COMPTE-RENDU DE LA SEMAINE DES COMITES

DE L'ASTM - DECEMBRE 1986

PROJET: 84 11 25

COMPTE-RENDU DE LA SEMAINE DES COMITES DE L'ASTM - DECEMBRE 1986

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

Sainte-Foy, le 17 décembre 1986

COMPTE-RENDU DE LA SEMAINE DES COMITES

DE L'ASTM - DECEMBRE 1986

1.0 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 : Nouvelle Orléans, Louisiane

2.2 Durée : 1 au 5 décembre 1986.

2.3 Autorisation: 86-C-260

2.4 Raison du voyage : Participer, comme membre du comité D4, à la semaine des comités de l'ASTM.

3.0 CARACTERISTIQUES DE LA REUNION

3.1 Type de réunion: Internationale (Canada et E.U. surtout).

3.2 Nom de l'organisme responsable : American Society for Testing and Materials.

3.3 Contenu de la réunion

3.3.1 Liste des thèmes abordés:

Comité D-4: Matériaux routiers et de revêtement bitumineux.

Sous-comité
- .20 Essais mécaniques sur les mélanges bitumineux
- .21 Poids spécifique et densité des mélanges bitumineux.
- .22 Effet de l'eau et autres éléments sur les granulats enrobés de bitume.
- .23 Mélange de base et de surface en centrale.
- .24 Traitement de surface.
- .25 Analyse des mélanges bitumineux.
- .30 Méthodes d'échantillonnage.
- .35 Propriétés de friction.
- .37 Recyclage des revêtements bitumineux avec agents modifiants.
- .39 Essais non destructifs.

.40 Spécifications sur les bitumes.

Une copie des agendas des sous-comités de D-4 est présentée en annexe A.

Symposium — L'implication des granulats dans le design, la construction et le comportement des pavages flexibles. Une copie du programme et des sommaires est donnée en annexe B.

Comité	E-17	Caractéristiques des surfaces circulées.
Sous-comité	E17.41	Gestion des chaussées.

Comité	C-9	Béton de ciment
Sous-comité	C-9.03.01	Essais de détermination de la résistance du béton.
	C-9.03.12	Manuel d'essais sur le béton.

3.3.2 <u>Résumé des conférences et des discussions.</u>

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

1. Le système de coiffe des cylindres de béton au polyuréthane n'est bon qu'une ou deux fois avec des bétons de haute résistance. Le système au néoprène comprend des coiffes pour trois niveaux de résistance et peut être utilisé très souvent. L'AASHTO a une spécification sur ce dernier système.

2. L'ASTM oblige de faire l'essai de compression sur les bétons de ciment jusqu'à la rupture complète afin de pouvoir poser un jugement sur le type de rupture.

3. L'Institut de Recherche en ingénierie de l'Université du Nouveau Mexique est à compléter une recherche sur l'effet de la teneur en saturés ($< 25\%$, $> 25\% < 50\%$, 70%) dans les agents de recyclage de béton bitumineux.

4. Une étude a montré que la force de cisaillement du mortier varie de 122 à 141 psi pour les briques et de 144 à 154 psi pour les blocs, cela sous charges cycliques. (L.S. Johal et E.D. Anderson, PCA, Illinois).

5. L'essai de désenrobage des mélanges bitumineux devrait se faire à plusieurs % de vides différents. Le niveau de stabilité conservé devrait être considéré plutôt que le % de stabilité.

6. L'Alaska a une spécification qui requière que le % de volume comblé par le bitume soit compris entre 70 et 90%. De plus elle requière que le % de bitume dans le mélange soit l'optimum Marshall plus 0,4%.

7. Le % de bitume requis dans un mélange est minimum lorsque 70% des granulats sont fracturés.

8. La teneur en passant le 75 um des mélanges bitumineux denses conventionnels devrait être comprise entre 3 et 6%.

9. Le module d'élasticité d'une fondation granulaire avec pierre de grosseur maximale de 63 mm varie de 30 000 à 40 000 psi.

10. La presse giratoire prédit bien quels mélanges vont avoir un orniérage important.

11. Les mélanges à forte teneur en filler (passant 75 um) sont très sensibles aux variations de la teneur en bitume. De plus, la qualité du filler affecte beaucoup le comportement des bétons bitumineux (E.R. Brown U.S.A. Army Corps of Engineer).

12. Un mélange très facile à compacter en laboratoire est facile à compacter sur la route, et ainsi il est susceptible à l'orniérage.

13. Un traitement de surface triple sur une couche de fondation 0-63 mm avec un maximum de 6% de passant 75 um a donné une excellente performance sous trafic lourd.

14. L'essai Marshall ne varie pas beaucoup si l'on ne tient compte que des résultats d'un mode de compactage soit mécanique, soit manuel. C'est quand on traite toutes les données globalement

que l'on obtient des répétabilités et reproductibilités élevées. La grande majorité des laboratoires utilisent un compacteur mécanique.

15. L'essai de désenrobage Plancher indique parfois l'aptitude à la fissuration d'un mélange plutôt que la susceptibilité au désenrobage. Il faut donc également un examen visuel des briquettes pour déterminer s'il y a désenrobage.

16. La méthode de mix design produite par le groupe de travail de Richard Langlois passera au vote du sous-comité D 04.23 en mars 87. Si tout se passe sans trop de votes négatifs, la méthode pourra être publiée dans le volume 1988 de l'ASTM.

17. Le malaxeur Hobart C-100 n'est plus produit. La Cie Hobart recommande le modèle A-120 qui est un peu plus gros.

18. La méthode d'essai à la plaque Vialit pour les traitements de surface sera complétée par le groupe de travail de Richard Langlois et soumis au vote du sous-comité D 04.24 en mars 1987.

19. Pour les climats froids, l'essai Vialit devrait être fait à - 10°C et -20°C selon Richard Moore de Polysar.

20. La méthode D 2172 d'extraction du bitume devra être modifiée par le groupe de travail de Richard Langlois pour inclure le facteur de correction et exclure l'utilisation du benzène.

21. Une spécification sur les bitumes polymères classifiée par la viscosité a été présentée et passera au vote bientôt. (Annexe C).

22. Le système de mesure de l'épaisseur des couches de revêtement par radar est très fiable.

23. Les membres du sous-comité D04.40 ont manifesté le désir d'avoir une spécification pour un bitume de qualité supérieure. Cette qualité peut lui provenir de l'addition de tout agent modifiant (polymère, filler, carbon black, etc.).

3.3.3 Documentation recueillie

La documentation recueillie lors de ces réunions consiste en feuillets, minutes et brefs rapports des divers sous-comités et groupes de travail. Egalement, des résumés des conférences du symposium sur l'implication des granulats dans le design, la construction et la performance des chaussées flexibles ont été obtenus (Voir annexe B), en plus du texte complet de la conférence de E.R. Brown "Effect of Aggregates on Performance of Bituminous Concrete".

3.4 Liste des personnes assistant aux réunions

Plus de 1200 personnes assistaient aux divers comités et aucune liste n'était disponible.

4.0 NATURE DE MA PARTICIPATION

4.1 Participation à titre de membre de comité, de sous-comités, chairman et membre de groupes de travail.

4.2 Nature de mes interventions

Mes interventions ont consisté en votes pour appuyer ou rejeter des changements à certaines normes, en commentaires divers sur la valeur de corrections suggérées, en suggestions de modifications de normes d'essais et en questions diverses pour clarifier certains points et obtenir des renseignements techniques. De plus, comme président d'un groupe de travail sur le mix design des mélanges bitumineux, j'ai dirigé une réunion de ce groupe et présenté le rapport au sous-comité D 04.23. Comme membre du groupe de travail sur la densité maximale, j'ai participé à une réunion sur ce sujet. Enfin, j'ai présidé deux réunions de mon groupe de travail sur l'essai Vialit et ai présenté le rapport au sous-comité D 04.24.

Au sous-comité D 04.35, j'ai insisté fortement sur la nécessité pour ce groupe de faire une spécification sur les caractéristiques minimales de résistance à la glissance que devraient avoir les revêtements routiers.

4.3 Contacts et personnes rencontrées.

Les contacts avec diverses personnes de l'entreprise privée et des ministères des transports de plusieurs états ont été l'occasion d'échanges très fructueux et d'acquisition de connaissances nouvelles sur des produits et des méthodes d'essais. Une liste des principales personnes rencontrées est fournie en annexe D.

De plus, j'ai contacté la vice-présidente de l'ASTM qui s'occupe des réunions et évènements spéciaux, afin de lui suggérer que l'ASTM tienne une de ses réunions de comités à Québec. Mme Joan Mc Fadden m'a dit ne pas connaître les facilités de Québec et qu'elle serait heureuse de les évaluer. Au retour, j'ai donc contacté le Service du Tourisme, sections congrès, de la CUQ et leur ai fourni les coordonnées de Mme Mc Fadden afin qu'ils l'invite à Québec pour la convaincre d'y tenir un meeting de l'ASTM. La réponse de la CUQ fut très favorable et ils vont communiquer avec Mme Mc Fadden.

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 établir une spécification sur le volume comblé par le bitume dans les mélanges bitumineux. De plus, il devrait limiter le % passant le 80 um à 6% maximum.

2. Il y aurait intérêt à utiliser une pierre 0-63 mm au lieu de 0-20 mm pour les fondations à cause du module d'élasticité plus élevé et d'un comportement supérieur (surtout par sa teneur en passant le 80 um inférieure).

3. Le Laboratoire Central du MTQ devrait avoir un budget spécial (75,000$ U.S.) afin d'acquérir une presse giratoire pour mieux concevoir des revêtements bitumineux résistants à l'orniérage (voir annexe E).

4. Le Laboratoire Central du MTQ devrait devenir membre de l'AASHTO afin d'avoir toujours les plus récentes spécifications de cet organisme.

5. Le Laboratoire Central du MTQ devrait acquérir le système de coiffe au néoprène pour les cylindres de béton. De plus, il devrait se procurer la norme de l'AASHTO concernant ce système.

6.0 AUTRES INFORMATIONS

En résumé, cette réunion de l'ASTM a été très fructueuse par les échanges lors et en dehors des réunions que par les moyens mis à notre disposition (salles, tableau, distribution de documents, etc.). Assister aux réunions de l'ASTM est une nécessité pour une personne qui doit normaliser des essais et des produits pour y faire valoir le point de vue de son ministère, connaître celui des autres qui sont dans le même domaine et se procurer des renseignements et des publications que seule une présence aux réunions peut permettre. Aussi, le ministère devrait y déléguer plusieurs personnes afin que les principaux domaines le touchant soient couverts. Il faudrait, par exemple, avoir un représentant sur les comités C1 et C9 traitant des ciments et béton de ciment.

La prochaine réunion se tiendra à Cincinnati Ohio du 23 au 28 juin 1987.

Sainte-Foy, le 18 décembre 1986.

ANNEXE A

AGENDA DES SOUS-COMITES DE D 04

AGENDA

ASTM Subcommittee D04.20
Mechanical Tests of Bituminous Mixtures
New Orleans, Louisiana
~~Louisville, Kentucky~~
~~June 18, 1986~~
Dec 4, 1986

1. Approval of Minutes of Meeting, June 18, 1986, Louisville, Kentucky.

2. Subcommittee Membership

   2.1 Losses
   2.2 Appointments

3. Task Force Reports:

   Task Group A - Marshall Test - Thomas D. White, Chairman

   Task Group D - Gyratory Testing Machine - J. L. McRae, Chairman

   Task Group G - New Tests for Stiffness Measurement of Bituminous Concrete Mixtures (Including Creep, Complex Modulus - Sinusoidal Loading, Repeated Load - Compression - Tension - Flexure, Split-Tension) - Ervin L. Dukatz, Jr., Chairman

   Task Group H - Hveem Tests D 1560 and D 1561 - R. N. Doty, Chairman

   Task Group J - Compressive Strength of Bituminous Mixtures, D 1074 - S. R. Spelman, Chairman

   Task Group K - Indirect Tension Test Method for Resilient Modulus - T. W. Kennedy, Chairman

AMERICAN SOCIETY FOR TESTING AND MATERIALS

Committee D-4 on Road and Paving Materials

November 6, 1986

File: 11-3-2c

TO: Members, Subcommittee D04.22

Members:

G. J. Allen	A. W. Hart	F. W. Parsons
T. D. Atkinson	R. N. Jester	R. A. Pemberton
O. E. Briscoe	I. V. Kalcheff	H. Plancher
E. R. Brown	N. P. Khosla	W. W. Porter, Jr.
D. Clementoni	B. Kiggundu	V. P. Puzinauskas
R. S. Dalter	B. Kilburn	R. E. Root
R. L. Davis	R. Langlois ✓	C. G. Schmitz
E. L. Dukatz, Jr.	F. Martinez	H. G. Schreuders
J. N. Dybalski	G. W. Maupin, Jr.	W. T. Stapler
S. J. Emborsky	N. W. McLeod	M. Tia
J. A. Epps	K. A. Mesch	K. R. Wardlaw
J. L. Goodrich	H. R. Miller	T. D. White
R. A. Hanson	H. W. Muncy	M. Zupanick

Ladies and Gentlemen:

Enclosed please find minutes of the Subcommittee meeting held in Louisville, Kentucky on June 19, 1986. An attendance record is attached.

The Subcommittee will meet at the Sheraton New Orleans Hotel in New Orleans, Louisiana on Thursday, December 4, 1986 at 10:00 a.m. Our agenda includes the following:

1. Approval of the minutes of the meeting held in Louisville, Kentucky on June 19, 1986.

2. Report from Task Force IX, Susan Emborsky, Chairman on activity with respect to the Proposed Standard for Determination of the Effect of Water in Bituminous Paving Mixtures Containing Adhesion Improving Agents.

3. Report from Task Force X, R. E. Root, Chairman on status of Proposed Standard Test Method for Determining the Effect of Moisture and Antistripping Additives on Asphalt Paving Mixtures.

4. Report from Task Force XI, L. D. Coyne, Chairman on revision of D1075-81.

5. Report from Henry Plancher on the status of revision to Proposed Standard Method for Water Damage Susceptibility Test of Asphalt Aggregate Paving Mixtures to accommodate negative votes and comments.

6. Other items from Subcommittee members. If you have any please let Professor Tom White know. He has agreed to chair the meeting since I will be unable to attend. His address is the same as mine and his telephone is 317+494-2215.

If you cannot attend the meeting or be present by proxy, please advise. I'm sorry I won't be with you in New Orleans, but I hope you have a productive meeting.

Sincerely,

W. H. Goetz

W. H. Goetz, Chairman Subcommittee
D04.22 Committee D-4, ASTM

WHG/tb

Attachment

cc: William Gartner, Jr.
Ed Harrington

ASTM Committee D-4

Subcommittee D04.23

AGENDA

December 4, 1986

1. Minutes of meeting on June 19, 1986.

2. Subcommittee Membership.

3. Subcommittee Letter Ballot No. D04.23-86-1.

   Item 1. Revision of D 4215-82, Specification for Cold-Mixed, Cold-Laid Bituminous Paving Mixtures. Tally to be announced. Recommendations on negative votes and comments (if any), Task Group B, L. F. Ostermeyer Chairman.

   Item 2. New Standard Specification - Acceptance Type - for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures. Tally to be announced. Recommenda-tions on negative votes and comments (if any), Task Group D, R. F. Uthoff Chairman.

4. Subcommittee Letter Ballot No. D04.23-86-2.

   Item 1, Revision of D 995-81, Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures. Because of return dead-line of December 6, 1986, only partial tally can be announced. Recom-mendations on negative votes and comments (if any), Task Group N, E. R. Brown Chairman.

5. Plant Inspection, D 290 and D 2489 - Task Group A, O. E. Briscoe Chr.

6. Mixture Specifications, D 3515 and D 4215 - Task Group B, L. F. Ostermeyer Chairman. D 4215 needs revision or reapproval in 1987, and D 3515 in 1988.

7. Permeability, D 3637 - Task Group H, P. Gilbert Chairman.

8. Mix Design Practice - Task Group M, R. Langlois Chairman.

9. Old business.

10. New business.

11. Adjourn.

ASTM COMMITTEE D-4
SUBCOMMITTEE D04.24
Bituminous Surface Treatments
Wednesday, December 3, 1986, 3:30 P.M.
Sheraton New Orleans
New Orleans, Louisiana

AGENDA

1. Call to Order

2. Announcements

3. Review and Approval of Minutes of June 19, 1986 Meeting in Louisville, Kentucky

4. Status and Review of Standards:

   D 1369 Recommended Practice for Quantities of Materials for Bituminous Surface Treatments

   D 2995 Recommended Practice for Determining Application Rate of Bituminous Distributors

   D 3910 Recommended Practice for Design, Testing and Construction of Slurry Seal

5. Task Group Reports:

   Rod Birdsall - Development of Specification for Design of Surface Treatments

   Richard Langlois - Vialit Test

   [illegible] Hobart C100 recommend A-120

   Kevin Hardin - Slurry seal mixers used in Specification D 3910

   Don Jarboe - Report on asphalt quantities given in Tables 1A and 1B of Specification D 1369 add HFRS

6. Review of Approved Subcommittee Title and Scope:

   Title: Bituminous Surface Treatments

   Scope: The purpose and scope of this subcommittee is to develop through appropriate research, prepare, review and maintain up-to-date specifications and recommended practices for bituminous surface treatments.

7. New Business

8. Adjourn

ASTM Subcommittee D04.25
December 4, 1986
3:30 p.m.
New Orleans, Louisiana

AGENDA

1. Approval of minutes.

2. Loss of members.

3. New members.

4. Subcommittee letter ballot.

   Item 1 - New Standard Practice for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials.

   Item 2 - Reapproval of D2172, Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

5. Task Group D1461, Byron Ruth.

6. Task Group D1856, Conway Burton.

7. Task Group D2172, Richard Langlois.

8. Task Group D4125, Fred Waller.

9. Task Group A, New Method of Recovering Asphalt Cement.

10. Task Group B, Standard Practice for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials.

11. Round Robin Test for Asphalt Content (D2172 and D4125), Jon Epps.

12. Use of Methylene Chloride vs. Trichloroethylene in Abson Recovery Test, Conway Burton.

13. Old Business.

14. New Business.

15. Adjournment.

A G E N D A

SUBCOMMITTEE D04.30, METHODS OF SAMPLING

NEW ORLEANS SHERATON, NEW ORLEANS, LOUISIANA

THURSDAY, DECEMBER 4, 1986, 10:00 AM

1. Approval of minutes from the meeting of June 19, 1986 as distributed with Chairman's letter of July 30, 1986.

2. Membership Changes

3. Results of Subcommittee Letter Ballot 86-2. Revising D979,D75 and D140.

   15 ballots returned all affirmative. This item is now ready for main committee ballot.

4. Results of Subcommittee Letter Ballot (86-3)

   11 of 15 returned all affirmative. This is a revision to D3665. This matter is, also, ready for main committee ballot.

5. New Business

   Letter from Campbell Crawford concerning Section 3.3.2 of D979 (copy attached)

6. Other New Business -

   D4 Executive Committee ruling for highlighting revision to standards.

7. Adjourn

A G E N D A
ASTM SUBCOMMITTEE D04.35 ON FRICTIONAL PROPERTIES OF PAVEMENTS

Wednesday, December 3, 1986 1:30-3:30 P.M.
Sheraton Hotel - New Orleans, Louisiana

1. Signing of Attendance Roster for Members and Visitors

2. Approval of Minutes of June 18, 1986 Meeting in Louisville, Kentucky

3. Subcommittee Membership Status 20 = 8P + 12U + 3 N.V.

4. Status of Standards under Subcommittee Jurisdiction - D3042 and D3319

5. Report of Task Group 10 - Petrographic Insights into Polish Susceptibility (Sabir Dahir, Chairman)

6. Report of Task Group 11 - Seasonal Variation of Skid Resistance (S. W. Forster, Chairman)

7. Report of Task Group 13 - Revision of Method D3319 (W. E. Elmore, Chairman)

8. Discussion of Opinion Survey relative to Future of Subcommittee

9. Other Business

10. Adjourn

AGENDA

ASTM Subcommittee D04.37

Modifier Agents for Bitumens in Pavements

Thursday, December 4, 1986, 1:30 p.m. to 3:30 p.m.

Sheraton New Orleans Hotel
New Orleans, Louisiana

1. Approval of minutes from June meeting in Louisville, Kentucky.

2. Review of membership and methods under jurisdiction.

3. Task Group Reports
   a. Carbon Black - B. A. Vallerga
   b. Rubber Asphalts - R. D. Pavlovich

4. Old Business
   a. Subcommittee Letter Ballot, "Proposed Standard Specification for Rubber Filled Asphalt Cement"
   b. Subcommittee Letter Ballot, "Standard Practice for Classifying Hot Mix Recycling Agents"

5. New Business

6. Adjournment

AGENDA

D04.39 on Nondestructive Testing of Pavement Structures
New Orleans, Louisiana
Wednesday, December 3, 1986 - 10-12 a.m.

I. Introductions

II Review of Minutes of June 18, 1986

III. Task Group Reports

A. General Testing - Kileraski
B. Impulse Load Testing - R. Costigan
C. Surface Condition - J. Epps
D. Radar Testing - F. Holt

IV. Liaison Reports

A. D18 - R. Deen
B. E17 - A. Bush

ASTM SUBCOMMITTEE D04.40 -- ASPHALT SPECIFICATIONS

AGENDA FOR DECEMBER 3, 1986, MEETING

1. Review of Subcommittee Membership

2. Addition to Agenda

3. Approval of June 18, 1986, Meeting Minutes

4. Review of Subcommittee Standards

5. Results of Subcommittee Survey on Revision of D946, Penetration-Graded Specification for Asphalt Cements

6. Old Business

7. New Business

8. Adjournment

ANNEXE B

SYMPOSIUM: IMPLICATION DES GRANULATS SUR LE DESIGN, LA CONSTRUCTION ET LE COMPORTEMENT DES CHAUSSEES FLEXIBLES

Implication of Aggregates in the Design, Construction & Performance of Flexible Pavements

Abstracts

December 3, 1986
New Orleans, LA

1916 Race St · Philadelphia PA · 19103

ASTM

Symposium on the Implication of Aggregates in the Design, Construction, and Performance of Flexible Pavements

3 December 1986

Sheraton New Orleans
New Orleans, Lousiana

SYMPOSIUM CHAIRMEN:

Hans G. Schreuders
Westvaco Corporation
Polychemicals Department
Charleston Heights, South Carolina

Dr. Charles R. Marek
Vulcan Materials Company
Birmingham, Alabama

Ken R. Wardlaw
National Crushed Stone Association
Washington, District of Columbia

7:00 p.m. **INTRODUCTION**
H. G. Schreuders
Symposium Chairman

7:10 p.m.

HMA Moisture Susceptibility Problems: The Need To Test and Specify Via a Common Procedure — *R. S. Phillips and ~~C. R. Marek~~, Vulcan Materials Company, Birmingham, Alabama*

7:30 p.m.

Evaluation of Percent Fracture and Gradation on Behavior of Asphalt Concrete — *J. R. Lundy and R. G. Hicks, Oregon State University, Corvalis, Oregon; R. McHattie, Alaska Department of Transportation and Public Facilities, Fairbanks, Alaska*

7:50 p.m.

Performance of a Thin-Surface Crushed Stone Base Pavement — *R. D. Barksdale, Georgia Institute of Technology, Atlanta, Georgia; R. L. Greene, Investigators, Inc., Charlotte, North Carolina; A. J. Bush, Waterways Experiment Station, Vicksburg, Mississippi; and C. A. Machemehl, Vulcan Materials, Birmingham, Alabama*

8:10 p.m.

Effect of Aggregate Grading on Performance of Asphalt Concrete — *E. R. Brown, Waterways Experiment Station, Vicksburg, Mississippi; J. L. McRae, Vicksburg, Mississippi; and A. Crawley, Mississippi State Highway Department, Jackson, Mississippi*

8:30 p.m.

Use of Thin Asphalt Surfaces Over Aggregates—*E. L. Dukatz, Vulcan Materials Company, Birmingham, Alabama; S. Wu, North Carolina Department of Transportation*

Papers which are not on the program but will appear in the publication (STP) are:

- E.L. Dukatz, Jr. a~~nd Shin Wu~~ -- "Use of Thin Asphalt Surfaces Over Aggregate Base Courses For Heavy Axle Truck Roads"
- Kuo Hung Tseng and Robert L. Lytton -- "Prediction of Permanent Deformation in Flexible Pavement Materials"
- A. A. Selim and N. A. Heidari -- "Measuring the Susceptibility of Seal Coats to Debonding"
- K.W. Lee, M. A. Al-Dhalaan and T. W. Kennedy -- "Rutting, Asphalt Mix-Design, and Proposed Test Road in Saudi Arabia"

HMA MOISTURE SUSCEPTIBILITY PROBLEMS: THE NEED TO TEST AND SPECIFY VIA A COMMON PROCEDURE

By Richard S. Phillips[1] and Charles R. Marek[2]

One of many problems facing the hot-mix asphalt designer, specifier and producer is how to properly predict the behavior of the asphalt concrete when exposed to moisture. At present, a broad spectrum of accelerated test procedures are available to the engineer that, to some degree, "predict" the moisture susceptibility of the mix. These procedures include modified versions of the Lottman test, the immersion-compression test, and the boiling water stripping test. With the number of procedures available, and with different procedures being specified in different parts of the country, the engineer must answer the question of which procedure best suits the prediction of future performance.

Failure of an asphalt mixture due to moisture is often classified as stripping. This type of failure is most prevalent with siliceous aggregates such as granites and gravels, and is characterized by a near total loss of adhesion between the asphalt film and the aggregate surface.

Another type of failure, however, is exhibited in carbonate type aggregates. In this case, the adhesion is maintained, but the cohesion of the asphalt cement is weakened. Choice of test method can influence how well each mechanism is quantified.

Once a procedure is chosen, then the method by which the data are interpreted becomes important. In one version of the Lottman procedure, splitting tensile specimens are prepared at 7±2 percent air voids. Grossly different and misleading results will be obtained if conditioned specimens having 9 percent air voids (7+2%) are tested and compared to control specimens having 5 percent air voids (7-2%). While the preceding combination can suggest lower than actual performance, the opposite is possible if the extremes are reversed. Either case is undesirable and can prove costly if (1) a local aggregate is excluded for a false failure, or if (2) a poor material is accepted for a false passing value.

The authors suggest that a better procedure is to prepare specimens representing the low (4 to 6%), midpoint (6 to 8%), and high (8 to 10%) end of the air void range allowed for the test. Do this for both the conditioned and

---

1 Laboratory Supervisor, C.M. Research & Development Laboratory, Vulcan Materials Company, Birmingham, Alabama, 35253.

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the control specimens. After determination of the splitting tensile strength for each specimen, the results should be plotted strength versus air voids for each condition. Via graphical interpolation, the strength at 7 percent voids for each test condition can be determined and a valid comparison can be made for all conditions.

Another suggestion of the authors is that a minimum conditioned tensile strength at 7% air voids be specified in conjunction with a minimum retained tensile splitting ratio (TSR). Certain mix combinations using antistrip agents may exhibit conditioned strengths higher than the unconditioned strengths of control mixes made without the antistrip. When the conditioned strength exceeds the minimum tensile strength specified, the TSR requirement may be waived.

EVALUATION OF PERCENT FRACTURE AND GRADATION ON BEHAVIOR OF ASPHALT CONCRETE MIXTURES

James R. Lundy,* R.G. Hicks,** and Robert McHattie***

The effects of percent fracture and fines content on the laboratory performance of asphalt mixtures were investigated. The objectives of this study were to develop an approach for the effective utilization of crushed aggregates in highway and airfield pavements. Additionally, the current Alaskan specifications were evaluated in light of this laboratory testing.

The repeated load diametral test device was used to measure the mixture performance in terms of modulus, permanent deformation, and fatigue. Experimental variables included percent fracture, percent passing the 200 sieve, and aggregate source. Testing was conducted at temperatures representative of Alaskan environmental conditions.

Test results show optimum asphalt contents to be minimized at approximately 7 percent. At temperatures tested, little increase in modulus or fatigue life was attributable to fracture level. Significant reductions in laboratory lives were noted when fines contents were varied from the 6 percent currently specified.

Laboratory testing indicates the current specification for fines content is appropriate and, in fact, the mid-range value of 6 percent maximizes fatigue lives. At the temperatures tested, little increase in fatigue life can be attributed to increase in fracture.

KEY WORDS

Bituminous concrete, flexible pavements, aggregates, fine content, crushed faces, fatigue life, modulus.

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PERFORMANCE OF A THIN-SURFACED CRUSHED STONE BASE PAVEMENT

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An experimental pavement approximately 200 m (650 ft.) long was constructed in May of 1978 and consisted of a 19 mm (0.75 in.) triple surface treatment over a 460 mm (18 in.) crushed stone base. By 1985 the pavement had been subjected to about 1.4 million equivalent 80 kN (18 kip) single axle loads, and had a present serviceability rating of 3.0 to 3.5. About 6.5 percent surface cracking had, however, developed within about the last two years. The pavement is constructed on a clayey and sandy silt subgrade which is relatively dry and has a field CBR of 10. The crushed stone base is well-graded, has a maximum aggregate size of about 30 mm (1.5 in.), and contains less than about 2.0 percent fines. Field tests performed on the pavement included static plate load tests, Benkelman beam, surface strain measurements and falling weight deflectometer (FWD) tests.

Using the AASHTO design method, a base course layer coefficient for the upper 305 mm (12 in.) was back-calculated to be 0.18, and 0.16 for the remaining stone base. The elastic modulus of the base was backfigured from the FWD test results to be 406 MN/m^2 (59 ksi). The elastic moduli of the base and subgrade, however, depend upon not only the test method but also the mean stress and shearing strain to which the material was subjected. Because of the difference in loading conditions, the elastic modulus of the base should be somewhat lower under a dual wheel, 80 kN (18 kip) axle loading than under the 40 kN (9 kip) FWD test.

Effect of Aggregates on Performance of Asphalt Concrete

by E. R. Brown*
John L. McRae**
Alfred B. Crawley***

Aggregate comprises approximately 95 percent of asphalt mixtures and hence has a major effect on performance of mixtures. The quality of filler and amount of filler greatly affect asphalt concrete performance. To insure satisfactory performance procedures must be available that can be used to detect poor-quality mixtures and there must be techniques available for improving mixture properties.

The objective of this paper is to present data from various studies that show the effect of aggregate grading on performance of asphalt mixtures. Test methods to evaluate these mixture properties are discussed.

A well-graded crushed aggregate should be used to provide the highest-quality asphalt concrete. Uncrushed aggregates such as natural sands and uncrushed gravels produce mixtures with lower stability and decreased durability. A well-graded aggregate fits together tighter during compaction resulting in lower required asphalt content and improved stability and durability.

The maximum aggregate size is important to control stability, skid resistance, and compactibility of the mixture. A larger maximum size aggregate produces a higher stability and usually required less asphalt content. The larger size aggregate also provides for improved skid resistance. Compaction of thin layers is difficult when the maximum aggregate size is too small. The compacted lift thickness should be at least two times the maximum aggregate size.

The amount of mineral filler in a mixture greatly affects the overall mix quality. Since the filler tends to fill the voids in the mineral aggregates, an increase in filler results in a corresponding decrease in optimum asphalt content. Laboratory test results also indicate that a mixture design performed for an aggregate with higher filler content will result in a significantly higher stability than that for lower filler content. The type of filler used also affects the mixture properties.

The quality of the aggregate must be controlled to insure a quality asphalt concrete. Some properties that must be considered are maximum aggregate size, amount of crushed particles, and amount and quality of filler.

---

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USE OF THIN ASPHALT SURFACES OVER AGGREGATE BASE COURSES FOR HEAVY AXLE TRUCK ROADS

By E. L. Dukatz, Jr.,[1] and Shin Wu[2]

Crushed stone base (overlain with asphalt or portland cement concrete) serves as an integral part of a roadway in providing structural integrity, and in many cases drainage, and will minimize construction costs. At the present time, however, crushed stone is frequently not being used to its full advantage in pavement construction. Crushed stone is not given full structural credit to which it is entitled. Recent laboratory tests have shown that a properly designed and constructed crushed stone base is much stronger than is widely believed.

A concern of many engineers across the country is the deformation of pavements (rutting) due to the loadings of heavy truck traffic. Vulcan Materials Company (VMC) has been involved with several test roads designed to provide information about the effectiveness of pavements constructed with thin asphalt surfaces over thick aggregate base courses. One of these test roads is a section of SR 1508 in North Carolina that was constructed in early 1985 and is a haul road for a VMC quarry in North Carolina. The test road consists of two inches of NC I-2 surface mix over 13 inches of aggregate base course. The NC pavement is underlain by a silty, clay subgrade. The NC test road was designed to have a five-year life. The road was constructed with a well-graded crushed stone base that was compacted to 100 percent of AASHTO T 180 density.

The North Carolina test section is trafficked by all incoming and outgoing aggregate haulers from the quarry. Last year all of the aggregate required for the expansion of the Raleigh-Durham airport travelled over this road. At the present time, the road shows a minimal amount of distress. After two years of truck traffic, the number of equivalent axle loads exceeded the five-year design number for the pavement.

The flexible experimental pavement has demonstrated excellent performance. The pavement has been subjected to about 3×10^6 equivalent 18-kip single-axle load applications.

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Pavement condition evaluations have been periodically performed by the North Carolina State University, the North Carolina Department of Transportation, and the Vulcan Materials Company. The calculated modulus of elasticity of the crushed stone base was found to be higher than what is normally considered to be a typical value. These results are due to obtaining adequate compaction in the base section during construction. The structural coefficient was back-calculated for the crushed stone base from the truck traffic count on the test pavement section. The calculated structural coefficients are closer to 0.2 than to 0.14, which is the value typically used for crushed stone bases.

Prediction of Permanent Deformation in Flexible Pavement Materials

by

Kuo Hung Tseng[1] and Robert L. Lytton[2]

ABSTRACT

The purpose of this paper is to present a method to predict the permanent deformation (rutting) in pavements using an analytical - empirical model of material characterization. Three permanent deformation parameters are developed through materials testing to simply represent the curved relationship between permanent strains and the number of load cycles. Equations are developed by regression analysis which determine how these three parameters are affected by the material properties, environmental conditions (moisture and temperature), and stress state. These relations are important in calculating the permanent deformation of pavement layers since the relation between permanent deformation and cycles of load from the laboratory are usually conducted in test conditions that are significantly different from the field conditions. The permanent deformations calculated form the method presented are compared with results measured in the field in Florida and are found to be accurate.

The permanent deformation is calculated as the sum of the resilient strains multiplied by the fractional increase of total strains for each material layer of the pavement. The resilient

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strains of pavement structures under highway loadings are calculated using a finite element analysis which incorporates both linear and nonlinear stress-strain behavior of the pavement component materials. The fractional increase of total strains is basically in terms of three parameters which characterize the permanent deformation relations from the laboratory. The values of these parameters are developed for pavement materials such as asphalt concrete, gravel and crushed stone base course materials, and subgrade soils from a variety of data sources. The statistical equations for the three parameters are developed for each type of the material represented in the data. The most important terms in the equations are the asphalt content, temperature, resilient modulus, and stress state for asphalt concrete material, and the density, water content, resilient modulus, and stress state for base and subgrade soils, respectively. These equations and the method as mentioned above has been programmed into a modified ILLI-PAVE program to calculate the resilient strains and permanent deformation in each layer of pavement, taking into account realistic distributions of tire contact pressures, both vertical and horizontal.

The permanent deformation obtained is shown to be in reasonable agreement with the measured results. It is demonstrated that this method provides an appropriate and realistic analysis of the prediction of the permanent deformation, and further, the results are used in the prediction of the loss of serviceability index of pavements using the AASHO Road Test relation. The paper demonstrates the importance of accurate materials characterization in predicting the rutting of asphalt concrete pavements on granular base courses.

MEASURING THE SUSCEPTIBILITY OF SEAL COATS TO DEBONDING

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Asphalt mixes, hot and cold, can experience bond loss due to moisture damage, a phenomenon called "Debonding" or "Stripping". Debonding in hot mixes has been given more attention by researchers than debonding in cold mixes and seal coats, and there has been no documented methodology to quantify bond loss in seal coats. This report contains a description of a newly developed laboratory test experiment called Seal Coat Debonding Test (SDT) to examine the extent of seal coat susceptibility to moisture damage.

When the test was performed on several seal coat specimens, the nature of the outcome strongly suggested dividing seal coats into three categories according to their degree of vulnerability (DV) to moisture damage. Highly vulnerable seal coats are those that experience a loss of aggregate of more than twenty percent (based on the weight of the base bitumen and the totally intact aggregate). Moderately vulnerable seal coats lose more than ten percent and up to twenty percent, and low vulnerable seal coats lose up to ten percent.

The test is relatively easy to conduct and is considered unique in the sense that no similar tests are currently in use to quantify the amount of bond loss in seal coats.

RUTTING, ASPHALT MIX-DESIGN, AND PROPOSED TEST ROAD IN SAUDI ARABIA

K. W. Lee, Univ of Rhode Island, Kingston, RI, USA
M. A. Al-Dhalaan, Ministry of Communication, Riyadh, SA, and
T. W. Kennedy, Univ of Texas, Austin, TX, USA

The drastic change in traffic characteristics due to crash development programs in Saudi Arabia has introduced new forms of pavement distresses. Rutting, which was virtually absent ten years ago, becomes the principal distress mode. A feasibility study was performed on the Dhahran-Abqaiq road experiencing a severe rutting problem to formulate rehabilitation alternatives. The comparative study indicates that the Hveem mix-design method gives relatively lower optimum binder content than the Marshall mix-design method, and that some of the potential reasons for the rutting at the Dhahran-Abqaiq road were over-asphalting, fine-graded mix, and poor quality control. In addition, test results indicate that the SEA mixture can be utilized for solving the rutting problem, since it provided higher stability values. Finally, to provide a reliable solution to the wide-spread rutting in Saudi Arabia, a decision was made to include test sections in the rehabilitation program of this road.

ANNEXE C

SPECIFICATIONS POUR LES BITUMES-POLYMERES CLASSIFIES

SELON LA VISCOSITE

STANDARD SPECIFICATION FOR VISCOSITY-GRADED POLYMERIZED

ASPHALT CEMENT FOR USE IN PAVEMENT CONSTRUCTION

1. SCOPE

1.1 This specification covers polymerized asphalt cements graded by viscosity at 140°F (60°C) for use in pavement construction.

2. SIGNIFICANCE AND USE

3. APPLICABLE DOCUMENTS

2.1 ASTM Standards

D 5 - Test Method for Penetration of Bituminous Materials[2]
D 92 - Test Method for Flash and Fire Points by Cleveland Open Cup[3]
D 95 - Test Method for Water in Petroleum Products and Bituminous Materials by Distillation[3]
D 113 - Test Method for Ductility of Bituminous Materials[2]
D 140 - Methods of Sampling Bituminous Materials[2]
D1754 - Test Methods for Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)[2]
D2042 - Test Method for Solubility of Asphalt Materials in Trichloroethylene[2]
D2170 - Test Method for Kinematic Viscosity of Asphalts (Bitumens)[2]
D2171 - Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer[2]
D2872 - Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)[2]
D 412 - Test for Rubber Properties in Tension

4. MANUFACTURE

4.1 The polymerized asphalt cement shall be prepared by reacting (compatible asphalt cement) and polymers by suitable methods.

5. PHYSICAL REQUIREMENTS

5.1 The polymerized asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347°F (175°C).

5.2 The polymerized asphalt cements shall conform to the requirements given in Tables 1 as specified by the purchaser.

6. METHODS OF SAMPLING AND TESTING

6.1 Sample and test asphalt cements in accordance with the following methods:

6.1.1 Sampling-Method D 140.
6.1.2 Water-Test Method D 95.
6.1.3 Viscosity at 140°F (60°C)-Test Method D2171.
6.1.4 Viscosity at 275°F (135°C)-Test Method D2170.
6.1.5 Penetration-Test Method D5.
6.1.6 Flash Point, Cleveland Open Cup-Test Method D 92 (see Tables 1 and 2).
6.1.7 Solubility in Trichloroethylene-Test Method D 2042.
6.1.8 Thin-Film Oven Test-Test Method D 1754 (see Tables 1 and 2).
6.1.9 Rolling Thin-Film Oven Test-Test Method D 2872 (see Table 3).
6.1.10 Ductility-Test Method D 113.
6.1.11 Tensile Strength
6.1.12 Low Temperature Ductility
6.1.13 Force Ductility
6.1.14 Elastic Recovery by Ductilometer

TABLE 1.

RECOMMENDED SPECIFICATIONS FOR POLYMER-MODIFIED ASPHALT CEMENT

• • •

TEST	VISCOSITY GRADE					
	PAC-2.5	PAC-5	PAC-10	PAC-20	PAC-30	PAC-40
Viscosity, 60°C (140°F), poises	250 ± 50	500 ± 100	1000 ± 200	2000 ± 400	3000 ± 600	4000 ± 800
Viscosity, 135°C (275°F), CS, min.	125	200	250	300	350	400
Penetration, 25°C (77°F), 100 g., 5 sec., min.	220	140	80	60	50	40
Flash point, COC, C (F), min.	163 (325)	176 (350)	232 (450)	232 (450)	232 (450)	232 (450)
Solubility in tricholoroethylene, % min.	99.0	99.0	99.0	99.0	99.0	99.0
Test on Residue from Thin-Film Oven Test:						
Viscosity ratio,						
TFOT residue viscosity, P @ 140°F / Original viscosity, P @ 140°F	3.0	3.0	3.0	3.0	3.0	3.0
Test for Elasticity						
Tensile stress @ 800% elongation, 20°C (68°F), 500 mm/min. rate of pull, kg/cm², min. @ 4°C, min.	0.75	2.0	0.2	0.3	0.4	0.5
Elastic recovery by means of ductilometer, % min.	55	60	60	60	58	58

ANNEXE D

LISTE DES PRINCIPALES PERSONNES RENCONTREES

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ANNEXE E

DOCUMENTATION SUR LA PRESSE GIRATOIRE

Engineering Developments Company Inc.
POST OFFICE BOX 1109 Telephone 638-2072
Vicksburg, Mississippi 39180

25TH ANNIVERSARY ENGINEERING DEVELOPMENTS COMPANY, INC. VICKSBURG MISSISSIPPI

November 26, 1986

Saruon Khaur
Ministere des Transport
Laboratoire Central
Complex Scientifique
2700 rue Einstein
Ste-Foy, QC
GIP 3W8

Mr. Saruon Khauv:

Thank you for your letter of November 11 advising that the Gouvernment du Quebec, Ministere des Transports is interested in procurement of the EDCO Model 6B/4C/I Gyratory Testing Machine (GTM). We are pleased to comply with your expressed need for more information and are enclosing descriptive brochures.

The instrumentation work for the EDCO GTM is done by an electronics engineer who recently retired from the U.S. Army Corps of Engineers, Waterways Experiment Station, where he spent many years in the Instrumentation Division. The workmanship and the hardware are of the highest quality of course.

The manufacturers suggested list price F.O.B. factory is $72,051.49 with shipment scheduled 180 days after receipt of order.

We try to better this shipping time if possible and generally ship well within this time limit. Our dealers, listed in the brochure, receive a discount on this list price and will be able to quote a price below the suggested list.

EDCO only quotes on custom built units in which we work directly with the customer to furnish special engineering features and services. However we can furnish engineering services to train your personnel at a service charge of $50.00/hour for actual time in your laboratory plus travel and living expenses. If you desire this service please so request in your invitation to your bidders.

In the event any of your staff will be attending the December ASTM meeting in New Orleans, Louisiana, I'm enclosing a copy of a symposium program dealing with flexible pavements in which a paper by Brown, McRae and Crawley will include some of the latest developments in the application of the GTM.

Thank you for giving us the opportunity to serve you. We are informing our dealers of your interest by furnishing copies of this letter.

Sincerely yours,

John L. McRae

John L. McRae, P.E.
President

encl: as stated

cf: Hogentogler, Rainhart & Soiltest

Engineering Developments Company Inc.
POST OFFICE BOX 1109 Telephone 638-2072
Vicksburg, Mississippi 39180

Memorandum for Pavement Engineers:

Engineering Developments Company announces a new improved Gyratory Testing Machine (GTM). Enclosed is a brochure describing the new model 6B-4C-I and showing some actual test results. As illustrated, this new model incorporates modern instrumentation for easier testing and data reduction.

While the enclosed brochure deals with bituminous pavement, please note that the GTM is a combination compaction and shear testing machine for rational compaction and shear testing of soils and base course materials as well. For example see "Gyratory Compaction Method for Determining Density requirements for Subgrade and Base of Flexible Pavements," U.S. Army Engineer Waterways Experiment Station Miscellaneous Paper No. 4-494.

The enclosed page of photographs shows ruts in highway traffic lanes collecting water which creates traffic hazards and invites accelerated deterioration of the roadway because of ponding. Such rutting caused by traffic compaction, should be eliminated by requiring a density in the roadway that is based on laboratory compaction employing the anticipated design load and compacting to equilibrium under this stress. The GTM lends itself readily to adjust compaction requirements for changing design loads by introducing the design load and compacting to equilibrium. Note that optimum water content or optimum bitumen content as well as shear strength is determined simultaneously with the density.

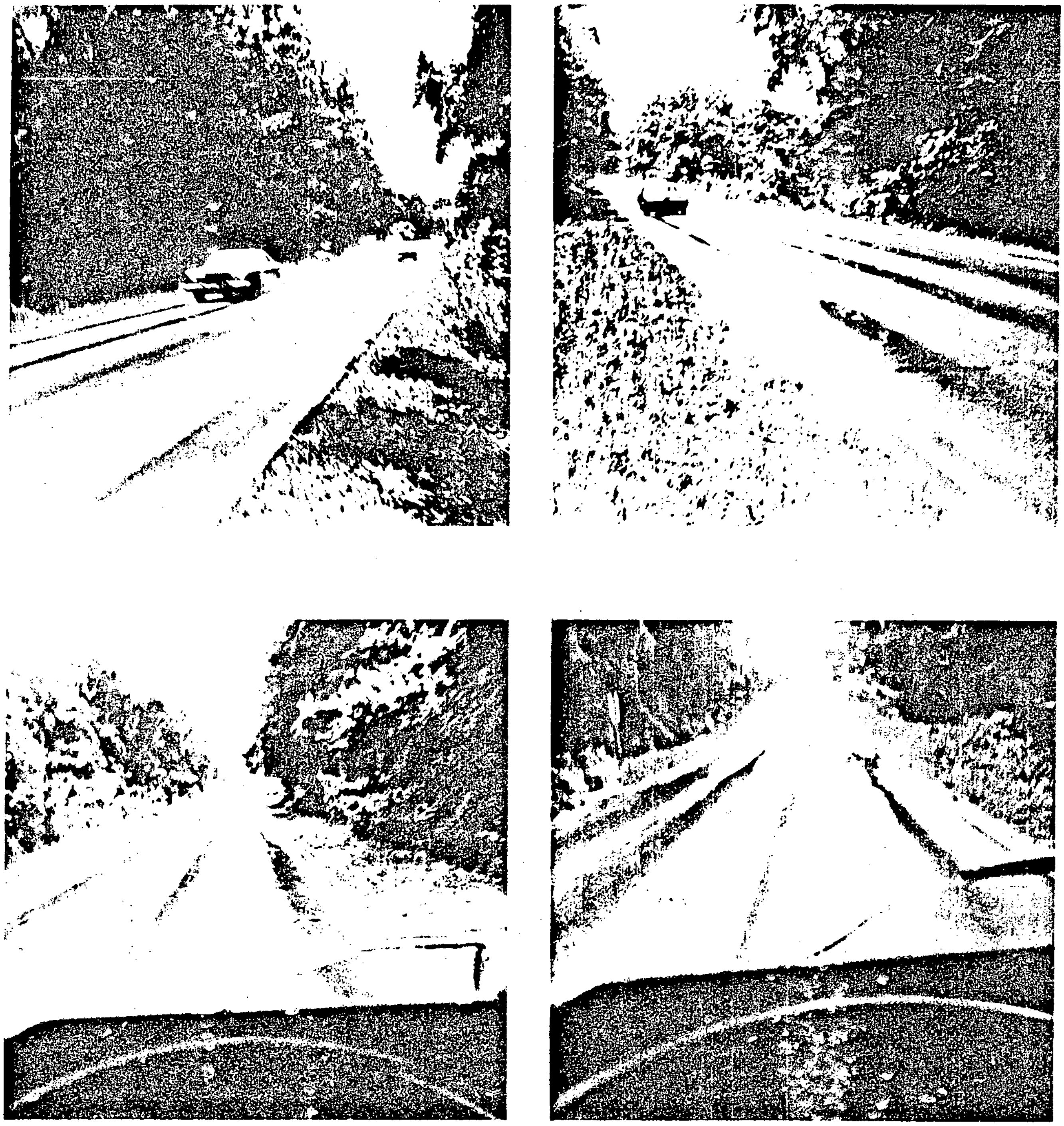
With regard to fiscal responsibility in furnishing your testing facilities, justification for a substantial investment is apparent when one considers the magnitude of the investment in pavements. It is admittedly difficult to get a reliable average cost estimate for high quality bituminous pavements with costs soaring so, but it appears to be on the order of $100,000 per mile and about half that for overlays. This means that the cost of a GTM is considerably less than the cost of one mile of pavement. This is an extremely modest investment in an engineering tool that when seriously applied, can do so much to insure the investment in pavements.

Current GTM owners can update their machines by installing a kit which will add the latest instrumentation to existing machines.

Some GTM owners have expressed interest in taking the GTM to the job site. EDCO can put the GTM in a mobile laboratory if you require it.

John L. McRae

John L. McRae, P.E.
President, EDCO



This rutting caused by traffic is the result of a combination of compaction and plastic flow. Such pavement failure could be avoided by using compaction requirements and a bitumen content reflecting a stable equilibrium condition under the design load as determined by the GTM.

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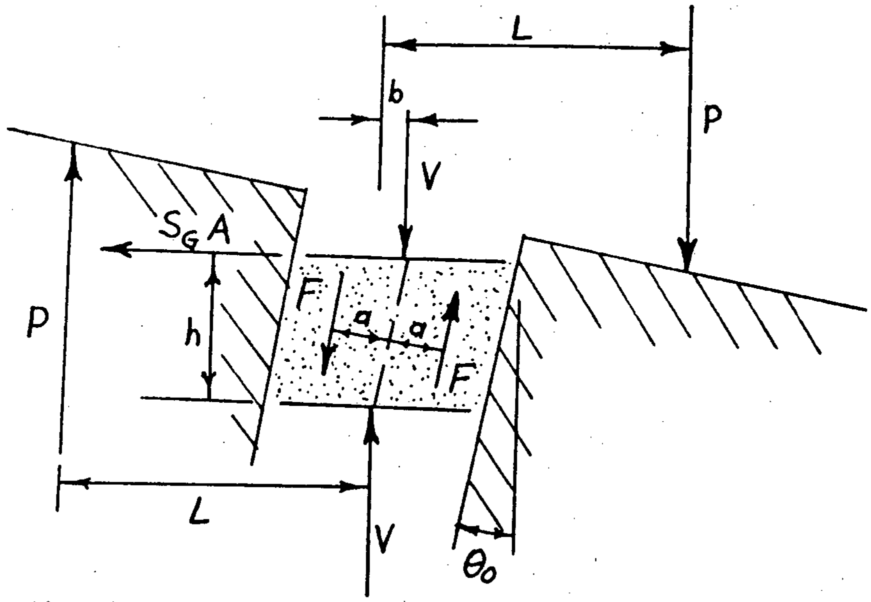
FOLLOWING ARE THE DERIVATIONS OF THE FORMULAS FOR CALCULATION OF GYRATORY SHEAR AND GYRATORY MODULI INCLUDING CORRECTION FOR WALL FRICTION



Referring to the above schematic, Gyratory Shear is defined as follows*:

$$2 \cdot P \cdot L = S_G \cdot A \cdot h + 2 \cdot F \cdot a - V \cdot b$$

$$S_G = \frac{2(P \cdot L - F \cdot a) + V \cdot b}{A \cdot h}$$

The Gyratory Shear Modulus is expressed by the formula:

$$G_G = \frac{S_G}{\theta}$$

The Gyratory Compression Modulus is expressed by the formula:

$$E_G = 2G_G(1 + \mu)$$

Where:

G_G = Gyratory shear modulus

E_G = Gyratory Compression Modulus

μ = Poisson's Ratio (Use 0.5 for cohesive material and 0.3 for cohesionless material)

$\epsilon = \frac{V}{E_G}$ = Gyratory Compression Strain

θ = Gyratory shear strain

* NOTE that this updated formula drops the (θ_{max}/θ_o) term that was part of the original formula. Experience has indicated that the shear stress at θ_{max} strain may be excessive for use in design. The shear stress at θ_o appears more applicable; however the magnitude of strain used in design is the empirical factor in this formula and therefore the value selected is subject to engineering judgement and experience.

ACTUAL EXAMPLE - STABLE MIX

Crushed Limestone (3/4" Max), 5.5% Bitumen
Tested at V = 200 psi Vertical Pressure; $\theta_o = 1^o$ (16mm); 250^oF

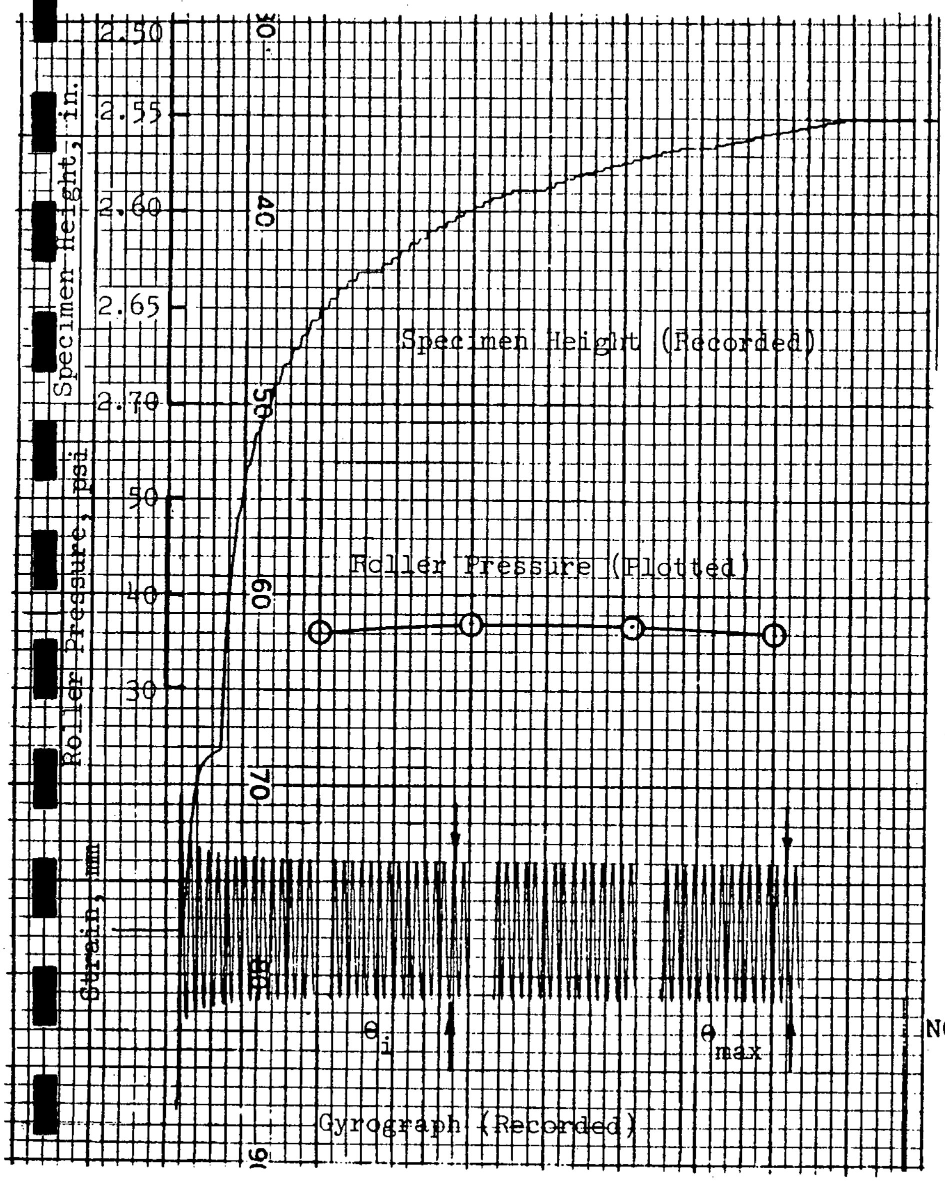
Gyratory Shear Modulus, $= G_G = \frac{S_G}{\theta_{max}} = \frac{78}{0.0197} = 3959$ psi

Gyratory Compression Modulus, $= E_G = 2G_G(1+\mu) = 2x3959x1.5 = 11,878$ psi

$\epsilon = \frac{V}{E_G} = \frac{200}{11878} = 0.0168$ in/in

$\tau_{max} = \frac{200}{3.14} = 64$ psi

Gyratory Shear Factor, $GSF = \frac{S_G}{\tau_{max}} = \frac{78}{64} = 1.22$



NOTE: Specimen height curve is becoming asymptotic, indicating approximate compaction equilibrium. Since roller pressure and gyrograph indicate a stable mix the vertical strain ϵ should be largely recoverable.

NOTE: No reduction in roller pressure indicates stable condition at this bitumen content.

NOTE: No widening of gyrograph indicates stable condition at this bitumen content, also reflected in GSI value of unity.

$GSI = \frac{\theta_{max}}{\theta_i} = \frac{18}{18} = 1.00$

θ_o = 16 mm (machine setting)

θ_i = 18 mm (scaled)

θ_{max} = 18 mm (scaled)

$\theta_{max} = \frac{18}{16} = 1.125^o = 1.125x1.75 = 1.969\%$

THE GTM MODEL 6B-4C-I IS A NEW IMPROVED GYRATORY TESTING MACHINE* WHICH INCORPORATES MODERN INSTRUMENTATION

MAJOR IMPROVEMENTS:

1. Convenient up-front recording of gyrograph and specimen height.
2. Upper roller load is conveniently read from front of machine on two digital panel meters.
3. Temperature recording.

FEATURES:

1. Caster mounted frame assembly.
2. Hydraulic loading system (1/3 HP hydraulic unit) with adjustable automatic control of vertical pressure and automatic shutoff when ram is fully retracted.
3. Adjustable gyrating mechanism powered by 2 HP gearmotor and consisting of mechanically driven roller carriage with mechanically adjustable lower roller and a load indicating upper roller assembly employing a load cell and two easily readable panel meters. (A pressure indicating air-filled roller assembly is available as an optional accessory)
4. Gyrating mechanism drive assembly including clutch to permit positioning roller carriage when adjusting gyratory angle.
5. Revolutions counter for gyrating mechanism.
6. Gyratory mold chuck with inserts for handling 6 in. and 4 in. I.D. molds.
7. Thermostat and thermostatically controlled heating elements mounted on mold chuck.
8. Bearing mounted upper head with interchangeable 6 in. diameter and 4 in. diameter specimen loading plates.
9. Fixed base with interchangeable 6 in. diameter and 4 in. diameter specimen loading plates.
10. Mounting shelf for strip chart recorders.
11. Single channel temperature recorder with necessary lead wire and thermocouple.
12. Dual channel recorder for gyrograph and ram travel.
13. Gyrograph transducer
14. Ram travel transducer
15. Wall friction apparatus.
16. Other accessories: Molds one each 4"X6" (101.6 mm X152.4 mm), 4"X12" (101.6 mmX 304.8 mm), 6"X7" (152.4 mm X 177.8 mm), and 6"X12" (152.4 mm X 304.8 mm), all precision ground and chrome plated; mold carrying trays; specimen length spacer blocks; mold chuck wrench and miscellaneous accessories.

ASTM STANDARDS:

ANSI/ASTM D3387 Standard test method for COMPACTION AND SHEAR PROPERTIES OF BITUMINOUS MIXTURES BY MEANS OF THE U. S. CORPS OF ENGINEERS GYRATORY TESTING MACHINE (GTM)

ASTM D 3496 Standard method for PREPARATION OF BITUMINOUS MIXTURE SPECIMENS FOR DYNAMIC MODULUS TESTING

MODERNIZATION KITS AVAILABLE TO OWNERS OF OLD MODELS

DIRECT INQUIRIES ON PRICE AND DELIVERY TO:

ENGINEERING DEVELOPMENTS CO., INC.
P. O. BOX 1109
VICKSBURG, MISSISSIPPI 39180

SOILTEST, INC.
2205 LEE STREET
EVANSTON, ILL. 60202

RAINHART COMPANY
600-608 WILLIAMS STREET
AUSTIN, TEXAS 78751

HOGENTOGLER AND CO., INC.
4 MEEM AVENUE
GAITHERSBURG, MD. 20760

* U.S. PAT. NOS. 2972249, 3478572; British Pat. No. 911155; others pending

ACTUAL EXAMPLE - STABLE MIX

Crushed Limestone (3/4" Max), 5.5% Bitumen
Tested at V = 200 psi Vertical Pressure; $\theta_o = 1^o$ (16mm); 250°F

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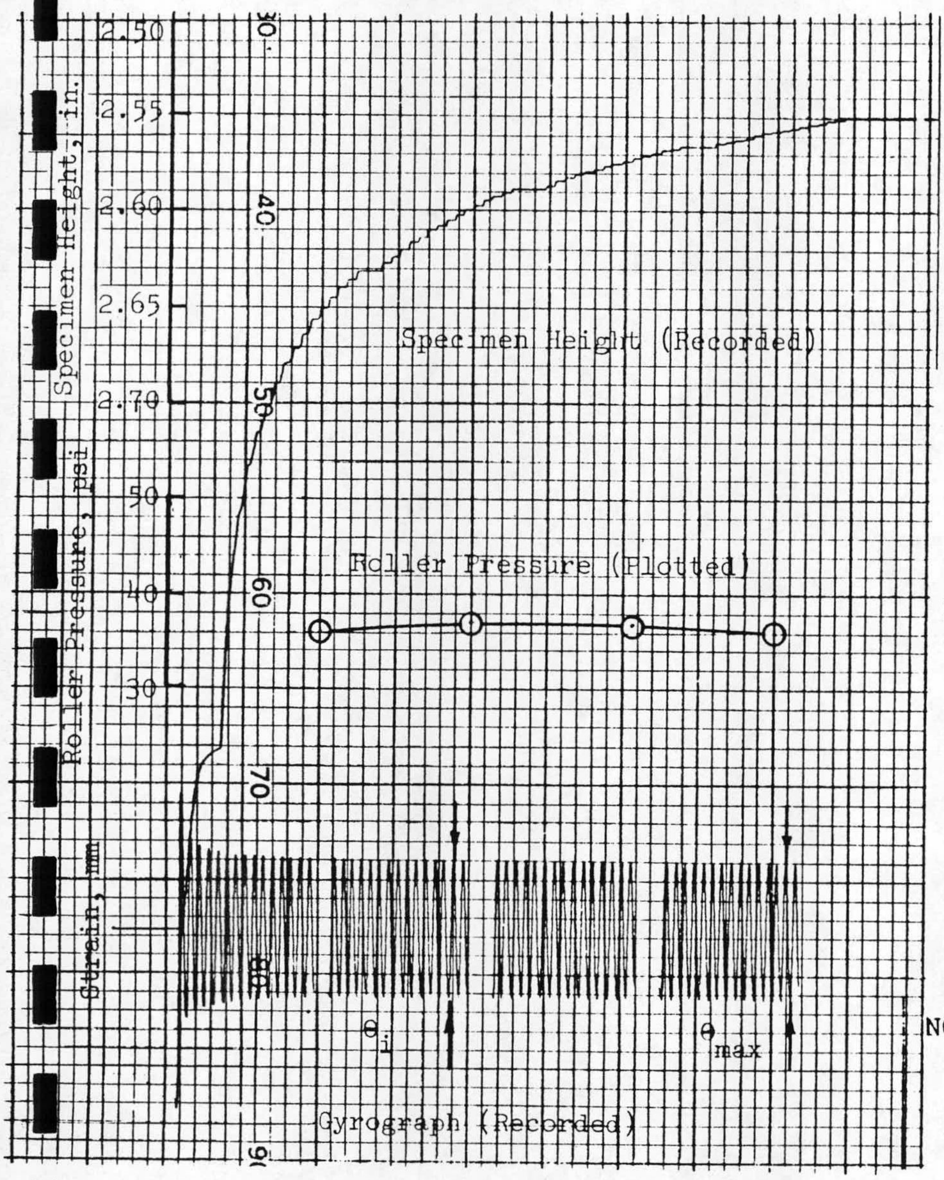
$$\epsilon = \frac{V}{E_G} = \frac{200}{11878} = 0.0168 \text{ in/in}$$

$$\tau_{max} = \frac{200}{3.14} = 64 \text{ psi}$$

$$\text{Gyratory Shear Factor, GSF} = \frac{S_G}{\tau_{max}} = \frac{78}{64} = 1.22$$



NOTE: Specimen height curve is becoming asymptotic, indicating approximate compaction equilibrium. Since roller pressure and gyrograph indicate a stable mix the vertical strain ϵ should be largely recoverable.

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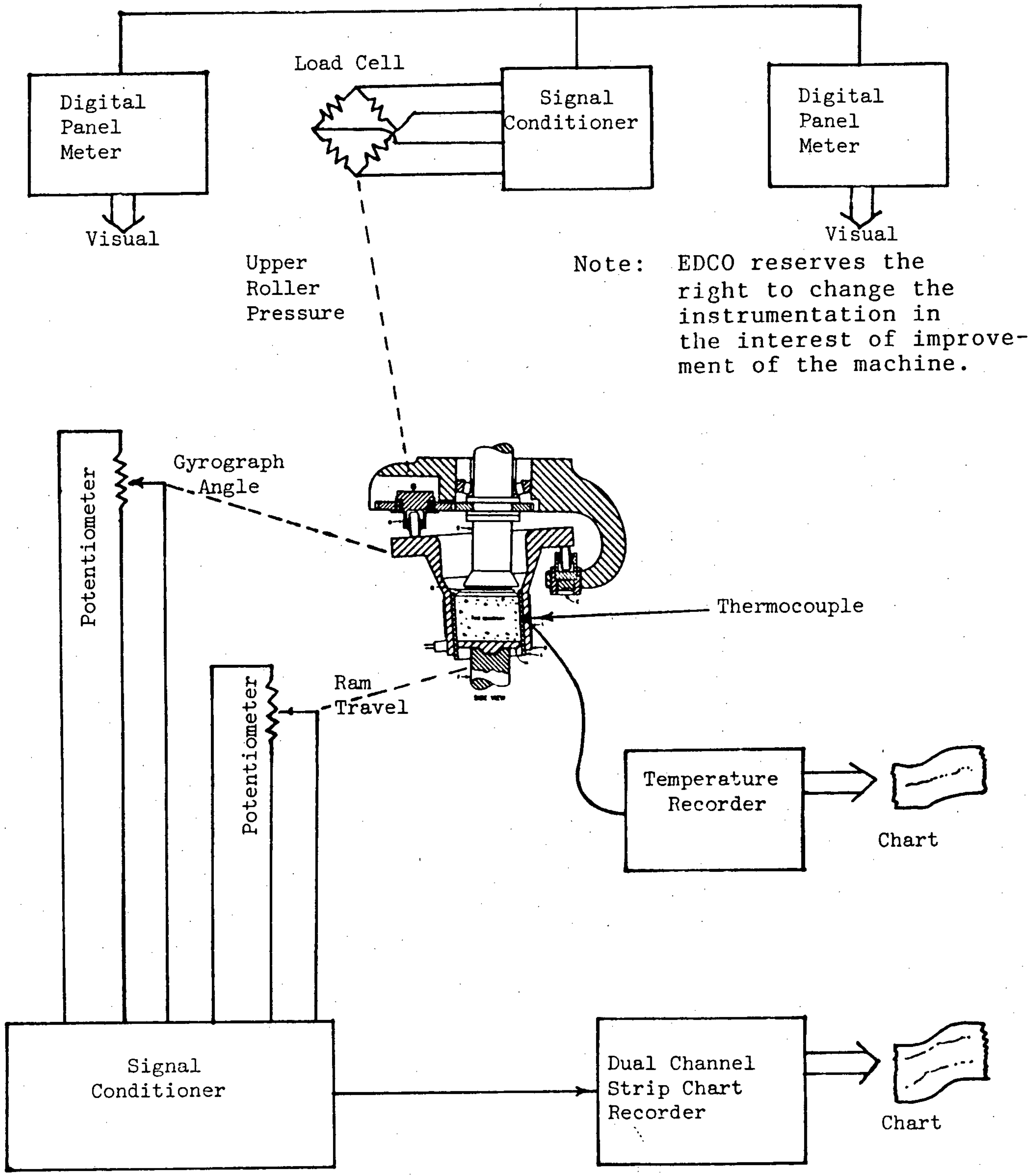

GTM MODEL 6B-4C-I

INSTRUMENTATION BLOCK DIAGRAMS