RUBBLIZATION OF EXISTING AIRFILED PAVEMENTS AT KING ABDULAZIZ INTERNATIONAL AIRPORT, JEDDAH SAUDI ARABIA

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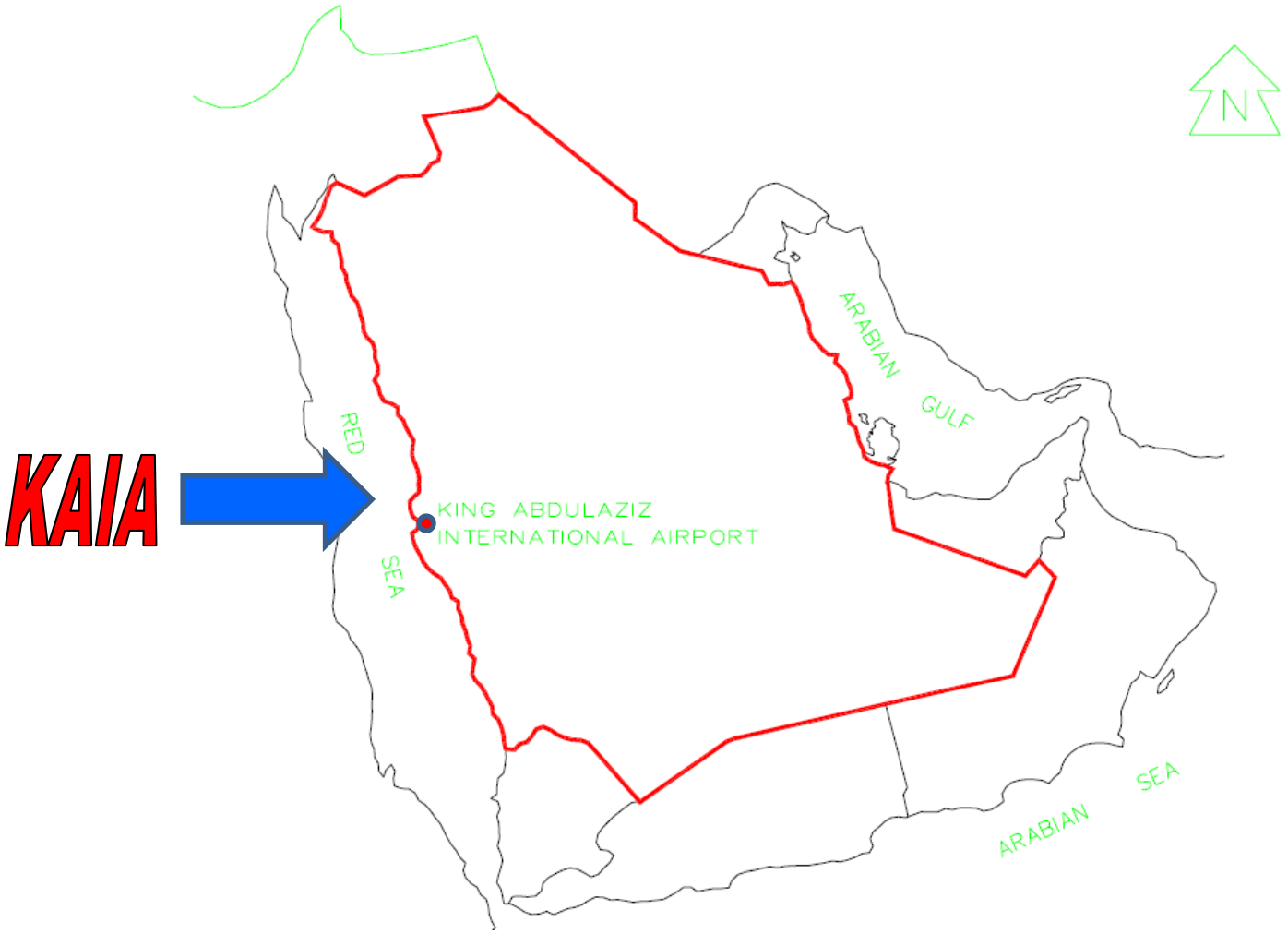
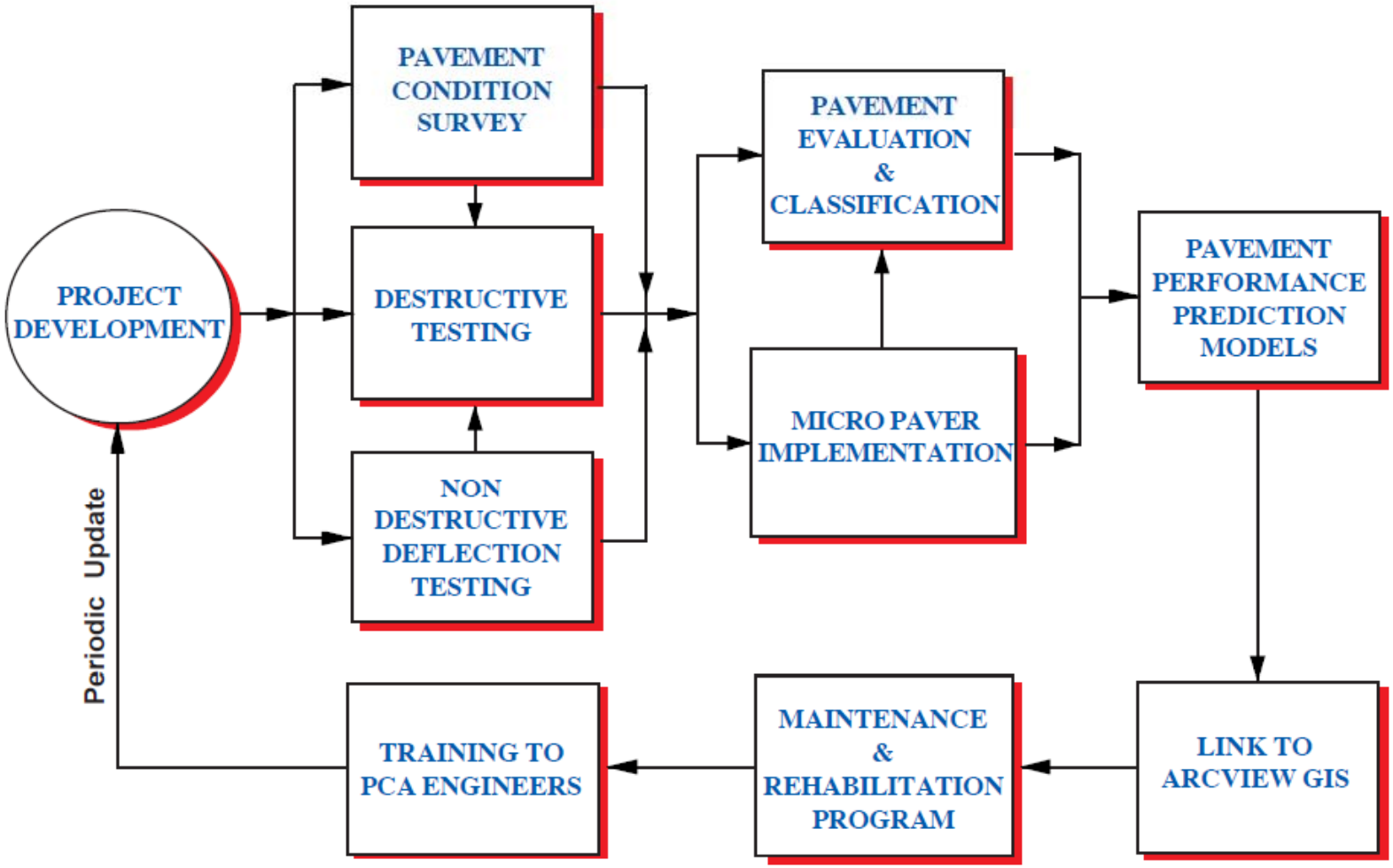


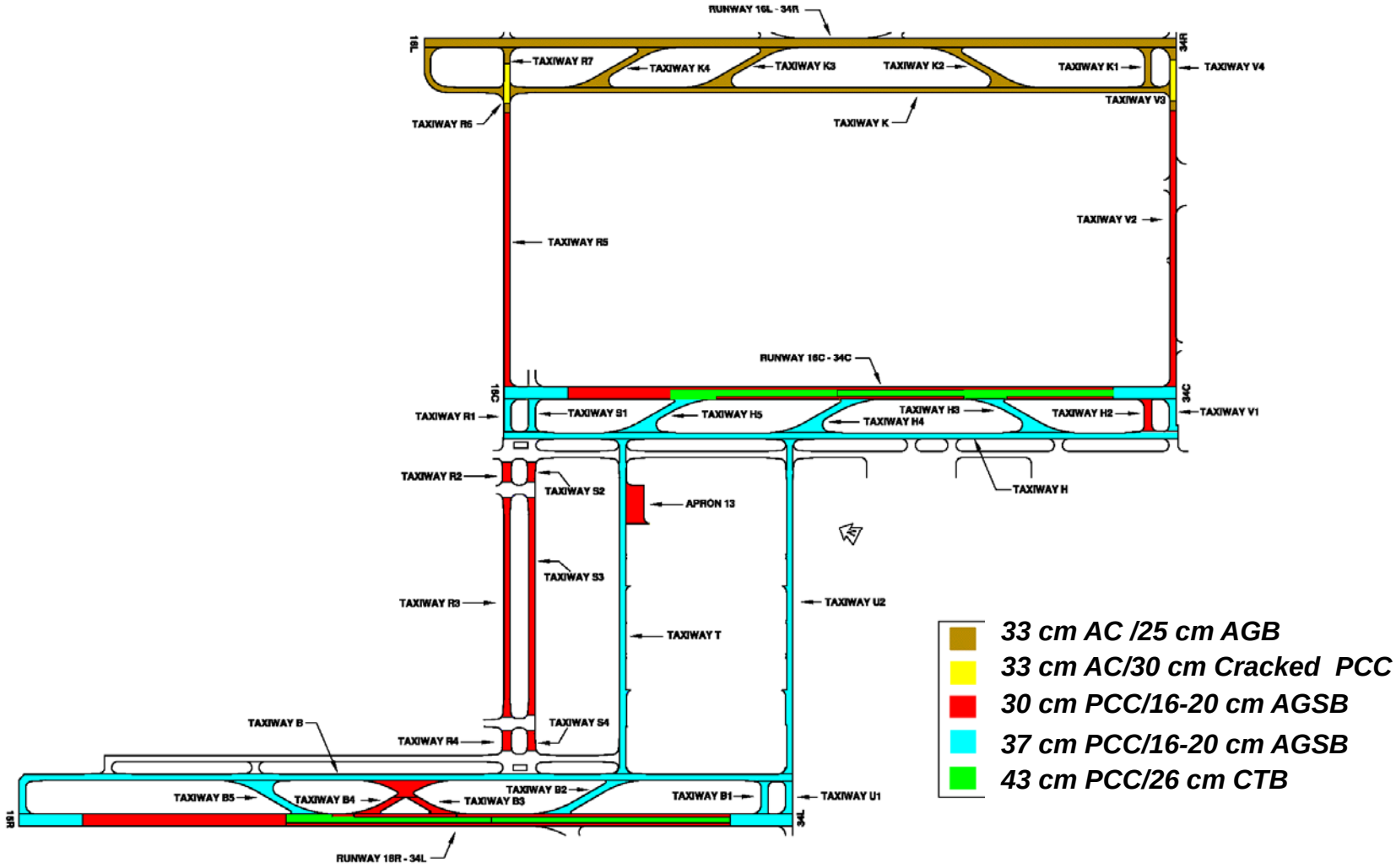
KAIA Airfield Pavements

- Three Parallel Runways.
- All runways oriented 16/34 North/South.
- RW-16L/34R (3,690mx45 m) & TW K were constructed with AC in 1982.
- RW-16C/34C (3,300mx60m) & RW-16R/34L (3,800mx60 m) & all related taxiways were constructed with PCC during 1976-1978 (part of keel sections were rehabilitated during 1982-1985) with area more than 1,300,000 sq. m

Pavement Evaluation & Management Approach



Construction History



Airfield Pavement Evaluation and Management Projects

- **1992-1994 Study**
- **1998-1999 Study**
- **2002-2004 Study**

Purpose: Provide GACA with detailed Maintenance and Rehabilitation program and an updated Pavement Management System .

Results of 2002-2004 Study

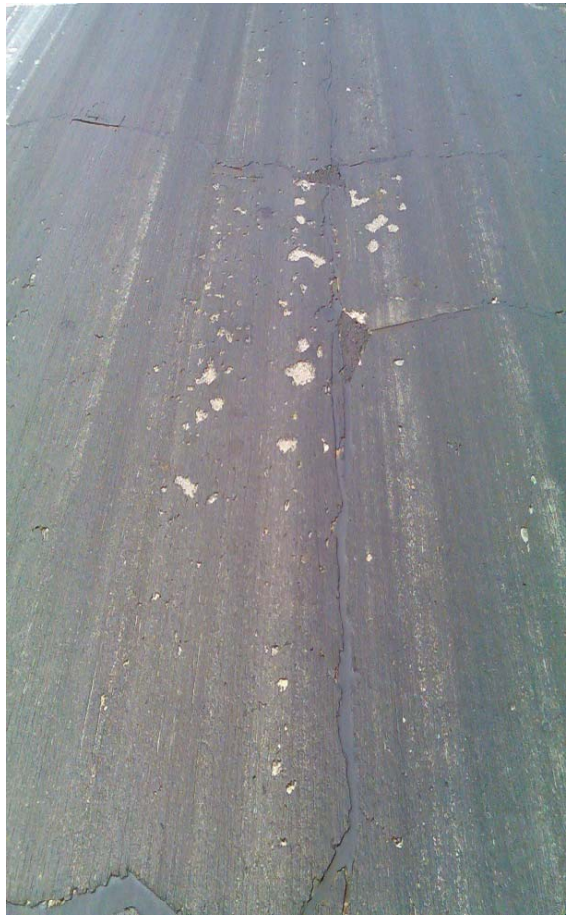
- Most of the AC Sections are 20 years old
- Most of the AC Sections are in Good Condition.
- The majority of the distresses on AC Sections are L&T Cracking, Block Cracking and Raveling and Weathering.

Results of 2002-2003 Study (Cont.)

- Most of the PCC Sections (Center and West Runway Network Systems) are in Failed to Poor Condition.
- The majority of the distresses on PCC Sections are Corner Breaks, Linear Cracking, Patching, Scaling, Shattered Slabs, Shrinkage Cracks and Joint Spalling.

Typical Distresses

Low to High Severity Scaling



Typical Distresses

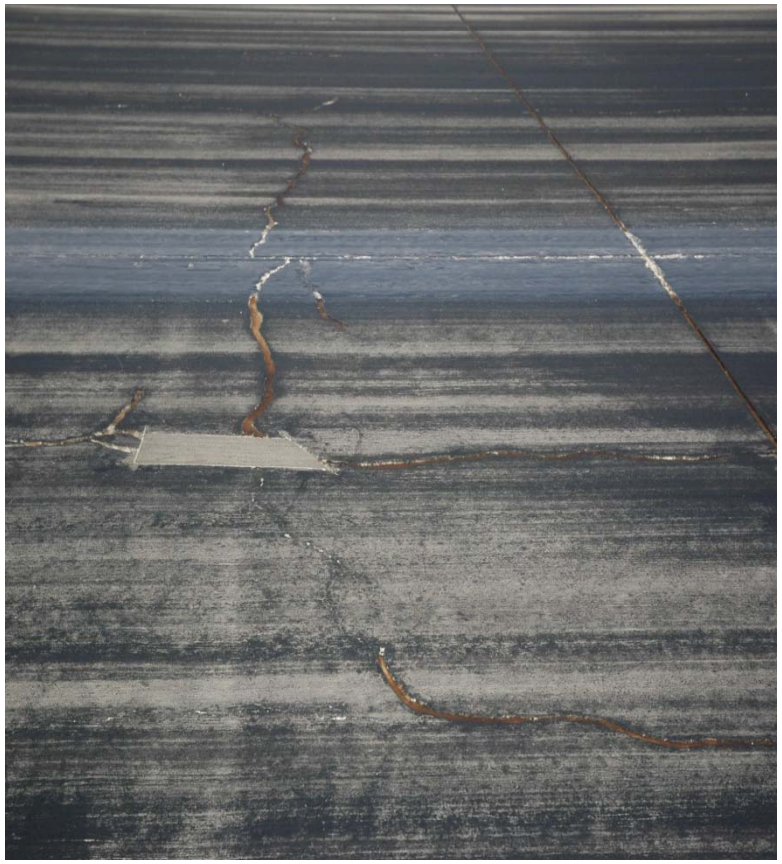
Low to High Severity Corner Break & Linear Cracking

Typical Distresses

Low to High Severity Shattered Slab & Patching

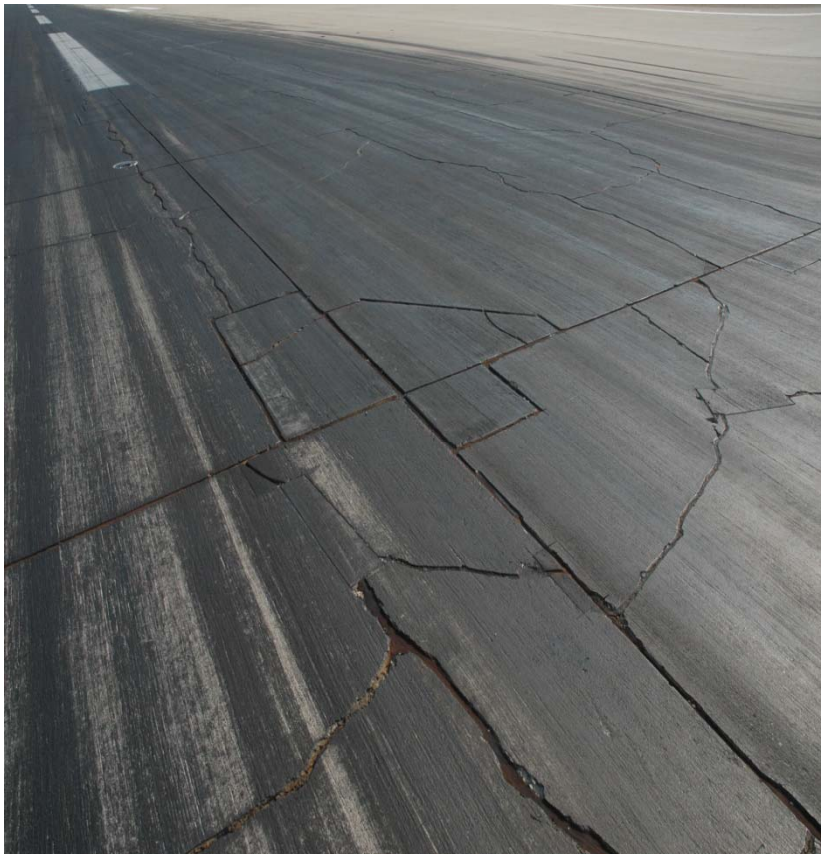
Typical Distresses

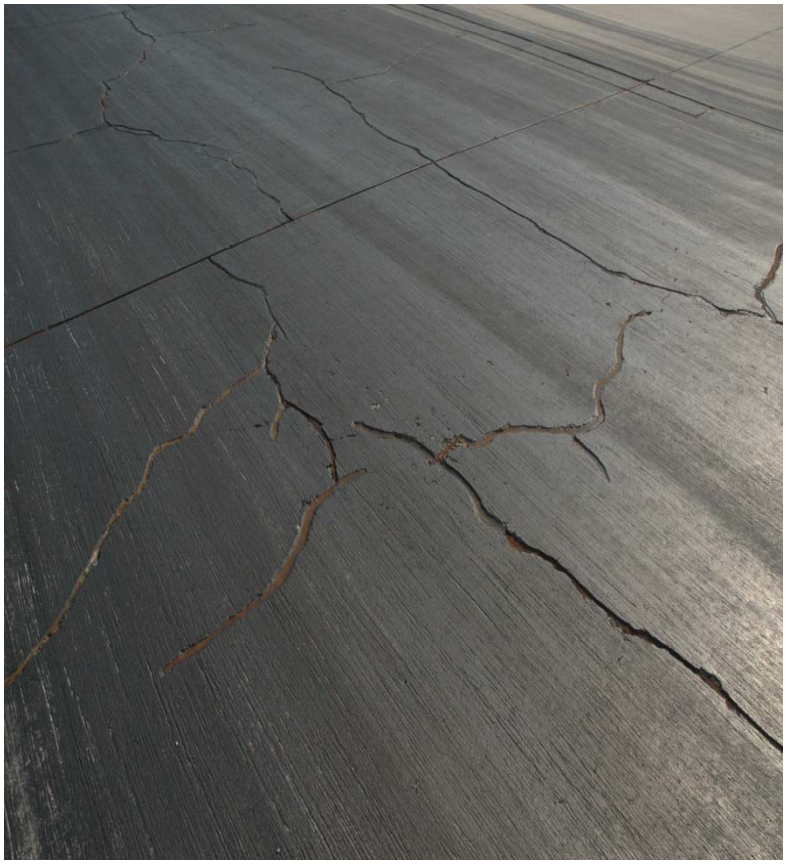
Low to High Severity Shattered Slab & Patching



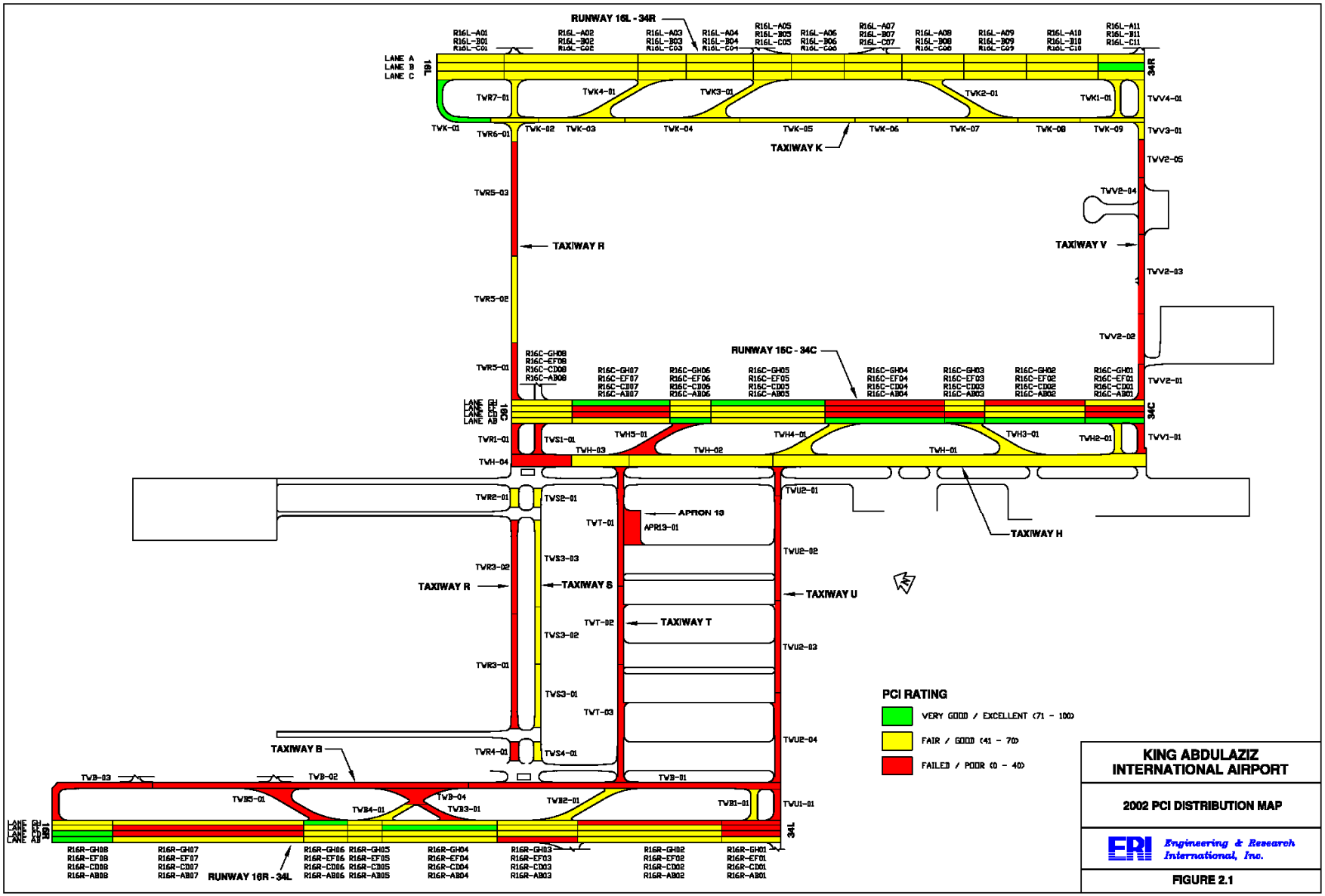
Typical Distresses

Low to High Severity Shattered Slab & Corner Break

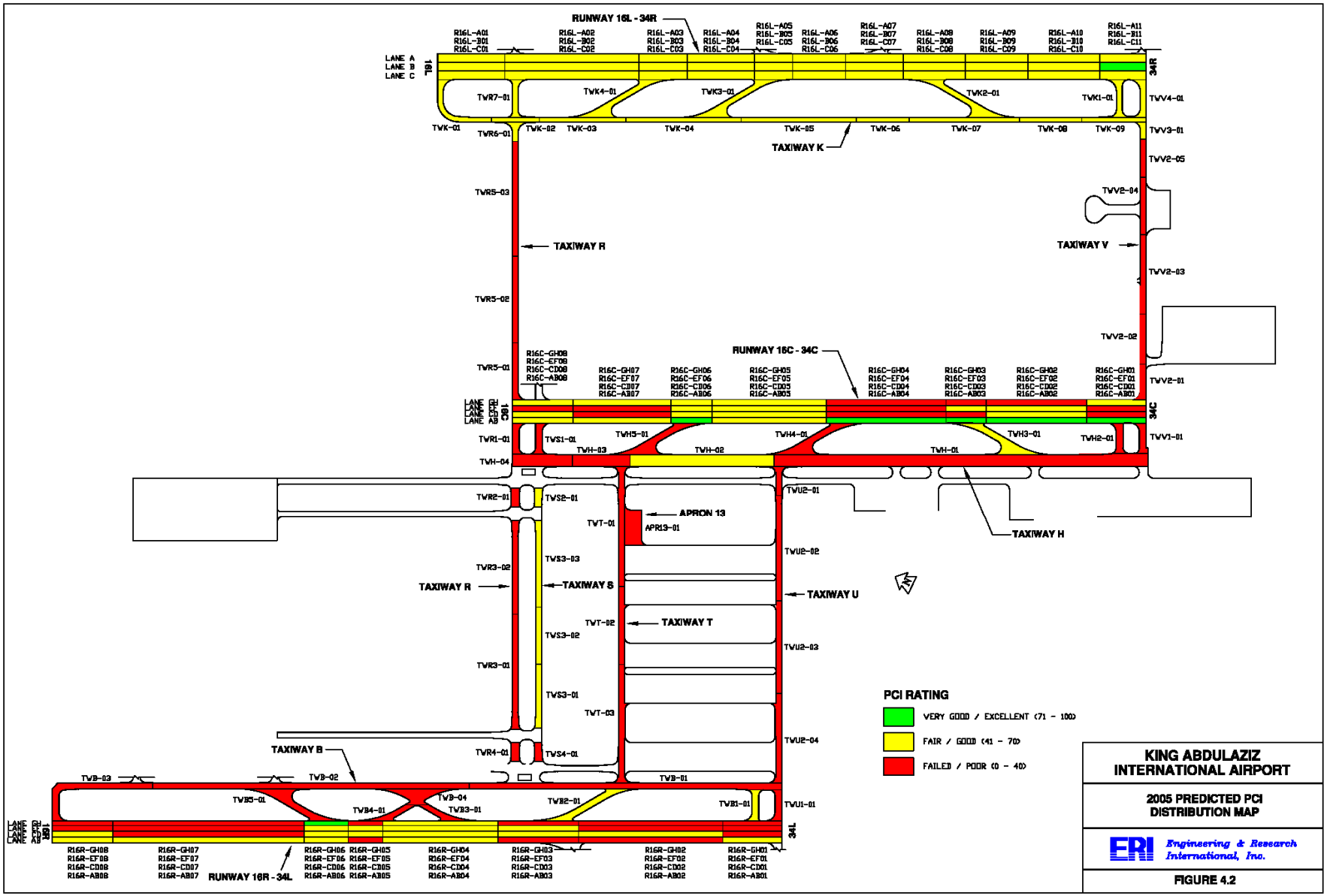




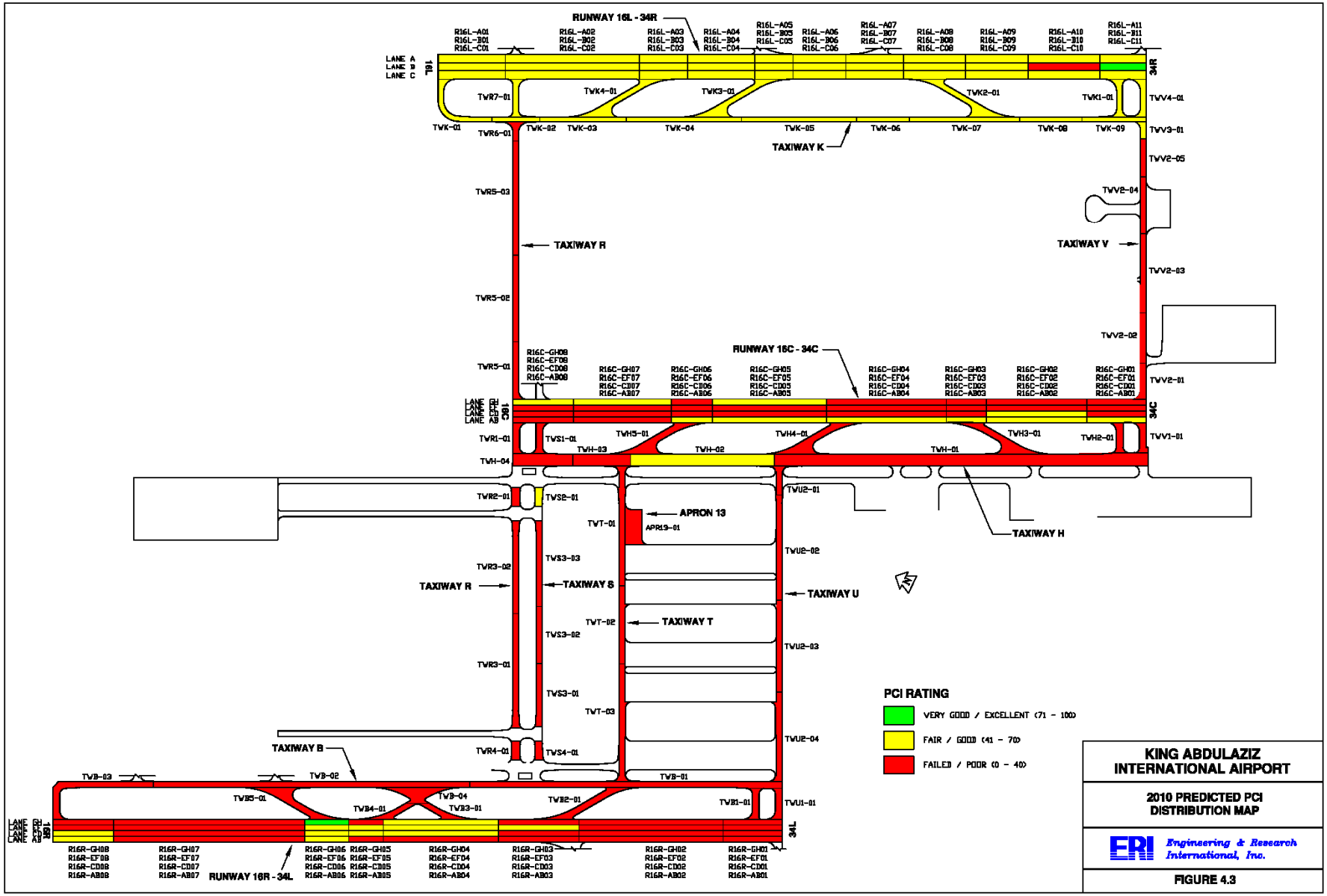
ACTUAL PCI 2002



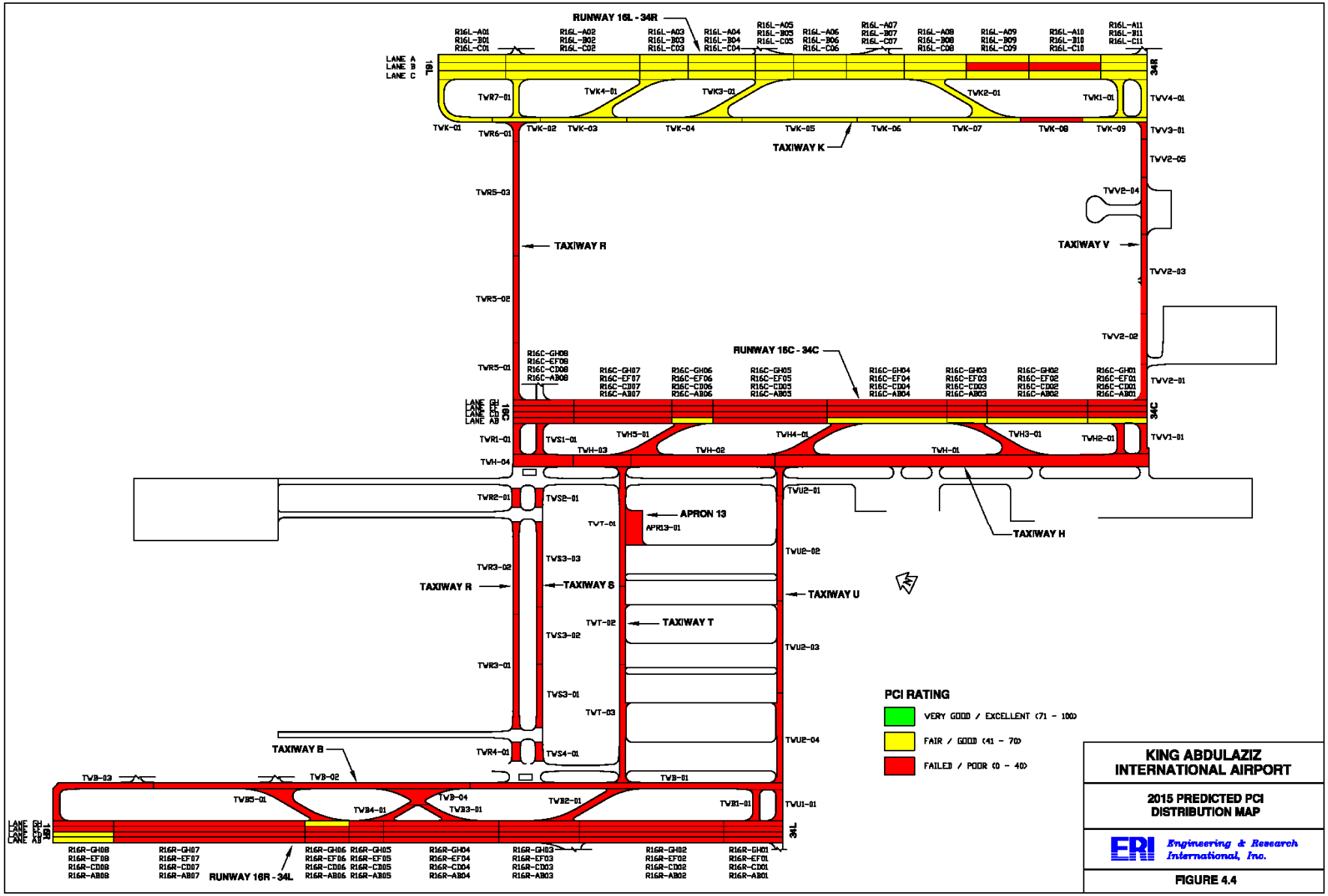
Predicted PCI 2005



Predicted PCI 2010



Predicted PCI 2015



Existing Pavement Condition

- **Based on 2002 PCI Survey:**
  - Average PCI of AC sections = 66
  - Average PCI of PCC sections = 44.
- **The predominant distresses in PCC sections:**
  - Linear cracking
  - Sattered slabs
  - Corner breaks
  - Joint seal damage
  - Patching
  - Scaling/crazing
  - Joint spalling
  - Shrinkage cracking and
  - Faulting.

Existing Pavement Structural Evaluation

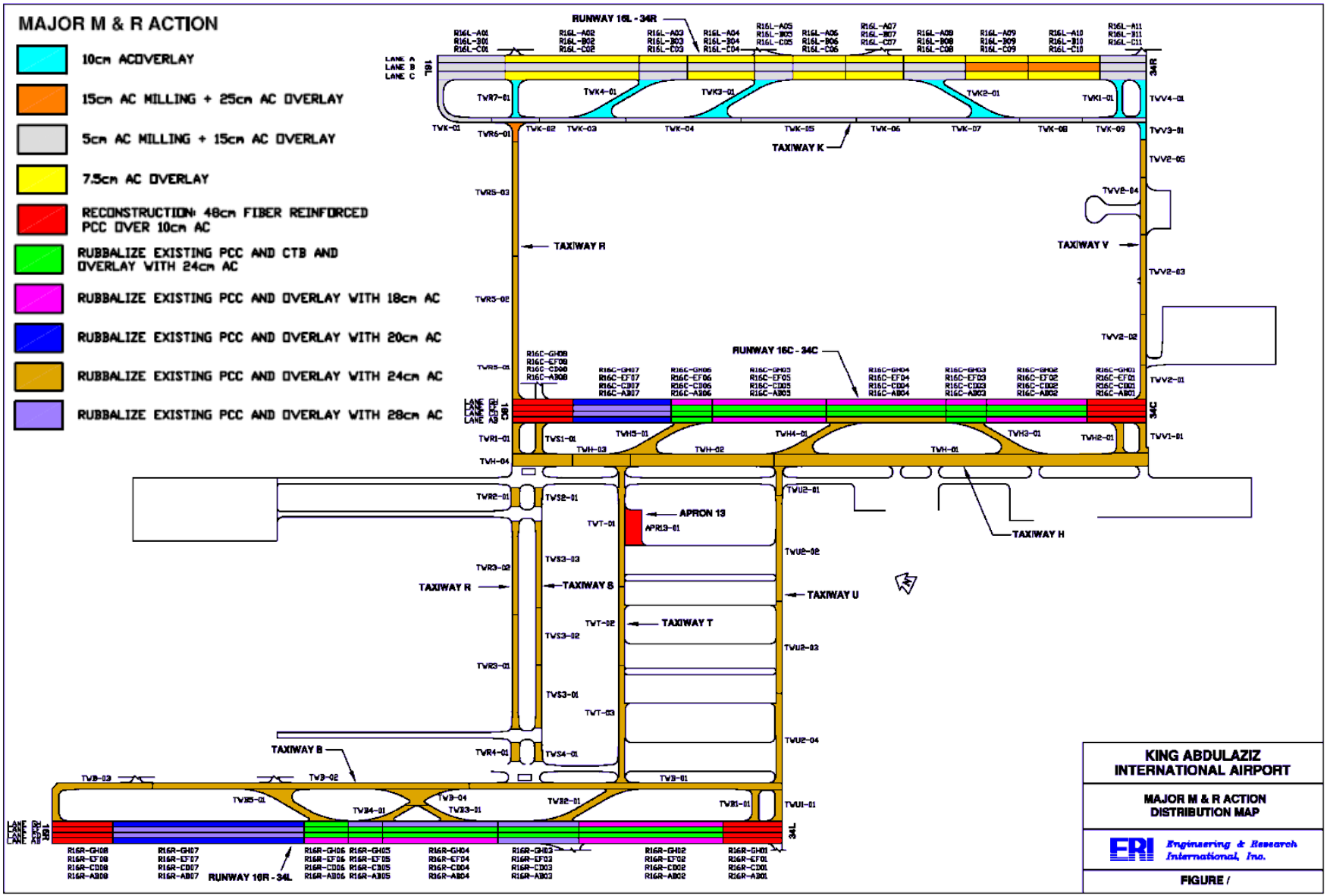
- Most of PCC sections had very low back-calculated PCC moduli values.

- The structural evaluation of existing PCC pavement sections showed that most of the PCC sections have failed.

Feasible Rehabilitation Options for PCC Pavements

- Option 1: Fiber Reinforced PCC Overlay
- Option 2: Prestressed Concrete Overlay
- Option 3: Reconstruction with Fiber Reinforced PCC
- Option 4: Rubblize Existing PCC and Overlay with AC
- Option 5: Reconstruction with AC
- Option 6: AC Overlay

Recommended Rehabilitation



Rehabilitation of Existing Pavements

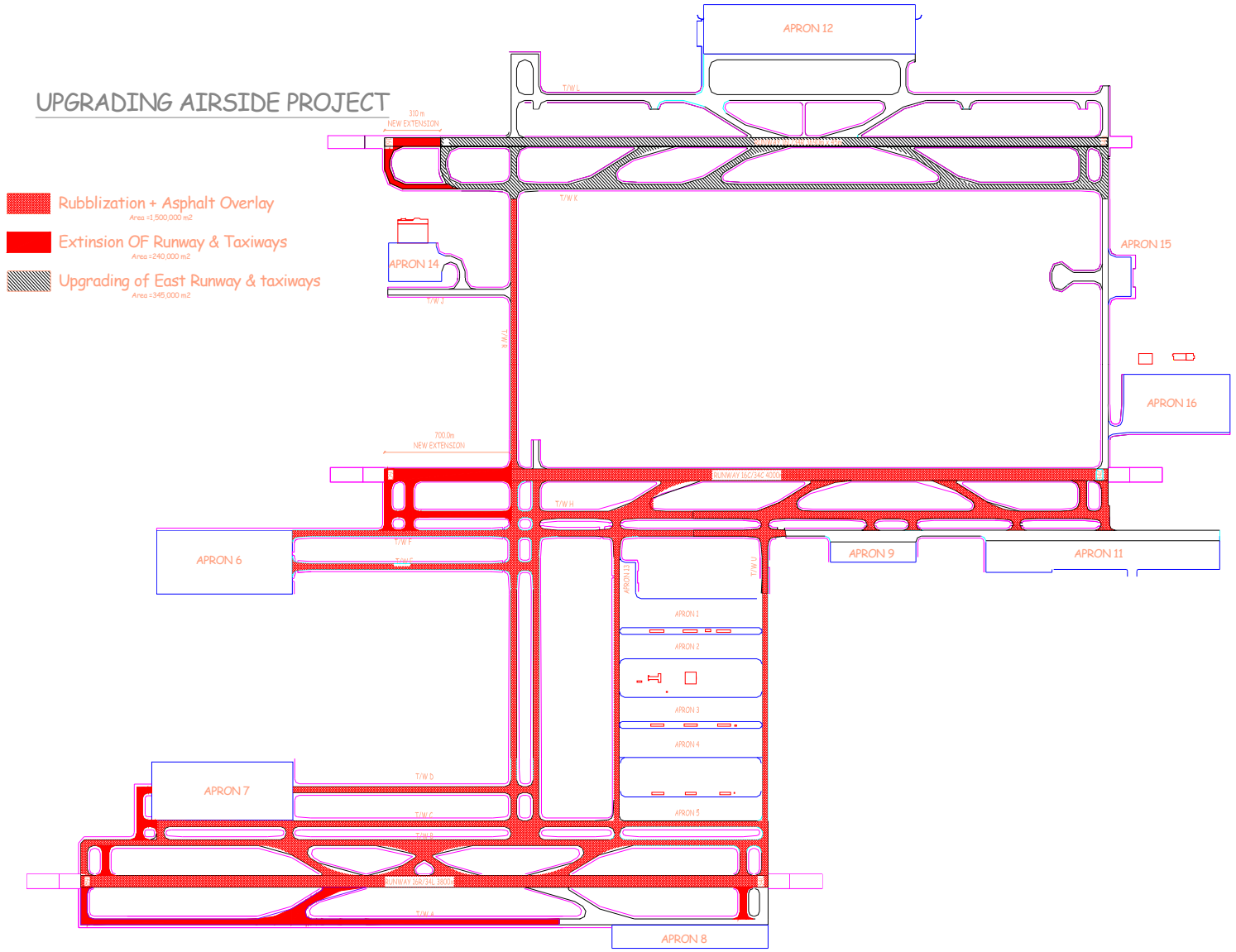
- An extensive maintenance program was put in place to maintain the pavements in operating condition while the major Airfield Upgrade Project was in planning stages.

- As a part of the major Airfield Upgrade Project for the PCC Pavements, the technique of RUBBLIZATION was selected and approved by the GACA Engineers.

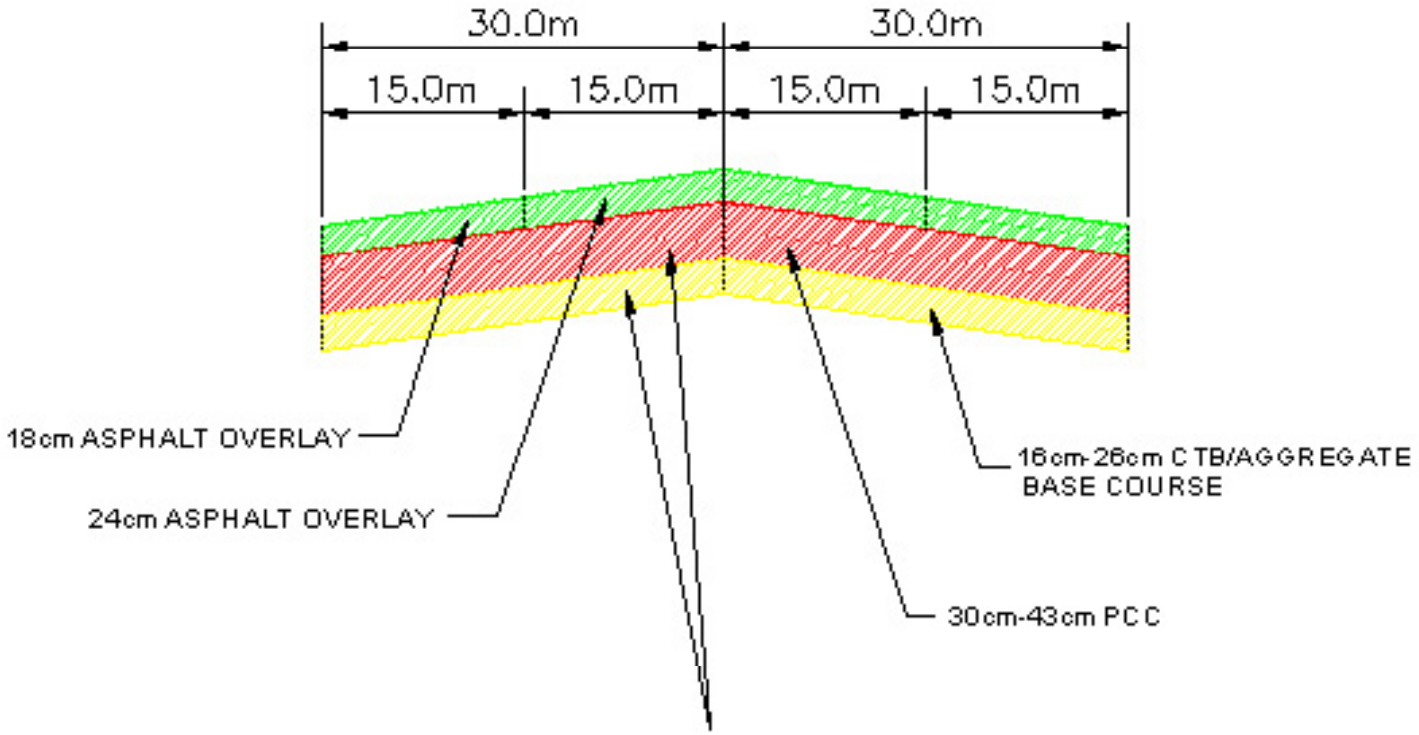
Why Rubblization?

- Eliminates Reflective Cracking in AC Overlays.
- Saves materials & transportation cost.
- Minimizes disruption to traffic operation.
- Saves Time

Airside Upgrading Project Layout



Asphalt Overlay with Rubblization



RUBBLIZE ENTIRE 60m WIDTH (PCC & CTB)
THEN ASPHALT CONCRETE OVERLAY

Rubblization Specifications

- ERI used the Federal Aviation Administration (FAA) Engineering Brief No. 66 as a reference document to review the rubblization specifications

Rubblization Specifications

- Rubblization and seating equipment
- Preparation prior to rubblization
- Test strip and test pit to establish rubblization procedure
- Rubblization criteria
- General rubblization procedures
- Dust control
- Damage to base, underlying structures and other facilities
- Removal of exposed reinforced steel
- Seating procedures
- Unstable area patching
- Acceptance of work
- Progress of work

Equipment used for Rubblization

8600 Badger Guillotine Breaker

The Guillotine Breaker weighing 5,440 kg (12,000 lb) with 2.4 m (8 ft) wide drop hammer was used to make the initial fracturing of the concrete layer.

Multi-Head Badger Breaker®.

After the Guillotine type breaker fractured the concrete the Multi-Head breaker was used to rubblize the concrete layer. The Multi-Head breaker was 4 m (13 ft) wide and had sixteen 450 kg (1,000 lb) individual drop hammers. Each hammer can be dropped individually from up to 1.5 m (5 ft) height.

"Z" grid roller

After the Multi-Head breaker finished the rubblization process, a 10 ton vibratory steel drum roller with 'Z' Grid attachment was used to break the bigger particles at the surface.

Pneumatic Tire Roller

A 20 tons pneumatic-tired roller was used to seat the rubblized surface.

Smooth Steel Drum Vibratory Roller

A 10 ton smooth steel drum vibratory roller was used to seat the rubblized surface and to provide smooth surface for AC overlay.

8600 BADGER GUILLOTINE BREAKER

ERI Engineering & Research Int'l, Inc.

General Authority of Civil Aviation, Saudi Arabia

MHB Badger Breaker 16-hammer

Z-Grid Roller

Z - Grid Roller

Pneumatic Tire Roller

Smooth Steel Drum Vibratory Roller

METHODS OF RUBBLIZATION

- Visual inspection of the pavement to be rubblized to identify any shallow underground structures.
- Test Strip For Rubblization. Before starting the process of rubblizing, the contractor prepared a test strip 50mx3.5m wide. To ensure the test strip is rubblized as per the specification. The test strips was repeated at each change of PCC thickness areas.

Test Strip – Taxiway C

METHODS OF RUBBLIZATION (Cont.)

- The initial breaking of the pavement was performed with the guillotine hammer

Test Strip – Taxiway C

Test Strip – Taxiway C

METHODS OF RUBBLIZATION (Cont.)

- The rubblizing was accomplished using a MHB.

Test Strip – Taxiway C

METHODS OF RUBBLIZATION (Cont.)

- Routine test pits were excavated for each 5000M2(lot) of rubblized area for inspection, quality control and acceptance as per specification.
- The rubblized material in the test pits was examined to check largest size within the guidelines of the specification.
- The operator adjusted the drop heights and/or impact spacing if necessary to achieve the required sizing.

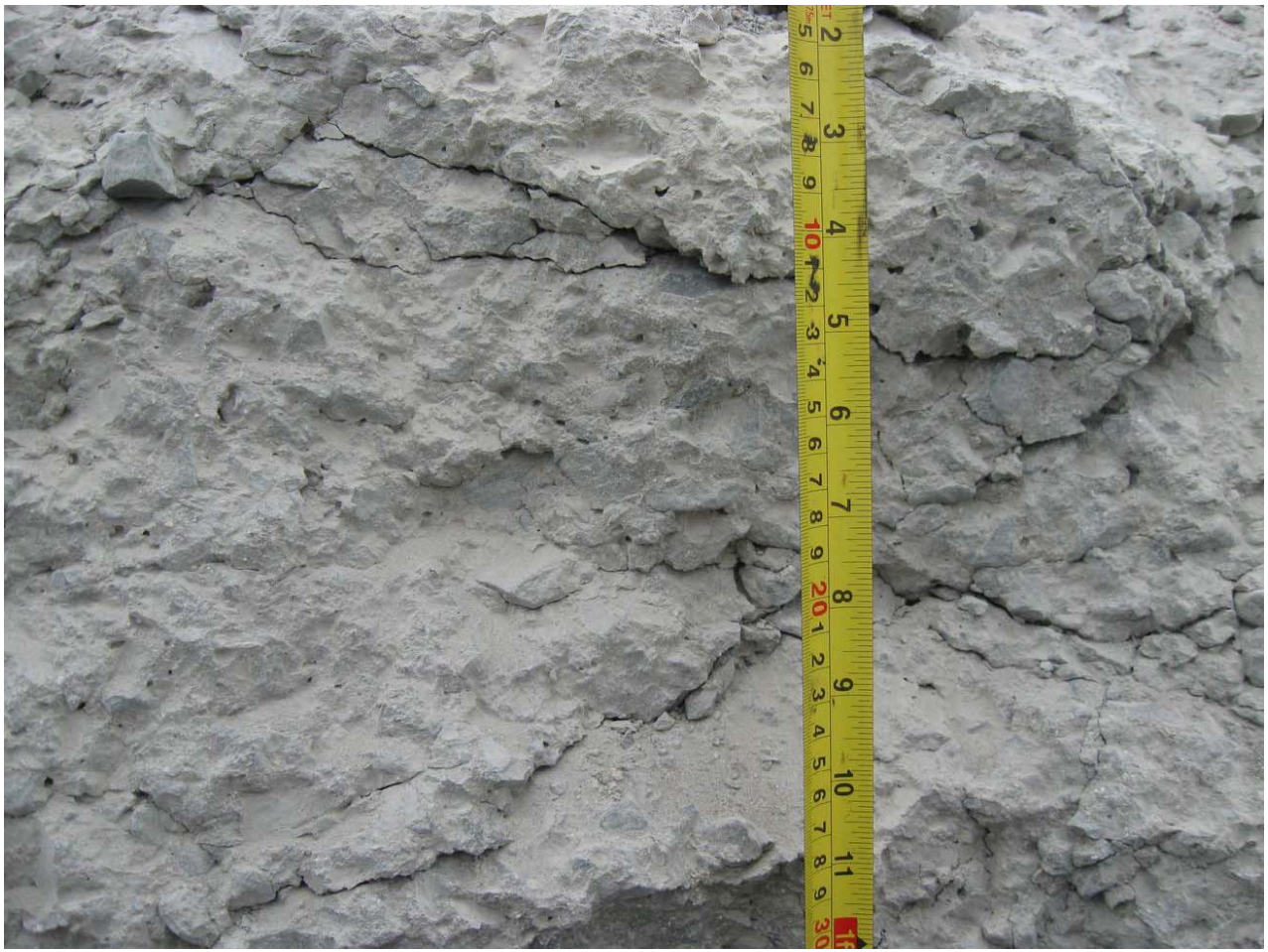
Test Pit – Taxiway C

Test Pit – Runway16R-34L

Test Pit – Runway 16R-34L

Test Pit – Runway 16R-34L

Test Pit – Runway 16R-34L



Test Pit – Runway 16R-34L

Test Pit – Runway 16R-34L

METHODS OF RUBBLIZATION (Cont.)

- **Before the asphalt overlay was placed, the rubblized pavement was compacted by a variety of compaction equipment in the following sequence:**
  - Vibratory steel drum roller with Z-grid attachment
  - 20 ton pneumatic-tired roller
  - 10 ton vibratory steel drum roller.

Test Strip – Taxiway C

Test Strip – Taxiway C

Test Strip – Taxiway C

METHODS OF RUBBLIZATION (Cont.)

- The pavement design for the upgrading of the rubblized PCC pavement was based on a layer modulus for the rubblized base of 500Mpa. In order that the geophones of FWD equipment make good contact with the surface, a layer of Asphalt base course of 60-75mm was placed on the rubblized layer. The rubblized material in the test pits was examined to check largest size within the guidelines of the specification.
- The FWD measurements were repeated for each change of PCC.

METHODS OF RUBBLIZATION (Cont.)

- The pavement layer moduli values of all layers including sub grade were determined from FWD data. The FWD measurements were repeated for each change of PCC.

QUALITY MANAGEMENT SYSTEM
Acceptance Criteria

- The rubblized PCC pavement were accepted based on a lot of 5000M2. A lot was accepted if the following criteria were met.
  - If the routine test pits indicate rubblization requirements are met as per the specification.
  - If all the phases of rolling (Z-grid, PTR & vibratory steel wheel) result in a stable compacted surface
  - The back calculated E-value of the PCC thickness tested by FWD on a test strip was equal to or more than the design value of 500 Mpa.

Conclusions

- The structural evaluation of existing PCC sections showed that most of the PCC sections have failed.
- Majority of the distresses in the PCC sections at KAIA were load related.
- An extensive maintenance program was put in place to maintain the pavements in safe operating condition while the major Airfield Upgrade Project was in planning stages.
- As a part of the major Airfield Upgrade Project for the PCC Pavements, the technique of RUBBLIZATION was selected and approved by the GACA Engineers.