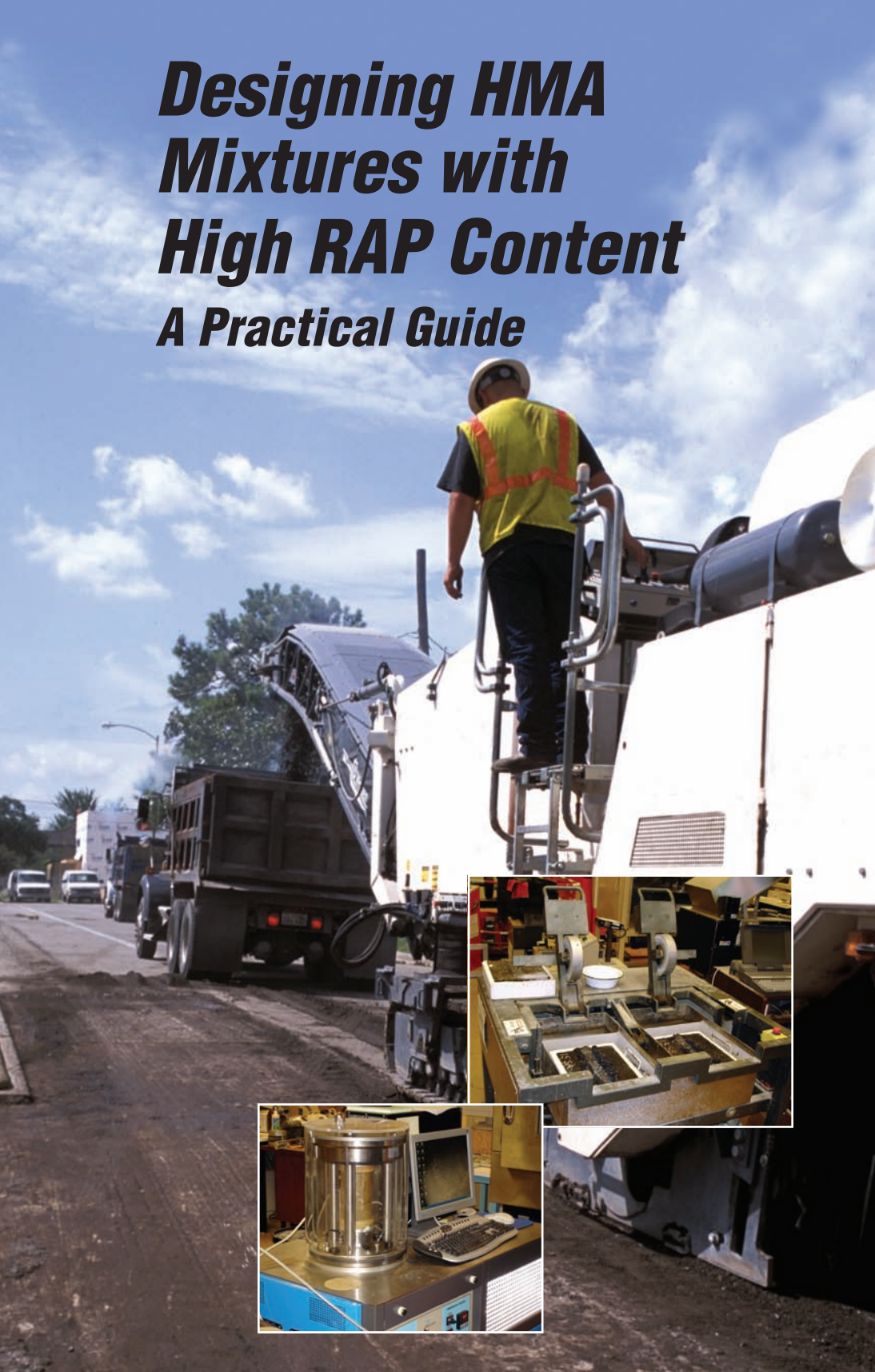


Quality Improvement Series 124



Designing HMA Mixtures with High RAP Content A Practical Guide



U.S. Department
of Transportation
Federal Highway
Administration

This publication is provided by the Members of the National Asphalt Pavement Association (NAPA), who are the nation's leading hot-mix asphalt (HMA) producer/contractor firms and those furnishing equipment and services for the construction of quality HMA pavements.

NAPA Members are dedicated to providing the highest quality HMA paving materials and pavements, and to increasing the knowledge of quality HMA pavement design, construction, maintenance and rehabilitation. NAPA also strongly supports the development and dissemination of research, engineering and educational information that meets America's needs in transportation, recreational, and environmental pavements.



NAPA Building ■ 5100 Forbes Blvd. ■ Lanham, MD 20706-4407
Tel: 301-731-4748 ■ Fax: 301-731-4621
Toll free 1-888-468-6499 ■ www.hotmix.org

This publication is designed to provide information of interest to NAPA Members and is not to be considered a publication of standards or regulations. The views of the authors expressed herein do not necessarily reflect the decision making process of NAPA with regard to advice or opinions on the merits of certain processes, procedures, or equipment.

COPYRIGHT NOTICE

Publications produced and published by the National Asphalt Pavement Association (NAPA) are copyrighted by the Association and may not be republished or copied (including mechanical reproductions) without written consent. To obtain this consent, contact the Association at the address given in this publication.

Designing HMA Mixtures with High RAP Content

A Practical Guide

by

David E. Newcomb
E. Ray Brown
Jon A. Epps



U.S. Department
of Transportation
**Federal Highway
Administration**

Acknowledgements

The authors would like to express their sincere appreciation for those who made this guideline possible. Members of the National Asphalt Pavement Association, especially the Recycling Task Force, took the time to review the document and provided a great deal of thoughtful insight and many constructive comments. Ewa Flom of the Federal Highway Administration (FHWA) reviewed the publication and provided her own comments along with others from FHWA. She worked with Ken Kobetsky of the American Association of State Highway and Transportation Officials (AASHTO) to provide the input from a number of AASHTO members. The AASHTO Subcommittee on Materials, especially Tom Baker (chair of Technical Section 2c, Asphalt-Aggregate Mixtures) and Rick Harvey (chair of Technical Section 2d, Proportioning of Asphalt-Aggregate Mixtures) provided excellent detailed comments and suggestions on the document's contents. It is a partnership effort that produced this joint NAPA/FHWA/AASHTO publication.

Designing HMA Mixtures with High RAP Content

A Practical Guide

CONTENTS

Introduction	5
Background	5
Purpose and Scope	6
Overview	7
Materials Evaluation	11
RAP	11
Aggregate	13
Binder	16
Additives and Modifiers	16
Mix Design	19
Introduction.....	20
Sample Preparation.....	20
Laboratory Mixing and Compaction.....	20
Volumetric Testing.....	20
Determination of Optimum Binder Content.....	21
Binder Testing	21
Mechanical Property Testing	21
Plant Verification	23
Initial Settings	23
Testing	24
Adjustments.....	24
Test Strip.....	24
Production	25
Quality Control	27
Introduction.....	27
Testing	27
Adjustments.....	31
Summary	33
References	35

FIGURES

Figure 1 Materials Evaluation	8
Figure 2 Mix Design Procedure	9
Figure 3 Plant Verification Procedure	10
Figure 4 Change in Penetration with Time (after Kandhal, 1977)	14
Figure 5 Change in Viscosity with Time (after Peterson, 1989)	14
Figure 6 Methods for Selecting RAP Content for the Desired Properties	17

TABLES

Table 1 Suggested Quality Control Schedule for Aggregates	28
Table 2 Suggested Quality Control Schedule for RAP	28
Table 3 Suggested Quality Control Schedule for Asphalt Binder	29
Table 4 Suggested Quality Control Schedule for HMA Mixtures	29