- ROUGH DRAFT - NOT FOR PUBLICATION -

CURRENT SLURRY SEAL RESEARCH AND TESTING DEVELOPMENTS

OR:

THE SEARCH FOR A "COLD MARSHALL" TEST FOR THIN LAYERED COLD MIX DESIGN

BY

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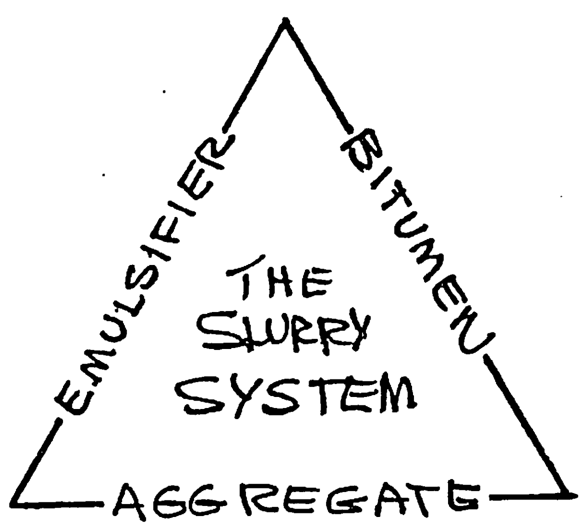
OUTLINE OF AN INFORMAL PRESENTATION PREPARED FOR THE ANNUAL ISSA WASHINGTON DC BOARD OF DIRECTOR'S CUSTOMER ORIENTATION MEETING AT THE VISTA INTERNATIONAL HOTEL, JUNE 4, 1986



(A) HISTORICAL PERSPECTIVE - THE SEARCH FOR OBJECTIVE NUMBERS

1964 - WET TRACK ABRASION TEST
1975 - LOADED WHEEL TEST
1975 - CONSISTENCY TEST
1978 - DESIGN TECHNICAL BULLETINS 1ST EDITION
1983 - MODIFIED COHESION TEST

(B) CURRENT DESIGN METHOD:

THE DESIGN APPROACH IS TO ASK AND ANSWER THESE QUESTIONS:

1. WILL "IT" MIX?
2. WILL "IT" SET AND CURE?
3. WILL "IT" LAST?
4. WILL "IT" BE SAFE?
*5. WILL "IT" PERFORM?

PHYSICAL SPECIMENS ARE PREPARED AND SUBJECTED TO SIMULATED FIELD CONDITIONS:

1. WTAT DETERMINES MINIMUM ASPHALT CONTENT
2. LWT DETERMINES MAXIMUM ASPHALT CONTENT - GRAPHICALLY COMBINED DATA DETERMINES THE OPTIMUM AC CONTENT.

(C) EXPERIENCES IN LAB DESIGN OF MANY MATERIALS COMBINATIONS INDICATE EXTREME VARIATIONS IN MIX PERFORMANCE.

THIS IS NOT SURPRISING WHEN THERE ARE:

1. 1300 DIFFERENT AGGREGATES
2. 400 DIFFERENT BITUMENS OR ASPHALTS
3. 10 DIFFERENT CLASSES OF EMULSIFIERS
4. 350 DIFFERENT EMULSION MANUFACTURERS

AGGREGATE IS NOT GRADATION
BITUMEN IS NOT PENETRATION
EMULSIONS ARE NOT VISCOSITY OR QS.

WE NOW LOOK AT THE TOTAL SYSTEMS APPROACH

WHAT IS IMPORTANT IS NOT THE PROPERTIES OF THE INDIVIDUAL MATERIALS, BUT HOW THE MATERIALS, INTERACT IN COMBINATION IN A MIX SYSTEM.

(D) REVIEW OF RECENT FINDINGS IN MIX SYSTEMS

1. MODIFIED COHESION TEST - CLASSIFICATION OF THE SYSTEM BY SET AND CURE OR DEVELOPMENT OF COHESIVE STRENGTH.

2. METHYL BLUE TEST - FRENCH/IRISH MEASURES A QUALITY OF THE FINE AGGREGATE - THE AMOUNT OF METHYL BLUE REQUIRED TO SATURATE THE FINES.
MEASURES CLAY, ORGANIC MATERIAL, ABSORPTIVE

3. STRIP CHART MIXING CHARACTERISTICS - POSSIBLE TO CLASSIFY SYSTEMS BY RESPONSE TO TIME-SHEAR FORCES.

4. SCHULZE - BREUER TUMBLING PILL AND RUCK ADHESION - MEASURES BITUMEN-FILLER COMPATIBILITY: 6-DAY SOAK.

5. 6-DAY VS. 1-HOUR SOAK WTAT - DIFFERENCES IN VARIOUS SYSTEMS.

6. 60C CURED COHESION TESTS - MANUAL CURVES AND MOTORIZED STRENGTH AND STRETCH CURVES.

(E) REVIEW OF PAPER, "EXPERIMENTS WITH CURED COHESION TESTING OF SLURRY SEALS AND THIN LAYERED COLD MIXES".

OR:

"THE SEARCH FOR COLD MARSHALL CURVES FOR THIN LAYERED COLD MIXES".

(F) RESEARCH IN PROCESS ON THE LOADED WHEEL TEST AND WHEEL TRACKING TEST.

1. TRRL EXPERIENCE WITH WTT. CRITERIA ESTABLISHED AT 2 MM/HOUR AT 45C FOR HEAVY TRAFFIC.

2. CORRELATION OF MARSHALL TEST WITH THE BRITISH WTT-SHEFFIELD POLYTECH UK.

3. CURRENT RESEARCH ON LWT TRACKING RATE AND % DISPLACEMENT CURVES VS. LAYER THICKNESS.

   (a) INVERSE SIMILARITY TO MARSHALL CURVES.

   (b) LAYER THICKNESS RESPONSE VARIES WITH THE POLYMER TYPE AND EMULSIFIER TYPE.

   (c) DIFFERENCES BETWEEN MODIFIED AND PLAIN SYSTEMS.

   (d) SIMILARITY OF PLAIN AND POST-ADDED CURED COHESION CURVES TO 1974 LWT CURVES AND MARSHALL FLOW AND WTT CURVES.

   (e) MODIFIED EMULSION 60C CURED COHESION CURVE SIMILARITY TO LWT TRACKING CURVES.

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Benedict, C. Robert — "An Introduction to the Potential Uses of a Loaded Wheel Tester (LWT) for the Traffic Count Design of "Slurry Seal" Presented ISSA convention Las Vegas, February 3-6, 1975.

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Benedict, C. Robert — "Experiments with Cured Cohesion Testing of Slurry Seals and Thin Layered Cold Mixes" Presented ISSA convention San Francisco, January 28, 1986.

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Breuer, J.U. — Dipl.-Ing. "Prufung der Wasserempfindlichkeit von Gesteinsmehlfullern" University Munick, 1964-received 1982.

Choyce, P.W., Lammiman, P.A. Taylor, I.F. — "Resistance to Deformation of Hot Rolled Asphalt" Highways and Transportation, No. 1 Volume 31 January 1984 (J of Inst. of Hgwy. group and Tptn. and HTTA.

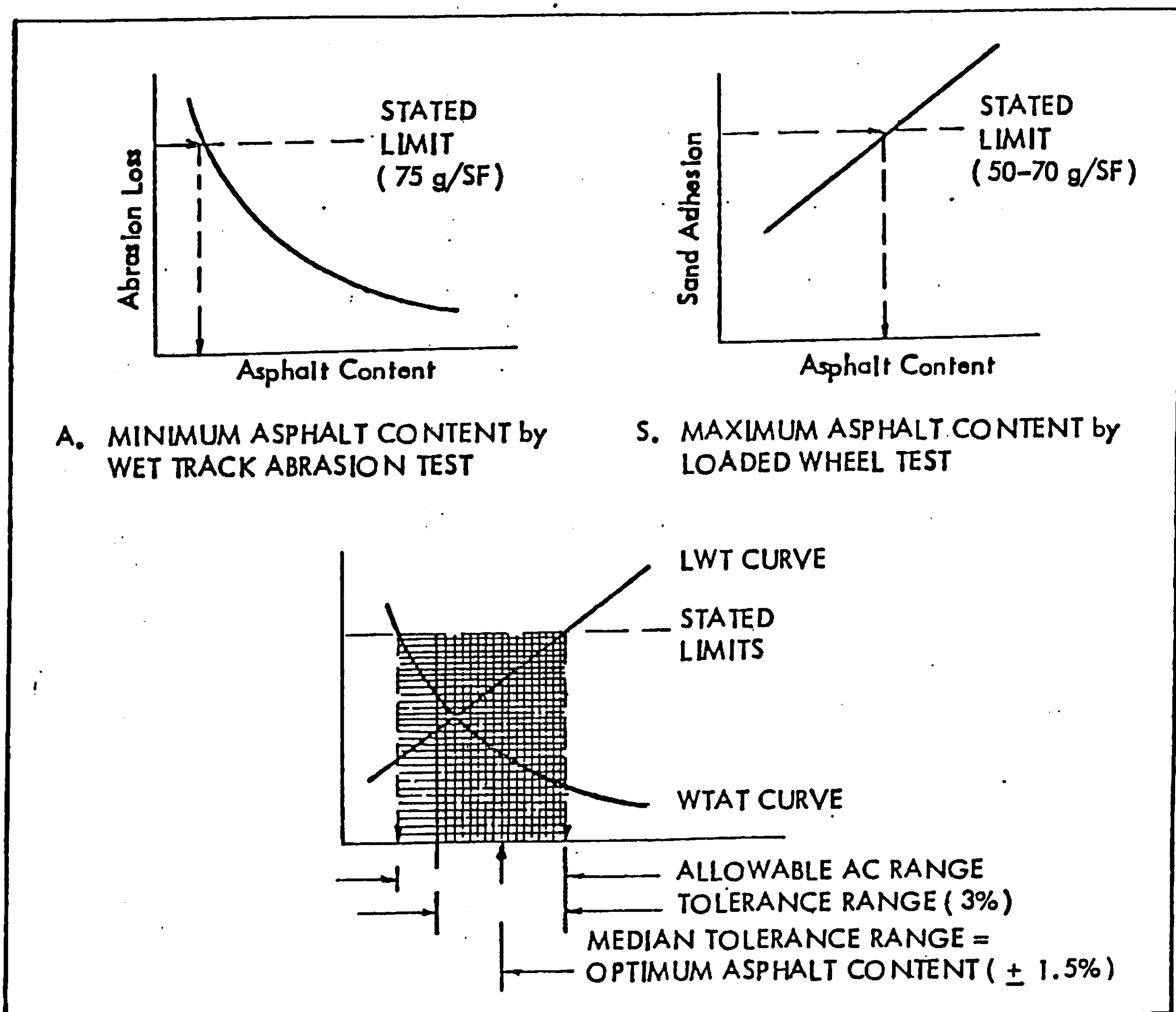
Marklund, Soren — "Measurement of Adhesion and Cohesion Loss by 6-day Soak Wet Track Abrasion Test" Presented ISSA convention San Francisco, January 28, 1986.

4. Physical Tests on Cured Slurry

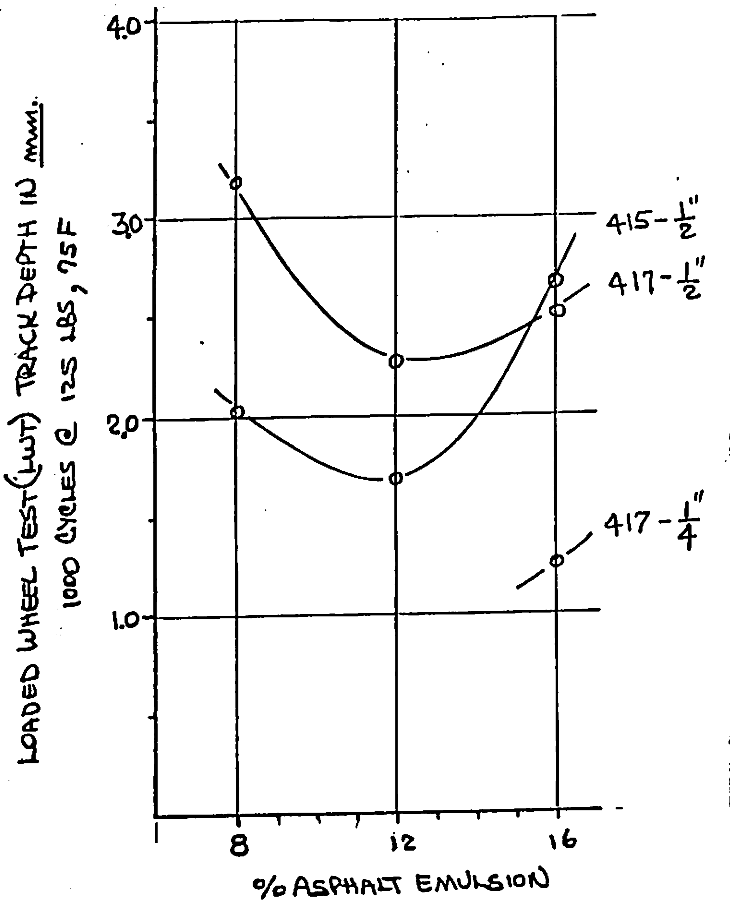
   a. Wet Track Abrasion Test (WTAT) - measurement of resistance to mechanical abrasion, kick-out, internal mat adhesion
   b. Loaded Wheel Test (LWT) - traffic simulation, measurement of resistance to flushing under heavy traffic loads

5. Selection of Optimum Design

   a. State Maximum limits to WTAT = minimum asphalt content (75g/SF?)
   b. State Maximum limits to LWT = maximum asphalt content or
      State Maximum LWT limits for Traffic Counts
      Light = 0 to 500 ADT (70 g per SF?) sand adhesion, 1000 ¢ @125 lbs,
      Medium = 250 to 1500 ADT (60 g per SF?)
      Heavy = 1500 to 3000 ADT (55 g per SF?)
      Very heavy = 3000 + (50 g per SF?)
   c. State Job Tolerance Limits (Contractor Proficiency)
   d. Draw graphs of the physical test data and superimpose the stated limits and read optimum asphalt content.

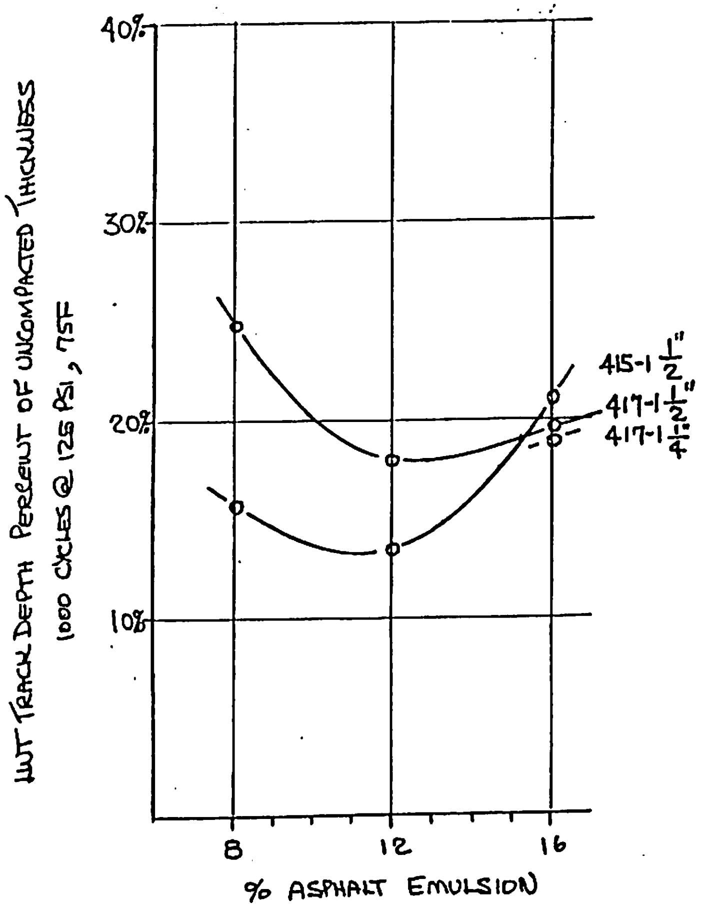


GRAPHICAL DETERMINATION OF OPTIMUM ASPHALT CONTENT



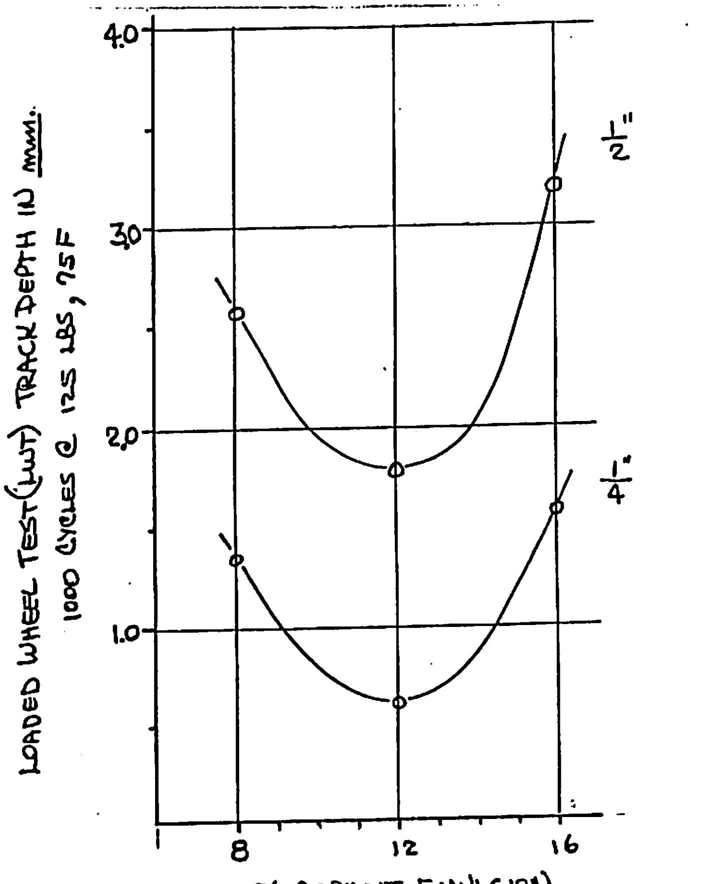
#415-1 & #417-1 vs. 0/5 mm. 75SE DOLOMITE

TRACK DEPTH VS. LAYER THICKNESS /CRB 5/86



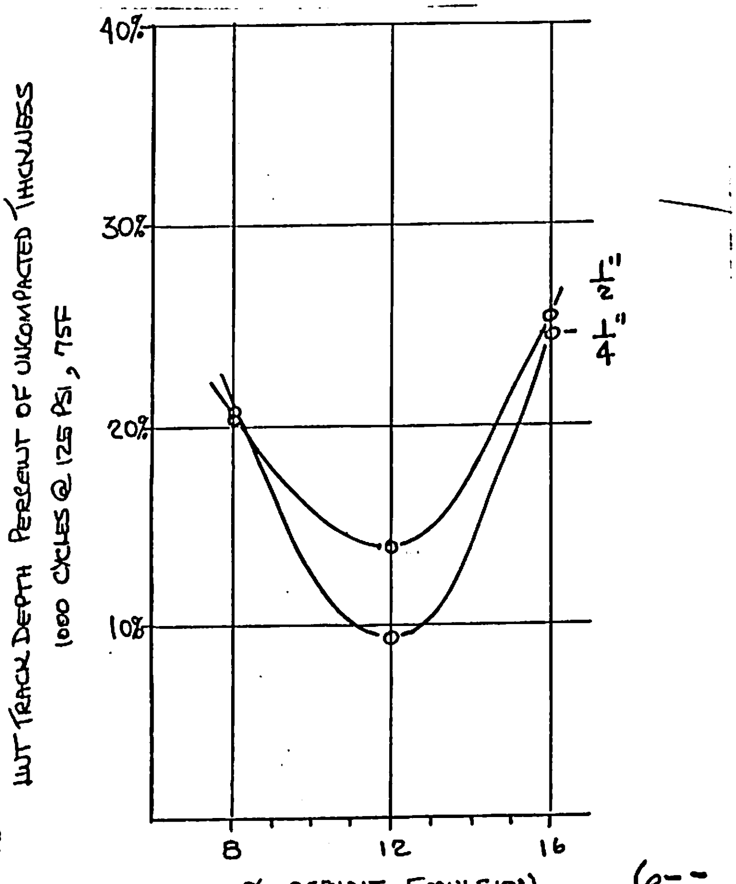
#415-1 & 417-1 vs. 0/5 mm., 75 SE DOLOMITE

% VERTICAL DISPLACEMENT VS. THICKNESS /CRB 5/86



#420-1 vs. 0/5 mm., 75SE DOLOMITE

TRACK DEPTH VS. THICKNESS /CRB 5/86



#420-1 vs. 0/5 mm, 75SE DOLOMITE

% VERTICAL DISPLACEMENT VS. THICKNESS /CRB 5/86

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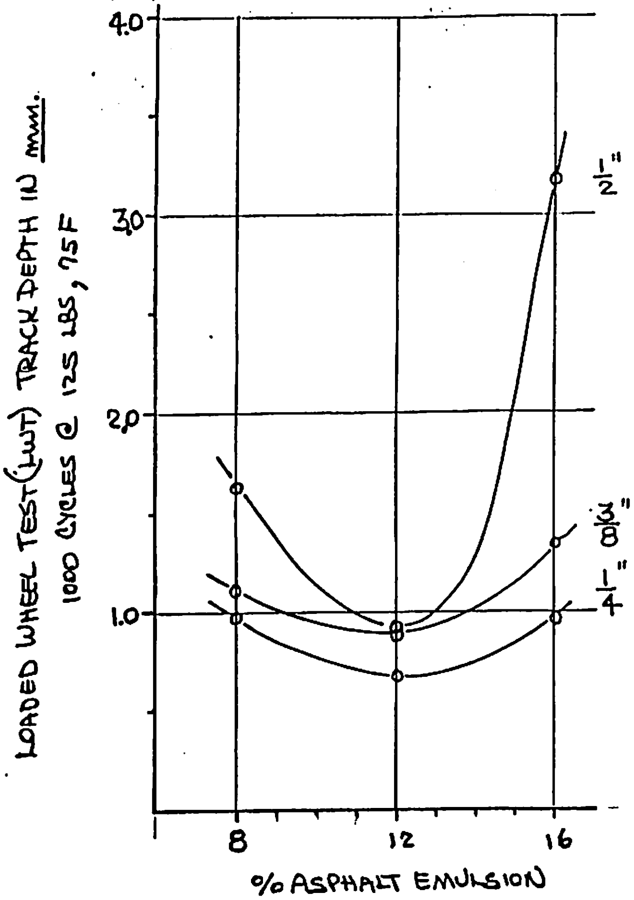
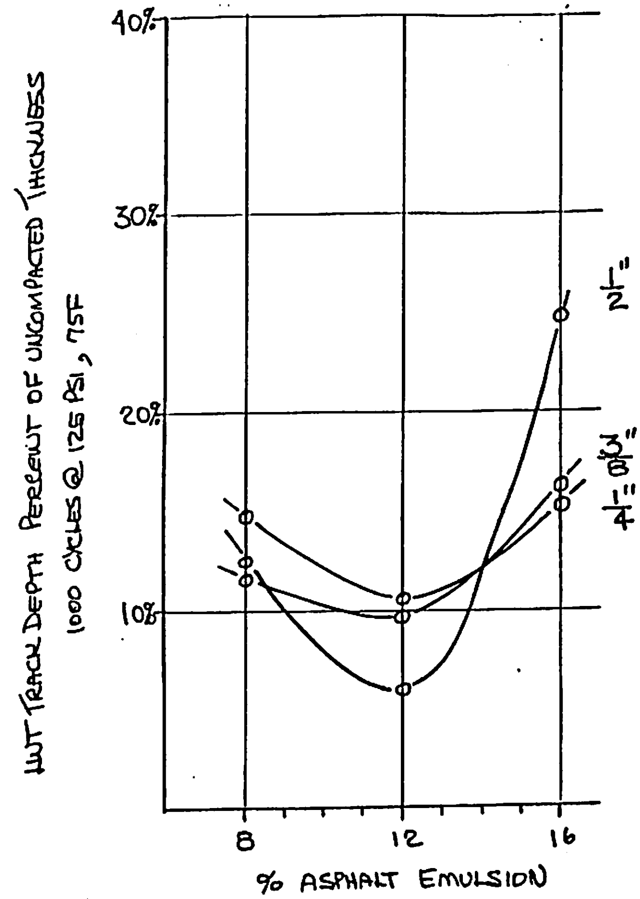


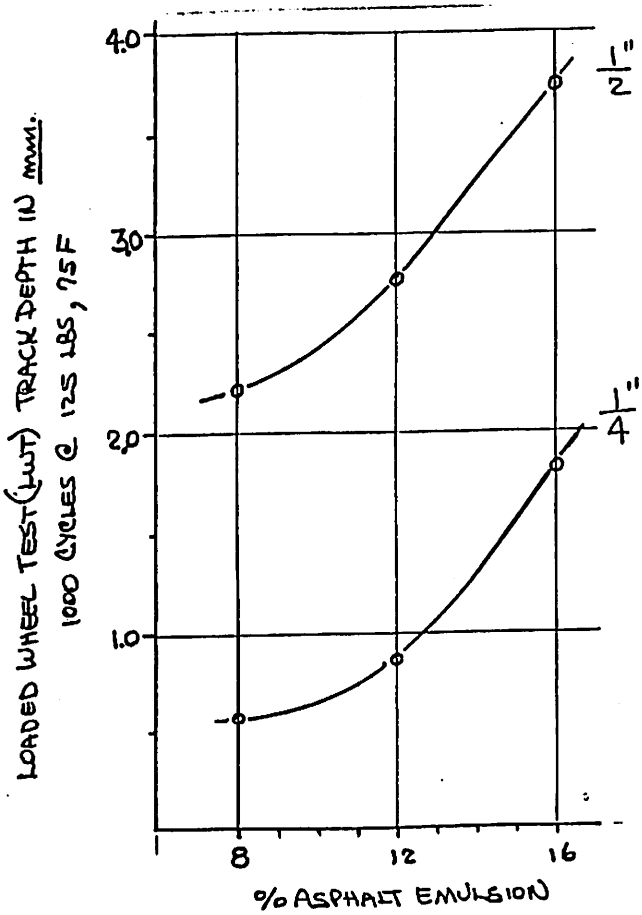
#928 vs. 0/5 mm, 75 S.E. DOLOMITE

TRACK DEPTH Vs. THICKNESS /CRB-5/86



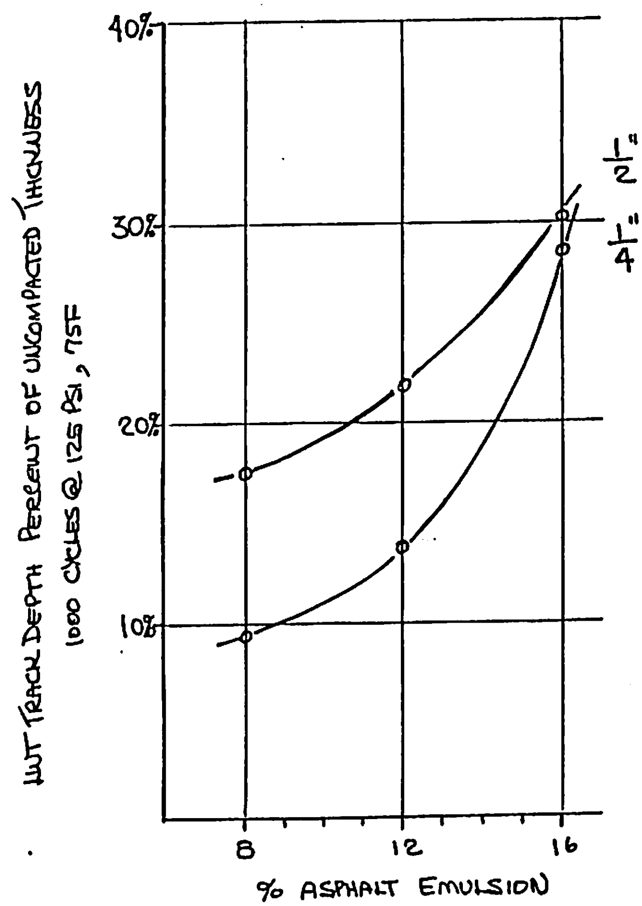
#928-1 vs. 0/5 mm., 75 SE DOLOMITE

% VERTICAL DISPLACEMENT VS. THICKNESS /CRB 5/86



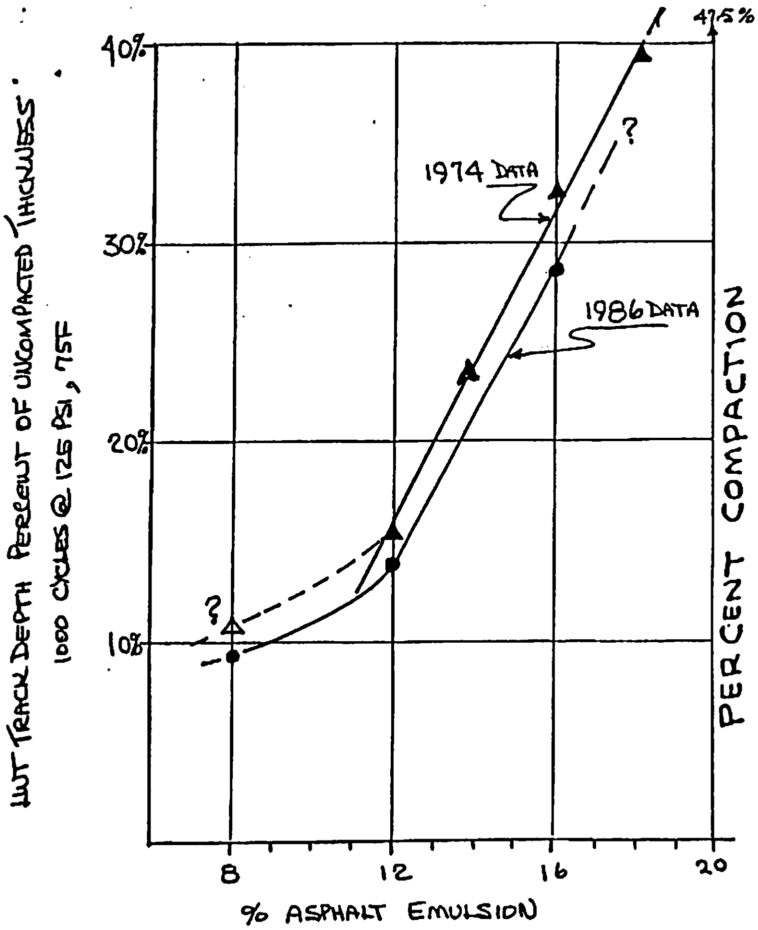
#517K vs. 0/5 mm, 75 SE GRAVEL

TRACK DEPTH vs. LAYER THICKNESS /CRB 5/86

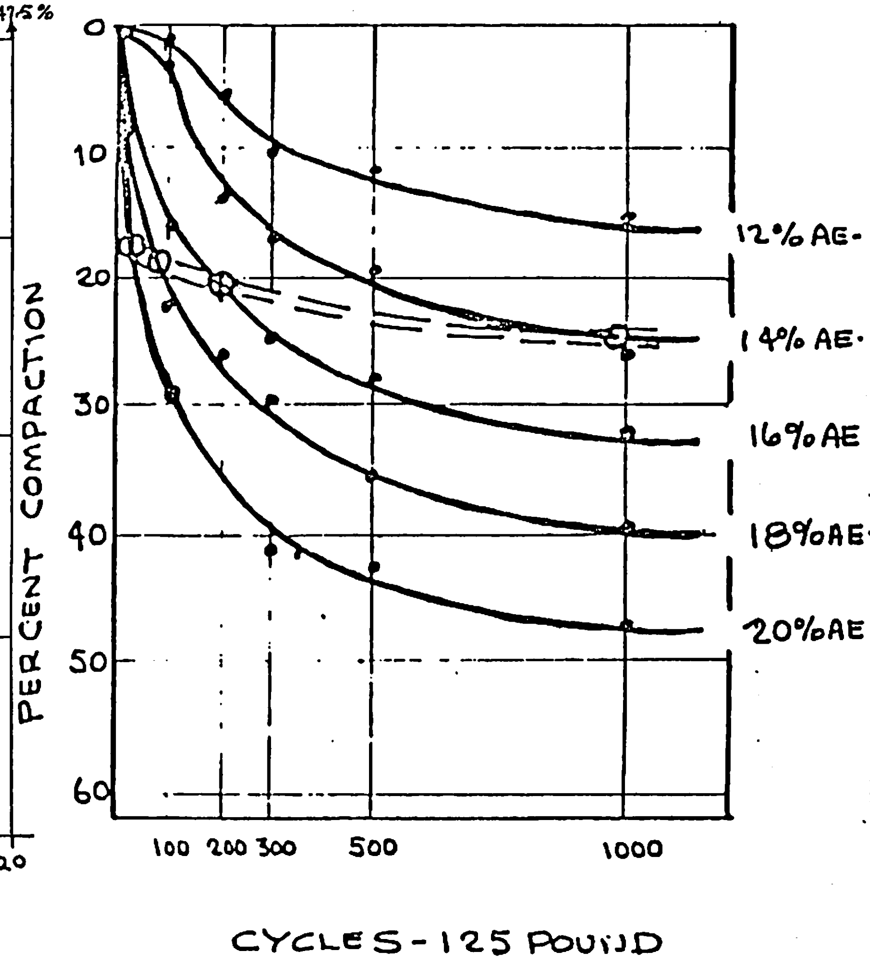


#517K vs. 0/5 mm, 75 SE GRAVEL

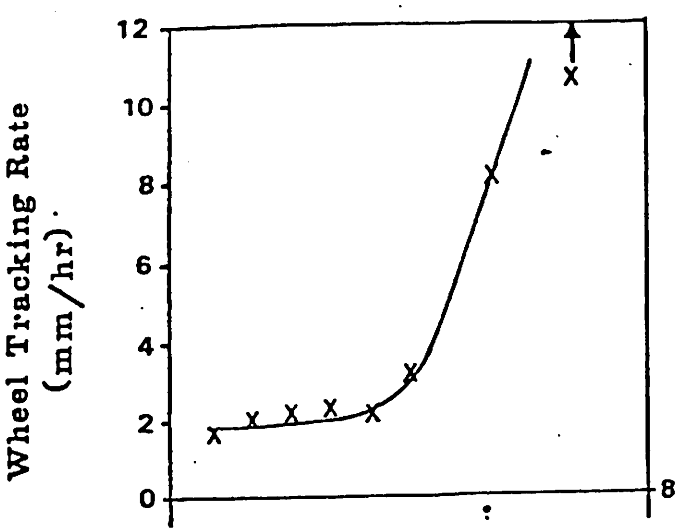
% VERTICAL DISPLACEMENT vs. THICKNESS /CRB 5/86

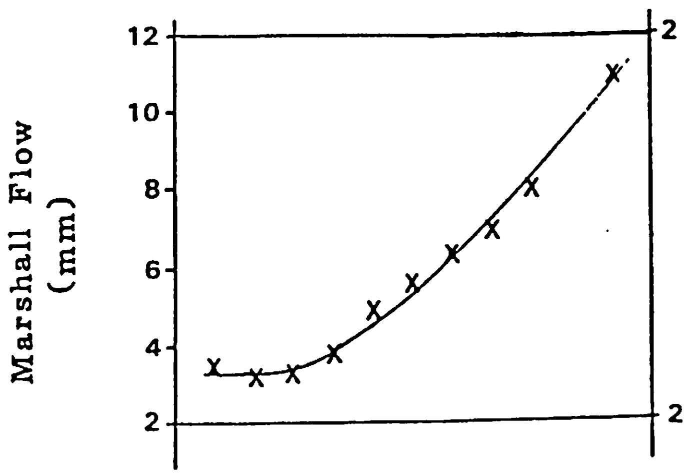


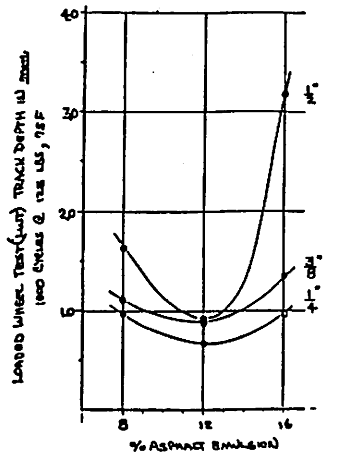
1974, 1/4" XENIA GRAVEL DATA COMPARED WITH
1986, 1/4" XENIA 755E VS. "COMMODITY" EMULSION
<u>% VERTICAL DISPLACEMENT OR COMPACTION</u> KRB 5/86



<u>FIG 12a</u> 125 POUND LWT COMPACTION CURVES - XENIA #4 + AGG. 60/70 PEN. ASPHALT

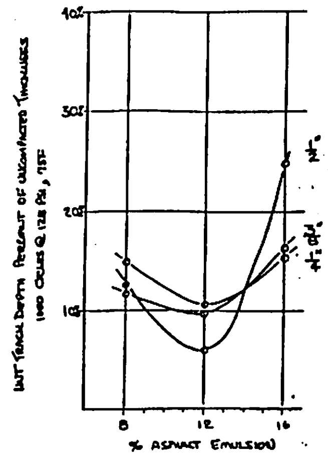






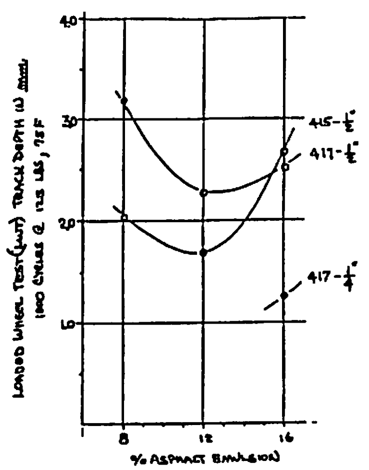
#428-1 vs. 0/5 mm, 75 SE Dolomite

Track Depth Vs. Thickness



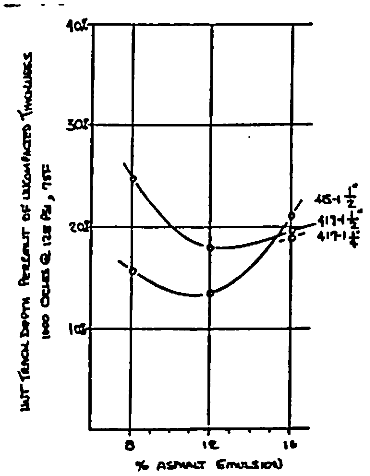
#428-1 vs. 0/5 mm, 75 SE Dolomite

% Vertical Displacement vs. Thickness



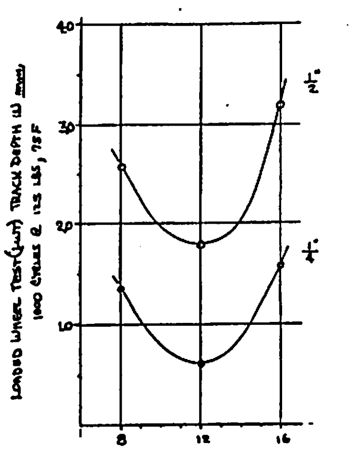
#415-1 & 417-1 vs. 0/5 mm 75 SE Dolomite

Track Depth vs. Latex Thickness



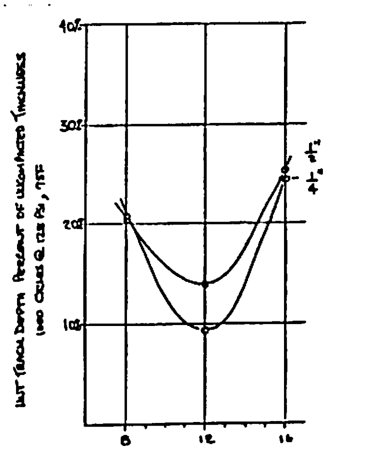
#415-1 & 417-1 vs. 0/5 mm, 75 SE Dolomite

% Vertical Displacement vs. Thickness



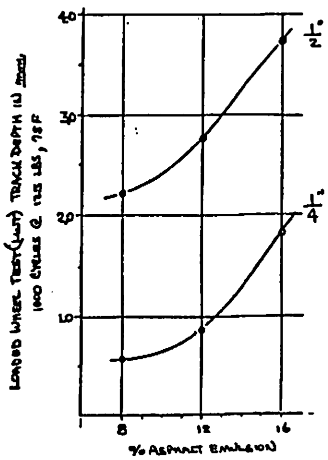
#420-1 vs. 0/5 mm, 75 SE Dolomite

Track Depth vs. Thickness



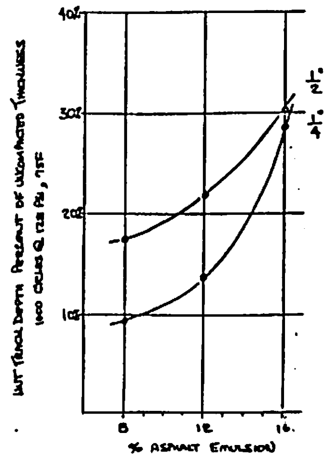
#420-1 vs. 0/5 mm, 75 SE Dolomite

% Vertical Displacement vs. Thickness



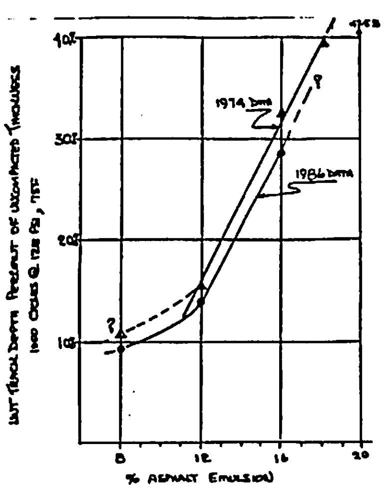
*5TTK vs. 0/5 mm, 75 SE Gravel

Track Depth vs. Layer Thickness

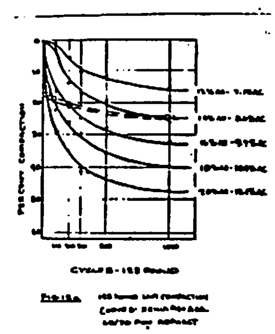


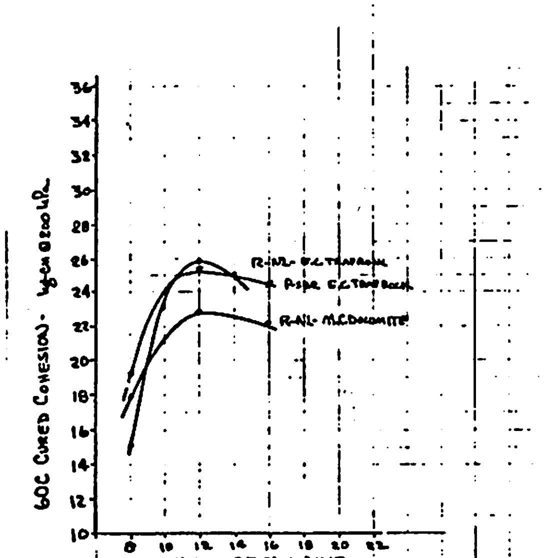
*5TTK vs. 0/5 mm, 75 SE Gravel

% Vertical Displacement vs. Thickness

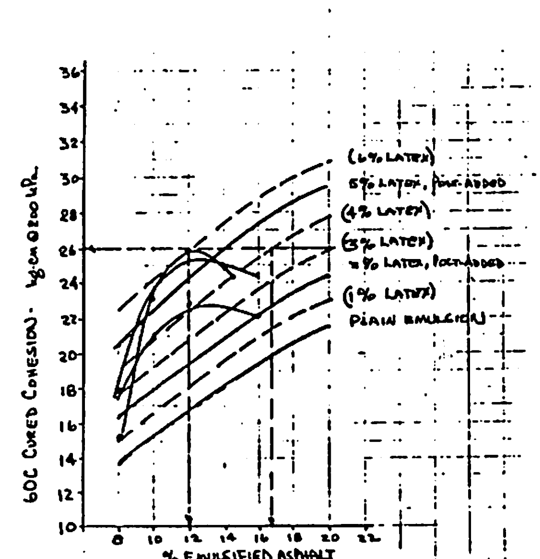


% Vertical Displacement or Compaction





Example 5. Effect of Latex Co-emulsification on Cured Cohesion



Example 6. Latex Post-Addition & Co-emulsification Equivalencies

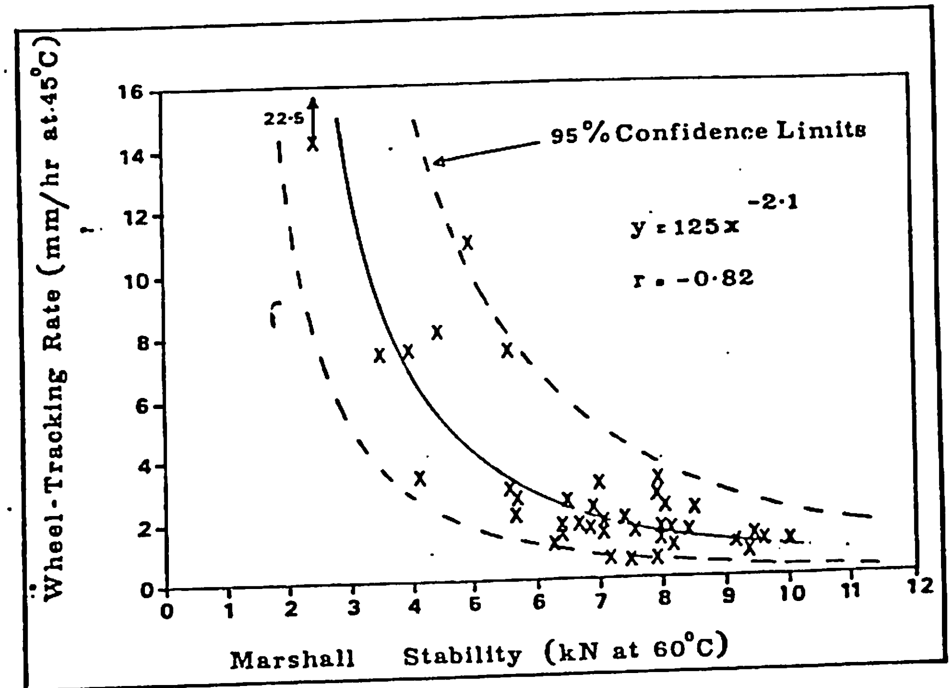


Fig 2 Marshall stability vs wheel-tracking rate.

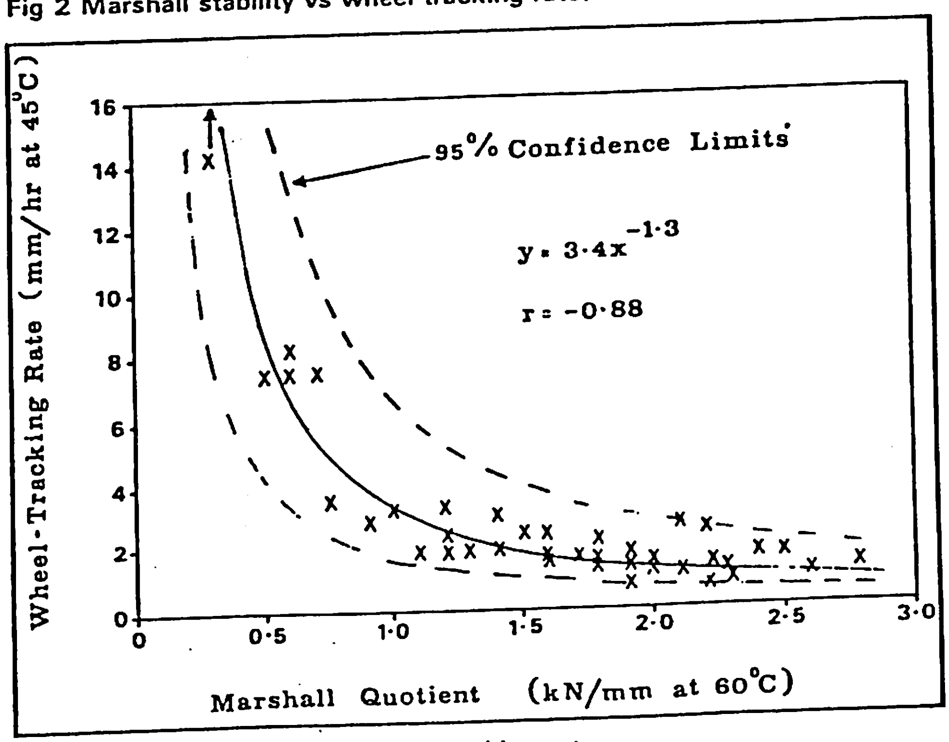


Fig 3 Marshall quotient vs wheel-tracking rate.