# LANGSTON UNIVERSITY ADDRESSING THE NEED FOR TECHNICAL SUPPORT SERVICES IN HOUSING THE OKLAHOMA DEPARTMENT OF TRANSPORTATION RESEARCH LIBRARY

## FINAL REPORT - FHWA-OK-08-006

ODOT SPR ITEM NUMBER 2102


By

Wilson Brewer
Assistant Director of Research

Dennis Howard
Director

Kimberly Anderson
Research Librarian

Donchelle Edwards
Librarian Assistant

Langston University
Transportation Center of Excellence
4205 N. Lincoln Blvd.
Oklahoma City, Oklahoma 73105

Technical Advisors:
Dawn Sullivan, P.E. Planning & Research Division Engineer
Jay Adams, Assistant Planning & Research Division Manager
Ron Curb, P.E., Planning & Research Division Engineering Manager




December 2008

## TECHNICAL REPORT DOCUMENTATION PAGE

| 1. REPORT NO. | 2. GOVERNMENT ACCESSION NO. | 3. RECIPIENT'S CATALOG NO. |
|---|---|---|
| FHWA OK-08-006 | | |

| 4. TITLE AND SUBTITLE | 5. REPORT DATE |
|---|---|
| Langston University Addressing the Need for Technical Support Services in Housing the Oklahoma Department of Transportation Research Library | December 19, 2008 |
| | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S) | 8. PERFORMING ORGANIZATION REPORT |
| Wilson Brewer, Dennis Howard, Kimberly Anderson, Donchelle Edwards, | |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS | 10. WORK UNIT NO. |
| Langston University<br>4205 N. Lincoln Blvd.<br>Oklahoma City, Oklahoma 73105 | 11. CONTRACT OR GRANT NO.<br>Item Number 2120 |
| 12. SPONSORING AGENCY NAME AND ADDRESS | 13. TYPE OF REPORT AND PERIOD COVERED |
| Oklahoma Department of Transportation<br>Planning and Research Division<br>200 N.E. 21st Street, Room 2A2<br>Oklahoma City, OK 73105 | Final Report<br>Oct. 2007 – Sept. 2008 |
| | 14. SPONSORING AGENCY CODE |

15. SUPPLEMENTARY NOTES

16 . ABSTRACT

The Oklahoma Department of Transportation (ODOT) Training Center utilizes Material's Division personnel from time to time to evaluate asphalt and aggregates lab work for building bituminous pavements. These personnel are needed for more critical engineering and management duties. The Principal Investigator (P.I.) completed aggregate and asphalt certification training held at the ODOT Materials Division laboratory. Procedures trained for were the sampling of aggregates, reducing samples of aggregates to testing size, etc. Other tests performed were sampling bituminous paving mixtures, reducing samples of hot-mix asphalt to testing size, etc.

Langston University (LU) provides technical assistance by organizing ODOT-OTC Research Day. This task included contacting speakers that have contractual research project obligations with ODOT and OTC arranging the speakers in a logical manner according to various transportation categories, inviting guest from the concrete and asphalt associations, provided agendas, arranged for food and organized poster displays'. Langston secured the technical support personnel which included operating the power point computer, photographing the event and video-taping speakers. A list of research ideas submitted during the brainstorming session was developed. There was a poster display.

The librarian and librarian assistant have been putting all available Compact Discs (CD) and research booklets into Paradox 10 database system at the Oklahoma Department of Transportation library. Personnel will facilitated and maintained access to recent and frequently requested materials, publications, CDs and other information. LU's undergraduate science department and the graduate program in education provided an avenue of support personnel for the library.

| 17. KEY WORDS | 18. DISTRIBUTION STATEMENT |
|---|---|
| Aggregates, Asphalt, Research Library, Literature | No restrictions. This publication is available from The Office of Research, Oklahoma DOT. |

| 19. SECURITY CLASSIF. (OF THIS REPORT) | 20. SECURITY CLASSIF. (OF THIS PAGE) | 21. NO. OF PAGES | 22. PRICE |
|---|---|---|---|
| Unclassified | Unclassified | 24 | |

# SI (METRIC) CONVERSION FACTORS

## *Approximate Conversions to SI Units*

| Symbol | When you know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| in | inches | 25.40 | millimeters | mm |
| ft | feet | 0.3048 | meters | m |
| yd | yards | 0.9144 | meters | m |
| mi | miles | 1.609 | kilometers | km |
| | | **AREA** | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ |
| $ft^2$ | square feet | 0.0929 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8361 | square meters | $m^2$ |
| ac | acres | 0.4047 | hectacres | ha |
| $mi^2$ | square miles | 2.590 | square kilometers | $km^2$ |
| | | **VOLUME** | | |
| fl oz | fluid ounces | 29.57 | milliliters | mL |
| gal | gallon | 3.785 | liters | L |
| $ft^3$ | cubic feet | 0.0283 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.7645 | cubic meters | $m^3$ |
| | | **MASS** | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.4536 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams | Mg |
| | | **TEMPERATURE (exact)** | | |
| °F | degrees Fahrenheit | (°F-32)/1.8 | degrees Celsius | °C |
| | | **FORCE and PRESSURE or STRESS** | | |
| lbf | poundforce | 4.448 | Newtons | N |
| $lbf/in^2$ | poundforce per square inch | 6.895 | kilopascals | kPa |

## *Approximate Conversions from SI Units*

| Symbol | When you know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| mm | millimeters | 0.0394 | inches | in |
| m | meters | 3.281 | feet | ft |
| m | meters | 1.094 | yards | yds |
| km | kilometers | 0.6214 | miles | mi |
| | | **AREA** | | |
| $mm^2$ | square millimeters | 0.00155 | square inches | $in^2$ |
| $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $m^2$ | square meters | 1.196 | square yards | $yd^2$ |
| ha | hectacres | 2.471 | acres | ac |
| $km^2$ | square kilometers | 0.3861 | square miles | $mi^2$ |
| | | **VOLUME** | | |
| mL | milliliters | 0.0338 | fluid ounces | fl oz |
| L | liters | 0.2642 | gallon | gal |
| $m^3$ | cubic meters | 35.315 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.308 | cubic yards | $yd^3$ |
| | | **MASS** | | |
| g | grams | 0.0353 | ounces | oz |
| kg | kilograms | 2.205 | pounds | lb |
| Mg | megagrams | 1.1023 | short tons (2000 lb) | T |
| | | **TEMPERATURE (exact)** | | |
| °C | degrees Fahrenheit | 9/5(°C)+32 | degrees Celsius | °F |
| | | **FORCE and PRESSURE or STRESS** | | |
| N | Newtons | 0.2248 | poundforce | lbf |
| kPa | kilopascals | 0.1450 | poundforce per square inch | $lbf/in^2$ |

# DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the views of the Oklahoma Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation. While trade names may be used in this report, it is not intended as an endorsement of any machine, contractor, process, or product

# ACKNOWLEDGEMENTS

The authors are appreciative of Dawn Sullivan, Jay Adams, Ron Curb and Rudy Brockelsby, for facilitating the successful establishment of the Oklahoma Department of Transportation (ODOT) research library on the Langston University (LU) OKC campus. We would also like to thank Dave Girdner for training the LU library staff. Additionally, we would also like to thank the ODOT Materials Division personnel; Danny Gierhart, Eric Roberts, Chuck Donavan, Ed Schratwieser, Jerry Smith and Donald McCullough for their flawless efforts in training the Principal Investigator (P.I.).

# TABLE OF CONTENTS

# LIST OF FIGURES

# INTRODUCTION

Langston University (LU) addressed the need of technical support services in the areas of evaluating personnel in aggregate and asphalt laboratory work, assisting ODOT personnel in the planning of Transportation Research Day, as well as, library housing and staffing. The Assistant Director of Research, Mr. Wilson Brewer, serves as the Principal Investigator (P.I.) and the Director Mr. Dennis Howard, serves as the Co-Principal Investigator (Co-P.I.) for this project. The P.I. provided technical services to the ODOT Materials Division, after completing training under the Materials Division for the evaluation of aggregates and asphalt laboratory work at the ODOT Training Center. ODOT Materials Division personnel are needed for more critical engineering and management duties in the central office.

The LU Transportation Center of Excellence staff assisted in planning, organizing, and publicizing the 2007 ODOT/Oklahoma Transportation Center (OTC) Transportation Research Day. A total of nine speakers presented project presentations. The LU staff also assisted in coordinating the lobby poster display.

The ODOT Planning and Research Division has out-sourced the ODOT Research Library to Langston University. All publications, Compact Discs (CDs), articles and journals are housed on the LU/Oklahoma City campus, located at 4205 North Lincoln boulevard. Management of the library is provided by the P.I. and Co-P.I. The Librarian and Librarian Assistant provide the day to day operation of the library which in includes literature searches, data input of materials received by ODOT, and fulfilling requests for project reports.

# MATERIALS CERTIFICATION TRAINING

The P. I. started and completed aggregate and asphalt training at the ODOT Materials Division laboratory under the supervision of the Bituminous Engineer. Training procedures consisted of aggregate certification, sampling of aggregates, reducing samples of aggregate to testing size, total evaporable moisture content of aggregate by drying materials finer than No. 200 sieve in mineral aggregates by washing, sieve analysis of fine and coarse aggregates, determining percent dust coating of cover aggregates for bituminous surface treatments, specific gravity and absorption of fine aggregate, and specific gravity and absorption of coarse aggregate.

The P.I. has completed the Oklahoma Highway Construction Materials Technician Certification and passed the ODOT AASHTO Certification in aggregate and asphalt administered by the Materials Division Laboratory. The training procedures for the asphalt certification sampling consisted of bituminous paving mixtures, reducing samples of hot-mix asphalt to testing size, plastic fines in graded aggregates and soils by use of the sand equivalent test, mechanical analysis of extracted aggregate, determining the specific gravity and unit weight of compacted bituminous mixtures, preparing and determining the density of hot mix asphalt specimens by means of the superpave gyratory compactor, theoretical maximum specific gravity and density of hot mix asphalt, determination of bitumen content in bituminous paving mixtures, and determining the specific gravity and unit weight of compacted bituminous mixtures using the corelok apparatus.

The training provided by the ODOT Materials Division was for the evaluation of ODOT and industry employees in aggregates and asphalt certification. The P. I. will follow the guidelines as determined by the standard specifications for “Highway Construction, Oklahoma State Highway Commission,” 1999 edition, the

“American Association of State Highway, Transportation Officials,” 2000 edition and other specifications, documents and testing methods used to clarify project requirements of project proposals and roadway plans.

## Aggregate Certification

Aggregate tests the P.I. must be proficient in performing are as follows:

**AASHTO T2 Sampling of aggregates:** This practice covers sampling of coarse and fine aggregates for coarse and fine aggregates for the preliminary investigation of the potential source of supply, control of operations at the site of use, and acceptance or rejection of materials.

**AASHTO T248 Reducing samples of aggregate to testing size**: This method covers the reduction of large samples of aggregate to the appropriate size for testing employing techniques that are intended to minimize variations in measured characteristics between the test samples

**AASHTO T255 Total evaporable moisture content of aggregate by drying**: This method covers the determination of the percentage of evaporable moisture in a sample of aggregate by drying both surface moisture and moisture in the pores of the aggregate. Some aggregate may contain may contain water that is chemically combined with the minerals in the aggregate. Such water is not evaporable and is not included in the percentage determined by this test method.

**AASHTO T11 Materials finer than No. 200 sieve in mineral aggregates by washing**: This method covers determination of the amount of material finer than a 75-μm (No. 200) sieve in aggregate by washing. Clay particles and other aggregate particles that are dispersed by the wash water, as well as, water-soluble materials, will be removed from the aggregate during the test.

**AASHTO T 27 Sieve analysis of fine and coarse aggregates**: This method covers the determination of the particle size distribution of fine and coarse aggregates by sieving.

**OHDL L-48 Determining percent dust coating of cover aggregates for bituminous surface treatments**: This test method covers determination of the amount of material finer than a No. 200 (75μm) sieve adhering to the coarse aggregate retained on the No. 8 (2.26 mm) by washing. Clay particles and other aggregate particles that are dispersed by the wash water, as well as water-soluble materials, will be removed from the aggregate during the test.

**AASHTO T 84 Specific gravity and absorption of fine aggregate**: This method covers the determination of bulk and apparent specific gravity, 23° C/23° C (73.4 ° F/73.4° F), and absorption of fine aggregate.

**AASHTO T 85 Specific gravity and absorption of coarse aggregate**: This method covers the determination of specific gravity and absorption of coarse aggregate. Specific gravity may be expressed as bulk specific gravity (saturated surface-dry (SSD), or apparent specific gravity. The bulk specific (SSD) and absorption are based on aggregate after 15 hours soaking in water. This method is not intended to be used with lightweight aggregates.

Figure 1. Ed Schratwieser (left) is extracting asphalt to run an aggregate gradation test while training Wilson Brewer (Anderson, 2007).

## Asphalt Certification

Asphalt tests the P.I. must be proficient in performing are as follows:

**AASHTO T 168 Sampling bituminous paving mixtures**: Sampling is equally as important as the testing and the sampler shall take every precaution to obtain samples that will yield an acceptable estimate of the nature and conditions of the materials which they are represent.

**AASHTO T 328 Reducing samples of hot-mix asphalt to testing size**: This practice outlines methods for the reduction of large samples of hot-mix asphalt (HMA) to the appropriate size for testing, employing techniques that are intended to minimize variations in the measured characteristics between the test samples so selected and the large sample.

**AASHTO T 176 Plastic fines in graded aggregates and soils by use of the sand equivalent test**: This method is intended to serve as a rapid test to show the relative proportions of fine dust or claylike material in soils or graded aggregates.

**AASHTO T 30 Mechanical analysis of extracted aggregate**: This method covers a procedure for the determination of the particle-size distribution of fine and coarse aggregates extracted from hot mix asphalt (HMA), using sieves with square openings.

**OHD L-14 Determining the specific gravity and unit weight of compacted bituminous mixtures**: This method of test covers the procedures for determining the bulk specific gravity and unit weight of specimens of compacted bituminous mixtures, as defined in the Standard Definition of Terms Relating to Specific Gravity (AASHTO Designation M132).

**AASHTO T 312 Preparing and determining the density of hot mix asphalt specimens by means of the superpave gyratory compactor**: This standard covers the compaction of cylindrical specimens of hot mix asphalt (HMA) using the Superpave gyratory compactor.

**AASHTO T 209 Theoretical maximum specific gravity and density of hot mix asphalt**: This method covers the determination of the theoretical maximum specific gravity and density of uncompacted hot mix asphalt (HMA) at 25$^{o}$ C (77$^{o}$ F).

**OHD L-26 Determination of bitumen content in bituminous paving mixtures**: This test method covers the determination of asphalt content of bituminous paving mixtures by ignition of the asphalt cement at 10,000$^{o}$F (583$^{o}$C) in a furnace. The asphalt in a sample of bituminous paving material is burned by ignition at 10,000$^{o}$F (583$^{o}$C). The asphalt content is calculated from the mass of ignited aggregate, moisture content, and temperature compensation for the change in mass of the sampler container. The asphalt content is expressed as mass percentage of the moisture-free mixtures. This method may not be applicable to mixes containing fibers or ground tire rubber (dry process).

**OHD L-45 Determining the specific gravity and unit weight of compacted bituminous mixtures using the corelok apparatus**: This method of test covers the procedures for determining the bulk specific gravity and unit weight of specimens of compacted bituminous mixtures, as defined in the Standard Definitions of Terms Relating to Density and Specific Gravity of Solids, Liquids, and Gases (AASHTO M 132).

Figure 2. Wilson Brewer is measuring a specific amount of asphalt to run a laboratory molded specimen test (Anderson, 2007).

# TRANSPORTATION RESEARCH DAY

## Planning, Preparing and Publicizing the Program

Langston University provides technical assistance to ODOT by organizing the ODOT-OTC Transportation Research Day program. This task includes contacting speakers that have contractual research project obligations with ODOT and OTC, arranging the speakers in a logical manner according to various transportation categories, inviting guest from the concrete and asphalt associations, preparing agendas, inviting attendees, and assisted in food and poster arrangements. LU staff secured ODOT technical support personnel for operating the computer and projector utilized for speaker presentations and photographing, as well as, video-taping several event activities. A categorized list of research ideas submitted during the brainstorming session has been developed and has been submitted to the ODOT Planning and Research Division personnel.

In organizing Transportation Research Day, LU assisted ODOT and the University of Oklahoma (OU), and represented OTC. The P.I.'s for this project collaborated together to establish a 2007 itinerary for Transportation Research Day, Opening remarks were presented by ODOT personnel, Director Gary Riley, followed by the introduction of Jay Adams, Acting Division Manager of Planning & Research as the moderator. A guest speaker, Dock Burkes talked a collaboration between universities. He was from the Southwest University Transportation Center located in College Station, Texas. A panel discussion on bridge infrastructures included presenters from ODOT, OTC, Oklahoma Turnpike Authority (OTA), Federal Highway Administration, (FHWA) and the Southwest University Transportation Center.

# ODOT-OTC Research Day Program

**2007 ODOT-OTC RESEARCH DAY**
Wednesday, October 17, 2007
ODOT Commission Room
200 N.E. 21st Street, Oklahoma City, Oklahoma

| | |
|---|---|
| 8:30am | Opening Remarks (ODOT) by Secretary Phil Tomlinson/Director Gary Ridley ODOT-OTC |
| 8:45am Session | Program Introduction/format by David Streb/Jay Adams, Moderators of the Morning |
| 8:50am | Title-Southwest UTC-OTC Collaboration, Dock Burke, SWUTC |
| 9:10 | Advanced Voice and Multimedia Communications System -ODOT Network, Monte Tull, OU |
| 9:30am | Development of an Improved System for Contract Time Determination, David Jeong, OSU |
| 9:50am | Break |
| 10:05am | Bridge Inspection Meets the Twenty-First Century, Kyran Mish, OU |
| 10:25am | Freight Movement Model, Guoquang Shen, OU |
| 10:45am | Title to be emailed today, Jim Nevels, ODOT |
| 11:05am | Poster Presentations (ODOT-OTC) (Foyer, front of Commission Rm) |
| 12:05pm | Lunch (Foyer, provided by OTC) |
| 1:25pm | Remarks on Afternoon Sessions, Steve Cross/Musharraf Zaman, Moderators |
| 1.30pm | The Future of Recycled Asphalt Mixes in Oklahoma, Sharon Lewis, LU |
| 1:50pm | evaluation of ODOT's Percent within Limits (Asphalt) construction Specifications, Steve Cross OSU |
| 2:10pm | Stability and Permeability of Proposed Aggregate Bases in Oklahoma, Naji Khoury, OU |
| 2:30pm | Break |
| 2:45pm | Panel Discussion-ODOT, OTC, OTA, FHWA, and SWUTO/Dock Buke ODOT-Bob Rusch; OTC Robert Emerson; OTA |
| 3:45pm | Brainstorming New Research Ideas |
| 4:30pm | Adjourn |

Poster Presentations:

- Significance of Specific Gravity and Specific Surface Area of Aggregate in HMA, Ashish Gupta, OU
- Soil Stabilization in pavement Structures, Pranshoo Solanki, OU
- Field Validation of Asphalt Compaction Analyzer, Sesh Commuri, OI
- An Evaluation of WMA Additives, Sasobit and Asphalmin, on binder Viscosity and High Temperature Grading, Justin Sneed, OU
- Bridge Inspection Meets the Twenty-First Century, Kyran Mish, OU
- Data Mining the National Transit Database, Istvan Jonyer, OSU
- Monitoring Pavement Surface Condition using Mica2 Motes, Jinsong Pei, OU

## Brainstorming New Research Ideas

At the end of the ODOT-OTC Transportation Research Day program, all of the attendees were invited to participate in the brainstorming session for new research ideas. Utilizing ideas submitted during this session, new projects may develop.

# TRANSPORTATION RESEARCH LIBRARY

## Introduction

The ODOT research library functions that the Librarian and Librarian Assistant perform were established by ODOT guidelines and job descriptions of duties. ODOT and the LU Transportation Center personnel coordinated operations of the library. Typical Librarian and Assistant Librarian required functions consist of cataloging and maintaining databases of incoming publications and to coordinate updates and webpage links with the Planning and Research Division's liaison in the Technology Support Services branch. LU personnel have facilitated and maintained regular access to recent and frequently requested publications, CDs and other information. The LU undergraduate science department and the graduate education program have provided an avenue of support personnel for library staffing for the ODOT Research Library. The LU Oklahoma City campus was a central location for the OSU, OU and LU that are involved in both the ODOT and OTC research programs.

The former ODOT Planning and Research Division Librarian, Dave Girdner, trained the LU staff librarian how to input data in to the Paradox 10 system and perform literature searches on various websites. The LU Librarian and Librarian Assistant placed all available compact discs and research publications into the Paradox 10 database system at the ODOT headquarters in Oklahoma City.

In January, 2008, the ODOT research library materials were packed into boxes and were later transported to the LU Oklahoma City campus.

March, 2008 LU received bookcases from the Oklahoma Correctional Industries to house the ODOT's research library compact discs, publications, and other materials. LU also set up several computers in the library to accommodate the Paradox program. An overflow of research material required the purchase of additional book shelving. The library accommodates searches for states Departments of Transportations, the OTC, various universities, other transportation centers and other initiates. The library currently houses over 8,000 research materials. It is divided into seventeen sections of outside publications, plus materials from Oklahoma State University (OSU), OU, LU and the OTC.

Figure 3. Kimberly Anderson and Wilson Brewer are shown displaying ODOT's research publications.

## Section/ Item List

The library staff inputs publications and CD information into the system by their section and the items type. This a complete list uses to classify the books and CDs.

SECTION: PLANNING AND ADMINISTRATION

ITEM: 1 AGENCY ORGANIZATION
ITEM: 2 DATA AND INFORMATION SYSTEMS
ITEM: 3 FINANCE AND ECONOMICS
ITEM: 4 FORECASTING, MARKET ESTIMATION AND MODAL SELECTION
ITEM: 5 LAND USE
ITEM: 6 PERSONNEL MANAGEMENT
ITEM: 7 PLANNING PROCESS; STATE, REGIONAL AND URBAN TRANSPO
ITEM: 8 STRATEGIC MANAGEMENT
ITEM: 9 TRANSPORTAION DEMAND MANAGEMENT
ITEM: 10 TRANSPORTATION OF THE DISAVANTAGED
ITEM: 11 TRAVEL BEHAVIOR

SECTION: ENERGY AND ENVIRONMENT

ITEM: 12 ALTERNATIVE FUELS
ITEM: 13 ECOLOGICAL SYSTEMS
ITEM: 14 HAZARDOUS WASTES
ITEM: 15 HISTORIC PRESERVATION
ITEM: 16 NOISE AND AIR QUALITY
ITEM: 17 WATER QUALITY
ITEM: 18 WETLANDS

SECTION: TRANSPORTATION LAW

ITEM: 20 CONTRACT LAW
ITEM: 21 EMINENT DOMAIN AND LAND USE
ITEM: 22 ENVIRONMENT LAW
ITEM: 23 MOTOR VEHICLE AND TRAFFIC LAW
ITEM: 24 TORT LIABILITY

SECTION: HIGHWAY AND FACILITY DESIGN

ITEM: 25 ARCHAEOLOGY AND SCENIC VISTAS
ITEM: 26 ENVIRONMENTAL DESIGN AND MITIGATION
ITEM: 27 HIGHWAY GEOMETRICS
ITEM: 28 PHOTOGRAMMETRY,DIG.MAPPING,REM.SENSING,& SURVEYIN
ITEM: 29 TRAF.BARR.SIGN SUPP. & HWY.SAFETY APPURTENANCES
ITEM: 30 UTLITIES ACCOMMODATION

SECTION: PAVEMENT DESIGN, MANAGEMENT AND PERFORMANCE

ITEM: 31 CLASSIFICATION SYSTEMS
ITEM: 32 FLEXIBLE AND RIGID PAVEMENT DESIGN
ITEM: 33 PAVEMENT DATA COLLECTION AND ANALYSIS

ITEM: 34 PAVEMENT DISTRESS
ITEM: 35 PAVEMENT MANAGEMENT
ITEM: 36 REHABILITATION STRATEGIES
ITEM: 37 RESPONSE OF PAVEMENTS TO LOAD & ENVIRON.FORCES
ITEM: 38 SKID RESISTANCE
ITEM: 39 SURFACE UNEVENNESS
ITEM: 40 SYSTEMS FOR VEHICLE COUNTING
ITEM: 41 WEIGH IN MOTIN

SECTION: BRIDGE, OTHER STRUCTURES, HYDRAULICS AND HYDROLOGY

ITEM: 42 BRIDGE SAFTY, ECONOMY AND SERVICE LIFE
ITEM: 43 DESIGN OF STEEL, CONCRETE & TEMBER BRIDGES
ITEM: 44 FILED TESTING AND DYNAMIC RESPONSES OF BRIDGES
ITEM: 45 HYDROLOGY AND HYDRAULICS
ITEM: 46 STRUCTURAL DESIGN OF CULVERTS AND HYDRAULIC STRUC
ITEM: 47 STRUCTURAL USES OF COMPOSITE MATERIALS
ITEM: 48 TUNNEL DESIGN, CONSRTUCTION AND PERFORMANCE

SECTION: GEOLGY AND FOUNDATIONS

ITEM: 49 EARTHQUAKES AND LANDSLIDE
ITEM: 50 ENVIRONMENT EFECTS ON SOIL
ITEM: 51 EXPLOR.PROPERTIES, ID, CLASS. &TRMNT.OF SOIL & ROCK
ITEM: 52 MECHANICS OF SOIL, ROCK AND LAYERED SYSTEMS
ITEM: 53 SUBSURFACE DRAINAGE

SECTION: MATERAL AND CONSTRUCTION

ITEM: 54 BITUMINOUS MATERIALS AND MIXES
ITEM: 55 CEMENT AND CONCRETE
ITEM: 56 CONSTRUCTION
ITEM: 57 GENERAL MINERAL
ITEM: 58 AGGREGATES SPECIFICATIONS MATERIAL
ITEM: 59 QUALITY CONTROL

SECTION: MAINTENANCE

ITEM: 60 EQUIPMENT MAINTENANCE
ITEM: 61 MAINTENANCE MANEGEMENT
ITEM: 62 RUNWAY AND GUIDANCE MAINTENANCE
ITEM: 63 SNOW AND ICE CONTROL
ITEM: 64 STRUCTURES, ROADWAY AND ROADSIDE MAINTENANCE
ITEM: 65 TRAFFIC SERVICE MAINTENANCE

SECTION: HIGHWAY OPERATIONS, CAPCITY AND TRAFFIC COTROL

ITEM: 66 HIG-OCCUPANCY VEHICLES
ITEM: 67 INTELLIGEN VEHICLE-HIGHWAY SYSTEMS
ITEM: 68 LAW ENFORCEMENT
ITEM: 69 OPERATING EFFECTS OF ROADWAY ELEMENTS
ITEM: 70 PARKING AND PARKING FAUILTIES
ITEM: 71 RAILROAD-HIGHWAY GRADE CROSSINGS
ITEM: 72 TRAFFIC CONTROL DEVICES AND SYSTEM
ITEM: 73 TRAFFIC FLOW AND HIGHWAY CAPACITY
ITEM: 74 TRAFFIC MEASUREMENT AND EVALUATION METHODS

ITEM: 75 TRANSPORTATION COMMUNICATION SYSTEMS
ITEM: 76 TRANSPORTATION SYSTEM OPERATIONS
SECTION: SAFTY AND HUMAN PERFORMANCE

ITEM: 77 ACCIDENT COUNTERMEASURES
ITEM: 78 BICYCLES
ITEM: 79 EMERGENCY MEDICAL SERVICES
ITEM: 80 HUMAN BEHAVIOR, PERFORMANCE ASSOC.WITH TRANSPORT
ITEM: 81 MEASUREMENT OF SAFTY PERFORMANCE
ITEM: 82 PEDESTRAINS
ITEM: 83 PLANNING, MANAGEMENT AND FINANCING OF SAFTY
ITEM: 84 RIGHT-OF-WAY & VEHCULAR DESIGN, OPERATIONS & MAIN
ITEM: 85 SYSTEM SAFTY
ITEM: 86 TRAUMA TREATMENT
ITEM: 87 WORK ZONE SAFTY

SECTION: AVIATION

ITEM: 88 AIR TRAFFIC CONTROL
ITEM: 89 AIRCRAFT TECHNOLOGY
ITEM: 90 AIRLINES (INCLUDING REGIONAL AND COMMUTER)
ITEM: 91 AIRSIDE & LANDSIDE AIRPORT DESIGN & OPERATION
ITEM: 92 BUSINESS & GENERAL AVIATION
ITEM: 93 FINANCE
ITEM: 94 FORCASTING
ITEM: 95 INTER-GOVERNMENTAL RELATIONS
ITEM: 96 MARKET ANALYSIS
ITEM: 97 PLANNING
ITEM: 98 SAFTY

SECTION: AVIATION

ITEM: 99 SOCIO-ECONOMICS
ITEM: 100 USER NEEDS

SECTION: PUBLIC TRANSIT

ITEM: 101 COMMUTER RAIL
ITEM: 102 DESIGN, OPER, AND MAINT. OF VEHIC & FIXED FACILTIES
ITEM: 103 PARATRANSIT
ITEM: 104 PLAN. ADMIN. ECON. FINANCE & PERF. OF RAIL, BUS & TRANSIT
ITEM: 105 RURAL PUBLIC TRANSPORTATION
ITEM: 106 SAFETY

SECTION: RAIL

ITEM: 107 COMMUNICATION SYSTEMS
ITEM: 108 DESIGN, CONSTR. & MAINT. OF TRACK SYS. & TRAIN CONTRO
ITEM: 109 PLAN, ADM, REG, SAFETY & OPER. OF RAIL SYS; PASS & FREIGHT

SECTION: FREIHGT TRANSPORTATION

ITEM: 110 PLAN, ADMIN, DESIGN, CONST, MAINT, REGUL, OPER, & SAFETY
ITEM: 111 TRANSPORTATION OF HAZARDOUS MATERIALS
ITEM: 112 TRUCK, RAIL, WATER, PIPE, & INTERMODAL FREIGHT TRANS.

SECTION: MARINE TRANSPORTATION

ITEM: 113 MARINE TRANSPOTATION

# REFERENCES

American Association of State Highway and Transportation Officials. (2004). *Standard Specifications for Transportation Materials and Methods of Sampling and Testing.* Washington, D.C.

Oklahoma Department of Transportation. (1999). *Standard Specifications for Highway Construction.* Oklahoma City, Ok.