

COMPTE-RENDU DE LA 66IEME REUNION

ANNUELLE DU T R B, JANVIER 1987

*Langlois*

Préparé par: Richard Langlois, ing.  
Chef - Division Matériaux  
Ministère des Transports  
2700, rue Einstein  
Sainte-Foy (Québec)  
G1P 3W8

C.C. Service des Relations Ministérielles

MM. Claude Lortie, s.m.a.  
Yvan Demers, s.m.a.  
Jean-Réal Lahaye, ing.  
Pierre Lafontaine, ing.  
Paul Brochu, ing.  
Robert Doucet, ing.  
Alain Vallières, ing.  
Gérard Tessier, ing.  
Richard Pagé

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206

Sainte-Foy, le 3 février 1987



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COMPTE-RENDU DE LA 66IEME REUNIONANNUELLE DU T R B, JANVIER 19871.0 IDENTIFICATION DU PARTICIPANT

- 1.1 Nom : Richard Langlois
- 1.2 Fonction : Ingénieur, chef de la div. Matériaux
- 1.3 Service : Laboratoire Central

2.0 DESCRIPTION DES VOYAGES

- 2.1 Endroit : Washington
- 2.2 Durée : du 10 au 16 janvier 1987
- 2.3 Autorisation: CT 86-C-292
- 2.4 Raison du voyage : Participer au TRB et à la réunion du SHRP à titre de coordonnateur Québécois du SHRP et membre du groupe de coordination de la recherche en infrastructure des transports.

3.0 CARACTERISTIQUES DES REUNIONS

- 3.1 Type de réunion: Nationale à caractère international
- 3.2 Nom de l'organisme: Transportation Research Board  
responsable :
- 3.3 Contenu de la réunion
  - 3.3.1 Liste des thèmes abordés: Elle est présentée en annexe A.
  - 3.3.2 Résumé des conférences et des discussions.

Les sessions techniques ont été des plus intéressantes et très diversifiées: Les auteurs venaient de différents milieux, de gouvernements, de municipalités, d'universités et de diverses entreprises privées.

Les principaux faits techniques découlant des diverses rencontres, discussions et présentations techniques se résument ainsi:

- 1- Les appareils nucléaires ordinaires de mesure de densité mesurent la densité d'une couche de 75 à 100 mm de profondeur. Avec un appareil spécial muni de 2 détecteurs, il est possible de mesurer avec précision la densité d'une couche mince de 25 mm.
- 2- La densité des carottes est toujours supérieure à celle mesurée avec des nucléodensimètres (Troxler, CPN, Seaman), sur un joint ou ailleurs. La densité des joints est en moyenne 96 Kg/m<sup>3</sup> inférieure. L'écart type des mesures de densités par carottes, est inférieure à celui des nucléodensimètres. La compacité des joints est de 4% inférieure si elle est mesurée par des carottes et de 7% inférieure par les nucléodensimètres.
- 3- Les normes de compacité du Texas sont de 92 à 97% de la densité maximale Rice. En 83-84, alors que les normes de compacité n'étaient pas en vigueur, la compacité moyenne des revêtements était de 92,7% avec un écart type de 2,3, alors qu'en 86, avec la mise en force de la norme, la compacité moyenne est passée à 95,2% avec un écart type de 1,13.
- 4- L'état du Nouveau-Mexique a recyclé à froid une couche de 75 mm de BB en utilisant un train de recyclage composé de: une fraiseuse Rota Mill-1000 tirant un concasseur derrière lequel est attaché une usine d'enrobage à froid (Pug mill) qui met le mélange en andain lequel est ramassé par un élévateur spécial installé devant une finisseuse (paver). La production horaire de ce train est de 350 T/h. Une émulsion HF 150 est utilisée au tout, de 1 à 1,25% de bitume résiduel. Le compactage se fait à 300 m derrière la finisseuse pour laisser évaporer l'eau suffisamment. Cette procédure permet d'économiser environ \$4.00/v<sup>2</sup> (\$7,12/v<sup>2</sup> comparativement à \$11,00/v<sup>2</sup> par la méthode usuelle de SAMI pour réduire les fissures de réflexions). Le mélange recyclé a une stabilité Marshall à 22°C qui varie de 8,9 KN à 33,4 KN après 7 jours de curage à 22°C.
- 5- L'institut de recherche en ingénierie de l'université du Nouveau-Mexique a fabriqué deux vidéo: un sur le procédé de recyclage à froid décrit en 4 et une sur la fracturation et l'assise des dalles de béton avant recouvrement. M. Dale Decker, de cet institut, a promis de m'envoyer ces deux vidéo et les frais ne seront que le coût d'une vidéo-cassette.

- 6- Une extraction par stage a montré que le bitume sur le granulat a une distribution variable de sa consistance: la microcouche de surface est sévèrement durcie, alors que la seconde couche l'est moins et que la couche en contact avec le granulat retient la même consistance qu'au moment de la construction du revêtement bitumineux. Les agents de rajeunissement AC-25, AE-150 et Mobisol-30 sont plus effectifs pour ramollir le bitume durci des deux microcouches extérieures.
- 7- Le coulis de chaux hydraté est le meilleur agent pour réduire le désenrobage dans les mélanges bitumineux. Le ciment et la chaux hydrate sèche n'améliore pas beaucoup la résistance au désenrobage.
- 8- L'addition de Ethylène - Vinyle - Acétate au bitume produit des mélanges avec une résistance à la fatigue accrue. L'ajout de 50% de soufre est deuxième pour l'augmentation de cette résistance suivi de l'addition de caoutchouc au bitume, et en dernier lieu, les fibres de polypropylène.
- 9- Un mélange bitumineux satisfaisant peut-être produit avec une teneur de 20% de rebut de toiture, si le choix du bitume et de la granulométrie des granulats est fait judicieusement.
- 10- La profondeur d'ornièrre augmente avec l'épaisseur de la couche de béton bitumineux posé sur le béton de ciment. Le taux d'orniérage est fort durant la première année de service puis il décroît avant d'augmenter de nouveau après que le trafic a complètement compacté le milieu de l'ornièrre.
- 11- L'appareil nucléaire Troxler 3241 permet de déterminer la teneur en bitume sur deux briquettes Marshall avec une erreur maximale de  $\pm 0,1\%$ .
- 12- Selon le Texas, une couche d'usure antidérapante à granulométrie ouverte (Open-Graded Friction Course) doit avoir 8 à 10% passant le 2 mm, 2 à 3% passant le 80  $\mu$ m et un vide d'environ 15%. Pour évaluer les caractéristiques de surface de l'OFC l'essai au sable n'est pas valable, c'est l'essai du mastic (putty) qui est le meilleur. L'OFC est très antidérapant à toute vitesse à condition qu'il ne soit pas recouvert d'eau car alors il devient glissant s'il est recouvert de 1.8 mm d'eau et plus. L'ajout de silicone aide à placer ce genre de mélange. La vie normale d'un OFC est de 6 à 12 ans selon le trafic (100 à 200 millions de passages).

- 13- La Californie utilise les OFC depuis 40 ans. On ne peut poser un OFC sur un vieil OFC, il faut l'enlever par fraisage à froid avant. C'est un grade plus dur de bitume qui est utilisé pour les OFC par rapport aux mélanges denses. La grosseur maximale de la pierre est de 12.5 mm, le maximum passant le 80  $\mu\text{m}$  est le 3% et ce revêtement ne se pose jamais à des températures inférieures à 21°C. Quant à la Georgie, elle a posé plus de 3000 Km de OFC depuis 1970. En 1982, elle a débuté l'ajout de chaux hydratée pour empêcher le dégenrobage. Le taux de pose utilisé est de 33 Kg/m<sup>2</sup>. Le Nouveau-Mexique utilise les OFC depuis la fin des années 50. La granulométrie est de 90 à 100% passant le 10 mm, 0 à 10% passant le 2 mm. La température du mélange est en moyenne 115°C et se pose jamais à une température ambiante inférieure à 15°C. Pour empêcher l'arrachement, il est préférable d'utiliser un bitume polymère comme le Styrelf. Le Michigan pose des OFC depuis 1973 au taux de 55 Kg/m<sup>2</sup>. Le Montana en pose depuis 1975 (encore en service) avec la granulométrie suivante: 10  $\mu\text{m}$  - 100%, 5  $\mu\text{m}$  - 30 à 40%, 2.25  $\mu\text{m}$  - 5 à 15%, 80  $\mu\text{m}$  - 2 à 5% passant. La chaux hydratée est incorporée et un liant d'accrochage est utilisé. L'Ontario en pose depuis 1976 et a remarqué une diminution des accidents sous la pluie de 40%.
- 14- En Illinois on a trouvé une bonne corrélation ( $R^2=0,82$ ) entre l'orniérage et le pourcentage passant le 400  $\mu\text{m}$  et retenu le 175  $\mu\text{m}$  ainsi que la déviation du passant le 400  $\mu\text{m}$  par rapport à la courbe de la puissance 0,45.
- 15- En Californie un béton polymère de 19 mm d'épaisseur avec une pierre 9.5 mm de grosseur maximale a été posé sur des surfaces usées par les chaînes. Ce revêtement est ouvert au trafic après 12 heures de mûrissement.
- 16- Dans les mélanges au bitume - caoutchouc la granulométrie doit être modifiée pour allouer de l'espace aux particules de caoutchouc. Le design du mélange peut se faire par la méthode Marshall à condition que le compactage de briquettes se fasse à 190°C. La teneur en caoutchouc par rapport au bitume est de 15 à 18%.
- 17- Le mélange au bitume moussé avec sable contenant plus de 5% passant le 80  $\mu\text{m}$  est plus résistant à l'orniérage en couche de base que les stabilisations à chaud de sable.

- 18- La bombe d'oxydation sous pression est très valable pour simuler l'oxydation du bitume et des mélanges bitumineux. Le point de fragilité Fraas est un bon indicateur de la mesure du taux de vieillissement du bitume.
- 19- Au Texas, une usine expérimentale de recyclage du béton bitumineux, à chaud par micro ondes est en fonction. Cette usine permet de recycler à 100% et d'éliminer l'excès de fines du vieux béton bitumineux concassé. Le coût d'usage est présentement de \$13 US la tonne.
- 20- Maidzadeh a développé un nouveau modèle de prédiction des fissures de réflexions induites par la variation de température.
- 21- Le bitume AR-2000 ( $\sim$  85-200) additionné de Carbon Black (environ 20%) se comporte à basse température comme un AR-2000 mais à haute température comme un AR-8000 ( $\sim$  60-70). Un tel bitume modifié peut servir à améliorer les mélanges faits avec des granulats de moins bonne qualité.
- 22- Le latex SBR est l'additif qui augmente le plus le PVN du bitume, donc qui réduit le plus sa susceptibilité à la température: les autres additifs étudiés sont le SBS Kraton de Shell, l'Ethylène Vinyle Acétate, le Polyéthylène de Novophalt et le Carbon Black. De plus le SBR réduit l'oxydation du bitume alors que les SBS, le Polyéthylène et le Carbon Black durcissent le bitume encore plus lorsqu'entreposé à 175°C pendant 48 heures.
- 23- Le gauchissement du béton sous l'effet des différentiels de température provoquent la réflexion des fissures dans les revêtements bitumineux qui recouvrent les dalles de béton.
- 24- L'Orégon a construit, en 1985, 10 sections expérimentales de route pour évaluer 7 additifs différents et deux combinaisons de deux additifs dans le mélange bitumineux (Plus Ride 12, Arm-R-Shield, Fiber Pave, BoniFibers, Pave Bond, Lime, Polymer, Pave Bond + Lime, Polymer + Lime).

### 3.3.3. Documentation recueillie

L'annexe B fournit les titres des exposés, des conférences et des documents techniques recueillis en plus de ceux marqués d'un astérisque \* en annexe A avec la liste des thèmes abordés.

### 3.4 Liste des personnes assistant aux réunions

Plus de 1500 personnes assistaient aux différentes réunions et aucune liste n'était disponible. Seule la liste des conférenciers était disponible et elle est présentée en annexe C.

## 4.0

NATURE DE MA PARTICIPATION1. Sessions techniques et comités

J'ai posé des questions ou fait des commentaires sur la plupart des conférences et ateliers des différents comités où j'ai assisté (A 2 F 0 6, A 2 F 0 2, A 2 D 01, A 2 D 04, A 2 D 01).

J'ai proposé que la compacité de revêtements bitumineux soit déterminée de la même façon par tout le monde; soit par rapport à la densité maximale Rice. J'ai été appuyé par Tom Kennedy du Texas et E.R. Brown du US corps of Engineers.

2. Réunion des coordonnateurs SHRP.

Dimanche, de 8h.30 à 17h00, à titre de coordonnateur québécois du SHRP, j'ai participé à cette réunion.

J'y ai posé plusieurs questions afin d'obtenir des éclaircissements entre autres sur les sections SPS.

J'ai de plus proposé l'organisation, par chaque coordonnateur, de colloques d'information sur le programme SHRP dans chaque état ou province, en mentionnant que j'avais déjà débuté cela au Québec et que c'était très bien accueilli. L'agenda de la réunion est présenté en annexe D.

3. Souper de la francophonie

J'ai organisé un souper le jeudi soir pour permettre aux francophones assistants au TRB de se rencontrer et d'échanger: 5 français et 4 québécois y ont participé. De plus en demandant à M. Harry Smith du TRB une recommandation pour un restaurant, celui-ci nous a invité à une dégustation de vin à sa suite, et nous a accompagné avec deux de ses employés au restaurant. Cela a permis des échanges fructueux et la création de liens amicaux avec mon collègue de France.

## 5.0

POINTS D'INTERET POUR LE MTQ

Tous les faits techniques énumérés dans le résumé des conférences et des discussions sont d'un intérêt pour le MTQ. Les points suivants sont d'un intérêt peut-être plus marqué.

- 1- Le MTQ devrait avoir une exigence spéciale sur la densité des joints.
- 2- La chaux hydratée devrait être utilisée dans les mélanges bitumineux en Abitibi car du désenrobage y a été décelé.

- 3- Le MTQ devrait se procurer de nouveaux appareils nucléaires Troxler pour déterminer la densité des couches minces.
- 4- Le MTQ devrait utiliser plus les OFC pour des couches d'usure sur autoroutes (Voir 12 et 13 de l'article 3.3.2).
- 5- Un essai du mélange mince au béton polymère devrait être fait par le MTQ sur une section expérimentale de route en béton.

6.0

#### AUTRES INFORMATIONS

En résumé, cette réunion a été l'objet d'échanges très fructueux pour tous les participants grâce aux très bonnes dispositions matérielles mises à leur service. La prochaine réunion annuelle se tiendra à Washington en janvier 1988, et elle méritera elle aussi que le Québec y délègue des représentants, non seulement pour acquérir de nouvelles connaissances, mais aussi pour faire profiter aux autres ses propres connaissances. De plus, les personnes déléguées devraient avoir une bonne connaissance de l'anglais, des connaissances techniques importantes et une aisance à parler en public afin d'y faire valoir le point de vue du Québec et de faire bénéficier les autres des techniques développées au Québec. Le TRB est le congrès où les principales recherches en Amérique dans le domaine des transports et des infrastructures du transport sont présentées. Il serait donc très important que les différents secteurs soient couverts par un spécialiste dans le domaine. Pour ce faire, le MTQ devrait déléguer à chaque année au TRB les spécialistes suivants:

| Domaine                     | Service concerné                                   |
|-----------------------------|----------------------------------------------------|
| 1- Béton Bitumineux :       | Laboratoire Central                                |
| 2- Béton de Ciment :        | Laboratoire Central                                |
| 3- Mécanique des chaussées; | Sols et Chaussée                                   |
| 4- Collectes de données :   | Relevés Techniques                                 |
| 5- Transport                |                                                    |
| 6- Recherches en général :  | Direction de la Recherche<br>et Coordonnateur SHRP |
| 7- Equipement et Opération: | Direction des Opérations                           |



**ANNEXE A**

**LISTE DES THEMES ABORDES**

No. SESSION

Nom de celui qui a

le texte de la conférence.

2

Monday, 9:00 a.m., Rockville Room, Sheraton  
CONCRETE AND CONCRETE CONSTRUCTIONCharles F. Scholer, Purdue University, pre-  
siding(Sponsored by Committees on Performance of Concrete,  
on Chemical Additions and Admixtures for Concrete, and  
on Rapid Pavement Construction and Rehabilitation)Papers:\* THE RELATIONSHIP OF FERROUS DOLOMITE AGGREGATE TO RAPID  
CONCRETE DETERIORATION, Wendell Dubberke and Vernon  
J. Marks, Iowa Department of TransportationSULFATE IMPURITIES FROM DEICING SALT AND DURABILITY OF  
PORTLAND CEMENT MORTAR, Myron C. Schuler, John A.  
Pitt, and Dah-Yinn Lee, Iowa State University\* MOISTURE RETENTION TESTS AND AGITATION FOR MEMBRANE-  
FORMING CURING COMPOUNDS FOR PORTLAND CEMENT CON-  
CRETE, A.E. Meyer, Matthew D. Loeffler, Chryssis G.  
Papaleontiou, and D.W. Fowler, University of Texas at  
AustinFIELD EVALUATION OF CONCRETE PAVEMENT CONSOLIDATION,  
Shiraz D. Tayabji and David A. Whiting, Construction  
Technology LaboratoriesFIELD EVALUATION OF DOWEL PLACEMENT IN CONCRETE PAVI-  
MENTS, Shiraz D. Tayabji and Paul A. Oramoto, Con-  
struction Technology Laboratories

Daniel Vézina

(1, 2)

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71

Tuesday, 9:00 a.m., South Cotillion Room,  
SheratonRobert McGennis, Asphalt Institute, presiding  
(Sponsored by Committee on Flexible Pavement Construc-  
tion and Rehabilitation)Papers:\* CORRELATION OF NUCLEAR DENSITY RESULTS WITH CORE  
DENSITIES, James L. Burati, Jr., Clemson University  
and George B. Elzoghbi, Crawford and Russell, Inc.\* A NUCLEAR DENSITY GAUGE FOR THIN OVERLAYS OF ASPHALT  
CONCRETE AND PORTLAND CEMENT, Ali Regimand, Troxler  
Electronic Laboratories, Inc.\* STUDY OF JOINT DENSITIES IN BITUMINOUS AIRPORT PAVE-  
MENTS, James L. Burati, Jr., and George B. ElzoghbiPresentation:FIELD EVALUATION OF ASPHALT MIXTURE DENSITIES IN TEXAS,  
Thomas W. Kennedy, University of Texas at AustinPaper:\* IN SITU COLD RECYCLING, Douglas I. Ranson, New Mexico  
State Highway Department, and Robert Williams, Santa  
Fe, New Mexico

Richard Langlois

(3, 4, 5)

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(418) 872-1107 (Res.)Richard Langlois, Ing. M.Sc.  
Chef de la Division Matériaux

Monday, 8:00 p.m., Wilmington Room, Sheraton

Vytautas J. Puzinauskas, Asphalt Institute, President

(Sponsored by Committees on Characteristics of Bituminous Materials and on Characteristics of Nonbituminous Components of Bituminous Paving Mixtures)

Papers:

- 1 EVALUATION OF ASPHALT CEMENTS FOR LOW-TEMPERATURE PERFORMANCE, S.C. Leung and R.O. Anderson, University of Alberta, Canada
- 6 \* REJUVENATOR DIFFUSION IN BINDER FILM FOR HOT-MIX RECYCLED ASPHALT PAVEMENT, A. Samy Mourseldin and Leonard E. Wood, Purdue University
- 7 \* ANTISTRIP ADDITIVES: A FIELD PERFORMANCE STUDY, John S. Coplanitz and Jon A. Epps, University of Nevada, and Leo Quilica, Nevada Department of Transportation
- 8 \* FOUR VARIABLES AFFECTING THE PERFORMANCE OF LIME IN ASPHALT-AGGREGATE MIXTURES, Mary Stroup-Gardiner, Herb Waite, and Jon A. Epps, University of Nevada
- 9 \* THE EFFECT OF ADDITIVES ON BITUMINOUS HIGHWAY PAVEMENT MATERIALS EVALUATED BY THE INDIRECT TENSILE TEST, F. Rafati-Afsar and R.J. Salter, University of Bradford, England
- 10 \* ROOFING WASTE IN ASPHALT PAVING MIXTURES, Greg L. Paulsen, Mary Stroup-Gardiner, and Jon A. Epps, University of Nevada

53

Monday, 8:00 p.m., South Cotillion Room, Sheraton

PAVEMENT REHABILITATION USING CONCRETE

Theodore L. Neff, Concrete Reinforcing Steel Institute, presiding

(Sponsored by Committees on Rigid Pavement Construction and Rehabilitation and on Pavement Rehabilitation)

Papers:

- 1 MONTANA'S EXPERIENCE WITH AND STRATEGIES FOR CONCRETE PAVEMENT REHABILITATION, John C. Elberg, Montana Department of Highways
  - 11 \* DRAINCRETE IN PAVEMENT REHABILITATION, Torbjorn J. Larsen and Jamshid M. Armoeghani, Florida Department of Transportation
  - 12 \* FIELD PERFORMANCE OF BONDED CONCRETE OVERLAYS, Gerald F. Voigt, Michael I. Darter, and Samuel E. Carpenter, University of Illinois at Urbana-Champaign
  - 13 \* CONSTRUCTION OF A THIN-BONDED PORTLAND CEMENT CONCRETE OVERLAY IN SOUTH DAKOTA, Daniel P. Johnston, South Dakota Department of Transportation
- Presentation:
- COMPARISON OF CONCRETE PAVEMENT REHABILITATION TECHNIQUES IN OHIO DEMONSTRATION PROGRAM, Samir Majidzadeh, A. Abdulshafi, and K. Kaloush, Resource International, Inc., and Kenneth M. Miller, Ohio Department of Transportation
- UTAH'S EXPERIENCE WITH WHITETOPPING, Douglas L. Anderson, Utah Department of Transportation

54

Monday, 8:00 p.m., Colorado Room, Sheraton

GEOTECHNICAL ENGINEERING

J. Allan Tice, Law Engineering Testing Company, presiding

(Sponsored by Committees on Mineral Aggregates, on Transportation Earthworks, on Foundations and Bridges and Other Structures, and on Exploration and Classification of Earth Materials)

Papers:

- 14 \* RELIABILITY OF THE DIMETHYLSULFOXIDE (DMSO) ACCELERATED WEATHERING TEST TO PREDICT DEGRADATION OF AGGREGATES, Tom Symonist, Pavement Services, Inc.; Ted S. Vinson, Oregon State University; and James E. Wilson, Oregon Department of Transportation
  - 15 \* AN IMPROVED CALIFORNIA BEARING RATIO TEST PROCEDURE, Colin A. Franco, Rhode Island Department of Transportation, and Lang-Won Wayne Lee, University of Rhode Island
- COHESIONLESS SOIL PARAMETERS IN LATERAL DIRECTION RELATED TO FLAT-DILATOMETER DATA, E. Sabri Motan, Bradley University, and Brian J. Jacot, Fred C. Bart Associates, Inc.

texte de la conférence.

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Guy Dallaire, Ing.  
Chef, division des sols et granulats

No. SESSION

Nom de celui qui a le

texte de la conférence.

**94** Tuesday, 2:00 p.m., Alexandria Room, Sheraton  
A RESEARCH POTPOURRI

Kenneth A. Brewer, Iowa State University,  
presiding

(Sponsored by Committees on Conduct of Research; on  
Structures Maintenance; on Pavement Maintenance; and  
on Adhesives, Bonding Agents and Their Uses)

Papers:

POSTERING INNOVATION IN THE STRATEGIC HIGHWAY RESEARCH  
PROGRAM, William A. Hyman, ARE, Inc.

COST-EFFECTIVENESS ANALYSIS FOR STRENGTHENING EXISTING  
BRIDGES, Terry J. Wipf, Donald L. Erickson, and F.  
Wayne Klaiber, Iowa State University

\* RUTTING OF ACP OVERLAYS ON CRCP IN THE STATE OF TEXAS,  
C.L. Barai, B. Frank McCullough, and M.P. Aslam,  
University of Texas at Austin

STATIC AND REPEATED LOAD TESTING OF POLYMER MODIFIED  
MATERIALS, George Kelsey and Manmay Biswas, Duke  
University

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Richard Langlois, Ing. M.Sc.  
Chef de la Division Matériaux

**98** Tuesday, 2:00 p.m., Washington Ballroom,  
Sheraton

## PAVEMENT MARKING

Blaine Himmelman, Minnesota Department of  
Transportation, presiding

(Sponsored by Committee on Coatings, Signing and Marking  
Materials)

Presentation:

PAVEMENT MARKINGS: PERFORMANCE AND QUALITY CONTROL,  
Philip O. Russell, Federal Highway Administration

A NEW LOW-COST PORTABLE RETROREFLECTOMETER, James  
Kalchbrenner, Potters Industries Inc.

A NEW LASER RETROREFLECTOMETER, Justin J. Reinnilson,  
Retro-Tec

Papers:

\* THE DETERMINATION OF LIFE-CYCLE COSTS OF PAVEMENT MARK-  
ING MATERIALS, John Jewett Benry, Charles E. Antle,  
and Joseph L. Carroll, Pennsylvania State University

\* TRAFFIC PAINT PERFORMANCE IN ACCELERATED WEAR TESTS,  
James E. Bryden and Ronald A. Lorini, New York State  
Department of Transportation

## MEASURES OF SNOWPLOWABLE RAISED PAVEMENT MARKER

REFLECTOR WEAR, Sanat N. Bhavsar, New Jersey Depart-  
ment of Transportation

Presentation:

WET NIGHT THERMOPLASTIC STUDY IN GEORGIA, Charles W.  
Niessner, Federal Highway Administration

Jean-Claude Hébert

MINISTÈRE  
DES TRANSPORTS  
LABORATOIRE  
CENTRAL

COMPLEXE SCIENTIFIQUE  
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G1P 3W6  
TÉL. BUR (418) 643-3178

JEAN-CLAUDE HÉBERT, CHIM. P.  
CHEF DE LA DIVISION  
CHIMIE

\* Texte recueilli

## No. SESSION

115

Nom de celui qui a le

texte de la conférence

Thursday, 8:00 p.m., Annapolis Room, Sheraton  
 James S. Moulthrop, Exxon Chemical Company,  
 presiding  
 (Sponsored by Committee on Quality Assurance and Acceptance Procedures)

Paper:

SPECIFICATIONS FOR QUALITY CONTROL: A CASE STUDY, Claude Gentry, Byrd, Tallamy, MacDonald and Lewis, and William A. Trjanson, American Concrete Pavement Association

19 \* GARBAGE IN: GARBAGE OUT: Richard L. Davis, Roppers Company, Inc.

ELEMENTS OF A FRAMEWORK FOR THE DEVELOPMENT OF PERFORMANCE-RELATED MATERIALS AND CONSTRUCTION SPECIFICATIONS, Paul E. Irick, Hampton, Virginia

20 \* USE OF MARSHALL SPECIMENS IN A NUCLEAR ASPHALT CONTENT GAUGE, James L. Burati, Jr., and Hoke S. Bill, Jr., Clemson University, and Thomas E. Freeman, William F. Freeman Associates

Presentation:

PRECISION AND REPEATABILITY OF THE LOTTMAN AND MODIFIED LOTTMAN PROCEDURES, Ervin L. Dukatz, Jr., Vulcar Materials Company

STATISTICAL EVALUATION OF THE SELECTION OF SAMPLING LOCATIONS FOR UNBOUND AGGREGATE, David A. Anderson, and Charles E. Antle, Pennsylvania State University, and K. Gill Shaw, John Portman and Associates

Richard Langlois

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Richard Langlois, Ing. M.Sc.  
 Chef de la Division Matériaux

119

TAPE

Tuesday, 8:00 p.m., Wilmington Room, Sheraton  
 James A. Scherocman, Scherocman Associates,  
 presiding  
 (Sponsored by Committee on Characteristics of Bituminous-Aggregate Combinations to Meet Surface Requirements)

Paper:

21 \* USE OF FRICTION COURSE MIXES IN ONTARIO, Kai K. Tan and Daniel F. Lynch, Ontario Ministry of Transportation and Communications, Canada

22 \* THE DEVELOPMENT OF SPRAY-REDUCING MACADAM ROAD SURFACINGS IN UNITED KINGDOM, 1967-1987, D.M. Colwill and M.E. Daines, Transport and Road Research Laboratory, England

✓ OPEN GRADED FRICTION COURSES IN TEXAS: SPECIFICATIONS, DESIGN, CONSTRUCTION, AND MAINTENANCE, Bob M. Gallaway, David A. Bass, Kenneth W. Faults, and Charles B. Little, Texas A&M University System

Presentations--STATE VIEW:

CALIFORNIA, Raymond A. Forsyth, California Department of Transportation

GEORGIA, William T. Stapler, Georgia Department of Transportation

NEW MEXICO, Douglas I. Banson, New Mexico Highway Department

MICHIGAN, Fred Copple, Michigan Department of Transportation

MONTANA, Don M. Barriott, Montana Department of Highways

OREGON, Robert Blensly, Oregon Department of Transportation

Richard Langlois

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Richard Langlois, Ing. M.Sc.  
 Chef de la Division Matériaux

\* Texte recueilli

No. SESSION

Nom de celui qui a le

**129** Wednesday, 9:00 a.m., Rockville Room, Sheraton  
**RIGID PAVEMENT**  
 John F. Janiewski, Arizona State University,  
 President:

(Sponsored by Committees on Rigid Pavement Design, or  
 Rigid Pavement Construction and Rehabilitation, and on  
 Pavement Rehabilitation)

**Paper:**  
**NINE-YEAR PERFORMANCE EVALUATION OF ARIZONA'S PRE-  
 STRESSED CONCRETE PAVEMENT**, Richard L. Powers and  
 John F. Janiewski, Arizona State University  
**PEACONE III COMPUTER PROGRAM FOR AN ANALYSIS OF JOINTED  
 CONCRETE PAVEMENTS**, Wang Tia, Chung-Lung Wu, Sha-  
 lei, and Kevin L. Toyt, University of Florida, and  
 Jamsnid M. Armaghani, Florida Department of Trans-  
 portation  
**TRICKNESS DESIGN OF ROLLER-COMPACTED CONCRETE PAVEMENT**,  
 Shiraz D. Tayadji, Construction Technology Labora-  
 toires, and David J. Halpenny, Portland Cement Asso-  
 ciation

**ENGINEERING PROPERTIES OF ROLLER-COMPACTED CONCRETE**,  
 Shiraz D. Tayadji and Paul A. Casamato, Construction  
 Technology Laboratories  
**EFFECT OF CONCRETE OVERLAY DEBONDING ON PAVEMENT PER-  
 FORMANCE**, Thomas Van Dae, M.Y. Soanin, and Eleandro  
 Blackmon, U.S. Army Construction Engineering Re-  
 search Laboratories

Daniel Vézina (22)

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 Ministère des Transports  
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**Daniel Vézina, ing.**  
 Division Matériaux

135

Wednesday, 9:00 a.m., South Cotillion Room,  
 Sheraton  
**HERBERT I. SOUTHGATE, University of Kentucky,**  
 President:  
 (Sponsored by Committee on Flexible Pavement Design)

**Paper:**  
**FIELD ANALYSIS OF RUTTING IN OVERLAYS OF CONCRETE INTER-  
 STATE PAVEMENTS IN ILLINOIS**, Samuel E. Carpenter and  
 Lynn Erickson, University of Illinois at Urbana-  
 Champaign

**DELINEATING ZONES OF DETERIORATION AND SEASONAL CHANGES  
 IN MODULUS PROFILES OF SECONDARY ROADS WITH THE RASH-  
 METHOD**, Scheil Nazarian and Kenneth E. Stokoe II,  
 University of Texas at Austin, and Robert C. Briggs,  
 Texas State Department of Highways and Public Trans-  
 portation

**ANALYSIS OF AXLE LOADS AND AXLE TYPES FOR THE EVALUATION  
 OF LOAD LIMITS ON FLEXIBLE PAVEMENTS**, Emmanuel G.  
 Fernando and David R. Lutz, Pennsylvania State Uni-  
 versity, and Bari K. Saxena, Jaipur Department of  
 Public Works, India

**RELIABILITY OF THE FLEXIBLE PAVEMENT DESIGN MODEL**, John  
 C. Potter, U.S. Army Engineer Waterways Experiment  
 Station

**DYNAMIC RESPONSE OF PAVING MATERIALS**, Jorge B. Sousa and  
 Carl L. Monismith, University of California, Berkeley

**ANALYTICAL EVALUATION OF VARIABLES AFFECTING SURFACE  
 MAINTENANCE OF PAVEMENTS**, Ignacio Sanchez-Salvador,  
 Jose M. Moeset, Glenn J. Rix, and Kenneth E. Stokoe  
 II, University of Texas at Austin, and Ho-Young Shao,  
 Marza Engineering Company

Richard Langlois (24)

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**Richard Langlois, Ing. M.Sc.**  
 Chef de la Division Matériaux

\* Texte recueilli

**Wednesday, 8:00 p.m., Baltimore/Annapolis Room, Sheraton**

**M. Paul Knoke, North Carolina State University, presiding**

(Sponsored by Committees on Characteristics of Bituminous Materials and on Bituminous Paving Mixtures To Meet Structural Requirements)

Nom de celui qui a le

texte de la conférence.

Richard Langlois (25 à 28)

- 25 **\* Paper:**  
FAA MIXTURE DESIGN PROCEDURE FOR ASPHALT-RUBBER CONCRETE, Fredov L. Roberts, Auburn University, and Robert L. Lytton, Texas A&M University System
- 26 **\* STRUCTURAL RESPONSE OF FOAMED ASPHALT SAND MIXTURES IN HOT ENVIRONMENTS, Amir F. Bissada, Kuwait University**  
USE OF CLIMATIC DATA FOR THE ASSESSMENT OF RUTTING POTENTIAL, Mikael P.J. Olsen, Jun Li, and Dallas K. Little, Texas A&M University System
- 27 **\* EVALUATION OF INDIRECT TENSILE TESTS FOR ASSESSING STRIPPING OF ALABAMA ASPHALT CONCRETE MIXES, Frazier Parker and Fouad A. Gharaibeh, Auburn University**
- 28 **\* DEVELOPMENT OF LABORATORY OXIDATIVE AGING PROCEDURES FOR ASPHALT CEMENTS AND ASPHALT MIXTURES, Ok-lee Kim and Chris A. Bell, Oregon State University, and James E. Wilson and Glenn Boyle, Oregon Department of Transportation**
- HOT-MIX RECYCLING WITH MICROWAVE HEATING, James A. Scherocman, Scherocman Associates, and Robert E. Nath, C D High Technology, Inc.**

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Richard Langlois, Ing. M.Sc.  
Chef de la Division Matériaux

**Thursday, 9:00 a.m., Baltimore Room, Sheraton**  
**Committee on Pavement Rehabilitation**  
Gordon W. Beecroft, Oregon Department of Transportation, presiding  
(Sponsored by Committee on Pavement Rehabilitation)

Richard Langlois

- Papers:**  
SUBSEALING AND LOAD TRANSFER RESTORATION, Ronald J. Mcman and Mohamed Y. Shahin, ERES Consultants, Inc.
- 29 **\* DEVELOPMENT OF A DEMONSTRATION PROTOTYPE EXPERT SYSTEM FOR CONCRETE PAVEMENT EVALUATION, Kathleen T. Hall, Michael I. Darter, Samuel B. Carpenter, and James M. Connor, University of Illinois at Urbana-Champaign**  
NUMERICAL ASSESSMENT OF PAVEMENT TEST SECTIONS, T. Krauthammer and H. Kharlarsadeh, University of Minnesota
- DEVELOPMENT OF A DISTRESS INDEX AND REHABILITATION CRITERIA FOR CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS USING DISCRIMINANT ANALYSIS, B. Frank McCullough and Chia-Pei Chou, University of Texas at Austin**
- A MECHANISTIC MODEL FOR THERMALLY INDUCED REFLECTION CRACKING OF PORTLAND CEMENT CONCRETE PAVEMENT WITH REINFORCED ASPHALT-CONCRETE OVERLAY, Samir Majidzadeh and A. Abdulshafi, Research International, Inc., and Aston McLaughlin, Federal Aviation Administration**
- NEW MEXICO STUDY OF INTERLAYERS USED IN REFLECTIVE CRACK CONTROL, Virginia M. Lorenz, New Mexico State Highway Department**

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Chef de la Division Matériaux

\* Texte recueilli

## No. SESSION

**200** Thursday, 9:00 a.m., Wilmington Room, Sheraton  
**ENVIRONMENTAL EFFECTS ON PAVEMENTS, PART 1: TEMPERATURE**  
 Byron E. Ruth, University of Florida, presiding  
 (Sponsored by Committee on Strength and Deformation:  
 Characteristics of Pavement Sections)

Paper:

PROCEDURES FOR ESTIMATION OF ASPHALT-CONCRETE PAVEMENT  
 MODULI AT IN SITU TEMPERATURES, Kwasi Badu-Tweneboah,  
 Manu Tia, and Byron E. Ruth, University of Florida  
 STRESS CAUSED BY TEMPERATURE GRADIENTS IN PORTLAND  
 CEMENT CONCRETE PAVEMENTS, Joseph M. Richardson,

McNeese State University, and Jamshid M. Armeqhani,  
 Florida Department of Transportation

CHARACTERIZING TEMPERATURE EFFECTS FOR PAVEMENT

ANALYSIS AND DESIGN, Marshall R. Thompson, Barry J.  
 Dempsey, and H. Bill, University of Illinois at  
 Urbana-Champaign, and J. Vogel, Illinois State Water  
 Survey

30 \* **TEMPERATURE RESPONSE OF CONCRETE PAVEMENTS**, Jamshid M.  
 Armeqhani, Torbjorn J. Larsen, and Lawrence L. Smith,  
 Florida Department of Transportation  
**AN EXAMINATION OF ENVIRONMENTAL VERSUS LOAD EFFECTS ON**  
**PAVEMENTS**, W. K. Hudson, University of Texas at  
 Austin, and Patricia E. Flanagan, ARL, Inc.

## TAP: 201

Thursday, 9:00 a.m., North Cotillion Room,  
 Sheraton

SYMPOSIUM ON SOME ASPECTS OF ASPHALT PAVINGTHE EFFECTS OF MODIFIED ASPHALT MIXTURES

B.A. Vallerqa, B.A. Vallerqa, Inc., presiding  
 (Sponsored by Committee on Characteristics of Bituminous  
 Paving Mixtures To Meet Structural Requirements)

Presentation:

PHYSICAL PROPERTIES OF ASPHALT MIXTURES CONTAINING  
 MODIFIED BINDERS, Carl L. Monismith, University of  
 California, Berkeley  
 EFFECT OF POLYMER MODIFIERS ON MIXTURE PROPERTIES, R.D.  
 Pavlovich, T.S. Shuler, J.H. Collins, and M. O'Leary,  
 University of New Mexico  
 EFFECTS OF POLYMERIC ADDITIVES ON ASPHALT MIXTURE  
 PROPERTIES, Dallas N. Little and Joseph W. Button,  
 Texas A&M University System  
 EFFECTS OF SELECTED ASPHALT ADDITIVES ON ASPHALT-  
 CONCRETE STRUCTURAL RESPONSES, Dallas N. Little,  
 Jamil Ahmed, and Joseph W. Button, Texas A&M Uni-  
 versity System

31 \* Paper:  
**PERFORMANCE COMPARISONS OF POLYMER MODIFIED AND UN-**  
**MODIFIED ASPHALT-CONCRETE MIXTURES**, Samuel E.  
 Carpenter and Thomas Van Dam, University of Illinois  
 at Urbana-Champaign

## 213

Thursday, 2:00 p.m., Rockville Room, Sheraton

Freddie L. Roberts, Auburn University,  
 presiding

(Sponsored by Committee on Monitoring, Evaluation and  
 Data Storage)

Paper:

FACTOR ANALYSIS OF PAVEMENT DISTRESSES FOR SURFACE  
 CONDITION PREDICTIONS, J.J. Bajek, Ontario Ministry  
 of Transportation and Communications, and Ralph C.G.  
 Baas, University of Waterloo, Canada

PRESENT SERVICEABILITY-ROUGHNESS CORRELATIONS USING  
 RATING PANEL DATA, Raymond E. Moore, University of  
 Kansas, and G. Norman Clark and Gary N. Plumb, Kansas  
 Department of Transportation

ESTIMATING THE LIFE OF ASPHALT OVERLAYS USING LONG-  
 TERM PAVEMENT PERFORMANCE DATA, J.J. Bajek, William  
 A. Phang, and A. Prakash, Ontario Ministry of  
 Transportation and Communications, Canada

32 \* **DEVELOPMENT OF A UTILITY EVALUATION FOR NONDESTRUCTIVE**  
**TESTING EQUIPMENT USED ON ASPHALT-CONCRETE PAVE-**  
**MENTS**, Shelly M. Stoffels, ERES Consultants, Inc.,  
 and Robert L. Lytton, Texas A&M University System  
**VIDEO IMAGE DISTRESS ANALYSIS TECHNIQUE FOR THE IDAHO**  
**TRANSPORTATION DEPARTMENT PAVEMENT MANAGEMENT**  
**SYSTEM**, Jim Baker and Basil Dahlstrom, VideoComp,  
 and Keith Longenecker and Tri Buu, Idaho  
 Transportation Department

Nom de celui qui a le  
 texte de la conférence.

Daniel Vézina

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Richard Langlois, Ing. M.Sc.  
 Chef de la Division Matériaux

## No. SESSION

**215** Thursday, 2:00 p.m., Wilmington Room, Sheraton  
**ENVIRONMENTAL EFFECTS ON PAVEMENTS, PART 2: WATER**  
 Robert L. Lutton, Texas A&M University  
 System, presiding  
 (Sponsored by Committees on Strength and Deformation;  
 Characteristics of Pavement Sections, on Subsurface  
 Drainage, and on Environmental Factors Except Frost,

Papers:

**MOISTURE IN PORTLAND CEMENT CONCRETE**, Donald J. Janssen,  
 University of Washington

**THE EFFECT OF RAINFALL ON THE PERFORMANCE OF RIGID  
 PAVEMENTS IN TEXAS**, C.L. Saraf, Chia-Pei Chou, and  
 B. Frank McCullough, University of Texas at Austin  
**THE EFFECT OF MOISTURE ON THE STRUCTURAL PERFORMANCE OF  
 GRANULAR ROAD BASES**, M.B. Tonn and Stephen F. Brown,  
 University of Nottingham, England  
**WATER-INDUCED FLEXIBLE PAVEMENT DISTRESSES IN A WET  
 TROPICAL CLIMATE**, Tien-Pang Fwa, National University  
 of Singapore  
**EVALUATION OF DESIGN HIGH-WATER CLEARANCES FOR PAVI-  
 MENTS**, M.R. Eliano, Virginia Department of Highways  
 and Transportation, and J.L. Davidson, University of  
 Florida  
**THE ECONOMIC IMPACT OF PAVEMENT SUBSURFACE DRAINAGE**,  
 Raymond A. Forsyth, Gordon E. Wells, and James E.  
 Woodstrom, California Department of Transportation

Nom de celui qui a le  
 texte de la conférence.

Daniel Vézina

(33)

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**Daniel Vézina**, ing  
 Division Matériaux

216

## TAPI

**216** Thursday, 2:00 p.m., North Cotillion Room,  
 Sheraton  
**ASPHALT PAVING**  
**FIELD EXPERIENCE**  
 Ronald L. Terrel, Edmonds, Washington,  
 presiding  
 (Sponsored by Committee on Characteristics of Bituminous  
 Paving Mixtures To Meet Structural Requirements)

Presentation:

**FIELD EXPERIENCE IN MINNESOTA WITH MODIFIED ASPHALTS**,  
 Roger C. Olson, Minnesota Department of Transpor-  
 tation

**EFFECTS OF CARBON-BLACK MODIFIED ASPHALTS ON FIELD  
 PERFORMANCE OF ASPHALT CONCRETE**, B.A. Vallerge, B.A.  
 Vallerge Inc., and Larry T. Newman and R. W. Ander-  
 son, Cabot Corporation

**CHEMICAL MODIFIERS TO IMPROVE THE STRENGTH AND DURA-  
 BILITY OF ASPHALT CONCRETE**, William A. Higgins,  
 Lubrizol Corporation

Panel:

**ROAD**,  
 G. Hicks, Oregon State  
 University, and Keith Martin, James E. Wilson and  
 Dale Allen, Oregon Department of Transportation

Panel discussion:

This session will conclude with a discussion among the  
 authors of both sessions and the audience on asphalt  
 mixtures with modified binders.

Richard Langlois

(3-435)



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**Richard Langlois**, Ing. M.Sc.  
 Chef de la Division Matériaux

\* Texte recueilli



**ANNEXE B**

**DOCUMENTATION RECUEILLIE**

Noms et adresses des personnes auprèsde qui on peut se procurer les documents:

Gouvernement du Québec  
Ministère des Transports  
**Laboratoire central**

2700, rue Einstein  
Ste-Foy, Québec G1R 3W8  
(418) 643-3178

Nos. 1, 2, 11, 12,  
13, 23, 30 et 33.

**Daniel Vézina, ing**  
Division Matériaux

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Nos. 3, 4, 5, 6, 7, 8, 9,  
10, 16, 19, 20, 21, 22, 24,  
25, 26, 27, 28, 29, 31, 32,  
34 et 35.

**Richard Langlois, Ing. M.Sc**  
Chef de la Division Matériaux

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Nos. 14, 15

**Guy Dallaire, Ing.**  
Chef, division des sols et granulats

MINISTÈRE  
DES TRANSPORTS

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**JEAN-CLAUDE HÉBERT, CHIM. P.**  
CHEF DE LA DIVISION  
CHIMIE

Nos. 17, 18

## PROBLEM STATEMENT

- I. TITLE: Methods to Minimize Rutting in Asphalt Concrete Pavements.
- II. THE PROBLEM:

Rutting is one of the leading causes of early failure in asphalt concrete pavements. Asphalts that are too soft, slow setting or highly temperature susceptible can contribute to rutting. Aggregates that are predominantly rounded and smooth textured, contain excessive sand-sized particles or insufficient filler or consist of small top-size particles have been associated with rutting. Chemical reactions between asphalt and aggregate fines in the presence of heat can change the rheological properties of asphalt cement. Paving mixtures containing excessive air voids, voids in the mineral aggregate or foreign materials (such as unburned liquid fuels or liquid antistripping additives) or mixtures that are water susceptible are candidates for rutting. Other considerations include mixing plant types, traffic, environmental and geographical factors.
- III. OBJECTIVES:

Assemble and analyze significant publications and data regarding rutting in asphalt pavements and prepare a concise document for implementation by Highway Departments. Rutted and non-rutted pavements across the U.S. should be critically analyzed to accurately determine the source of rutting (subgrade, base or surface). If rutting is in the flexible pavement courses, further investigation should be conducted. Collect samples and data from rutted and non-rutted pavements and conduct carefully coordinated laboratory and field experiments to isolate the cause(s) of rutting. Seek new approaches (tests, standards, techniques and specifications) to identify and control rut-prone mixes. For example, develop stress-strain relationships to be considered in mix design which reflect pavements strengths and demands by traffic and the environment. Develop realistic mathematical models to predict rutting.
- IV. CURRENT ACTIVITIES:
  - A. Key Words: Asphalt Concrete Pavement, Rutting, Permanent Deformation, Plastic Deformation
  - B. Related Activities:

Concerns of WASHTO have precipitated two NCHRP studies which indirectly address rutting: (1) Development of Asphalt-Aggregate Mixture Analysis System and (2) Mechanistic-Empirical Pavement Design Methods. These studies will begin in 1986. The University of Kentucky developed PAVRUT in 1985. PAVRUT is a model (based upon one mixture) designed to predict pavement rut depth. Based upon preliminary results from the Texas A&M University, certain additives may provide important contributions toward methods to control rutting.

## V. URGENCY:

In 1984, WASHTO stated that in some states rutting in asphalt concrete pavements "is the most pressing issue presently facing the highway agencies". Findings of this research should be used to develop a concise document for use by highway agencies as a guideline to reduce the probability of rutting in asphalt concrete pavements.

Statement Prepared by: Joe W. Button Date: February 25, 1986

TRB Committee: A2D01 Committee Chairman: Vyt Puzinauskas

Endorsed by Section \_\_\_\_\_, with the following comments re:

Urgency, Relevancy, and Implementability: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Section Chairman

COURSE NUMBER: 13123

COURSE TITLE: HIGHWAY MATERIALS ENGINEERING

COURSE ANNOUNCEMENT: To be issued February 1987 for presentation in fall of 1987 and spring 1988.

COURSE FEE: Estimated \$3,000

LENGTH: 6 weeks

MAXIMUM CLASS SIZE: 30

DESCRIPTION: The course provides a mix of theory and state-of-the-art knowledge in highway engineering materials and quality control. Coverage includes one week in each of (1) soils and soil aggregate mixtures, (2) portland cement concrete (3) miscellaneous materials such as aluminum, wood and polymers and (4) materials control methods. Two weeks will be devoted to bituminous materials and one week to a specialty option (in lieu of one week of designated study) to be identified by the participants in cooperation with the faculty advisor.

OBJECTIVES: Upon completion of the course, participants should be able to:

1. Identify and describe the characteristics and engineering properties of the materials utilized in highways, and demonstrate a conceptual understanding of the load carrying capabilities, stress strain relationships, particle and ingredient interactions, etc.
2. Identify and describe the selection and design criteria for highway materials, and demonstrate understanding of strength of materials versus load demands in terms of selecting the proper natural materials or setting the requirements of designed materials.
3. Describe the important steps and considerations in the mix design procedures for designed materials, and demonstrate a conceptual understanding of how and why of combining of soils and aggregates, stabilization of soils, and asphaltic and portland cement concretes.
4. Describe the current, most effective field testing and materials control procedures, and show the relationship of field testing methods to laboratory designs as well as materials quality control during construction.
5. Identify and describe the key principles and functions of the field production equipment, and demonstrate understanding of the suitability and proper operation of equipment in terms of obtaining quality in-place materials.
6. Develop an effective materials control program to provide for proper and adequate materials selection, design, and control. Demonstrate understanding of the traditional "methods and materials" approach and the "quality assurance" approach.

FOR WHOM DESIGNED: Design, construction, and materials engineers and technologists in highway transportation agencies, who have sufficient engineering, math and science background to qualify for admission for graduate study.

PREREQUISITES: Bachelor of Science in engineering or engineering technology or academic and professional backgrounds sufficient to qualify for admission to university graduate level study.

PRESENTED BY: Purdue University

COURSE COORDINATOR: Roger L. Dean  
Federal Highway Administration  
6300 Georgetown Pike  
McLean, Virginia 22101  
(703) 285-2782

KENTUCKY TRANSPORTATION CABINET  
DEPARTMENT OF HIGHWAYS  
SPECIFICATIONS FOR  
POLYMER-ASPHALT EMULSIONS  
FOR  
SEAL COAT APPLICATIONS

I. Description -

These products are designed for surface treatment by the technique specified in Section 406 of the Kentucky Standard Specifications for Road and Bridge Construction.

II. Test Requirements -

| <u>Test</u>                                                                                         | CRS-2 or RS-2S |             | AE-90S      |             |
|-----------------------------------------------------------------------------------------------------|----------------|-------------|-------------|-------------|
|                                                                                                     | <u>Min.</u>    | <u>Max.</u> | <u>Min.</u> | <u>Max.</u> |
| 1. Viscosity, SSF, @ 122°F. (AASHTO-T-59)                                                           | 175            | 450         | 50+         |             |
| 2. Storage Stability Test, 24 hrs., % (AASHTO-T-59)                                                 | ---            | 1           |             | 1           |
| 3. Sieve Test, 20 mesh, % (AASHTO-T-59)                                                             |                | 0.1         |             | 0.1         |
| 4. Distillation: (AASHTO-T-59)                                                                      |                |             |             |             |
| Oil Distillate by Vol. of Emulsion, %:                                                              |                | 3           |             | 3.0         |
| Residue from Distillation, %:                                                                       | 65             |             | 65          |             |
| Test on Residue from Evaporation or Distillation:<br>(AASHTO-T-59)                                  |                |             |             |             |
| 5. Penetration, 77°F., 100, 5 sec. (AASHTO-T-49)                                                    | 90             | 150         | 90          | 150         |
| 6. Ductility, 77°F., cm (AASHTO-T-51)                                                               | 50+            |             | 50+         |             |
| 7. Ductility, 34± 1°F. (AASHTO-T-51)                                                                | 15+            |             | 15+         |             |
| *8. Ductility, 34± 1°F. (AASHTO-T-51)                                                               | 55+            |             | 55+         |             |
| 9. Solubility in Trichloroethylene, % (AASHTO-T-44)                                                 | 97.5           |             |             |             |
| 10. Demulsibility, 0.02N CaCl <sub>2</sub> , % (AASHTO-T-59)                                        |                |             |             |             |
| Anionic Emulsion                                                                                    | 40+            |             | 40+         |             |
| 11. Demulsibility, 35 ml., 0.8% Sodium Dioctyl<br>Sulfosuccinate, % (AASHTO-T-59) Cationic Emulsion | 20+            |             |             |             |
| 12. Float Test @ 140°F. sec. (AASHTO-T-59)                                                          |                |             |             | 1200+       |

Suppliers of the specified CRS-2S, RS-2S, or AE-90S may be required to perform and certify conformance to the above test requirements prior to shipment of the material.

\*This test is an extension of the routine ductility test. When the specimen is extended 10 cm. the distressed area is severed in the middle by a pair of shears. After 1 hour at the test temperature the severed distressed ends are returned to contact and the ductilometer reading is read again. The sample must recover at least 55% of the 10 cm. distance or to a reading of 4.5 or less.

III APPLICATION -

CRS-2S is intended to be used in chip-seal applications where the stone is silicious, minus no. 200 sieve fines are less than 3%, high skid resistance is desired, and early retention of aggregate is required. In many cases CRS-2S has been found to work well with limestone aggregate. RS-2S is intended to be used like CRS-2S except it is to be used with limestone aggregate. AE-90S is to be used with limestone but due to its slower setting speed is more tolerant of fines than the other products. (This statement is not intended to increase the maximum of 3% minus No. 200 sieve materials but rather to identify a property that may occasionally improve performance with a borderline aggregate.) Aggregates that are not clearly defined as limestone or silicious should be evaluated for compatibility with the intended emulsion to assure the

best retention of aggregate. Non-compatibility is judged to be failure of an aggregate to adhere to a particular emulsion.

Generally the quality of the finished product improves as aggregate fines are decreased. Increased fine material less than a no. 200 sieve always decreases the quality of a seal-coal application.

P.E.M.B. = POLYETHYLENE-MODIFIED BITUMEN  
A SUCCESSFUL BINDER ON ITALIAN TOLLROADS

G. Legnani

The use of P.E.M.B. or Polyethylene-Modified bitumen, for road construction purposes, started late in Italy in 1982, when Autostrade S.p.A., the State owned Corporation responsible for construction, operations and maintenance on two thirds of the Italian toll-road system (2,700 Km), decided to start some full-scale trials on a number of bridges located on a very critical section of their network; the Bologna-Florence section crossing the Appennine Mountains.

These full-scale applications were the result of a rather extensive laboratory work aiming at a better understanding of the rheology of the new binder and the design of mixtures exhibiting:

- = high mechanical strength, even with high binder content,
  - = and complete impermeability (low Voids content),
- both for wearing and binder courses.

The Novophalt technology was adopted, and the addition of the Polyethylene (P.E.) to standard 80/100 pen. bitumen effected by means of a specially designed high-shear mixing equipment.

Two "degrees" of "modification" were initially considered in the preparation of the binder; 4% and 7% for the wearing course and 4% for the binder course.

Total thickness of the two courses, wearing and binder, on bridge decks is normally 9 to 10 cm. (4 inches), and the average characteristics of the mixtures laid on the first 4 viaducts (Gambellato, Pattano, Merizzano e Gamberi) resulted as follows:

Wearing course

| a) = P.E.M.B.           | 80/100 + 4% P.E. | 80/100 + 7% P.E. |
|-------------------------|------------------|------------------|
| b) = Binder content (°) | 6.20%            | 6.50%            |
| c) = Marshall stability | 1,260 Kg.        | 1,350 Kg.        |
| d) = Marshall flow      | 4 mm.            | 3.6 mm.          |
| e) = Stiffness c)/d)    | 315 Kg/mm        | 375 Kg/mm        |
| f) = Voids (Marshall)   | 2.2 %            | 1.8 %            |

(°) referred to the aggregate



**FIFTEEN-YEAR PAVEMENT CONDITION HISTORY**  
of  
**ASPHALT RUBBER MEMBRANES**  
in  
**PHOENIX, ARIZONA**



US Department  
of Transportation

**Federal Highway  
Administration**

Research, Development,  
and Technology

# Course Announcement 86-10

B-10

SUBJECT: 13036 - Inspection of Fracture Critical Bridge Members

The Federal Highway Administration (FHWA), through the National Highway Institute and in cooperation with the Office of Implementation and the Bridge Division, is sponsoring up to 36 presentations of this 2-day course. The curriculum material was developed for FHWA by Byrd, Tallamy, MacDonald and Lewis and the course will be taught by staff from this firm.

FOR WHOM DESIGNED: This course is intended primarily for FHWA, State and local bridge inspectors who have responsibility for on-site inspection of highway bridges. Supervisors, project engineers, bridge maintenance engineers, and designers will also benefit from the course.

PREREQUISITES: None, although previous hands-on inspection experience of bridges is desirable.

COURSE DESCRIPTION: Bridges that have fracture critical members (FCMs) are susceptible to catastrophic collapse as was most recently demonstrated by the Mianus River Bridge failure. It is imperative that bridge inspectors be trained to recognize and inspect FCMs in order to guarantee public safety and protect the investment in our Nation's bridges.

Participants of this course will learn what "fracture critical" means, and then review stresses, redundancy, basic fracture mechanics, and fatigue prone details. The techniques for inspection will be examined, and proper preparation of fracture critical inspection reports will be explained. While this course will acquaint inspectors with procedures to be used in making detailed visual bridge inspections, nondestructive testing methods are discussed only briefly. Nondestructive testing methods are the topic of another National Highway Institute course, 13023 - Nondestructive Testing Methods for Steel Bridges.

In addition to a participant notebook, attendees will receive a comprehensive, well-illustrated manual that has been developed to be used by bridge inspectors as a guideline for identifying and inspecting FCMs within existing bridges. This manual will supplement FHWA's "Bridge Inspector's Training Manual 70."

**National Highway Institute**

COURSE OBJECTIVES: Upon completion of the course the participants should be able to:

1. Recognize whether a bridge is redundant or non-redundant.
2. Identify the FCMs within a non-redundant bridge.
3. Identify common modes of failure of FCMs.
4. Be familiar with the various nondestructive testing methods commonly used for inspecting steel highway bridges.
5. Write a bridge inspection report emphasizing the condition of FCMs from visual inspection.
6. Evaluate the condition of the FCMs from the inspection and relate the results to the rating of the bridge.

NUMBER OF PARTICIPANTS: Class size is limited to a maximum of 40 participants.

COST: The cost for sponsoring this course is \$2,000. The sponsoring agency is also responsible for furnishing a meeting room, inviting participants, providing visual-aid equipment, and taking care of other housekeeping duties. Travel and per diem for participants must be funded by their own agencies.

COURSE REQUESTS: Pilot courses have been conducted in Washington, D.C. and in St. Paul, Minnesota. The course is now available for scheduling in response to requests from State highway agencies and others. First preference will be given to conducting one presentation in each FHWA region. Other presentations will be scheduled on a first-come-first-served basis. State highway agencies desiring to host presentations should submit requests to the National Highway Institute through the local FHWA division office. Local agencies are requested to submit requests through the State highway agency.

CONTACT: For information on scheduling, course material, etc., please contact:

Mr. Larry E. Jones  
National Highway Institute (NHI-22)  
Turner-Fairbank Highway Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101  
Telephone: (703) 285-2779

DISTRIBUTION:

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U.S. Department  
of Transportation

Federal Highway  
Administration

Research, Development  
and Technology

# Course Announcement 86-3

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**SUBJECT:** 13108 - Techniques for Pavement Rehabilitation

This announcement supersedes Course Announcement 84-3. It has been revised to reflect a policy decision to charge a fee for this course.

The Federal Highway Administration (FHWA), through the National Highway Institute, and in cooperation with the Office of Engineering, is offering presentations of the subject course to be sponsored by public highway agencies. This course was developed under a contract with ERES Consultants, Inc. and is presented under a continuing contract with the same firm.

**FOR WHOM DESIGNED:** The course is directed to State and local highway agency design, construction and maintenance engineers involved in the development of pavement resurfacing, restoration and recycling techniques. The course serves as an excellent introduction of the subject for the young, inexperienced engineer and also provides the depth of coverage needed by more experienced engineers.

**PREREQUISITES:** None

**COURSE DESCRIPTION:** This 28-hour course is presented over a 4-day period, normally starting at 8 a.m. on the first day and concluding at noon on the fourth day. A variety of instructional techniques is employed, including lecture and discussion with visual aids, case studies and workshops. Each participant will receive a copy of the notebook, "Techniques for Pavement Rehabilitation" which should serve as a valuable future reference on the subject. The following sessions are included in the course:

- Project Survey and Evaluation
- Restoration
- Recycling
- Resurfacing
- Selection of Design Alternatives
- Workshop on Rehabilitation Design

**COURSE OBJECTIVES:** Upon completion of this course, participants should be able to:

1. Identify common pavement distress types, determine their causes, and be familiar with the procedures for project field surveys and overall project evaluation.

**National Highway Institute**

2. Recognize the principles and the importance of proper preparation of the existing pavement prior to resurfacing or restoration.
3. Recognize the basic principles and state-of-the-art technology of pavement rehabilitation.
4. Understand the design procedures and their applicability to various types of overlays.
5. Select the most cost-effective pavement rehabilitation alternative for a given project.

NUMBER OF PARTICIPANTS: Maximum of 40 participants.

COST: Cost for sponsoring this course is \$3,000. Travel and per diem for participants must be funded by their own agencies. The sponsoring agency also is responsible for furnishing a meeting room, providing visual-aid equipment, inviting participants, and other housekeeping duties.

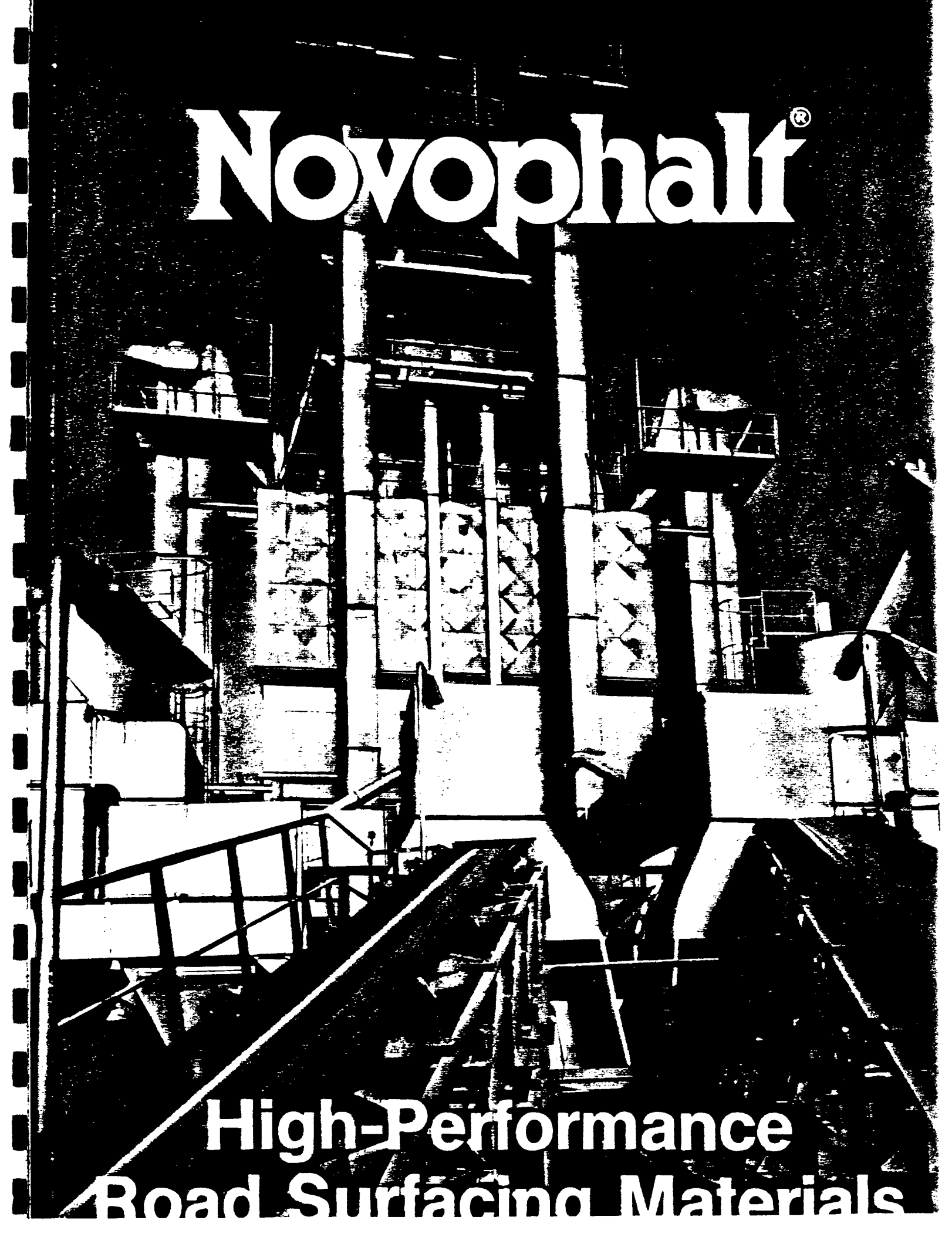
COURSE REQUESTS: Federal, State or local agencies may sponsor the course. Presentations will be scheduled on a first-come-first-serve basis. All course requests should be made through the local FHWA division office.

CONTACT: For information on scheduling, availability, course materials, etc., contact:

Mr. William Y. Bellinger  
National Highway Institute  
Federal Highway Administration  
6300 Georgetown Pike  
McLean, Virginia 22101-2296  
Telephone: (703) 285-2776

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High-Performance  
Road Surfacing Materials



U.S. Department  
of Transportation

Federal Highway  
Administration

# TECHNICAL SUMMARY

## PAVEMENT SURFACE TEXTURE: SIGNIFICANCE AND MEASUREMENT

Research, Development,  
and Technology

Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

REPORT NO. FHWA/RD-84/092

SEPTEMBER 1986

*HNR-1*

*HNR-1*



U.S. Department  
of Transportation

Federal Highway  
Administration

# TECHNICAL SUMMARY

## DATA COLLECTION PROCEDURES FOR USE WITH SKID RESISTANCE MEASUREMENTS

Research, Development,  
and Technology

Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

REPORT NO. FHWA/RD-84/109

SEPTEMBER 1986



U.S. Department  
of Transportation

Federal Highway  
Administration

# TECHNICAL SUMMARY

## IMPROVED METHODS TO ELIMINATE REFLECTION CRACKING

Research, Development,  
and Technology

Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

REPORT NO. FHWA/RD-86/075

OCTOBER 1986

*HNR-1*



U.S. Department of Transportation  
Federal Highway Administration

B-17

Research, Development,  
and Technology

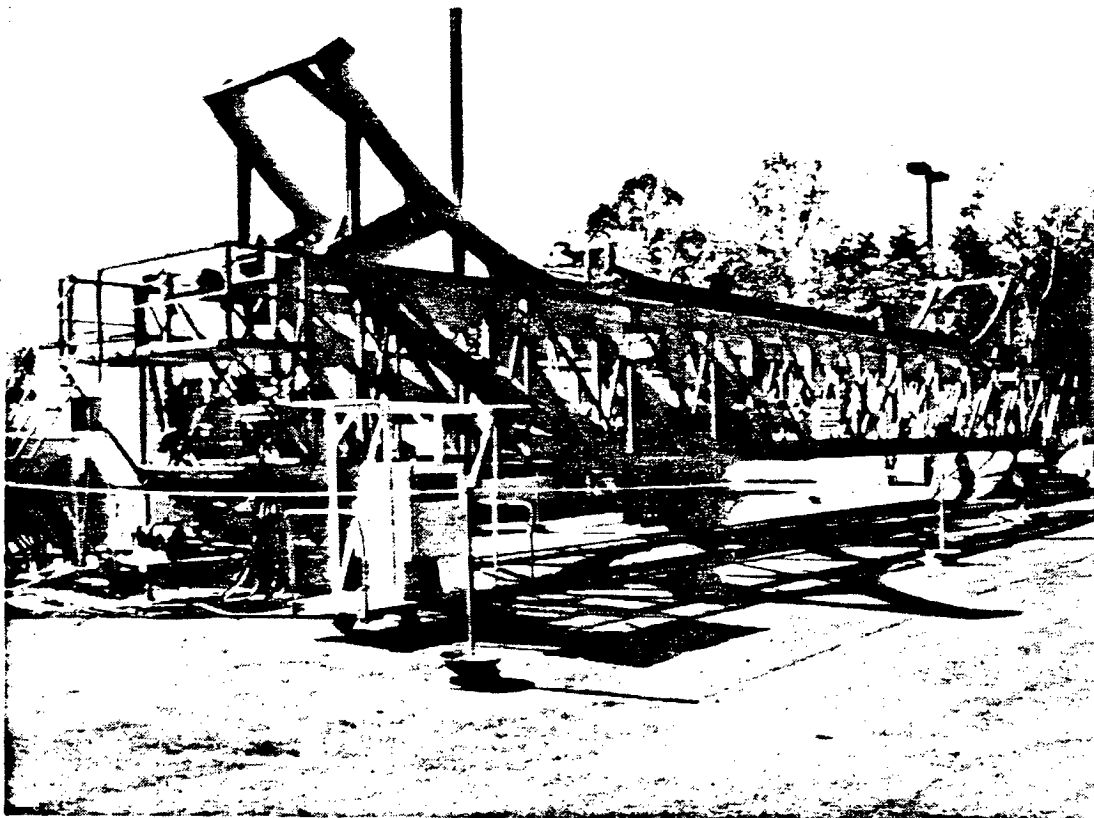
Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101

January, 1987

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# PAVEMENT TESTING FACILITY

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*The Accelerated Loading Facility Pavement Testing Machine*

The Pavement Testing Facility is an outdoor, full-scale accelerated pavement testing laboratory located at Federal Highway Administration's Turner-Fairbank Highway Research Center in McLean, Virginia. The facility consists of two bituminous concrete pavement test sections, each 200 feet long, and the Accelerated Loading Facility (ALF) machine. Put into operation on October 20, 1986, ALF has completed loading of a portion of test lane 1. Preliminary analysis of the data indicates good agreement with the predicted performance based upon the American Association of State Highway and Transportation Officials pavement design procedure. Additionally, the Pavement Testing Facility has proven its potential as an accelerated pavement testing tool.

---

Office of Engineering and Highway Operations R & D  
Pavements Division

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

# TECHNICAL SUMMARY

## DATA COLLECTION PROCEDURES FOR USE WITH SKID RESISTANCE MEASUREMENTS

Research, Development,  
and Technology  
Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

**REPORT NO. FHWA/RD-84/109**

**SEPTEMBER 1986**



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

# TECHNICAL SUMMARY

## IMPROVED METHODS FOR PATCHING ON HIGH-VOLUME ROADS

Research, Development,  
and Technology

Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

**REPORT NO. FHWA/RD-86/076**

**JANUARY 1986**

HED-1



U.S. Department  
of Transportation

**Federal Highway  
Administration**

# TECHNICAL SUMMARY

## FINAL DESIGN OF AUTOMATED PAVEMENT CRACK MEASUREMENT INSTRUMENTATION FROM A SURVEY VEHICLE

Research, Development,  
and Technology

Turner-Fairbank Highway  
Research Center  
6300 Georgetown Pike  
McLean, Virginia 22101-2296

**REPORT NO. FHWA/RD-85/077**

**MAY 1986**



**With This  
Type Of Traffic,  
How Long Will This  
Pavement Last?**

# Planning and Scheduling Work Zone Traffic Control

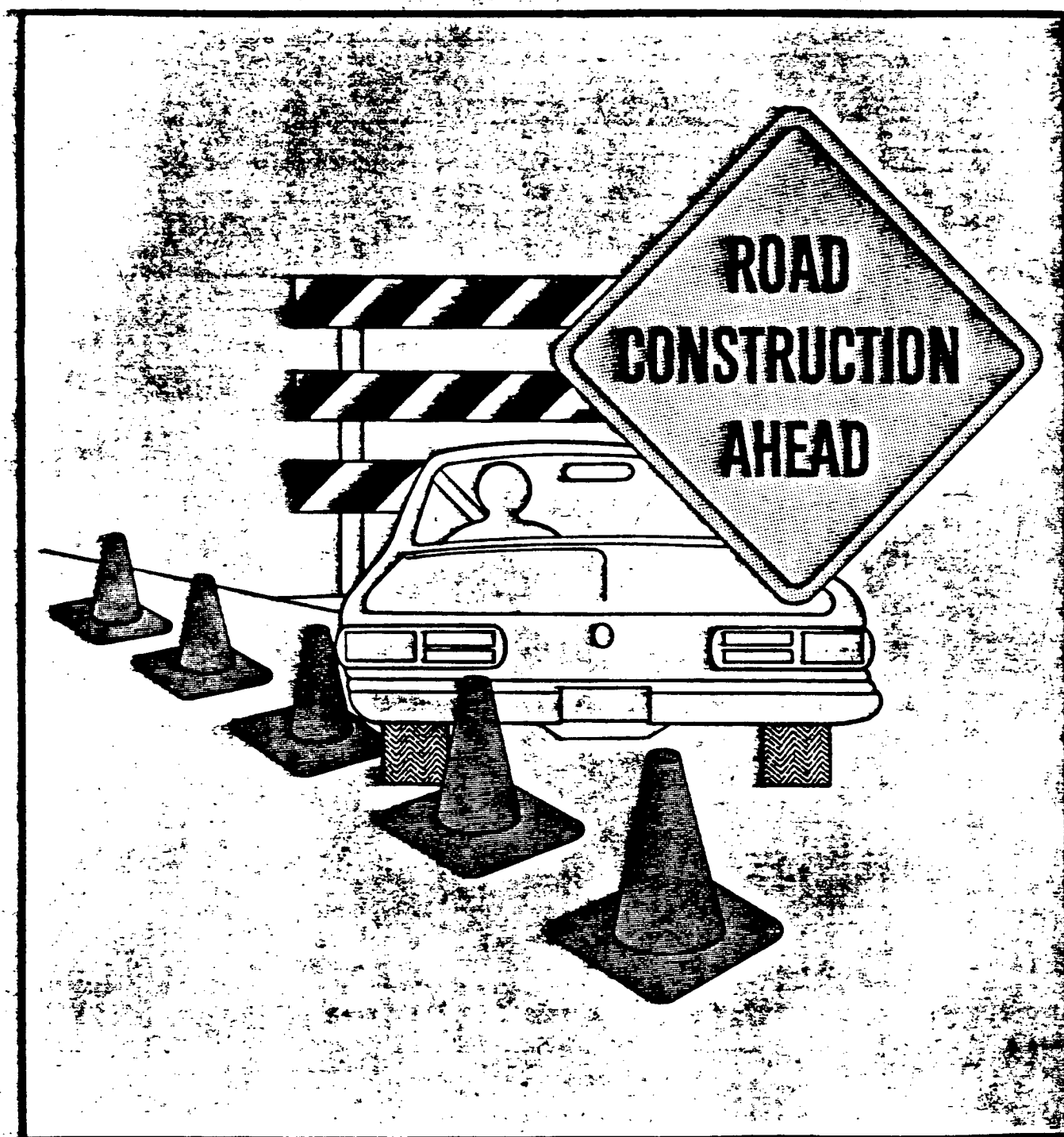
Implementation Package  
FHWA-IP-81-5  
User Guide

October 1981



U.S. Department  
of Transportation

Federal Highway  
Administration



FHWA DATA BANK FOR RECYCLED  
BITUMINOUS CONCRETE PAVEMENTS

by  
James F. Shook\*  
Rosemary Allender\*\*

ABSTRACT

The FHWA Data Bank for Recycled Bituminous Concrete Pavements was assembled in 1981 from data collected from a variety of sources. The Data Bank includes general project information, design information, construction details, recycled pavement performance evaluations, maintenance and rehabilitation records, and detailed physical properties of mixes from 32 special projects. In its present form the Data Bank consists of data from 204 recycled projects, and 4 control projects.

Most project entries include basic location data, information on the recycling method used, and some data on binder and mixture characteristics. In addition, about one-third of the projects reported results of measurements made on the recycled pavement from one to six years after recycling, including pavement distress, ride quality, and deflection measurements.

The Data Bank includes data from projects in 42 states. Most states reported the use of more than one recycling method. The hot recycling process was used in 30 (81%) of the 42 states, the cold recycling process in 11 states (30%), and surface recycling in 8 states (22%).

The Data Bank also includes information on recycling construction operations. In general, mixing and lay-down practices appeared to be standard with no substantial deviations from normal practice.

Analyses were made of recycled mix design and mixture component proportioning methods, changes in binder properties, and other effects of recycling on binder and mix properties. The findings from these analyses indicate that reclaimed asphalt pavements can be used to produce mixes having properties similar to conventional mixes.

---

\* Sr. Vice President, ARE Inc., Riverdale, Maryland (Formerly with The Asphalt Institute)

\*\*Formerly Analyst with The Asphalt Institute.



**INTERNATIONAL SURFACING, INC.**  
**GUIDE SPECIFICATION**  
**FOR ASPHALT-RUBBER SURFACE TREATMENTS**

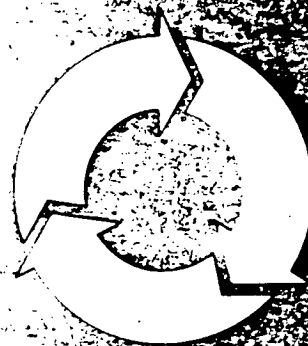
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J.P. AUGOYARD  
L. PONSART  
GTM-ENTREPOSE

A NEW PROCESS FOR THE LAYING OF MONOLITHIC COMPOSIT C.R.C. PAVEMENTS

Nanterre, November 28th, 1986

68a



# RECYCLING PORTLAND CEMENT CONCRETE



U.S. Department  
of Transportation  
Federal Highway  
Administration



Demonstration  
Projects Program  
FHWA-OP-97-05

# REDESIGN AND FIELD OPERATION OF A SELF- PROPELLED CAVITATING CONCRETE REMOVAL SYSTEM



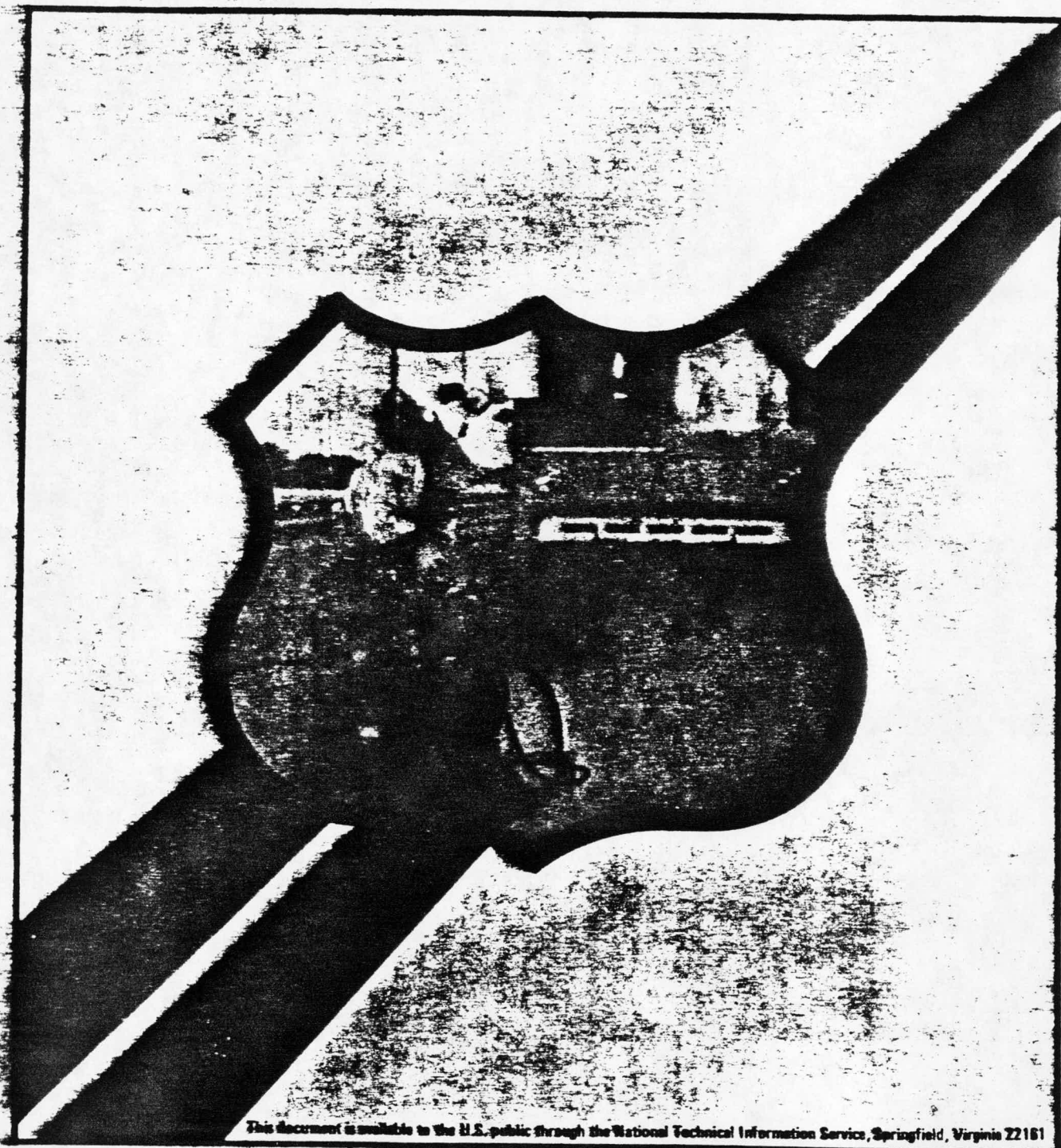
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Research Center  
3300 Georgetown Pike  
McLean, Virginia 22101

Report No.  
FHWA-TS-84-207

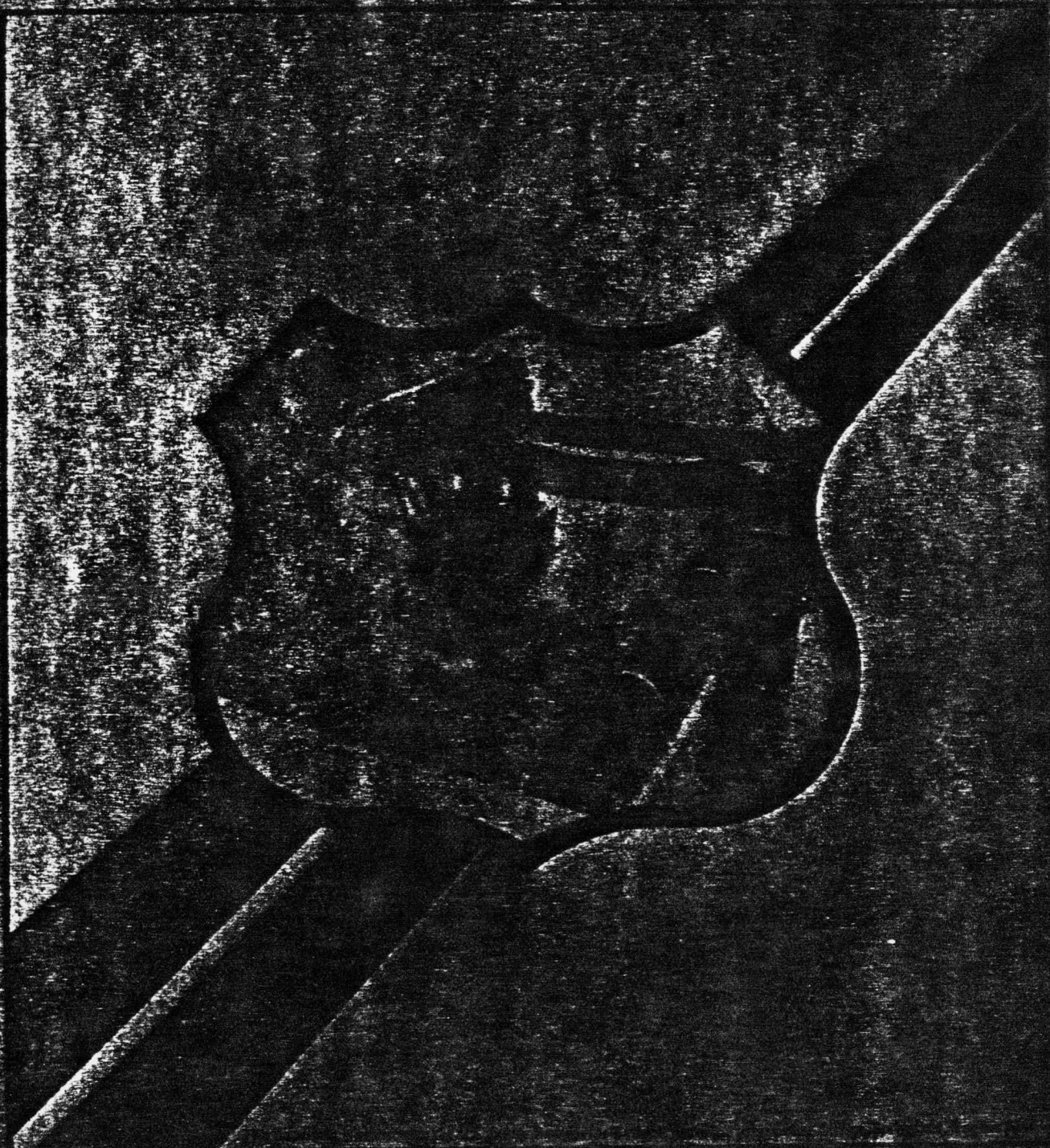
Final Report  
May 1984



# DEVELOPMENT OF A HIGH PRESSURE WATER JET FOR THE RAPID REMOVAL OF CONCRETE

2

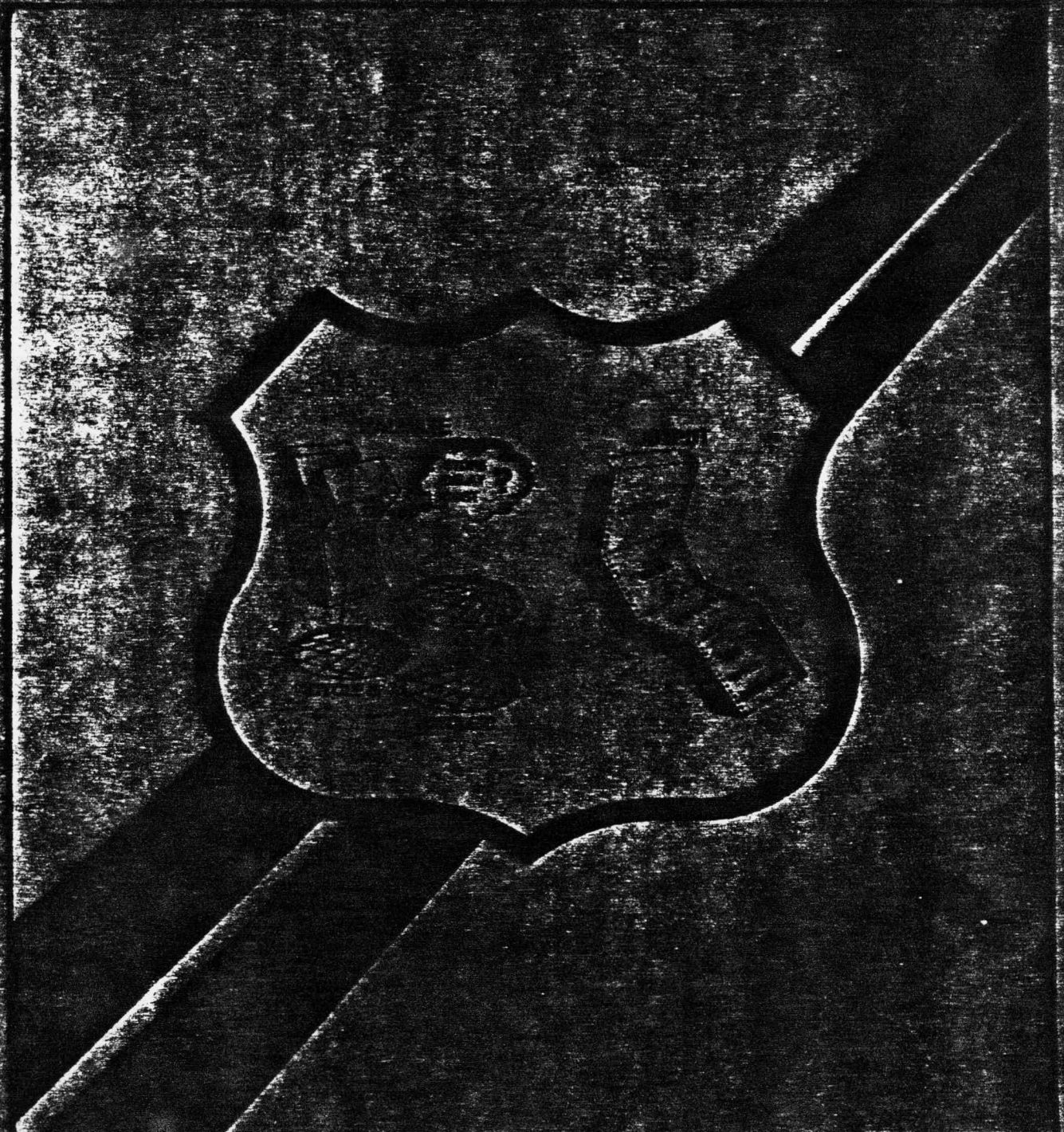
U.S. DEPARTMENT OF COMMERCE  
BUREAU OF COMMERCE  
WASHINGTON, D.C. 20540



# SIGOP-III User's Manual

U.S. Department of  
Defense

Office of  
Management and  
Administration



**INTERNATIONAL SURFACING GUIDE**  
**SPECIFICATION FOR ASPHALT-RUBBER USED**  
**AS HOT-MIX ASPHALT CONCRETE BINDER**

## **1.0 GENERAL**

### **1.1 Scope**

This specification covers requirements for materials and manufacturing asphalt-rubber mixtures for use as a binder in hot-mix asphalt concrete. The asphalt rubber may be used as binder for most types of asphalt concrete paving including open graded friction courses, dense surface mixtures, and base courses for highway pavement applications.

### **1.2 Types**

This specification covers two types of asphalt-rubber binders, Type I and Type II. Type I asphalt rubber is a lower stiffness material suited for use in cooler climates, while Type II is a higher stiffness material suited for use in warmer climates.

## **2.0 MATERIALS**

### **2.1 Description**

The asphalt rubber binders shall be a uniform and reacted mixture of compatible paving grade asphalt cement, granulated reclaimed vulcanized rubber, and, if required, liquid anti-stripping agent.

### **2.2 Asphalt Cement**

The asphalt cement shall be an appropriate grade as determined by the asphalt-rubber supplier and shall meet requirements of ASTM D946 or ASTM D3381 for the specific grade used. As an alternative, state or local specifications may be used. The asphalt cement shall be tested by the asphalt-rubber supplier to determine and assure that appropriate characteristics are achieved when blended with the granulated rubber.

#### **2.2.1 Asphalt Grade Selection**

Generally, the following grades of asphalt cement are used for the manufacture of Types I and II asphalt-rubber binder.

##### **2.2.1.1 Type I Asphalt-Rubber**

ASTM D3381 - AC-2.5, AC-5, AR-1000  
ASTM D946 - 120-150, 200-300

# A PAVEMENT MOISTURE ACCELERATED DISTRESS (MAD) IDENTIFICATION SYSTEM

Vol. 1  
September 1981  
Final Report



Prepared for



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

Offices of Research & Development  
Structures and Applied Mechanics  
Division  
Washington, D.C. 20590

Document is available to the public through  
the National Technical Information Service,  
Springfield, Virginia 22161



ANNEXE C

LISTE DES CONFERENCIERS

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 ABKOWITZ, Mark, 199  
 ABT, Steven R., 8  
 ABU-EISHEH, Sameer A., 14  
 ADAMS, Charles, 209  
 ADAMS, Robert, 82  
 ADAMS, Ron, 38  
 ADAMS, Terry L., 57  
 AGARWAL, A.C., 1  
 AGNEW, William G., p. 15  
 AHLBECK, Donald R., 12  
 AHMED, Jamil, 201  
 AITCIN, Pierre-Claude, 194  
 AKI, Adel Y., 156  
 ALBERSHEIM, Steven R., 86  
 ALBRECHT, Pedro, 27, 127  
 ALEXANDER, Ernest R., 57  
 ALGERMISSEN, S.T., 74  
 ALI, N.A., 184  
 ALLEN, D.L., 39  
 ALLEN, Dale, 216  
 ALLEN, Gary M., 80, p. 16  
 ALLEN, Tony, 54  
 ALLEN, W. Bruce, 106  
 ALPERN, Bernard, 73  
 ALTERMATT, W.E., 156  
 AMPT, Elisebeth, 14  
 ANDERSON, Ardell, 112  
 ANDERSON, Bradley A., 8  
 ANDERSON, David A., 115, 136  
 ANDERSON, Douglas L., 53  
 ANDERSON, K.O., 52, 141  
 ANDERSON, Loren R., 96  
 ANDERSON, R.W., 216  
 ANDERSON, Robert B., 51  
 ANDERSON, Virgil L., 141  
 ANDREWS, William H., Jr., 103  
 ANDRIE, Stephen, J., 4  
 ANTHONY, David, 209  
 ANTLE, Charles E., 98, 115  
 AREND, Geoffrey, 110  
 ARLINGHAUS, Sandra L., 4  
 ARMAGHANI, Jamshid M., 53, 129, 200  
 ARMIZO, David J., 222  
 ARMSTRONG, W. Howard, 167  
 ARNOLD, Charles J., 214  
 ARRINGTON, Steve, 21  
 ASHFORD, Norman, 211  
 ASIAM, M.P., 94  
 ATCHISON, Harvey K., 105  
 ATKINSON, Wallace G., 153  
 AU, Tung, 24  
 AXHAUSEN, Kay, W., 95  
 AYYUB, Bilal, 127  
 BAASS, Karsten, 144  
 BACH, Roberto, 190  
 BACHTEL, Bradley, 112  
 BACHUS, Robert C., 202  
 BADU-TWENEBOAH, Kwasi, 200  
 BAGATI, Moussa, p. 58  
 BAHANDARI, A., p. 33  
 BAILEY, Robert J., p. 53  
 BAKER, Jim, 213  
 BAKER, Norman H., 17  
 BAKER, Paul, 175  
 BAKER, Raphael, 33  
 BAKER, William T., 218  
 BAKHT, Baidar, 1  
 BALAGURU, P.N., 90  
 BALDWIN, James W., Jr., 1  
 BALKUS, Kozmas, 148  
 BALLANTYNE, John D., 96  
 BALLINGER, Craig A., p. 53  
 BALOG, John N., 157, 170  
 BAMBERG, Wolfgang, 21  
 BANG, Sangchul, 156  
 BANKS, Robert L., 13  
 BARBER, Edward J., 179  
 BARETT, George, 85  
 BARKER, Walter R., 164  
 BARKSDALE, Richard D., 49  
 BARNETT, J.M., 26  
 BARNOFF, Robert M., 186  
 BARROS, Ricardo T., 198  
 BASS, David A., 119  
 BATES, D.R., 34  
 BATHURST, R.J., 49, 100  
 BATTEL, John F., 32  
 BAUMEL, C. Phillip, 164, 189  
 BAYOMY, Fouad M., 134  
 BAZANT, Zdenek P., 31  
 BEAL, David B., 1  
 BEATTY, T.L., 134  
 BEBERMEYER, Gene, 50  
 BECKER, A. Jeff, 59  
 BEECROFT, Gordon W., 195  
 BEHNKE, Robert, 128  
 BEIMBORN, Edward A., 44, 57  
 BELKNAP, Edwin R., 96  
 BELL, Chris A., 181, 212  
 BELL, Terry, p. 53  
 BEN-AKIVA, Moshe, 37  
 BENCHEMAN, Messaoud, 211  
 BENNER, Ludwig, 103  
 BENSON, Paul, 175  
 BENTSEN, R.A., 196  
 BENZ, Gregory P., 84, 126  
 BERCHER, Steve, 158  
 BERG, Dennis, 10  
 BERG, Robert J., 117  
 BERG, William D., 198  
 BERMAN, Wayne, 128  
 BERNSTEIN, Robert, 117, 208  
 BEROLDO, Steve J., 208  
 BERRY, Donald S., 30  
 BERRY, Henry, 136  
 BETZ, Mathew J., p. 33  
 BEVERLY, Eddie, 114  
 BEVON, Leo, 15  
 BHAVSAR, Sanat N., 98  
 BHISE, Vivek D., 118  
 BIBAS, Helene T., 208  
 BILDILLI, James, 150  
 BISHOP-EDKINS, Christine, 56, 124  
 BISSADA, Amir F., 181  
 BISWAS, Minmay, 94  
 BLACK, William R., 38  
 BLACKBURN, Albert W., 89  
 BLACKMON, Eleanor, 129  
 BLANCHARD, Laurence, 142  
 BLENSELY, Robert, 119  
 BLODGETT, James, 8  
 BLOMME, George W., 46  
 BLOWER, Howard E., 156  
 BLUMENFELD, Dennis E., 42  
 BLY, P.H., 63  
 BOCCARA, Bruno, p. 58  
 BOLDUC, Denis, 37  
 BOLLINGER, G.A., 74  
 BOLTON, Clayton, 114  
 BONAPARTE, Rudolph, 49  
 BONILLA, Carlos R., 64, 130  
 BONNER, Brian T., 117  
 BONNER, Vernon, 65  
 BONNESON, James A., 70  
 BOOKER, Scott C., 159  
 BOOTH, Rosemary, 206  
 BORDIN, Jeffrey T., 77  
 BOREN, Mark D., 161  
 BOTTIGER, William K., 163  
 BOUCHER, Debra L., 100  
 BOVET, David M., 124  
 BOWER, Richard W., 186  
 BOWIE, Washington, IV, 209  
 BOWLEY, William, 86, 193  
 BOWMAN, Brian L., 103, 142  
 BOYCE, Chris, 7  
 BOYCE, David E., 47, 63, pp. 43, 74  
 BOYLE, Glenn, 181  
 BRACKETT, Quinn, 26  
 BRADLEY, Mark, 14  
 BRADSHAW, Thomas W., Jr., p. 16  
 BRAGDON, Clifford R., 86  
 BRAME, Daniel S., 35  
 BRANCH, William, 209  
 BRAND, Daniel, 61, 128  
 BRANDRUP, Len, 169  
 BRAUN, Richard P., pp. 16, 25  
 BRELIN, J.M., 9  
 BREWER, Kenneth A., 94  
 BREWER, William E., 24  
 BRIGGS, Dwight W., 218  
 BRIGGS, Robert C., 135  
 BRIGHT, John, 186  
 BRING, Dan, 62  
 BRISCOE, Katheryn, 113  
 BRODIE, Dorothy, 21  
 BROGAN, Rita, 111  
 BRONSTAD, Maurice E., 6, 29  
 BRONZINI, Michael S., 36, 55  
 BROTON, M.R., 163  
 BROWN, Dale E., 156  
 BROWN, David, 95  
 BROWN, James L., 97  
 BROWN, Kirk, 105  
 BROWN, Scott A., 8  
 BROWN, Stephen P., 49, 184, 215  
 BRUNO, Nicholas J., 29  
 BRYDEN, James E., 29, 98  
 BRYER, Thomas E., 70  
 BRYSON, Donald A., Jr., 193  
 BUCHANAN, Harold, 18  
 BUCHANAN, Lewis, S., 67  
 BUDD, Harry S., 110  
 BUEKETT, John, 12  
 BULLARD, Diane L., 51  
 BULLEN, A.G.R., 15, 70  
 BULLEY, William A., p. 43  
 BUNT, Paul D., 144  
 BURATI, James L., Jr., 71, 115  
 BURDETTE, Edwin G., 7  
 BURKE, Edward, 191  
 BURKE, Martin P., Jr., 99, 214  
 BURNHAM, Michael W., 48, 91  
 BURNS, David H., 101  
 BURNS, Elmer N., 73  
 BURNS, Lawrence D., 42  
 BURNS, N.H., 7  
 BURRITT, Benjamin E., 159  
 BUTLER, Stewart E., 123  
 BUTT, Abbas A., 163  
 BUTTON, Joseph W., 201  
 BUU, Tri, 213  
 CALKINS, Dale E., 126  
 CALLANAN, Frank, 49  
 CALVERT, George, 90  
 CAMBRIDGE, Joedy W., 55  
 CAMPBELL, Eric C., 96  
 CAMPION, Douglas R., 76  
 CAPE, William, 25  
 CAPO, Carol K., 84  
 CAREY, James Steele, 174  
 CARINO, Nicholas J., 90  
 CARLSEN, Thomas E., 143  
 CARLSON, Candace, 222  
 CARLTON, James D., 176  
 CARMICHAEL, R. Frank, III, 132  
 CARNEY, James A., 167  
 CARPENTER, James R., 137  
 CARPENTER, Samuel H., 53, 135, 163, 187, 195, 201  
 CARREIRA, L.H., 3  
 CARROLL, Joseph L., 98  
 CARSTEN, Oliver, 131  
 CARTER, Everett C., 66, 164  
 CASE, E. Myerson, 73  
 CASS, Patricia, 145  
 CASSANO, Robert C., 186  
 CASTELLANI, Ed, 21  
 CATHCART, Christopher, 120  
 CATION, Kathryn A., 163  
 CAUSEY, James W., 35  
 CETINICH, John, 144  
 CHAMBERLIN, William P., 214  
 CHANG, Edmond Chin-Ping, 178, 183, 193  
 CHANG, Gang-Len, 14

- CHANG, Myung-Soon, 70  
 CHAPLEAU, Robert, 144  
 CHAPMAN, Daniel J., 196  
 CHATFIELD, Benjamin V., 131  
 CHATTERJEE, Arun, 19, 59  
 CHEN, Leon, 117  
 CHEN, Yung-Hai, 8  
 CHICOINE, James E., 24  
 CHONG, G.J., 193  
 CHOU, Chia-pei, 195, 215  
 CHOUERI, Elias, M., 130  
 CHRISTISON, Tom, 136  
 CHRISTOPHER, Barry R., 49  
 CHUA, Koon Meng, 156  
 CHUI, Margaret K., 80  
 CICHOWSKI, W.G., 9  
 CISNEROS, Al, 13  
 CLABAUGH, Mark R., 162  
 CLAPP, T.G., 196  
 CLARK, Carolyn V., 60  
 CLARK, G. Norman, 213  
 CLARK, J. Edwin, 157  
 CLARK, James, 51  
 CLARK, John H., 31  
 CLARK, Michael, 190  
 CLAYTON, Alan M., 173  
 CLECKLEY, Eugene, 146  
 CLEVELAND, Donald E., 64  
 CLIFTON, A.W., 11, 100  
 CLINTON, Kathryn, 41  
 COGSWELL, Richard U., 133  
 COHEN, Stephen L., 51, 95, 183  
 COMOE, Ken, 122  
 COLAVINCENZO, Ovi, 122  
 COLLINS, J.H., 201  
 COLLINS, S.A., 49  
 COLLURA, John, 131  
 COLMER, John W., 114  
 COLPITTS, Ray, 35  
 COLWILL, D.M., 119  
 CONKLIN, Alan H., 203  
 CONNER, D. William, 89  
 CONNOR, James M., 195  
 CONTEE, Joseph, 166  
 COOGAN, Matthew A., 61, 126  
 COOK, Allen R., 4  
 COOK, John, 109  
 COOKE, Donald, 70, 116  
 COOPER, Frank F., 143  
 COOPER, Sally H., 79  
 COPLANTZ, John S., 52  
 COPPLE, Fred, 119  
 CORBETT, John J., p. 21  
 CORCORAN, Debra C., 196  
 CORLEY, W. Gene, 1  
 CORLEY, W.L., 28  
 CORRADINO, Joseph C., 15  
 CORSI, Thomas M., 205  
 COSTIGAN, R.R., 196  
 COTTON, David M., 54  
 COWAN, Charilyn, p. 57  
 COX, Donald, 203  
 CRAWFORD, William L., 17  
 CREASEY, Thomas, 68  
 CRESCO, Robert F., 87  
 CRIMMINS, Timothy, 87  
 CRONSHAY, Roger, 65  
 CRUMPTON, Carl F., 161  
 CSAGOLY, Paul F., 1, 182  
 CUMMINGS, Andrew, 51  
 CUNAGIN, Wiley D., 212  
 CUNNINGHAM, Isabella, 140  
 CUNNINGHAM, Lawrence F., 20, 106, 151, 211  
 CURRY, David, 208  
 CYNECKI, Michael J., 35, 93  
 DAGAN, Doron, 130  
 DAGANZO, Carlos F., 42  
 DAHIR, Sabir H., 69  
 DAHLSTROM, Basil, 213  
 DAINES, M.E., 119  
 DALE, George A., 68  
 DARE, Charles E., 79  
 DARNELL, Kenneth E., 137  
 DART, Olin K., Jr., 92  
 DARTER, Michael I., 53  
 187, 195  
 DASKIN, Mark S., p. 74  
 DAUGHTRY, James, 17  
 DAVIDSON, J.L., 215  
 DAVIES, Peter, 212  
 DAVIES, Tony, 122  
 DAVIS, Darryl W., 48  
 DAVIS, Richard L., 115  
 DAVIS, Stanley R., 65  
 DEAN, Darrell R., Jr., 96  
 DEAN, Donald L., 20  
 DEARDORF, Raymond G., 117  
 DEEGAN, Tulinda, 22  
 DEEN, Thomas B., p. 43  
 DEGASPERIS, Siro, 19  
 DEGROVE, John, 180  
 DEGHANI, Youssef, 107  
 DeLAGARZA, Patrick, 108, 203  
 DeLUCIA, Barbara Hilger, 185  
 DEMMA, Maribeth, 110  
 DEMOSTHENES, Philip B., 60, 148  
 DEMPSEY, Barry J., 200  
 DERBEZ, Louis E., 13  
 DERR, B. Ray, 183  
 DeSANTO, Robert S., 172  
 DeVRIES, Ate, 83  
 DEWAR, Robert E., 68, 118  
 DIAL, Bob, 128  
 DIAMOND, Sidney, 154, 194  
 DICER, Gary N., 36  
 DICKENS, Ray, 28  
 DIESNER, Bruno, 108  
 DIFFERT, Douglas E., 148  
 DILL, Jennifer, 41  
 DILLON, Dan S., 73  
 DOCKENDORF, John, 59  
 DOERR, Donna, 222  
 DOLAN, Joseph F., 88  
 DONDE, Prakash M., 138  
 DONNELLY, Denis E., 66  
 DONOHUE, Robert, 22  
 DOOLITTLE, John T., 169  
 DOWNING, Roger H., 15  
 DOWNS, Mary, 40  
 DOYLE, Mike, 168  
 DRIVER, Cornelius, 112  
 DUBBERKE, Wendell, 2  
 DUCCA, Frederick W., 63  
 DUDEK, Conrad L., 68, 159  
 DUEKER, Kenneth J., 47, 123  
 DUFFY, Brian, 32  
 DUKATZ, Ervin L., Jr., 115  
 DuMONTTELE, Paul B., 74  
 DUNCAN, J.M., 49  
 DUNHAM, Oris, Jr., 40  
 DUNKER, Kenneth F., 69, 127  
 DUNLAP, John, 210  
 DUNK, E., 134  
 DUNPHY, Robert, 16  
 DWIGGINS, J.M., 156  
 EAGLE, David, 123  
 EASH, Ronald, 63  
 EBERHARD, John, 92  
 EBERHARDT, A.C., 196  
 EBERLE, Bruce, 110  
 ECHOLS, James C., 84, p. 46  
 ECK, Ronald W., 3, 121, 142, 164  
 ECK, Theodore, 18  
 ECKARD, E. Woodrow, 211  
 ECKSTEIN, Jonathan, 81  
 EDNER, Sheldon M., 47, 169  
 EDSON, Wendy, 210  
 EDWARDS, Rex, 36, 55  
 EGILSRUD, Philip, 138  
 EGLY, Steven C., 10  
 EISELE, Donald O., 220  
 ELFINO, M.K., 215  
 ELIOT, William S., 167  
 ELLIOTT, Robert P., 132  
 ELMS, Charles, 21  
 ELZOGHBI, George B., 71  
 EMERY, John J., 134  
 EMILIUS, Paul J., 96  
 ENGQUIST, Cynthia A., 176  
 ENOCKSON, Lynn, 135  
 EPPS, Jon A., 52, 187  
 ERHARD, Charles, 166  
 ERICKSON, Donald L., 94  
 ESCH, David C., 155  
 EURITT, Mark Allen, 80  
 EVANS, Leonard, 131  
 EVERETT, Peter B., 111, 206  
 EYERLY, Raymond W., 15  
 FAGNANI, Jeanne, 125  
 FAIRFAX, Barry W., 35  
 FAIZ, Asif, p. 33  
 FARBER, Eugene, 77, 130  
 FARID, Foad, 24  
 FARRAH, Morton, 56  
 FARRINGTON, Robert, 16  
 FARRIS, Robert E., 88, p. 25  
 FAULKNER, T., 154  
 FAULTS, Kenneth W., 119  
 FEGAN, John, 50  
 FEIGHAN, Kieran J., 163  
 FERGUSON, Wayne, 109  
 FERNANDO, Emmanuel G., 135, 187  
 FIALKOFF, Sheldon, 126  
 FIELDING, Gordon J., 111  
 FINN, Anne Margaret, 193  
 FINN, Fred N., 187  
 FIRTH, Derek, 12  
 FISCHER, John W., 147  
 FISHER, John W., 7, 127  
 FLANAGAN, Patrick R., 187, 200  
 FLYNN, Sydwell M., 206  
 FONDA, Albert G., 131  
 FONTANA, Jack J., 27  
 FOREST, Lawrence R., Jr., 106  
 FORKENBROCK, David, 82  
 FORSYTH, Raymond A., 119, 215  
 FORTEY, Nicholas, 222  
 FORTUNIEWICZ, Jan S., 29  
 FOWLER, D.W., 2  
 FRANCO, Colin A., 54  
 FRANCOIS, Francis B., pp. 15, 57  
 FRANK, Earl E., 34  
 FRANKS, Larry, 49  
 FRANTZAKIS, John M., 30  
 FRASER, P., 93  
 FRAVEL, Frederick D., 44, 106  
 FREDERICK, Stephenie J., 41  
 FREDLUND, D.G., 11  
 FREEH, William S., 162  
 FREEMAN, Thomas E., 115  
 FRICK, Michael C., 42  
 FRICKER, Jon D., 57, 178  
 FRIEDMAN, Nancy R., 101  
 FROELICH, David, 8, 91  
 FROMM, Glen J., 117  
 FRYDMAN, Sam, 33  
 FRYE, Ann, 153  
 FULLER, John W., 62  
 FURTH, Peter G., 59, 84  
 FWA, Tien-Pang, 140, 215  
 GABRIEL, Lester H., 156  
 GADDIS, William J., 165  
 GALLAWAY, Bob M., 119, 134  
 GANDHAHL, Rune, 155  
 GARRETT, Vernon K., Jr., 165  
 GARRISON, R.J., 3  
 GASPARINI, Dario, 27  
 GAVIRIA, Juan, p. 58  
 GEISY, Wendy, 146  
 GELTNER, David, 80  
 GENTRY, Claude, 115  
 GEORGE, Bruce F., 142  
 GERMAN, Alan, 131  
 GERSH, Mary Davidson, 45  
 GERSTEN, Marvin C., 73  
 GEURTS, Arthur C., 218  
 GHALI, Amin, 31  
 GHARAYBEH, Fouad A., 181  
 GILDENSTON, Robert F., 102  
 GILMORE, John B., 96  
 GILMOUR, Cam, 146  
 GIMMLER, Franz K., 61, p. 43  
 GIRARD, Robert J., 161  
 GIULIANO, Genevieve, 84  
 GLAUTHIER, Roy E., 179  
 GLAZER, Lawrence J., 208, 222

- GLENNON, John C., 64  
GLICKMAN, Dan, 147  
GLIKEN, Joseph D., 31  
GNILSEN, Reinhard, 138  
GODAR, Susan H., 217  
GODWIN, Stephen, 26  
GOHMANN, John W., 188  
GOLEBERG, Marvin, 117  
GOLOB, Thomas F., 14, 73  
GOMEZ-IBANEZ, Jose A., 189  
GOOD, Bob, 21  
GOODE, Larry R., 113  
GORALKA, Robert, 44  
GORDON, H. Roy, 188  
GORHAM, James E., 211  
GORSKI, Zygmunt M., 131  
GOSLING, Geoffrey D., 46  
GOTTEMOELLER, Frederick, 99  
GRAMLING, Wade L., 97  
GRANTZ, Walter, 107  
GRATTAN-BELLEW, Patrick E., 194  
GRAY, George E., 47  
GRAY, John, p. 43  
GREN, Andrew, p. 53  
GREENE, David L., 41, 125  
GREENE, Traci, 126  
GREENSTEIN, Jacob, 33  
GREPSHEIM, F.D., 202  
GREGORY, E.N., 127  
GREIDER, B. Kenneth, 221  
GRENZBACK, Lance, 205  
GRESHAM, William, 207  
GROSS, John, 32  
GRUBB, Michael A., 127  
GRUBBS, Albert B., 212  
GUENTHER, Hermann A., 159  
GUNTER, L.P., 3
- HAACK, Allan H., 46  
HAACK, Harvey, p. 42  
HAAR, Herbert R., Jr., 88  
HAAS, Ralph C.G., 193, 213  
HACKWORTH, T.J., 88  
HAEPNER, Lonnie, 36  
HAGIN, Faust, 122  
HAIKALIS, George, 104  
HAJEK, J.J., 193, 213  
HALBACH, Dan, 187  
HALKIAS, John A., 142  
HALL, Fred L., 73, 86  
HALL, Jerome W., 5, 130  
HALL, John T., 188  
HALL, Kathleen T., 195  
HALL, Mark D., 39  
HALL, Randolph W., 42, 126  
HALLIN, John, 72  
HALPENNY, David J., 129  
HAMBERGER, Cheryl B., 59  
HAMLETT, Cathy A., 189  
HAMPTON, Robert D., 76  
HAN, Anthony Fu-Wha, 37  
HANAOR, A., 90  
HANCOCK, Kathleen L., 6  
HANSCOM, Fred R., 5, 196  
HANSEN, Eric, 44  
HANSEN, Jack H., 9  
HANSMIRE, William H., 96  
HANSON, Carl, 39
- HANSON, Douglas I., 71, 119  
HANSON, Susan, 190, p. 30  
HARBESON, Paul C., 99  
HARDER, Barbara T., 66  
HARDY, Theodore C., 76  
HARGROVE, M.B., 34  
HARGUS, Tom, 167  
HARKER, Patrick T., p. 74  
HARMON, Robert J., 78  
HARNED, Ellis, 124  
HARPER, George C., 19  
HARRAL, Clell G., p. 33  
HARRIGAN, Edward T., 134  
HARRIOTT, Don M., 119  
HARRIS, Don, 25  
HARRIS, Richard M., 25  
HARRISON, Harold D., 12  
HARTGEN, David T., 58, 218, p. 30  
HARVEY, Greig W., 46  
HARWOOD, Douglas W., 121  
HAUER, Ezra, 142, 185  
HAYDEN, T.D., 194  
HAYWARD, John C., 17, 69  
HAZEN, G.A., 125  
HEALD, Kenneth L., 173  
HEARNE, John L., Jr., 114  
HEAVER, Trevor D., 13  
HEDERMAN, William F., 219  
HEFLIN, Larry H., 165  
HEIDERSBACH, Robert, 161  
HEINLEN, J.E., 114  
HEITMANN, Paul, 38  
HELENIUS, Edward, 126  
HELMAN, David L., 185  
HENDERSON, Jim, 205  
HENDERSON, Joseph L., 68  
HENDERSON, Michael, 169  
HENDERSON, Robert L., 118  
HENDRICKSON, Chris, 24, 178, 197  
HENK, Gregory, 105  
HENNESSY, James, 191  
HENRY, John Jewett, 98  
HENSEN, Ronald J., 77  
HERMAN, Alice, 174  
HERMAN, Robert, 116  
HERMS, Bruce, 35, 93  
HERSEY, Harry, 221  
HESS, Ronald W., 167  
HICKS, R. Gary, 97, 141, 184, 216  
HICKS, Thomas, 25  
HIGGINS, William A., 216  
HILL, Arthur, 3  
HILL, H., 200  
HILL, Hoke S., 115  
HILLS, Frederick S., 169  
HIMMELMAN, Blaine F., 98  
HINCKLEY, Alan L., 96  
HIPPE, Eberhard, 61  
HIRSCH, Harold R., 151  
HIRSCHMAN, Ira, 169  
HITCHCOCK, Anthony, 151  
HITLIN, Robert A., 206  
HIXSON, Robert E., 152  
HLAVINKA, Michael W., 175  
HOBEIKA, Antoine G., 123  
HOBSON, Karen, 126  
HOCHERMAN, Irit, 93
- HOCHSTEIN, Anatoly, 145  
HOEL, Lester A., 47, p. 74  
HOLCOMB, M.P., 9  
HOLLAND, Lester A., 188  
HOLLANDSWORTH, Douglas C., 20  
HOLLOWAY, Lee J., 138  
HOLMGREEN, R.J., Jr., 141  
HOLT, Stephen, 105  
HOLTZ, Robert D., 202  
HOMBURGER, Wolfgang, 130  
HOOVER, J.M., 141  
HOROWITZ, Alan J., 107  
HOROWITZ, Fred, 138  
HOROWITZ, Joel L., 37  
HOUTMAN, Jan Willem, 86  
HOVEY, Harold A., p. 16  
HOWARD, Mark P., 124  
HOWELL, Tommie F., 143  
HOWES, Jonathan B., p. 57  
HRYHORCZUK, Boris, p. 15  
HUANG, Ti, 1  
HUBBARD, Robert A., p. 25  
HUCHINGSON, R. Dale, 68  
HUDSON, Stuart W., 187  
HUDSON, W. R., 7, 132, 187, 200  
HUFF, James O., 190  
HUFT, David L., 196  
HULBERT, Slade, 118  
HUMBLE, Walter P., 6  
HUMMON, Norman P., 15, 70  
HUMPHREY, Thomas F., 57, p. 42  
HUPP, Cliff R., 8  
HURDLE, Vanolin, 95  
HURLE, Ned, 172  
HURST, Mitchell, 9  
HUTCHESON, Thomas B., 34  
HYMAN, William A., 94
- IFFLAND, Jerome S.B., 165  
IMBSEN, Roy A., 7, 182  
IMMERS, Ben H., 86  
INDSETH, Frithjof, 155  
INGRAM, Robert S., 149  
INYANG, Hilary I., 141  
IORDANIS, Damianos I., 30  
IRICK, Paul E., 115  
IRWIN, Lynne H., 66  
ISHIMARU, John M., 126  
ISMAEL, Nabil P., 33  
ISMART, Dane, 113  
IZADMEHR, Bahman, 212
- JACKSON, Lowell B., 17, p. 43  
JACKSON, Newton C., 97  
JACKSON, Thomas J., 9  
JACOBS, Marvin L., 177  
JACOBSON, I. Bernard, 36  
JACOT, Brian J., 54  
JAMES, George W., 83  
JAMES, Ray W., 156, 182  
JAMES, William, 78  
JANOFF, Michael S., 196  
JANSON, Bruce N., 41, 51  
JANSSEN, Donald J., 215
- JANSSEN, H. Hubert, 31  
JENNY, Robert J., 138  
JERMAN, Theodore I., 114  
JESTER, Norman J., 76  
JEYAPALAN, Jey K., 156  
JIANG, Naiyi, 156  
JIMISON, John W., 219  
JOHNS, William E., 109  
JOHNSON, Cheryl, 36  
JOHNSON, Eric G., 184  
JOHNSON, John H., 175  
JOHNSON, Larry R., 18  
JOHNSON, Lynn E., 91  
JOHNSON, Veretta, 183  
JOHNSON, W.F., 178  
JOHNSTON, Daniel P., 53  
JOHNSTON, James J., 205  
JONES, Bernie, 75  
JONES, C.R., 184  
JONES, Don H., 145  
JONES, J. Sterling, 48, 65  
JONES, John Edwin, 9  
JONES, Peter M., 14, 190, p. 30  
JONES, R.H., 155  
JORDAN, William C., 42  
JOVANIS, Paul P., 168, 197  
JUHAST, Barna, 60  
JUNG, Friedrich W., 77  
JURICH, David M., 96  
JUROW, Steven M., 56
- KADDATZ, Mike, 79  
KALCHBRENNER, James, 98  
KALISH, David, 167  
KALOUSH, K., 53  
KAMP, Robert N., 186  
KANE, Anthony R., 191, p. 42  
KANG, Kyungwoo, 19  
KANGARI, Roozbeh, 24  
KATONA, Michael G., 156  
KATZ, Franz, 145  
KEATING, Julie, 32  
KEATING, Peter B., 127  
KEENE, Catherine, 112  
KEHLER, Stuart E., 140  
KELLEY, Martin, 186  
KELSEY, George, 94  
KENIS, William J., 187  
KENNEDY, John B., 69  
KENNEDY, Thomas W., 71, 141  
KENNELLEY, Kevin J., 161  
KENT, Perry M., 212  
KENYON, Kay, 208  
KERMIT, M., 187  
KERPRICH, Gerald T., 221  
KERR, Peter M., 158  
KESSLER, Dan, 120, 204  
KETTLEHUT, Michael C., 203  
KHAN, Ata M., 44, 211  
KHANLARZADEH, H., 195  
KHEDR, Safwan A., 134  
KHOSLA, N. Paul, 181, 184  
KIEPPER, Alan F., 88, 106, 170  
KIERNAN, Laurence J., 123, 150  
KILARESKEI, Walter P., 136, 163

- KILIAN, Alan F., 54, 137  
 KILLEY, Myrna M., 74  
 KIM, H.T., 156  
 KIM, Ok-Kee, 181  
 KIM, Young Geol, 23, 116  
 KIMMELMAN, Gene, 147  
 KING, Gerhart F., 66  
 KING, Kirby, 138  
 KINSTLINGER, Jack, 180  
 KIRKBRIDE, Gary, 50  
 KISSINGER, Stuart, 171  
 KITAMURA, Ryuichi, 37,  
 125, 190, pp. 30, 74  
 KJERBOL, Georg, 138  
 KLAIBER, F. Wayne, 69, 94,  
 127  
 KLASSEN, M.J., 11, 100  
 KLEIST, Robert E., 133  
 KNAB, Lawrence I., 27  
 KNAPPEN, T.C., 106  
 KNIGHTON, Robert G., 44  
 KNOBLAUCH, Richard L., 93  
 KNORR, Rita E., 221  
 KOBER, Wayne W., 140  
 KOLTNOW, Peter G., 204  
 KOPPELMAN, Frank S., 37,  
 190, p. 30  
 KORPHAGE, Glenn, 3  
 KORINK, Richard, 36  
 KORLING, Hans-Georg, 95  
 KOROM, S.P., 48  
 KOSTYNIUK, Lidia P., 125,  
 p. 30  
 KOTT, Joseph, 44  
 KOTZEN, Herbert, 85  
 KOVACH, Gary R., 108  
 KOVER, Allan N., 9  
 KRAICHY, Patricia, 92  
 KRAMES, Raymond A., 159  
 KRAUSE, A., 114  
 KRAUTHAMMER, T., 195  
 KROLAK, Joseph, 91  
 KROON, David H., 161  
 KRUCKEMEYER, Kenneth, 99  
 KRUKAR, Milan, 212  
 KRUIKE, Kevin, p. 43  
 KRUMH, Robert J., 74  
 KSAIBATI, Khaled, 10  
 KUAH, Geok-Koon, 23  
 KUDEBEH, Karen, 210  
 KUDLAPUR, S., 90  
 KUDLICK, Walter, 107  
 KUEHNE, Robert L., 20  
 KUENMEL, David, 88  
 KULAKOWSKI, Bohdan T., 196  
 KULASH, Damian J., p. 15  
 KURDZIEL, John, 91  
 KURT, Carl E., 164  
  
 LACEY, John H., 75  
 LACONTE, Pierre, 107  
 LAHUE, Sanford P., 25  
 LAI, Mike C., 92  
 LAMAK, Bruce W., 81  
 LAMARE, Judith, 107  
 LAMM, Lester P., p. 25  
 LAMM, Ruediger, 130  
 LANG, Donald, 36  
 LAPHAM, George, 147  
  
 LARSEN, Torbjorn J., 53,  
 200  
 LARSON, James L., 220  
 LARSON, Thomas D., 87,  
 pp. 15, 25, 43  
 LARWIN, Thomas F., 111, 151  
 LATHROP, George T., 15  
 LAVIGUEUR, P., 144  
 LEADER, Richard, 176  
 LEBO, Dennis E., 57  
 LEBOWITZ, Herschel, 103  
 LEE, Byron, 169,  
 LEE, Clyde E., 183, 212  
 LEE, Dah-Yinn, 2  
 LEE, Douglass B., 189  
 LEE, Frank W., 217  
 LEE, Kang-Won Wayne, 54  
 LEE-GOSSELIN, Martin E.H.,  
 41  
 LEFFERS, Dan, 207  
 LEI, Shau, 129  
 LEILICH, Robert B., 188  
 LEISTER, Glen A., 217  
 LEONARD, John D., 51, 73  
 LEONARDS, Gerald A., 155  
 LERNER, Neil, 211  
 LESLEY, S. Joseph, 140  
 LESSER, Norman, 138  
 LESSIEU, Eugene J., 107  
 LEUNG, S.C., 52  
 LEVINE, Steven Z., 159  
 LEVINSON, Herbert S., 117  
 LEWIS, Albert D.M., 127  
 LEWIS, R.T., 178  
 LEWIS, Russel M., 159  
 LI, James Y., 91  
 LI, Jun, 181  
 LIEBERMAN, Edward B., 95  
 LIGHTFOOT, Ben, 89  
 LIN, Ben C., 179  
 LIN, Feng-Bor, 70, 116  
 LINDLEY, Jeffrey A., 73  
 LINGRAS, Pawan J., 30  
 LINGWOOD, Bob, 21  
 LIPPERT, David L., 132  
 LIST, George, 4, 149, 199  
 LISTER, Norman, 136  
 LITTLE, Charles H., 119  
 LITTLE, Dallas N., 134,  
 181, 201  
 LIU, Wen David, 182  
 LJUNGDAHL, L.G., 3  
 LOCKE, Carl E., 161  
 LOCKWOOD, Stephen C., 16  
 LOEFFLER, Matthew D., 2  
 LOEWEN, John, 5  
 LOFROOS, William N., 97  
 LONGENECKER, Keith, 213  
 LORD, Bryon N., 140  
 LORENZ, Virginia M., 195  
 LORINI, Ronald A., 98  
 LOUDIN, William R., 206  
 LOUKISSAS, Philippos J.,  
 170, 185  
 LOVE, Bradley W., 132  
 LOVEALL, Clellon L., 69,  
 214  
 LOWEN, Mark, 4  
 LUCIA, Patrick C., 49  
 LUCKE, Roy E., 92  
  
 LUHR, David R., 135, 187  
 LUNDE, Blair A., 196  
 LUPRO, Barbara, 192  
 LUSK, Jack, 170  
 LUSTER, Virginia, 161  
 LUTCHANSKY, Leo, 218  
 LYNCH, Daniel P., 119  
 LYNCH, Stanford W., 21  
 LYNCH, Tim, 78  
 LYONS, William M., 169  
 LYTTON, Robert L., 33, 156,  
 163, 181, 213, 215  
  
 MacGOWAN, John, 173  
 MACHEMEHL, R.B., 183  
 MacMASTER, J.B., 155  
 MAGGIED, Hal S., 180  
 MAHAEL, David, 5  
 MAHMASSANI, Hani S., 14,  
 23, 116, pp. 30, 74  
 MAHONEY, Joe P., 72, 141  
 MAJIDZADEH, Kamran, 53, 195  
 MAKRIIS, James, 120  
 MALEK, R.I., 194  
 MALLORY, Bradley L., 82  
 MALON, Stephan R., 69  
 MAMLOUK, Michael S., 184  
 MAMMANO, Frank J., 166  
 MANDLER, Marc B., 77  
 MANNERING, Fred L., 14, 80  
 MANNING, David G., 161  
 MANSEN, David J., 15  
 MARCHWINSKI, Tom, 220  
 MARGOLIN, Edward, 219  
 MARING, Gary E., 207  
 MARINO, John H., 188  
 MARKHAM, Stephen E., 169  
 MARKOWITZ, Joel E., 206  
 MARKS, Vernon J., 2, 90  
 MARONEY, Stephen, 68  
 MARSDEN, Blair G., 183  
 MARTIN, James E., p. 58  
 MARTIN, Keith, 216  
 MARTINELLI, David, 24  
 MARK, Robert W., 171  
 MASON, John M., Jr., 64  
 MAST, Truman M., 68, 157  
 MATHER, Joseph J., 37, 56  
 MATTHEWS, Ted, 38  
 MAY, Adolf D., Jr., 117,  
 183, 197  
 MAY, D.K., 48  
 MAYER, J.B., Jr., 6  
 MAZE, T.H., 4  
 MAZEN, Said Ossama, 33  
 McCALL, Billy M., 212  
 McCARRON, Frank R., 144  
 MCCARTHY, Ellen, 16  
 MCCARTHY, Paul D., 147  
 McCLUNG, Leo G., 46  
 McCLORE, Richard M., 69  
 MCCOLLUM, Brian, 84  
 MCCORD, Mark R., 14  
 MCCORMICK, Fred C., p. 53  
 MCCOY, Patrick T., 30, 70  
 MCCREARY, Charles R., Jr.,  
 182  
 MCCREE, John, 221  
 McCULLAGH, Frank R., 66  
  
 McCULLOUGH, B. Frank, 72,  
 94, 132, 195, 215  
 McCULLY, Wayne G., 28  
 McDAID, David, 79  
 McDERMOTT, Joseph M., 128  
 McDEVITT, Charles F., 6  
 McDONNELL, James J., 204  
 McDOWELL, Bruce D., 88  
 McELHANEY, David R., 204,  
 McFARLAND, William P., 80  
 McGEAN, Tom J., 21  
 McGENNIS, Robert, 71  
 McGHEE, K.E., 214  
 McGRAPH, Timothy J., 91  
 McGRATH, Dorn C., Jr., 152  
 McGuire, Francis A., 157  
 McINTYRE, Warren H., 177  
 McKay, E. Donald, 74  
 McKEEL, Wallace T., Jr.,  
 214  
 McKEEN, R. Gordon, 11, 33  
 McKELVEY, Francis X., p. 21  
 McKILLIP, Mark, 21  
 McKNIGHT, A. James, 67, 157  
 McLAUGHLIN, Aston, 195  
 McLEOD, Douglas S., 104,  
 211  
 McNEES, Roger W., 118  
 McNEIL, Sue, 178, 193  
 McSWENEY, James J., 219  
 MECKLENBURG, Marion P., 27  
 MECZKOWSKI, Leonard C., 6  
 MEHRANIAN, Maria, 208  
 MEISNER, Laurence J., 82  
 MELLOTT, Dale B., 69  
 MEMMOTT, Jeffrey L., 80,  
 113, 159  
 MERCER, Gene S., 22, 217  
 MERRELL, Roger L., 143  
 MESSER, Carroll J., 70, 116  
 MESSMER, Donald J., 84  
 MEURS, Henk, 14  
 MEYER, A.H., 2  
 MEYER, Keith G., 60  
 MEYER, Michael D., 47, 51,  
 124, 148, pp. 16, 42  
 MICHAEL, Robert S., p. 21  
 MICHIE, Jarvis D., 29  
 MIDDLETON, Dan R., 64  
 MILES-MCLEAN, Robin, 211  
 MILLAR, Fred, 62  
 MILLAR, Marianne, 18  
 MILLAR, William W., 111,  
 p. 43  
 MILLENDORF, Stuart, 43  
 MILLER, Arthur C., 65  
 MILLER, Eric J., 144  
 MILLER, Eugene, Jr., 209  
 MILLER, Gerald K., 106  
 MILLER, Herbert R., 67  
 MILLER, Kenneth M., 53, 97,  
 202  
 MILLER, Russell J., 96  
 MILLER, Sherry Brennan, 189  
 MINKARAH, Issam A., 69  
 MINNETTA, Norman, 40  
 MINSK, L. David, 3  
 MISCH, Gary S., 177  
 MITCHELL, Bridger, 191  
 MITNICK, James, 21

- MITNIC, Slobodan, 107  
 MKANDAMIRE, Austin, pp. 33, 56  
 MOE, Roderick D., 175  
 MOLINAS, Albert, 91  
 MOLITORIS, Jolene M., 78  
 MOMENTHY, Albert M., 89  
 MONISMITH, Carl L., 135, 187, 201  
 MONTENEGRO, Fernando M., 10  
 MONTGOMERY, Robert, 152  
 MOON, Henry E., Jr., 15  
 MOORE, Analee, 104  
 MOORE, Mark, 127  
 MOORE, Raymond R., 213  
 MOORE, Thomas, 174  
 MORGAN, R.D., p. 57  
 MORGAN, William, 205  
 MORRIS, Joseph R., 43  
 MORRISON, June L.C., 41  
 MOSES, Fred., 7, 182  
 MOSHER, Clarence, 109  
 MOTAN, E. Sabri, 54  
 MOULTROP, James S., 115  
 MOUSKOS, Kyriacos C., 23  
 MUDGE, Richard R., 40, 207  
 MUNCEY, Richard W., 206  
 MUNDLE, Subhash R., 151  
 MUNDY, Ray A., 20  
 MURPHY, Monty C., 167  
 MUTTI, Roger A., 132
- NAIK, M. Shankar, 31  
 NATH, Robert H., 181  
 NAVARRO, Ulises, 30  
 NAWY, E.G., 90  
 NAZARIAN, Soheil, 135  
 NEELY, Braxtel, 8  
 NEELS, Kevin, 37  
 NEFF, Theodore L., 53  
 NEKMAT, Rosli, 70  
 NELSON, David O., 220  
 NELSON, James T., 39  
 NELSON, Priscilla P., 202  
 NEMETH, Zoltan A., 5  
 NETHERCUT, Cynthia, 56, 124  
 NEUMAN, Cathy, 177  
 NEUMANN, Lance A., 57  
 NEWLON, Howard H., Jr., 87  
 NEWMAN, James T., 113  
 NEWMAN, Larry T., 216  
 NIBBE, Robert, 3  
 NICHOLAS, James, p. 16  
 NICHOLS, Brooks O., p. 15  
 NICHOLS, Elmer, 36  
 NICHOLSON, Robert M., 118  
 NIEMANN, Klaus, 122  
 NIESSNER, Charles W., 98  
 NIHAN, Nancy L., 178  
 NIXON, Peter, 140  
 NOOKALA, Marthand, 44  
 NORDLIN, Eric F., 6  
 NORTHINGTON, David K., 28  
 NOURELDIN, A. Samy, 52  
 NOWAK, Andrzej S., 69, 182  
 NOWAK, Edwin S., 131  
 NUNEZ, M.M., 163  
 NYSTUEN, D., 4
- OAKLEY, Paul C., 103  
 OBERMEIER, Stephen, 74  
 O'CALLATHAN, Juan C., 83  
 OIESEN, Rick, 150  
 OKAMOTO, Paul A., 2, 129  
 O'LEARY, M., 201  
 OLSEN, Kent, 144  
 OLSEN, Louis E., 151  
 OLSEN, Mikael P.J., 181  
 OLSON, Roger C., 216  
 O'NEILL, Michael W., 54  
 OPIELA, Kenneth S., 50  
 ORBAN, J.J.H., 194  
 ORDMAN, William A., p. 25  
 ORIARD, Lewis L., 114  
 ORLIN, Glenn S., 15  
 ORTGIES, Bernhard H., 10  
 ORTH, Paul A., 196  
 OSBORNE, William E., 79  
 OSTER, Clinton V., Jr., 20, 211  
 OTT, Marian T., 208  
 OVERTON, James M., 149  
 OWENS, Robert, 82  
 OWUSU-ANTWI, Emmanuel B., 141  
 OXLEY, Philip R., 59
- PAGE, Clyde W., Jr., 22  
 PAGE, Edith B., 199  
 PALLADINO, John, 167  
 PALMER, David A., 3  
 PANUSKA, Richard, 136  
 PAPALEONTIOU, Chryssis G., 2  
 PARKER, Frazier, 181  
 PARODY, Thomas E., 204  
 PAROLA, Art, 65  
 PARRISH, A. Scott, 196  
 PARRY, Stephen T., 169, 206  
 PAS, Eric I., p. 30  
 PATEL, Mahendra G., 69  
 PATTON, Edwin P., 38  
 PAULSEN, Greg L., 52  
 PAUTSCH, Gregory R., 164, 189  
 PAVLOVICH, R.D., 201  
 PAYNE, Harold J., 95  
 PEARSON, John R., 173  
 PELL, Kynric M., 3  
 PELLY, Susanne M., 210  
 PENNEWELL, John, 203  
 PENTIMONTI, Eugene K., 101  
 PERL, Josef, 23, 42  
 PERSAUD, Bhagwant, 95, 142, 198  
 PESSIKI, Stephen P., 90  
 PETERSEN, Harry C., 64  
 PETERSON, A.W., 48  
 PETERSSON, Sten, 155  
 PHANG, William A., 136, 193, 213  
 PHILIP, Craig E., 36  
 PHILLEO, Robert E., 154  
 PHILLIPS, David K., pp. 15, 43  
 PHILLIPS, Richard G., 86  
 PHILLIPS, William H., 137  
 PICKRELL, Don H., 84
- PICORNELL, Miguel, 33  
 PIKARSKY, Milton, 47, p. 43  
 PINCAVAGE, John V., 83  
 PIRAGES, Sueellen, 199  
 PISARSKI, Alan E., 204  
 PITT, John M., 2  
 PLASS, Mark, 198  
 PLATKIN, Richard H., 208  
 PLECNIK, Joseph M., p. 53  
 PLUMB, Gary N., 213  
 POHN, Howard A., 9  
 POINTNER, M.J. Peter, 146  
 POLUS, Abishai, 116, 121, 130  
 POMPEI, Marie, 28  
 POOLE, Marion R., 113  
 POOLE, Robert, 40  
 POPOVICS, Sandor, 90  
 POST, John R., 76  
 POST, Patti, 45  
 POTTER, Don L., 8  
 POTTER, John C., 135, 164  
 POWELL, Jimmie, 88  
 POWELL, Warren B., 81  
 POWERS, Richard L., 129  
 POWERS, Tom, 175  
 PRASHKER, Joseph N., 5  
 PRASKASH, A., 213  
 PRATHER, Larry, 55  
 PREIS, Lothar, p. 53  
 PRICE, Dennis L., 120  
 PROCTOR, Linda M., 124  
 PROPER, Greg P., 164  
 PUCCIO, Guy S., 214  
 PULASKI, Joseph B., 86  
 PURDY, Jeffrey E., 4  
 PURVIS, Ron L., 182  
 PUTMAN, Steven H., 63  
 PUZINAUSKAS, Vytautas P., 52  
 PYERS, Clyde, p. 42
- QUEEN, D., 199  
 QUILICI, Ledo, 52
- RABEK, N.E., 3  
 RAFATI-APSHAR, F., 52  
 RAFFENBERGER, Regis, 217  
 RAHARDJO, H., 11  
 RAJAPPAN, Bala M., 121  
 RAJARATHAM, N., 48  
 RAJENDRAN, N., 90  
 RAMAKRISHNAN, V., 90  
 RAMASWAMY, Rohit, 80  
 RAMSDELL, Edward L., 20  
 RANDOLPH, Robert, p. 25  
 RAPHAEL, David, 79  
 RAPPLEYE-MARSETT, Laurelee, 110  
 RATHI, Ajay K., 68, 95  
 RAUGHT, Raymond J., 150  
 RAY, Malcolm H., 6, 29  
 RAYMOND, Gerald P., 12, 49, 100  
 REA, Sam W.P., Jr., p. 57  
 REAGAN, Jack Wayne, 60  
 RECKER, Wilfred W., 51, 73  
 REED, George L., 148
- REED, Harry A., 148, 205  
 REED, Ronald F., 11  
 REESE, Morgan R., 172  
 REFSDAL, Geir, 155  
 REGAN, R.M., 9  
 REGAN, Thomas J., Jr., 76  
 REGIMAND, Ali, 71  
 REHFUS, Ruth, 172  
 REICHEL, Eric, 163  
 REICHMAN, Shalom, 190  
 REILLY, Eugene F., 66  
 REINSCHMIDT, A.J., 12  
 REITH, John L., 173  
 RENNICK, William J., 38  
 RENNILSON, Justin J., 98  
 REPILOGLE, Michael A., 158  
 REYNOLDS, John W., 152  
 RHINE, Linda T., 206  
 RIB, Harold T., 9  
 RICE, John, 150  
 RICHARDS, Dennis L., 65  
 RICHARDS, Frederick, 67  
 RICHARDS, Martin G., 14  
 RICHARDSON, Anthony J., 58, 116  
 RICHARDSON, E.V., 65  
 RICHARDSON, Harvey, 65  
 RICHARDSON, Joseph M., 200  
 RICHART, Lan, 172  
 RITCHIE, Stephen G., 58, 178, 193, 197  
 RIVERSON, John D.N., 141  
 RIX, Glenn J., 135  
 ROBERTS, Arthur W., III, 116  
 ROBERTS, Freddy L., 181, 213  
 ROBINSON, Carlton C., 30  
 ROBINSON, Hunter, p. 25  
 ROCK, Steven M., 207  
 ROCKWELL, Thomas H., 118  
 ROESS, Roger P., 30  
 ROESSET, Jose M., 135  
 ROGERS, Albert M., 74  
 ROGERS, C.D.F., 156  
 ROGERS, Jerry L., 87  
 ROGERS, Michelle M., 179  
 ROGNESS, Ramey C., 141  
 ROLLINGS, Raymond S., 164  
 ROLT, J., 184  
 ROMAN, Ronald J., 195  
 ROMIG, William J., 139  
 RONAYNE, James, 101  
 ROOD, Debra, 92  
 ROPER, David H., 128  
 ROSEN, Cecil C., III, 112  
 ROSENBLOOM, Sandra, 125, 153, 179  
 ROSENZWEIG, Karen, 179  
 ROSS, Hayes E., Jr., 29  
 ROSS, H. Laurence, 75  
 ROSS, Paul, 95  
 ROSSI, Louis, 149  
 ROY, Della M., 194  
 RUBIN, David, 211  
 RUDGE, Daniel, 208  
 RUOFF, Francine, 120  
 RUFF, James F., 8  
 RUHL, Aad, 125  
 RUJOPAKARN, Wiroj, 190

- RUSSELL, Eugene K., Sr., 199  
 RUSSELL, Philip O., 25, 96  
 RUSSO, David, 168  
 RUTH, Byron E., 200  
 RUTLEDGE, Nancy S., 88  
 RWEBANGIRA, Theophil, 141, 184  
  
 SAADI, Hilal, 24  
 SABRA, Ziad, 185  
 SACCOMANNO, F.P., 195  
 SACK, William A., 3  
 SAFWAT, K. Nabil A., 25  
 SAHAJ, Lynn, 79  
 SAITO, Mitsuru, 10, 57  
 SAKAR, L., 194  
 SALOMON, Ilan, 190  
 SALTER, R.J., 52  
 SALZBERG, Philip M., 75  
 SAMEH, Ahmed, 163  
 SANCHEZ-SALINERO, Ignacio, 135  
 SANDEGREN, Erik, 155, 165  
 SANDERS, Wallace W., Jr., 69, 127  
 SARAF, C.L., 94, 215  
 SARGAND, S.M., 202  
 SARIKELLE, S., 48  
 SARROS, Steve, 32  
 SAURENMAN, Hugh J., 39  
 SAXENA, Bari N., 135  
 SAXENA, Surendra K., 202  
 SAXTON, Lyle, 128, 168  
 SCALZI, John, 66, p. 74  
 SCANLON, Suzanne R., 79  
 SCAVO, Al, 50  
 SCHAEFER, V.R., 49  
 SCHANTZ, I.J., 196  
 SCHAUER, Peter M., 79, 192  
 SCHAUFFLE, Roger D., 89  
 SCHEFFEY, Charles F., 66  
 SCHELLING, David R., 127  
 SCHEROMAN, James A., 119, 181  
 SCHEUERNSTUHL, George J., 105, 117  
 SCHIAVONE, John, 4  
 SCHILLER, John W., 175  
 SCHLUTER, Myron C., 2  
 SCHMIDT, Joseph J., 133, 160  
 SCHMITT, Rolf R., 171, p. 58  
 SCHMITZ, Vicki, 152  
 SCHNEIDER, Jerry B., 176  
 SCHOENE, George W., 128  
 SCHOLEK, Charles F., 2, 141  
 SCHONFELD, Paul M., 177  
 SCHOTT, Janice, 43  
 SCHULTZ, Donald M., 1  
 SCHWAGER, Dianne S., 79, 192  
 SCHWARTZ, Gail Garfield, 191  
 SCHWARTZ, Samuel I., 210  
 SCOTT, K. Dow, 169  
 SCRAPTON, Derek, 61  
 SCRIVANICH, Claudia L., 68  
  
 SCULLION, Thomas, 163  
 SEBAALY, Boutros E., 184  
 SEEDS, Steven, 17, 72  
 SEISLER, Jeffrey, 18  
 SELIG, Ernest T., 100  
 SENEVIRATNE, P., 93  
 SHAFFER, Joseph L., 57  
 SHAFFER, Ray E., 102  
 SHAFFER, Wanda J., 192  
 SHAH, S.P., 90  
 SHAHIN, M.Y., 129, 163, 187, 195  
 SHANMUGAM, Rajendran, 142  
 SHAO, Ko-Young, 135  
 SHAPIRO, Phillip S., 5  
 SHARAF, Essam A., 163  
 SHARMA, Satish C., 30  
 SHARP, Ben, 147  
 SHATTUCK, Robert P., 91  
 SHAW, Alfred E., 34  
 SHAW, R. Gill, 115  
 SHAW, Richard, 112  
 SHAW, William, 40  
 SHEA, William, p. 21  
 SHEARIN, Rudolph K., Jr., 6  
 SHEARMAN, James O., 65  
 SHEFFI, Yosef, 81  
 SHEIKH, Shamim A., 54  
 SHERBECK, Celia, 22  
 SHILSTONE, James M., 24  
 SHIRLEY, Earl C., 104, 113  
 SHIU, K. Nam, 31  
 SHLADOVER, Steven, 61  
 SHOEMAKER, Cliff, 149  
 SHONDEEP, L., 194  
 SHOUP, Donald, 208  
 SHULDINER, Paul W., 131  
 SHULER, T.S., 201  
 SIAURUSAITIS, Victor, 5  
 SICKING, Dean L., 29  
 SIDDIQI, Aftab, p. 58  
 SIDES, Arie, 184  
 SIGOURNEY, James W., 137  
 SIMON, A.L., 48  
 SIMON, Andrew, 8  
 SIMON, Leonard, p. 57  
 SIMS, Jim, 45  
 SINGH, Margaret, 18  
 SINHA, Kumares C., 10, 141, 163, 206, pp. 33, 58  
 SINN, Roland, 3  
 SJOKVIST, Eric H., 160  
 SKABARDONIS, Alexander, 183  
 SKOLNICK, Marilyn, 170, 210  
 SLAVIS, Charles V., 162  
 SLOANE, Maurice, 22  
 SLOANE, Robert, 148  
 SMALL, Kenneth A., 41, 189  
 SMELLY, Phillip R., 144  
 SMIRNOFF, Timothy P., 165  
 SMITH, Dwight, 110  
 SMITH, Frank J., 207  
 SMITH, George C., 104  
 SMITH, Graham, p. 33  
 SMITH, H.R., 184  
 SMITH, Jene, 192  
 SMITH, Kenneth D., 122  
 SMITH, Lawrence L., 200  
 SMITH, M.J., 183  
 SMITH, Robert D., 141  
  
 SMITH, Robert L., Jr., 41  
 SMITH, Roger E., 187  
 SMITH, Steven A., 50, 93  
 SOBEY, Albert, 18  
 SOMMERVILLE, Fraser K., 212  
 SONNITAG, Ronald C., 51  
 SORLIE, Arne, 155  
 SOSSLAU, Arthur B., 204  
 SOSTKOWSKI, Ron, 185  
 SOTIR, Robbin B., 28  
 SOUSA, Jorge B., 135  
 SOUTHGATE, Herbert F., 135  
 SOUTHWORTH, Frank, 41  
 SPAULING, John, 16  
 SPEAS, R. Dixon, 22  
 SPENCE, Sandra, 192  
 SPERLING, Daniel, 41, 44  
 SPICHER, Robert E., p. 43  
 SPIELBERG, Frank, 206  
 SPIVACK, Gary, 45, 206  
 SPRAYBERRY, Robert, 22  
 SPRING, Gary S., 131  
 SPRINKEL, Michael M., 27, 90  
 STAHL, Agneta, 125, 153  
 STALEY, Richard A., 19, 43, 85  
 STANFORD, Charles L., 34, 102  
 STANGER, Richard M., 144  
 STANLEY, Harriett, 78  
 STAPLER, William T., 66, 119  
 STAPLIN, Lorin K., 157  
 STARK, David C., 154  
 STAUNTON, Vince P., 176  
 STEADFAST, David, 48  
 STEELE, Roger K., 34  
 STEER, Michael, 209  
 STEFANIAK, Peter R., 121  
 STEGMAN, Michael A., 180  
 STEIN, Howard, 5  
 STEINBERG, Malcolm L., 11, 146  
 STEIN-HUDSON, Kathleen E., 106  
 STEPHANEDES, Yorgos J., 82, 123  
 STEWART, Fred, 174  
 STEWART, Harry E., 100  
 STIMPSON, Edward W., 147  
 STOCK, A.F., 196  
 STOCKI, Mark, 222  
 STOETZEL, James R., 220  
 STOFFELS, Shelley M., 213  
 STOKOE, Kenneth H., 11, 135  
 STOLL, Robert D., 49  
 STONE, John R., 193  
 STONE, Judith, 109  
 STONE, Peter V., 176  
 STONER, James, 79  
 STONEX, Anne, 70  
 STOPHER, Peter R., 15, 58, 169  
 STORER, David, 151  
 STOWERS, Joseph R., 205  
 STRATHMAN, James G., 123  
 STRAUSS-WIEDER, Anne, 19, 85  
 STROMBOM, Cathy, 107, 117  
  
 STROUP-GARDINER, Mary, 52  
 STRUBLE, L., 194  
 STUART, Darwin G., 124  
 STUCKEY, Timothy A., 101  
 STUSNICK, Eric, 39  
 STUTT, James, 166  
 SUDOL, Joseph J., 132  
 SUEN, Ling, 153  
 SUHRBIER, John H., 16, 170  
 SULLIVAN, Cindy, 122  
 SUPERNAK, Janusz C., 14  
 SURTEES, John R., 12  
 SUTHARD, Robert L., 26  
 SWANSON, Curtis N., 152  
 SWENEY, Robert A.P., 7  
 SWERDLOFF, Carl N., 189  
 SWICK, Theodore P., 78  
 SWIERENGA, David, 22  
 SZYMONIAK, Tom, 54  
  
 TABB, John R., p. 25  
 TALLEY, Wayne K., 59  
 TAM, Kai K., 119  
 TANG, Huan Cheng, 99  
 TANNER, Bertrand D., 96  
 TARNOFF, Philip J., 168  
 TAUBE, Richard K., 179  
 TAYABJI, Shiraz D., 2, 129  
 TAYLOR, Roy W., 198  
 TAYLOR, Vail M., 36  
 TEACH, Ann, 99  
 TEAL, Roger F., 84, 153, p. 46  
 TEN EYCK, Thomas E., 124  
 TERREL, Ronald L., 216  
 THACKER, John R., 77  
 THENHAUS, Paul C., 74  
 THIEDE, Charles L., 189  
 THOM, N.H., 215  
 THOMAS, William, 48, 65  
 THOMPSON, Berke L., 96  
 THOMPSON, Larry M., 26  
 THOMPSON, Louis S., 104  
 THOMPSON, Marshall R., 72, 200  
 THOMPSON, Paul D., 57  
 THOMPSON, Philip L., 65  
 THOMPSON, Stephen J., 13  
 THORTON, Claiborne, 17  
 TIA, Mang, 129, 200  
 TIBERIO, Terrence J., 69  
 TICE, J. Allan, 54  
 TICKLE, Ronald, 3  
 TILLMAN, Erland A., 102  
 TISCHER, Mary Lynn, 62, 125  
 TISE, Larry E., 87  
 TITISHOV, A., 77  
 TOBER, Ronald J., 61  
 TOMECKI, Andrej B., 116  
 TONG, Chee-Chung, 14  
 TORREY, David C., 149  
 TOURVILLE, Richard, 62  
 TOWNSEND, Trevor, 190  
 TOYE, Kevin L., 129  
 TRENT, Roy E., 65  
 TRUE, Justin, 43  
 TRUEBE, Mark, 184  
 TRUEBLOOD, T., 114  
 TRUITT, Thomas M., 214

- TSAY, Huel Sheng, p. 58  
 TUCKER, John P., 111, 220  
 TUNG, Shiang-I, 178  
 TURNAGE, Howard, 166  
 TURNER, Daniel S., 64  
 TWARK, Richard D., 15
- UDDIN, Waheed, 132  
 UGGL, Alex, 73  
 ULBERG, John C., 53  
 ULLMAN, Gerald L., 159  
 UPCHURCH, Jonathan E., 5, 70, 77  
 URBANIK, Thomas, 11, 130  
 URMAN, Stephen C., 39  
 UZAN, Jacob, 33, 184
- VACCHIONE, Tony, 21  
 VALERIO, Nan, 93  
 VALLERGA, B.A., 201, 216  
 VAN AERDE, Michel, 73, 199  
 VAN DAM, Thomas, 129, 201  
 VANDEBONA, U., 46  
 VANDERCLUTE, Robert C., 133  
 VAN DER HORN, Toon, 37  
 VAN DER RAADT, Paul, 11  
 VAN HOUTEN, Donald T., 67  
 VAN MATRE, Patricia, 111, 179  
 VAN VLIET, D., 183  
 VAN VUREN, T., 183  
 VERMA, D., 182  
 VEST, Michael J., 169  
 VICTOR, Robert, 186  
 VIEST, Ivan M., 127  
 VIJAYAKUMAR, Sangarantham, 70, 116  
 VILLORIA, Olegario G., Jr., 14  
 VINSON, Ted S., 54  
 VOAS, Robert, 75  
 VOGEL, J., 200  
 VOIGT, Gerald F., 53  
 VOKAS, Constantine, 49  
 VOLTZ, William E., 32  
 VYAS, Anant, 18
- WACHS, Martin, 125, 208  
 WADE, Montie G., 60  
 WAGENMANN, Ronald G., 170  
 WAGNER, David, C., 127  
 WAGNER, Harald, 138  
 WAHLS, Harvey E., 202  
 WAINWRIGHT, W. Scott, 70  
 WAISSI, Gary K., 64  
 WAITE, Herb, 52  
 WALKER, Donald M., 189  
 WALKER, Melville, 178  
 WALKER, Richard D., 154  
 WALLACE, Charles E., 95  
 WALLACE, David W., 121  
 WALTON, C. Michael, 23, 62, 113, 121, 173, p. 16  
 WAMBOLD, James C., 196  
 WARD, D. Chris, 180  
 WARD, Don, 55
- WARNER, Robert T., 150, p. 36  
 WATKINS, Reynold K., 156  
 WATSON, Robert B., 133  
 WATTERS, B.K., 100  
 WATTICK, Patricia H., 164  
 WAY, George B., 163  
 WAYSON, Roger L., 86  
 WEATHERBY, David, 137  
 WEBER, Harold H., 134  
 WEBSTER, F.V., 63  
 WECK, Thomas, 209  
 WEED, Richard M., 198  
 WEEKS, F.C., 114  
 WEISGERBER, Frank E., 69  
 WEISS, David, 44  
 WELLAND, J. Douglas, 86  
 WELLANDER, Chris A., 117  
 WELLS, Gordon K., 215  
 WELLS, Raymond, 105  
 WERNER, Alexander, 30  
 WEYER, David, 55  
 WHEELER, Wayne C., 110  
 WHITE, Charles R., 169  
 WHITE, E.J., 9  
 WHITE, Frank, 95  
 WHITEHEAD, Ralph L., 162  
 WHITFORD, Robert K., 32  
 WHITING, David A., 2  
 WHITTLE, Charles, 65  
 WIEGEL, J., 3  
 WIEGMANN, John D., 4  
 WIERWILLE, Walter W., 118  
 WIGFIELD, James N., 91  
 WILBUR, Antoinette, 95  
 WILDER, J.R., 162  
 WILENT, Merrie, 222  
 WILKERSON, Robert, 120  
 WILKINSON, William C., 111, 158  
 WILLIAMS, David, 55  
 WILLIAMS, J.L., 219  
 WILLIAMS, James C., 116  
 WILLIAMS, John I., 102  
 WILLIAMS, Robert, 71  
 WILLIAMS, S.G., 184  
 WILSON, Eugene M., 68  
 WILSON, James E., 54, 181, 216  
 WILSON, L. Ed, 137  
 WILSON, Nigel H.M., 111  
 WILSON, Stephen C., 41  
 WINGER, James W., 12, 34  
 WINSTON, Clifford, 189  
 WINTERS, Philip L., 208  
 WIPF, Terry J., 94  
 WIRASINGHE, S.C., 46  
 WISE, Herb, 55  
 WITCZAK, Matthew W., 72  
 WITKOWSKI, James M., 123  
 WITZIG, Albert C., 56  
 WOLF, Norman B., 145, 177  
 WOLFE, Gregory D., 40  
 WOOD, James, 22  
 WOOD, Leonard E., 52  
 WOOD, Leonard E., 140  
 WOODRUFF, John, 173  
 WOODSTROM, James H., 215  
 WOODWARD, George C., 139  
 WRAY, Warren K., 11
- WRIGHT, Jeff R., 10  
 WRIGHT, Judy, 45  
 WRIGHT, Paul H., 5  
 WRONG, G.A., 155  
 WU, Chung-Lung, 129  
 WUESTEFELD, Norman B., p. 16  
 WYLLIE, Duncan, 96, 114
- YACHMETZ, Mark, 104  
 YAGAR, Sam, 73  
 YAKEMCHUK, Mike, 48  
 YAMANAKA, Jody, 46  
 YEARWOOD, Kevin W., 86  
 YEDLIN, Mark, 95  
 YEH, Che-I, 178  
 YEN, Ben T., 1, 127  
 YERUSALIM, Howard, 221, p. 42  
 YESBECK, Joseph, 220  
 YINGLING, Clifford, 166  
 YOKEL, Mike H., 19  
 YOUNG, G. Kenneth, 91  
 YOUNG, J. Francis, 154  
 YRJANSON, William A., 115
- YU, Shaw L., 91
- ZADOR, Paul, 5  
 ZAESKE, Earl R., 108  
 ZAIDEL, David M., 93  
 ZANIEWSKI, John P., 129, 187  
 ZAVATTERO, David A., 207  
 ZAZWORSKY, David E., 143, 216  
 ZEGER, Charles V., 93  
 ZEIGLER, Andrew J., 28  
 ZELLER, Michael E., 91  
 ZEMOTEL, Linda M., 15, 206  
 ZHOU, Jian Hau, 69, 182  
 ZIMMERMAN, Richard A., 182  
 ZION, Earl M., p. 53  
 ZOGBY, John J., 109  
 ZOGRAPOS, Konstantinos, 117  
 ZOZAYA-GOROSTIZA, Carlos, 41, 178  
 ZULLIG, Walter E., Jr., 220  
 ZUPAN, Jeffrey M., 56  
 ZWAHLEN, Helmut T., 68, 118

ANNEXE D

AGENDA DE LA REUNION DU SHRP

TENTATIVE AGENDA  
 STRATEGIC HIGHWAY RESEARCH PROGRAM STATE COORDINATORS MEETING  
 SUNDAY, 11 JANUARY 1987  
 SHERATON WASHINGTON HOTEL  
 WASHINGTON BALLROOM

OBJECTIVES:

The three major objectives of this meeting are:

- o To inform you on progress being made to implement SHRP and future activities planned.
- o To get your advice on how to ensure that SHRP is useful, timely, innovative, and efficient.
- o To discuss future LTPP plans, including priorities for recruitment of additional candidate sites.

| TIME    | TOPIC                                                              | SPEAKER                   |
|---------|--------------------------------------------------------------------|---------------------------|
| 8:30 AM | Continental Breakfast                                              |                           |
| 9:00    | Welcome and Objectives of Meeting                                  | Thomas Larson             |
|         | SHRP: Status of Current Activities and Future Outlook              | Damian Kulash             |
|         | Overview of the Development of LTPP                                | Pav. Perf. Committee Rep. |
|         | Site Selection: Status and Discussion of Problems and Next Steps   | Pav. Perf. Committee Rep. |
|         | Discussion of Plan to Obtain Additional Sites                      | Pav. Perf. Committee Rep. |
|         | Data Collection Plans                                              | Pav. Perf. Committee Rep. |
| Noon    | Buffet Lunch                                                       |                           |
| 1:00 PM | Equipment and Instrumentation: Coordination with Other State Needs | Pav. Perf. Committee Rep. |
|         | Questions and Concerns from a State Perspective                    | Francis Francois          |
|         | Key Issues from Federal Perspective                                | David Phillips            |
|         | Need for Sustained State Cooperation                               | John Tabb                 |
|         | Potential for Payoff in SHRP                                       | Thomas Larson             |
|         | Discussion of Key Issues                                           | State SHRP Coordinators   |
| 5:00    | Adjourn                                                            |                           |

ANNEXE E

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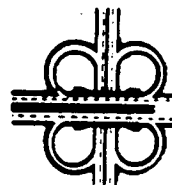
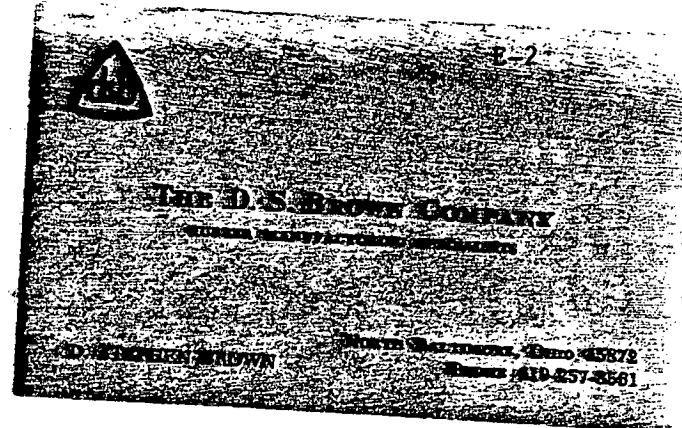
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