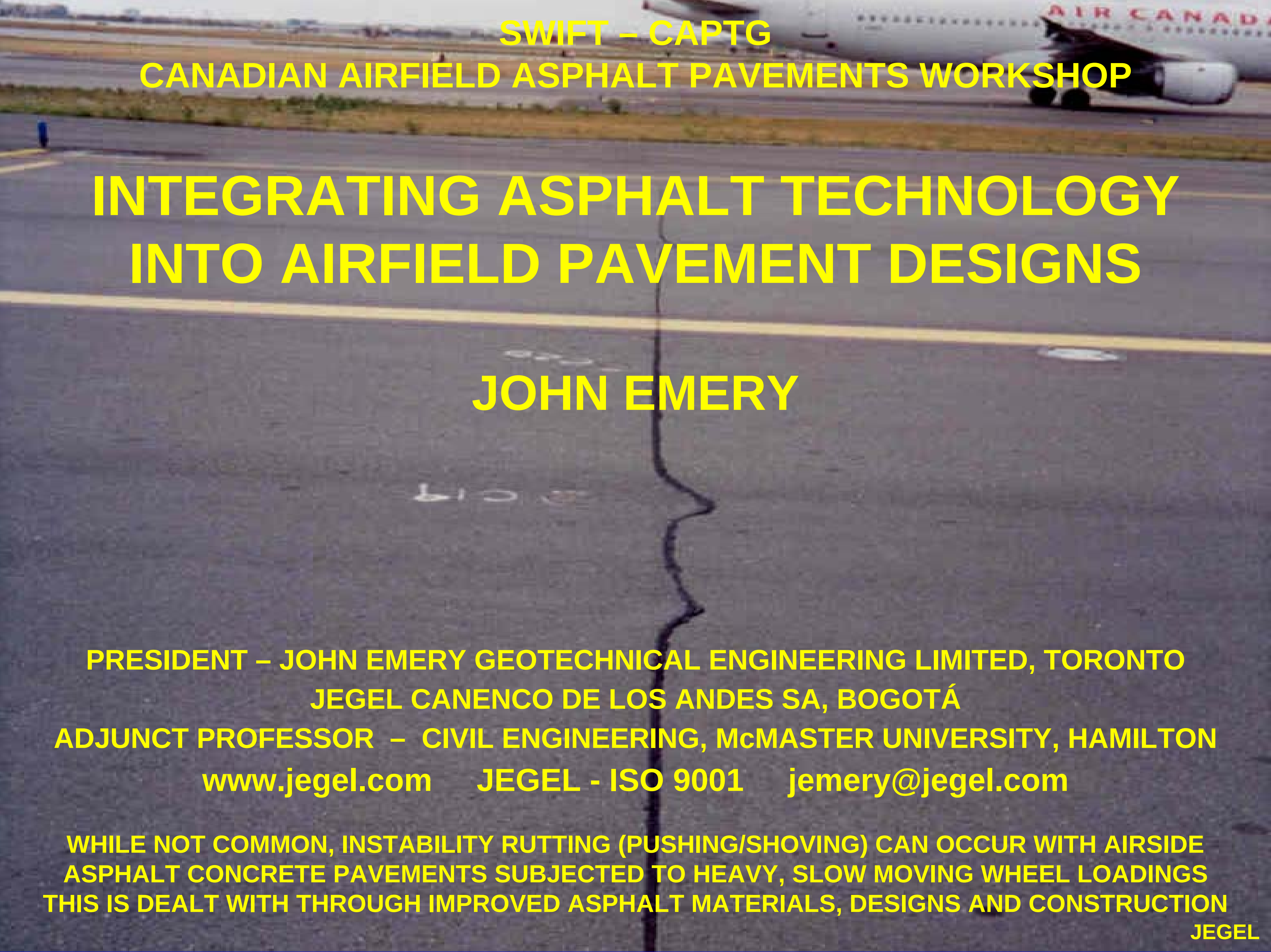

SWIFT – CAPTG

CANADIAN AIRFIELD ASPHALT PAVEMENTS WORKSHOP

INTEGRATING ASPHALT TECHNOLOGY INTO AIRFIELD PAVEMENT DESIGNS

JOHN EMERY

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JEGEL CANENCO DE LOS ANDES SA, BOGOTÁ

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WHILE NOT COMMON, INSTABILITY RUTTING (PUSHING/SHOVING) CAN OCCUR WITH AIRSIDE ASPHALT CONCRETE PAVEMENTS SUBJECTED TO HEAVY, SLOW MOVING WHEEL LOADINGS THIS IS DEALT WITH THROUGH IMPROVED ASPHALT MATERIALS, DESIGNS AND CONSTRUCTION

CAPTG, TORONTO

ASPHALT PAVEMENT LIFE

HMA/PAVEMENT DESIGN
SEPTEMBER 2005

ASSET MANAGEMENT
COMPREHENSIVE FRAMEWORK FOR MANAGING COST-EFFECTIVE RESOURCE ALLOCATION DECISIONS PERFORMANCE EXPECTATIONS, INVENTORY AND PERFORMANCE INFORMATION, ANALYSIS AND EVALUATION, PROJECT SELECTION AND PROGRAM IMPLEMENTATION

FEEDBACK

INPUT INFORMATION

PERFORMANCE CRITERIA
PAVEMENT MODELS

PAVEMENT SERVICEABILITY

PAVEMENT MATERIALS

PAVEMENT DESIGN
NEW, OVERLAY, REHABILITATION

CONSTRUCT PAVEMENT
OR
OVERLAY PAVEMENT
OR
REHABILITATE PAVEMENT

SYSTEMATIC PAVEMENT MAINTENANCE
MAINTENANCE MANAGEMENT SYSTEM

INVENTORY

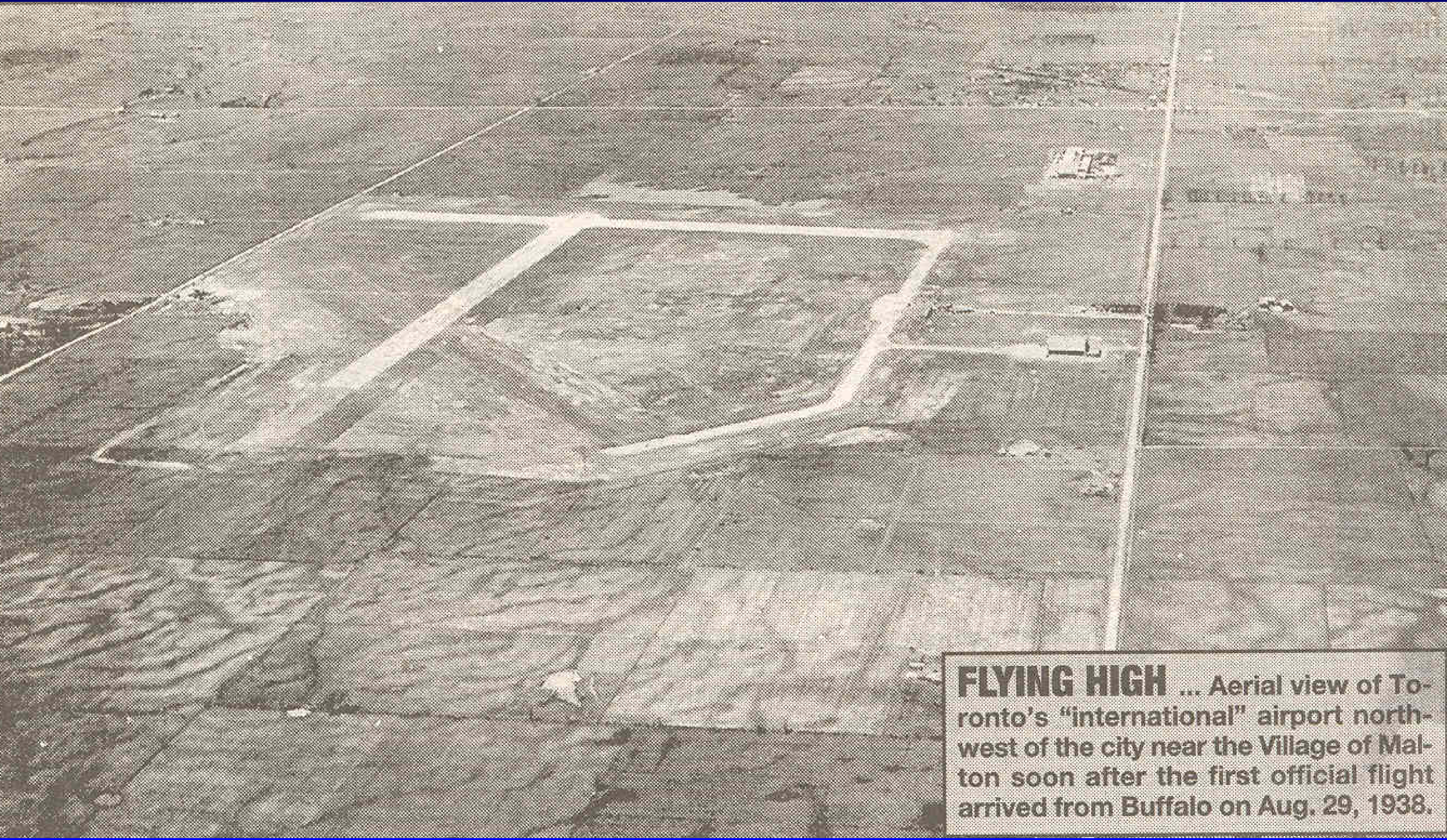
PAVEMENT MANAGEMENT SYSTEM
PERFORMANCE MONITORING

SAFE, SMOOTH, SURFACES
HAPPY CUSTOMERS

LIFE-CYCLE COST ANALYSIS AND VALUE ENGINEERING

FLEXIBLE PAVEMENT REHABILITATION IS REQUIRED WHEN SATISFACTORY FUNCTIONAL PERFORMANCE CANNOT BE MAINTAINED THROUGH SYSTEMATIC PRESERVATION STRATEGIES AND/OR THE PAVEMENT STRUCTURE IS NOT ADEQUATE

HAPPY CUSTOMER ENROUTE BEIJING TO SHANGHAI



FLYING HIGH ... Aerial view of Toronto's "international" airport northwest of the city near the Village of Malton soon after the first official flight arrived from Buffalo on Aug. 29, 1938.

MALTON AIRPORT (GTAA) 1938

GTAA 1998

NEW TAXIWAY AND RUNWAY ASPHALT PAVEMENTS UNDER CONSTRUCTION

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GTAA AIRBUS 380 GATE UNDER CONSTRUCTION 2005

CRUSHED RECYCLED CONCRETE FROM OLD TERMINAL TO THE LEFT

AIRFIELD ASPHALT PAVEMENTS ARE SUBJECTED TO A WIDE RANGE OF AIRCRAFT LOADINGS

HEAVY DUTY HOT-MIX ASPHALT IS REQUIRED FOR AIRFIELD ASPHALT PAVEMENTS SUBJECTED TO HEAVY AIRCRAFT LOADINGS

AIRFIELD ASPHALT PAVEMENTS ARE SUBJECTED TO A WIDE RANGE OF AIRCRAFT LOADINGS

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AIRFIELD ASPHALT PAVEMENTS ARE SUBJECTED TO A WIDE RANGE OF AIRCRAFT LOADINGS

THE ACTUAL LOADING OF CARGO IS ALSO IMPORTANT FOR HEAVY AIRCRAFT PARKED PERFORMANCE ON ASPHALT PAVEMENTS

CANADIAN AIRFIELD ASPHALT PAVEMENTS ARE SUBJECTED TO A WIDE RANGE OF CLIMATIC CONDITIONS

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AIRFIELD ASPHALT PAVEMENTS MUST BE ABLE TO RESIST SHOVING, RUTTING AND JET BLAST

AIRFIELD ASPHALT PAVEMENT MUST BE DURABLE UNDER SEVERE OPERATING CONDITIONS OF LOADINGS, MAINTENANCE AND WEATHER

NEW ASPHALT PAVEMENT OVERLAY, BEIJING AIRPORT
NOTE NEW TERMINAL BUILDING UNDER CONSTRUCTION FOR 2008 OLYMPICS

FAIRLY OLD ASPHALT PAVEMENT OVERLAY, HAMILTON
NOTE THAT THE DETERIORATION OF THE SHOULDER (NO LOADINGS) IS MORE SEVERE THAN FOR THE CENTRAL SECTION (KEEL) OF THE RUNWAY

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ASPHALT PAVEMENT PERFORMANCE REQUIREMENTS FOR AIRFIELD DENSE GRADED HOT-MIX ASPHALT

- WORKABLE DURING PLACEMENT AND COMPACTION
- CONTRIBUTE TO STRENGTH OF PAVEMENT STRUCTURE
- RESIST PERMANENT DEFORMATION (RUTTING)
- RESIST FATIGUE CRACKING
- RESIST THERMAL CRACKING
- RESIST THE EFFECTS OF AIR AND WATER (DURABILITY)
- IMPERMEABLE TO PROTECT PAVEMENT STRUCTURE FROM WATER
- EASILY AND COST-EFFECTIVELY MAINTAINED

PLUS FOR SURFACE COURSE

1. ADEQUATE FRICTIONAL PROPERTIES
2. ACCEPTABLE SMOOTHNESS
3. RESISTANCE TO ANTI-ICING AND DEICING CHEMICALS, ICE AND SNOW CONTROL, JET BLAST, AND AVIATION FUEL AND HYDRAULIC OIL SPILLS
4. RESISTANCE TO FOD POTENTIAL

AIRFIELD ASPHALT AND CONCRETE PAVEMENT DESIGNS REQUIRE INPUT INFORMATION ON DESIGN AIRCRAFT LOADING(S), SUBGRADE CONDITIONS, DRAINAGE AND CLIMATE (ENVIRONMENT)

PLATE LOADING TESTS WERE COMMONLY USED IN THE PAST FOR SUBGRADE AND BASE SUPPORT CONDITION DETERMINATION

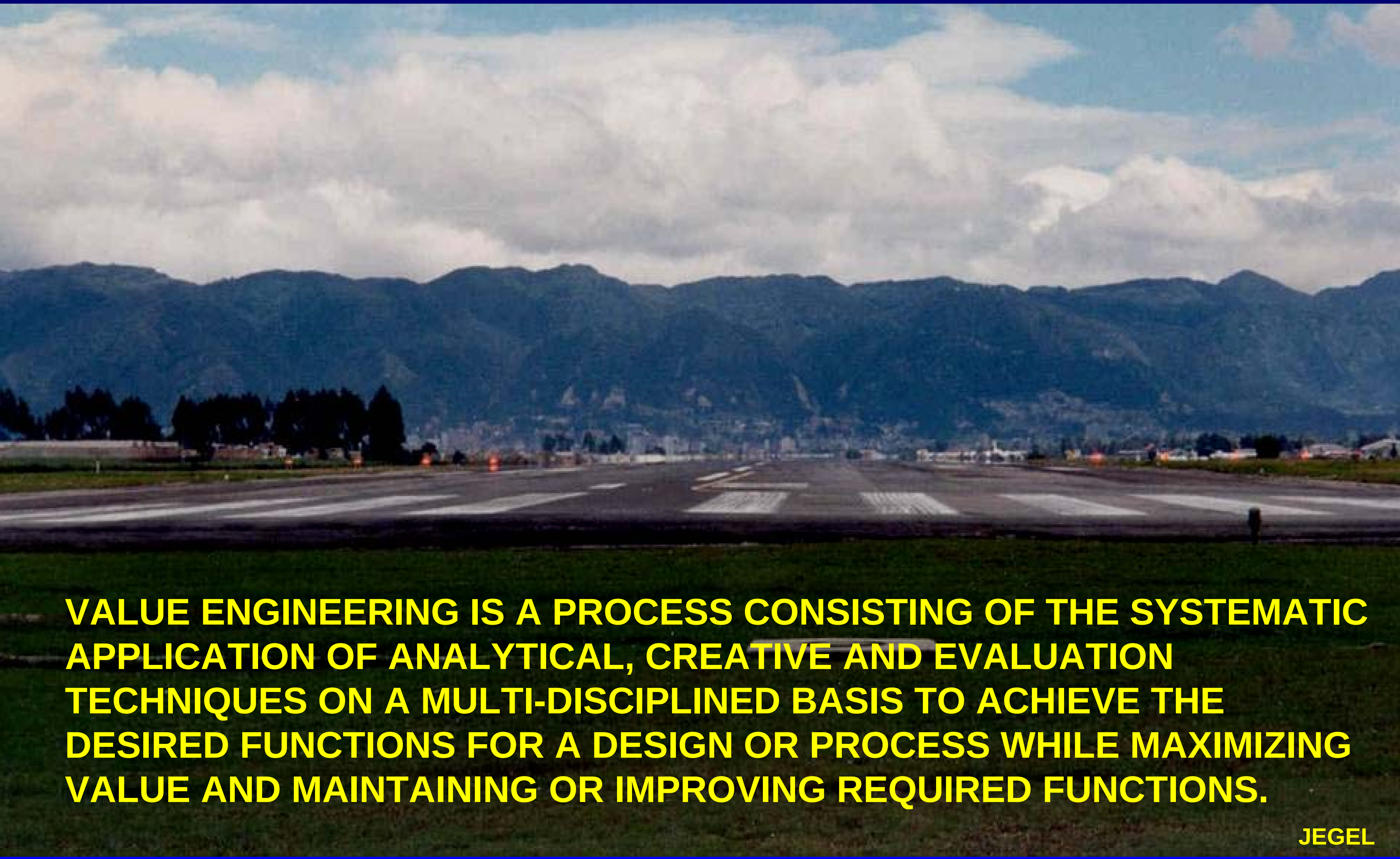
THE HWD IS NOW COMMONLY USED TO DETERMINE THE SUBGRADE AND BASE SUPPORT CONDITION AND Mr OF THE PAVEMENT COMPONENTS

A LIFE-CYCLE COST ANALYSIS, INCLUDING VALUE ENGINEERING, IS AN IMPORTANT COMPONENT OF AIRFIELD PAVEMENT DESIGNS

LIFE-CYCLE COST ANALYSIS SUMMARY

- ECONOMIC ASSESSMENT OF COMPETING, TECHNICALLY SUITABLE SYSTEMS OVER DESIGN LIFE
- COST COMPONENTS
  - INITIAL COSTS (CAPITAL COST)
  - MAINTENANCE COSTS
  - REHABILITATION COSTS
  - RESIDUAL/SALVAGE VALUE
  - USER COSTS (TRAFFIC DELAYS FOR INSTANCE)
- PRESENT-WORTH METHOD
  - DISCOUNT RATE
  - ANALYSIS PERIOD
- DETERMINISTIC AND PROBABILISTIC METHODS
  - JEGEL IS USING DETERMINISTIC METHODS BASED ON FHWA AND CRYSTAL BALL SOFTWARE

VALUE ENGINEERING



VALUE ENGINEERING IS A PROCESS CONSISTING OF THE SYSTEMATIC APPLICATION OF ANALYTICAL, CREATIVE AND EVALUATION TECHNIQUES ON A MULTI-DISCIPLINED BASIS TO ACHIEVE THE DESIRED FUNCTIONS FOR A DESIGN OR PROCESS WHILE MAXIMIZING VALUE AND MAINTAINING OR IMPROVING REQUIRED FUNCTIONS.

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BOGOTA EL DORADO INTERNATIONAL AIRPORT EXISTING RUNWAY 1994

VALUE ENGINEERING

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CONSTRUCTION OF THE NEW RUNWAY REQUIRED DIVERSION OF THE BOGOTÁ RIVER
THIS DIVERSION REQUIRED A DETAILED ANALYSIS OF THE MOST APPROPRIATED TYPE
RIGID OR FLEXIBLE – TO DEAL WITH POTENTIAL SETTLEMENTS

VALUE

VALIDATE THE INFORMATION AS IT IS ASSEMBLED

ALTERNATIVES - MAKE A LIST OF ALL THE POSIBILITIES

LOOK CLOSELY AT EACH IDEA - ANALYZE AND EVALUATE POSSIBILITIES

USE SUITABLE ALTERNATIVES - DEVELOP INTO SOUND RECOMMENDATIONS

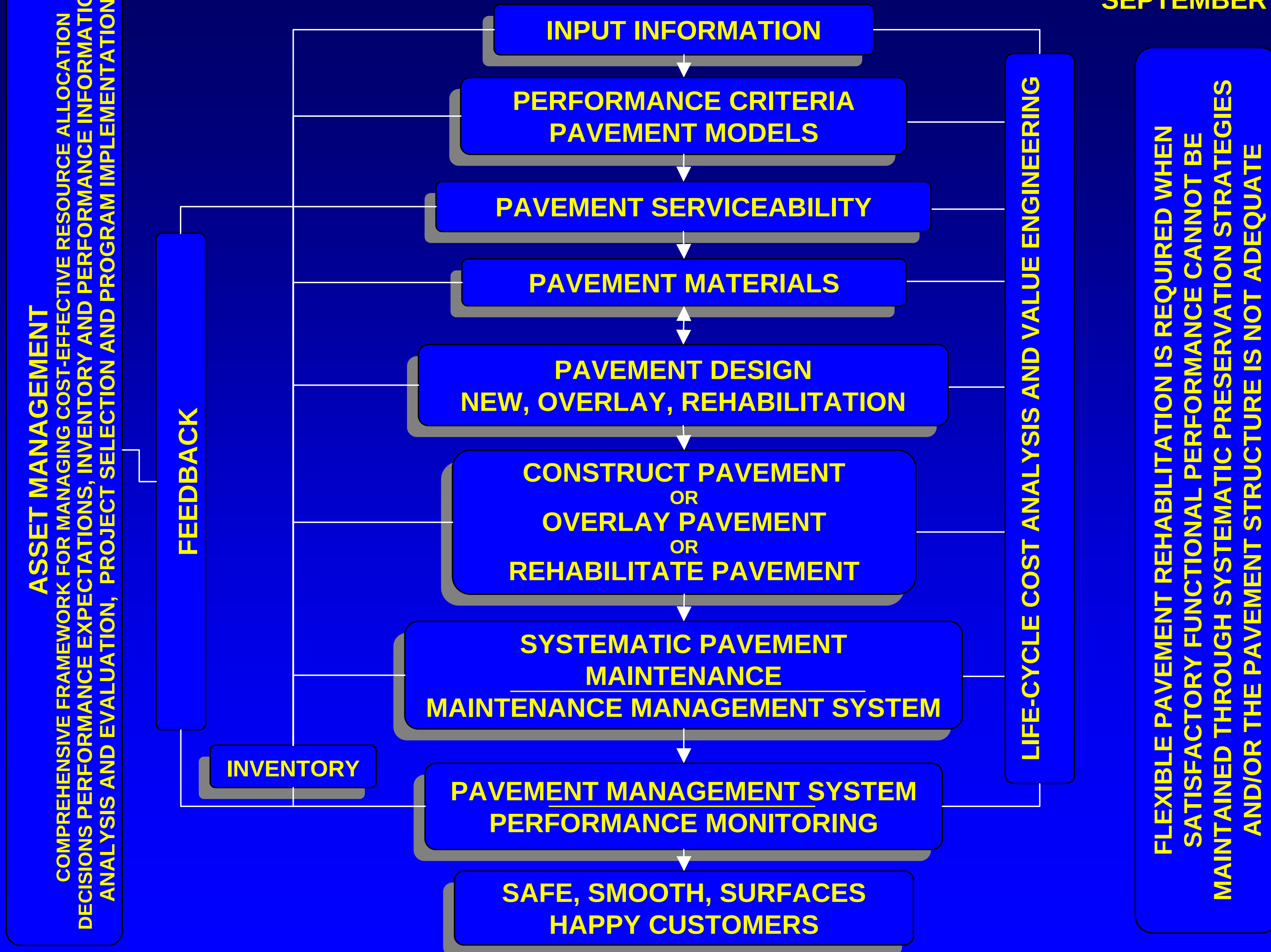
ENHANCE UNDERSTANDING - PRESENT RECOMMEDATIONS AND ASSIST IN CONCEPTUAL UNDERSTANDING

JEGEL

CAPTG, TORONTO

ASPHALT PAVEMENT LIFE

HMA/PAVEMENT DESIGN
SEPTEMBER 2005



AIRPORT PAVEMENT MANAGEMENT SYSTEMS

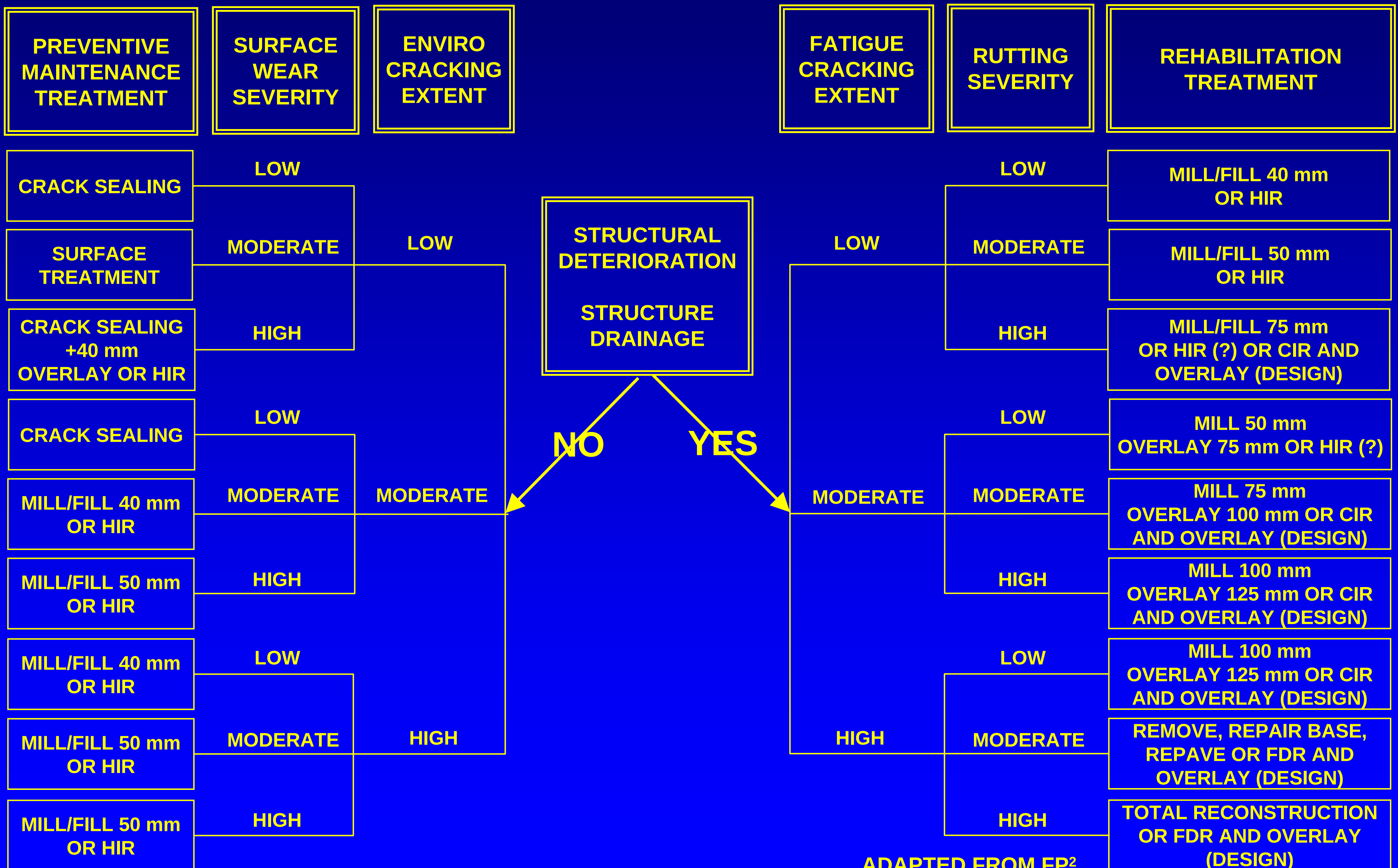
Micro PAVER 5.2

- USE OF PAVEMENT CONDITION INDEX
- PAVEMENT CONDITION PREDICTION MODELLING
- ANALYSIS OF ROUTINE AND MAJOR MAINTENANCE NEEDS
- WORK PLAN BASED ON AVAILABLE BUDGET OR MAINTAINING REQUIRED PAVEMENT CONDITION LEVEL
- REPORTING LINKED TO GEOGRAPHIC INFORMATION SYSTEM

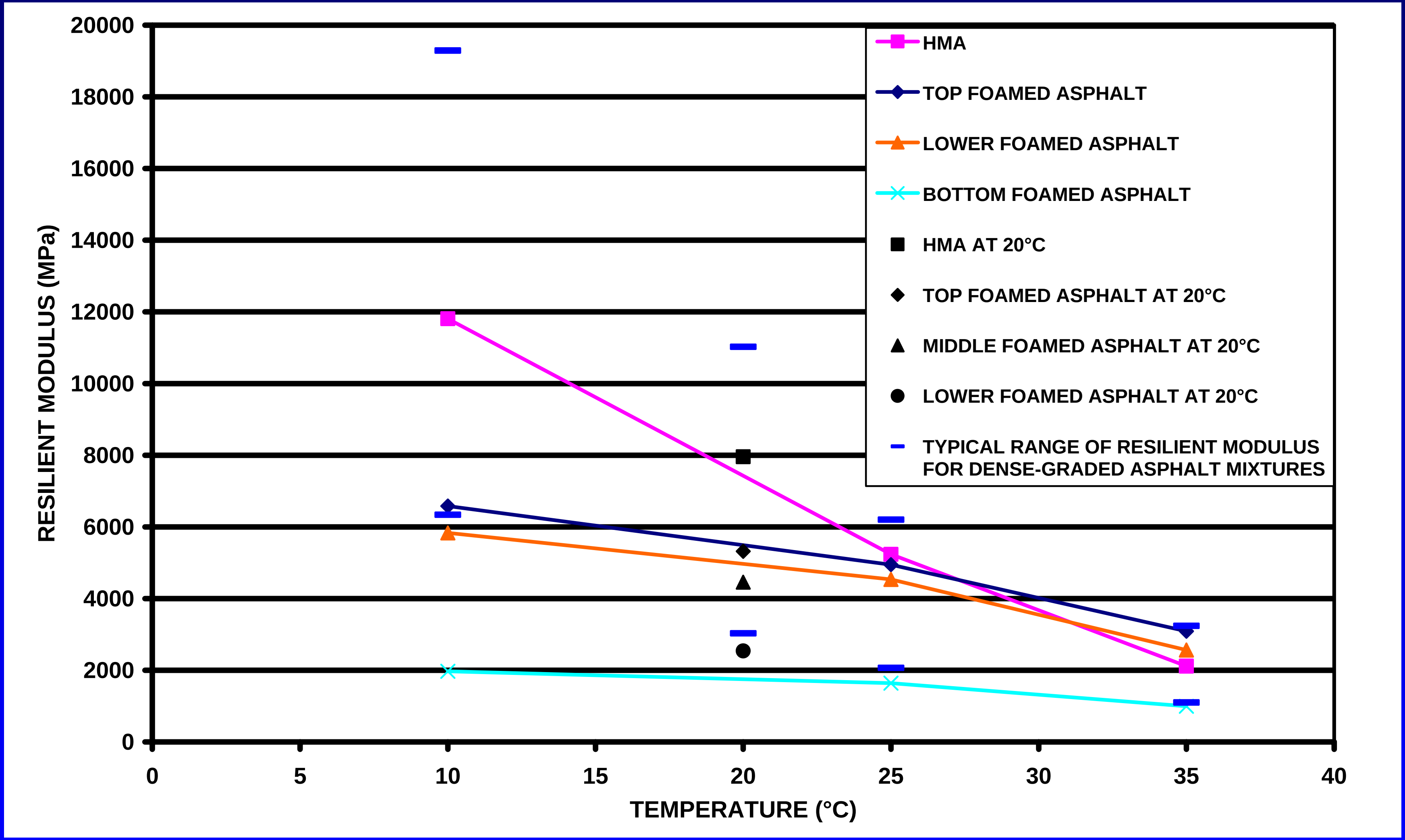
Micro PAVER GIS REPORT DISPLAY

GTAA

DECISION TREE FOR FLEXIBLE PAVEMENT MAINTENANCE AND REHABILITATION



FOAMED ASPHALT STABILIZATION IS A GROWING REHABILITATION TECHNIQUE FOR AIRPORT ASPHALT PAVEMENTS



RESILIENT MODULUS VERSUS TEMPERATURE RELATIONSHIP FOR HOT-MIX ASPHALT AND FOAMED ASPHALT, TYPICAL CORES, GEORGIA

AIRPORT ASPHALT AND CONCRETE PAVEMENT REHABILITATION CASE STUDY

GTAA 05/23 RUNWAY REHABILIATION EVALUATION AND SELECTION

THE GTAA USES A MicroPAVER BASED
PAVEMENT MANAGEMENT SYSTEM
THIS INCLUDES HWD LOAD RATING AND LASER PROFILOMETER
SMOOTHNESS MONITORING

AIRPORT ASPHALT AND CONCRETE PAVEMENT REHABILITATION CASE STUDY

RUNWAY 05/23 PRIOR TO REHABILITATION IN 2004 AND 2005

JEGEL

AIRPORT ASPHALT AND CONCRETE PAVEMENT REHABILITATION CASE STUDY

METHODOLOGY

- ENGINEERING SITE VISIT
- REVIEW OF PAVEMENT HISTORY
- PAVEMENT CONDITION SURVEY – MICROPAVER, PAVEMENT DISTRESSES, PCI
- FWD LOAD/DEFLECTION TESTING – DEFLECTION, ELASTIC MODULUS, LOAD TRANSFER, PRESENCE OF VOIDS
- GEOTECHNICAL INVESTIGATION – PAVEMENT CORING AND BOREHOLE/PROBEHOLE INVESTIGATION
- LABORATORY TESTING
- SYNTHESIS OF FINDINGS
- REHABILITAION METHODS SELECTION (PAVEMENT DESIGN, VALUE ENGINEERING AND LIFE CYCLE COST ANALISIS)

AIRPORT ASPHALT AND CONCRETE PAVEMENT REHABILITATION CASE STUDY

EVALUATION OF PAVEMENT CONDITION

PAVEMENT DESIGN ALTERNATIVES
KEEL SECTION

- CONCRETE PAVEMENT RESTORATION (CPR) AND THIN HMA OVERLAY
- THICK OVERLAY OVER EXISTING CONCRETE PAVEMENT
- CONCRETE PAVEMENT RUBBLIZATION AND THICK HMA OVERLAY
- CONCRETE PAVEMENT RECONSTRUCTION

AIRPORT ASPHALT AND CONCRETE PAVEMENT REHABILITATION CASE STUDY

LIFE-CYCLE COST ANALYSIS

ALTERNATIVE	INITIAL CONSTRUCTION	MAJOR MAINTENANCE	RESIDUAL VALUE	SALVAGE VALUE	30-YEAR LCC, PW
CPR AND THIN HMA OVERLAY	$2,712,900	$2,181,312	- $500,401	- $41,822	$4,351,989
THICK HMA OVERLAY	$2,660,875	$1,253,685	- $380,928	- $41,020	$3,492,612
RUBBLIZATION AND THICK HMA OVERLAY	$3,313,500	$1,125,026	- $380,774	- $51,112	$4,006,641
CONCRETE PAVEMENT RECONSTRUCTION	3,155,400			- $48,643	$3,106,757

SELECTED FOR LOGISTICAL (OPERATIONS) REASONS

RUNWAY RETURNED TO FULL AND SMOOTH SERVICE

NEW ASPHALT PAVEMENT CONSTRUCTION METHODS

PLACING LOWER COURSE HIGH PERFORMANCE HOT-MIX ASPHALT OVER PREPARED PORTLAND CEMENT CONCRETE SLABS WITH A POLYMER MODIFIED EMULSION TACK COAT, GTAA

NEW PAVING EQUIPMENT DEVELOPMENT

ASPHALT PAVERS WITH THE ABILITY TO APPLY EMULSIFIED ASPHALT TACK COAT OR PREFERABLY HOT ASPHALT CEMENT TACK COAT

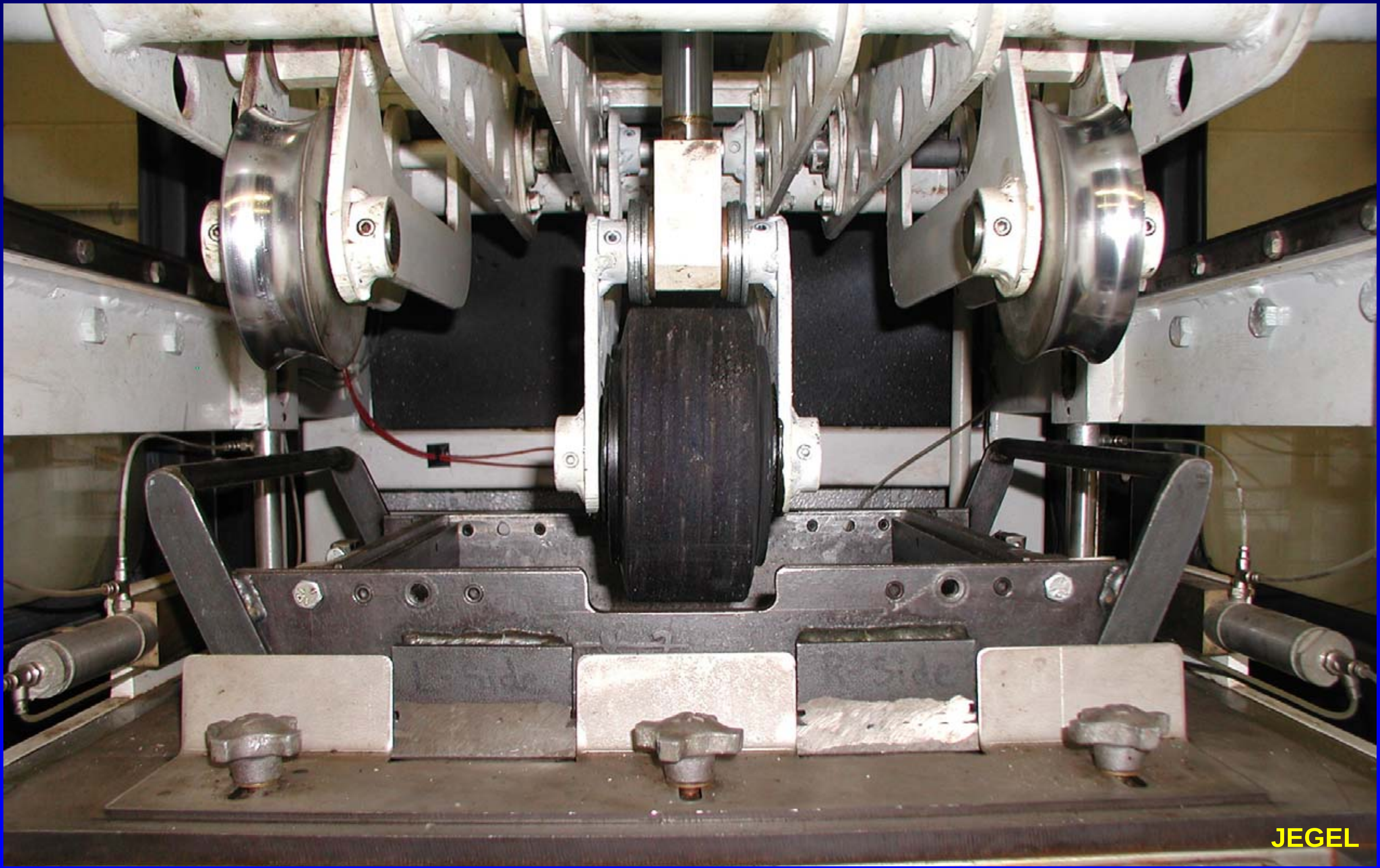
IMPROVED CRACK SEALANT METHODS DEVELOPMENT

WATER TRAPPED UNDER THE CRACK SEALANT, RUNWAY 08-26, CFB GOOSE BAY

IMPROVED CRACK SEALANT METHODS DEVELOPMENT

SAMPLE WITH ROUTED RESERVOIR FILLED WITH CRACK SEALANT AND THEN CONDITIONED IN WATER FOR 24 HOURS
READY FOR TESTING IN THE APA

IMPROVED ASPHALT LIFT INTERFACE PERFORMANCE



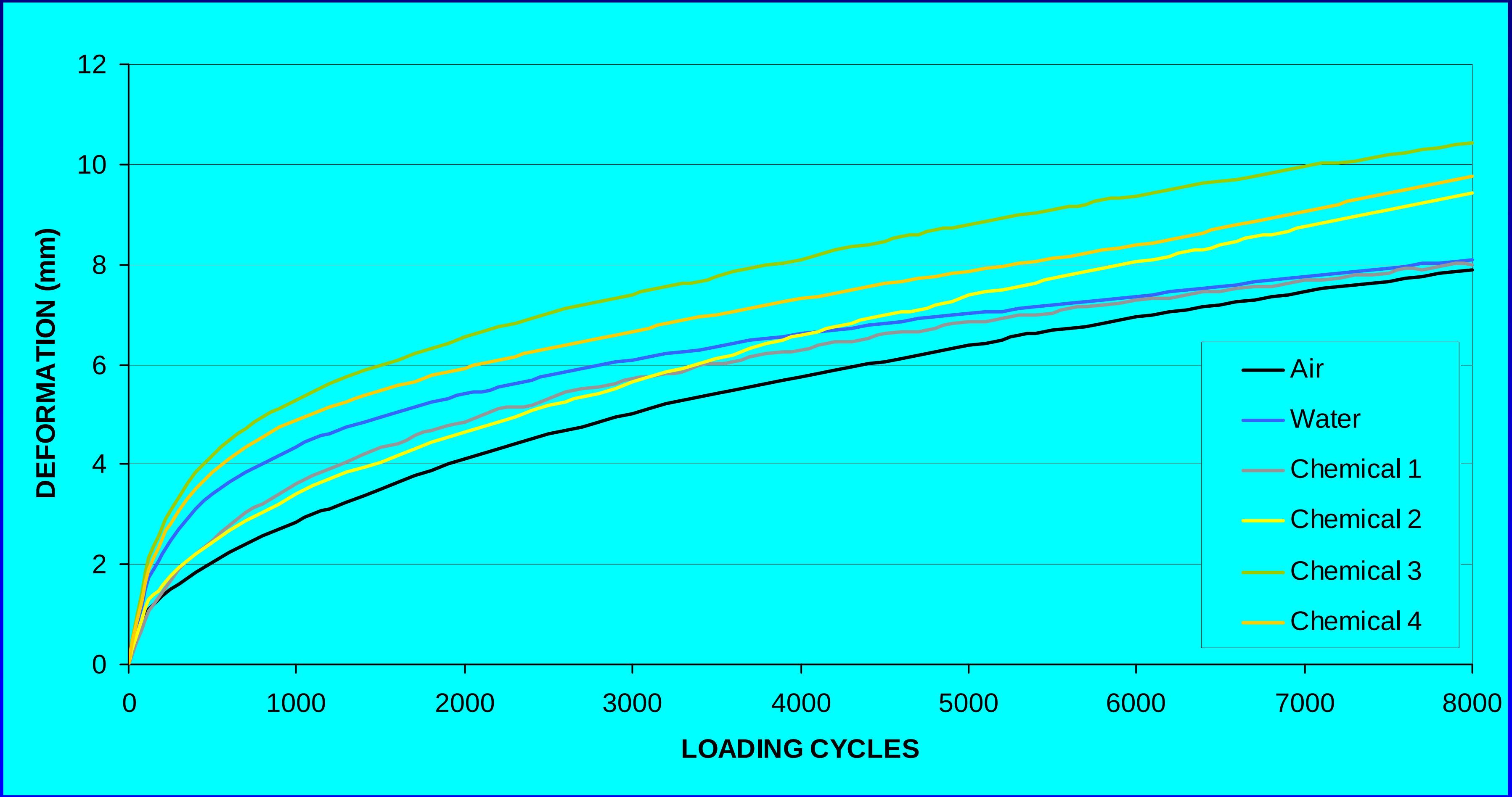
APA ASPHALT CONCRETE LAYERS INTERFACE SHEAR RESISTANCE AND 'LARGE SLAB' RESISTANCE TO RUTTING TESTS CONFIGURATION
(70 mm WIDE SOLID RUBBER WHEEL, SLAB 300 mm x 300 mm)

RESISTANCE OF HOT-MIX ASPHALT TO ANTI-ICING AND DEICING CHEMICALS

UREA DAMAGE TO HMA WITH A MOISTURE SUSCEPTIBILITY PROBLEM, DND GREENWOOD

RESISTANCE OF HOT-MIX ASPHALT TO ANTI-ICING AND DEICING CHEMICALS

EVALUATION USING THE ASPHALT PAVEMENT ANALYZER



PERMANENT DEFORMATION (APA) OF HOT-MIX ASPHALT IN DIFFERENT ANTI-ICING AND DEICING CHEMICALS

NEW ASPHALT PAVEMENT CONSTRUCTION METHODS

FIELD TESTING OF ASPHALT CONCRETE PAVEMENT WITH IMPACT-ECHO EQUIPMENT
TO DETERMINE CRACKING AND INTERFACE CONDITIONS
JEGEL IN ASSOCIATION WITH McMASTER UNIVERSITY

NEW ASPHALT PAVEMENT TESTING METHODS

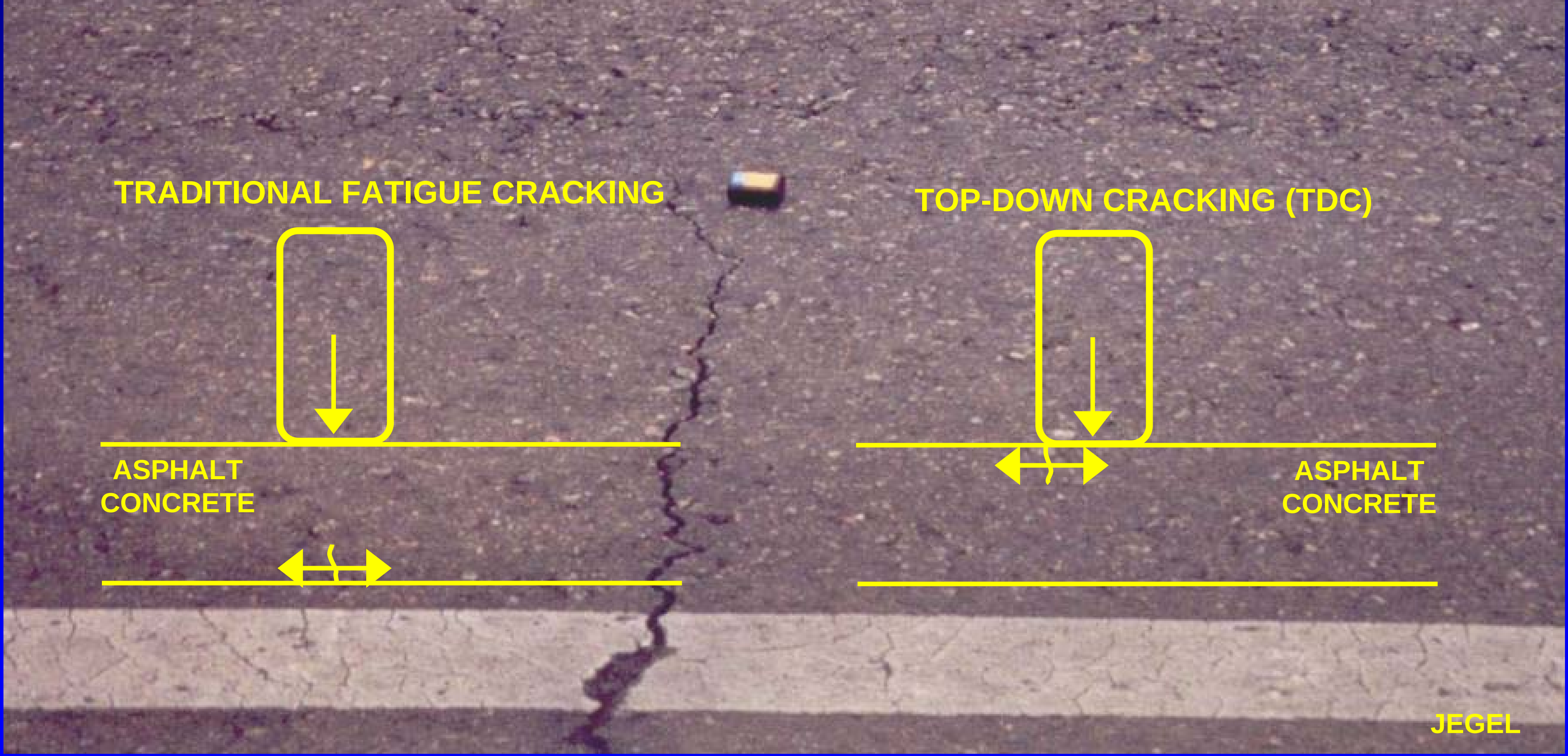
HYDRATED LIME SURFACE TREATMENT TO REDUCE
ASPHALT PAVEMENT TEMPERATURE (BLACK BODY ABSORPTION)

NEW ASPHALT PAVEMENT DISTRESS TYPE

TOP-DOWN CRACKING OF ASPHALT CONCRETE IS NOT GENERALLY CONSIDERED IN CURRENT ASPHALT DESIGN PROCEDURES

IT IS NOW BEING CONSIDERED FOR LONG-LIFE ASPHALT PAVEMENTS

TOP-DOWN CRACKING HAS NOT BEEN STUDIED FOR AIRFIELDS



CRACKING OF RELATIVELY NEW ASPHALT PAVEMENT HOTHOT, INNER MONGOLIA

TRANSVERSE THERMAL CRACK WITH TOP DOWN CRACKING (TDC) IN WHEELPATH

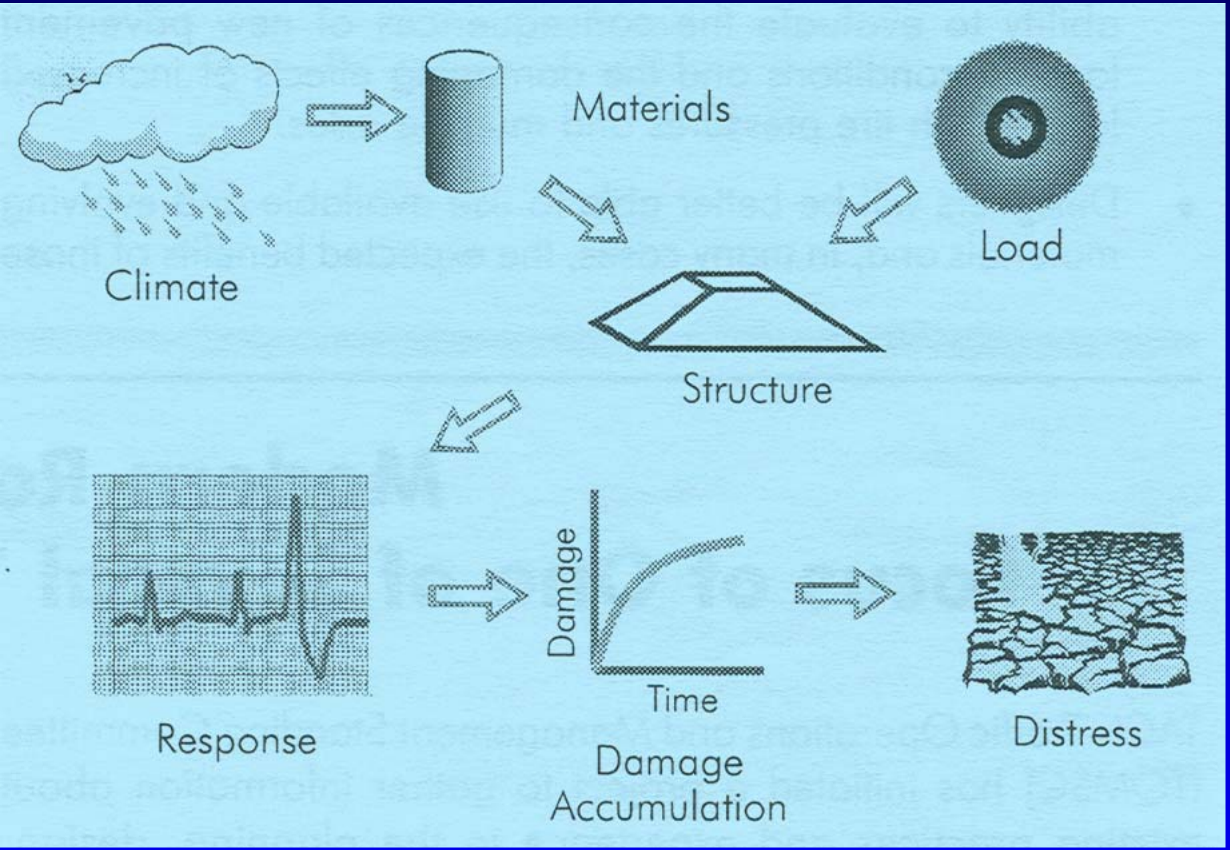
NEW ASPHALT PAVEMENT DESIGN CONCEPTS

STATE-OF-PRACTICE

ACTUAL CURRENT PRACTICE??

STATE-OF-THE-ART

AASHTO 2002 FOR ASPHALT PAVEMENT DESIGN



AASHTO's 2002 MECHANISTIC-EMPIRICAL DESIGN METHOD IS A HIERARCHICAL OR MULTI-LEVEL PROCEDURE BASED ON DESIGN DATA REQUIREMENTS REFLECTING ROADWAY CLASSIFICATION. A SIGNIFICANT CHANGE FROM PREVIOUS METHODS IS THE USE OF VEHICLE AXLE LOAD SPECTRA (AXLE LOAD DISTRIBUTION) RATHER THAN EQUIVALENT SINGLE AXLE LOADS (ESALs) TO EVALUATE PAVEMENT LOADING OVER SERVICE LIFE. AASHTO's 2002 GUIDE ALSO INCORPORATES THE LATEST TECHNOLOGIES IN MATERIALS CHARACTERIZATION AND IN THE USE OF CLIMATE DATA THROUGH THE APPLICATION OF AN ENHANCED INTEGRATED CLIMATE MODEL (ICM). BY USING THE ICM, VARIATIONS IN MATERIAL AND SUBGRADE PROPERTIES SPECIFIC TO LOCAL TEMPERATURES, HUMIDITY AND PRECIPITATION ARE ALL FACTORED INTO THE DESIGN PROCESS.

AASHTO 2002 FOR ASPHALT PAVEMENT DESIGN
GENERAL DESIGN APPROACH

ENVIRONMENT MATERIALS TRAFFIC

TM

PROCESS RAW INPUT FOR DISTRESS MODELING

TM

ASSEMBLE INPUT AND TRIAL DESIGN INFORMATION FOR EACH DISTRESS MODEL

TM

STRESS DEFLECTION ANALYSIS

CALCULATE STRESS ∪ CALCULATE DAMAGE ∪ PREDICT AMOUNT OF DISTRESS

TM

PREDICT SMOOTHNESS OVER TIME

TM

CHECK PREDICTED PERFORMANCE AGAINST DESIGN STANDARDS

TM

[REVISE DESIGN AS NECESSARY] TO SATISFY DESIGN STANDARD

TM

DESIGN COMPLETE

MICROSURFACING OF THE ASPHALT RUNWAY AT THE TORONTO ISLAND AIRPORT

YOU WILL SEE THE CITY AND ISLAND AIRPORT LIGHTS MONDAY!


JEGEL


HK-3111W
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