成为世界一流的机场建设和临空产业工程服务商

To be the world-class airport constructor and airport project servicer

Practice on Asphalt Overlay in China

2015.05

中国民航机场建设集团公司

China Airport Construction Group Corporation

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CACC

History and Performance

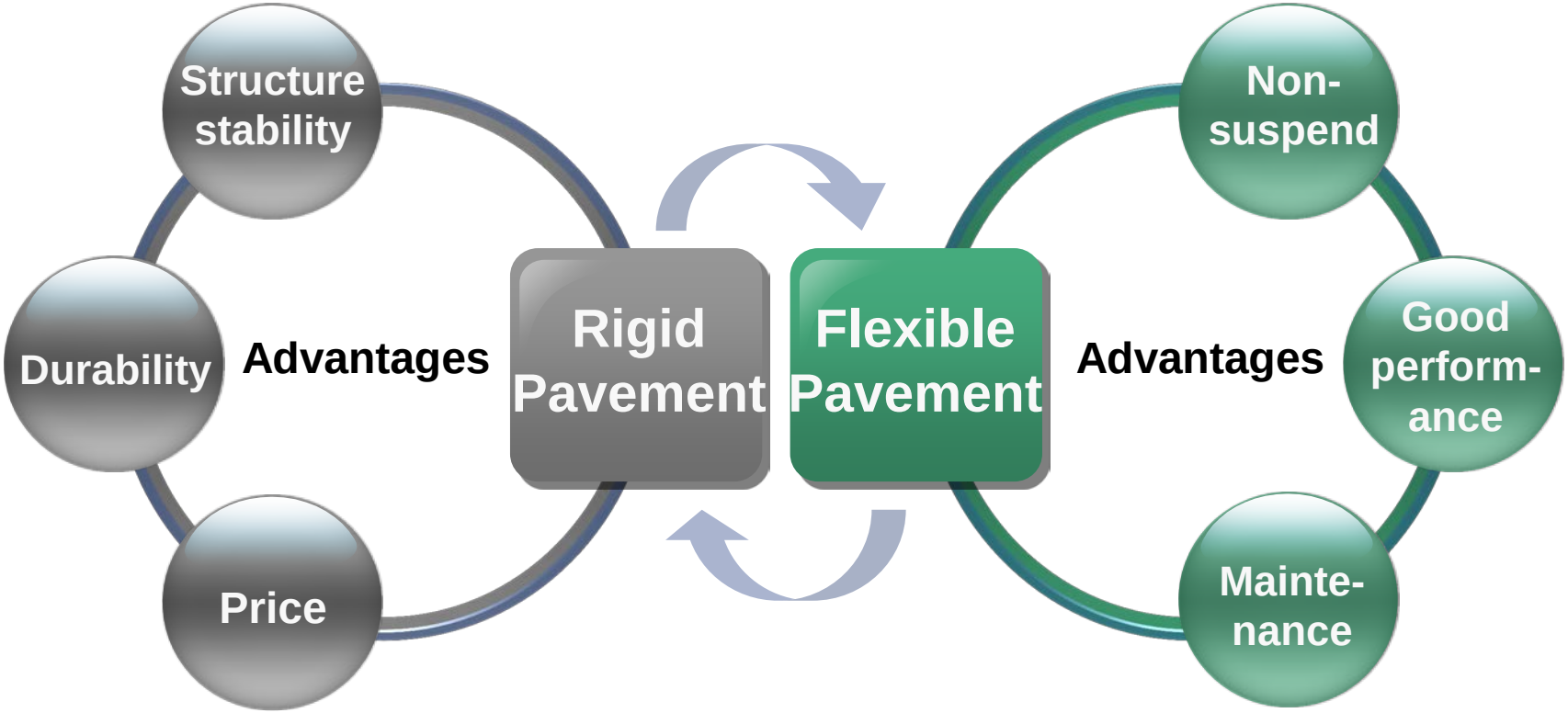
- Founded in 1954
- Technology-intensive SOE
- Provide all-round top-notch services for CAAC
- Dominant fields

  Design/ Consultation/ Research/ Supervision/ EPC/ Construction……
- Performance

  Over 150 airports

  Awards

Different Pavement Types



Asphalt Overlaid is the Optimal Choice in China

Contents

Projects Review

- 1989 Shanghai Hongqiao Airport
- 1991,1993 Nanjing, Guilin, Xi'ning
- 1994 Xiamen
- 1996 Beijing Capital Airport- Eastern Runway
- 1998 Zhanjiang, Hongqiao
- 2000 Beijing Capital Airport- West Runway, Xi'ning
- 2001 Harbin, Dunhuang
- 2002 Tianjin
- 2003 Dalian
- 2004 Kunming, Karamay
- 2005 Luzhou, Tacheng
- 2006 Hongqiao, Qingdao, Yan'an
- 2007- Changsha, Xiamen, Lijiang, Xining, Tongliao, Mangshi, Shenyang, Urumqi, Xi'an, Lhasa, Mudanjiang, Hongqiao, Kunming, Lvliang, Chongqing, Beijing……
- To be built： Chengdu, Beijing, Tianjin, Baoshan, Zhaotong……

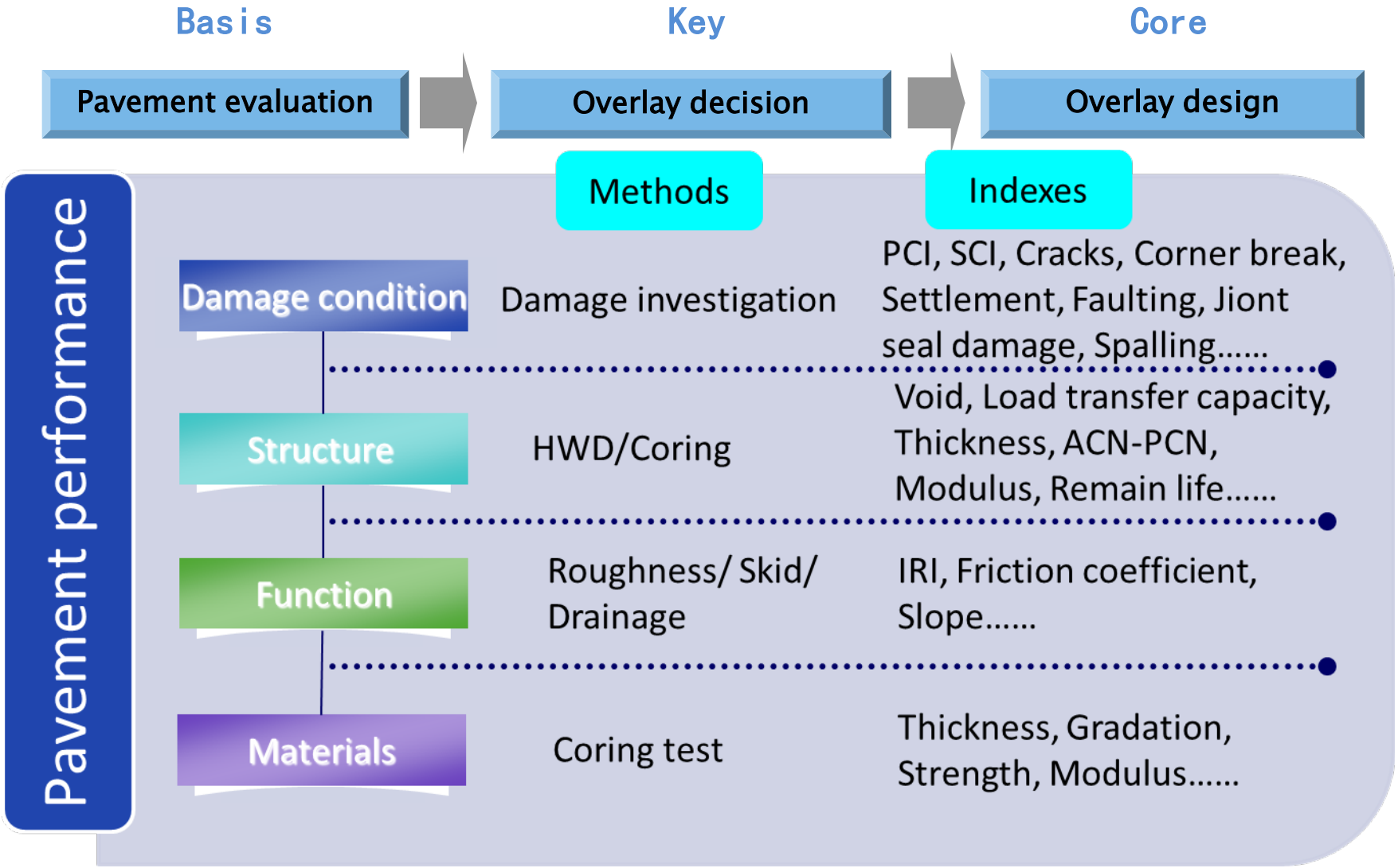
Asphalt Runway in China

Contents

Review of Design Methods

- Design Methods of Airport Asphalt Pavement
  - Empirical Methods (CBR)
    - FAA Method—Program: F806FAA.xls, etc.
    - USACE Empirical Method
    - Japan Method
    - CDOT Method
    - France Method
    - China Method
  - Mechanistic-Empirical (Elastic Layered System)
    - AI Method—Program: CP-3
    - FAA-Elastic layered system method—Program: LEDFAA
    - USACE-Elastic layered system method
    - Shell Method—Program: BISAR3.0
    - Australia Method—Program: APSDS
    - Holland Method—Program: PAVER

Asphalt overlay



Asphalt overlay

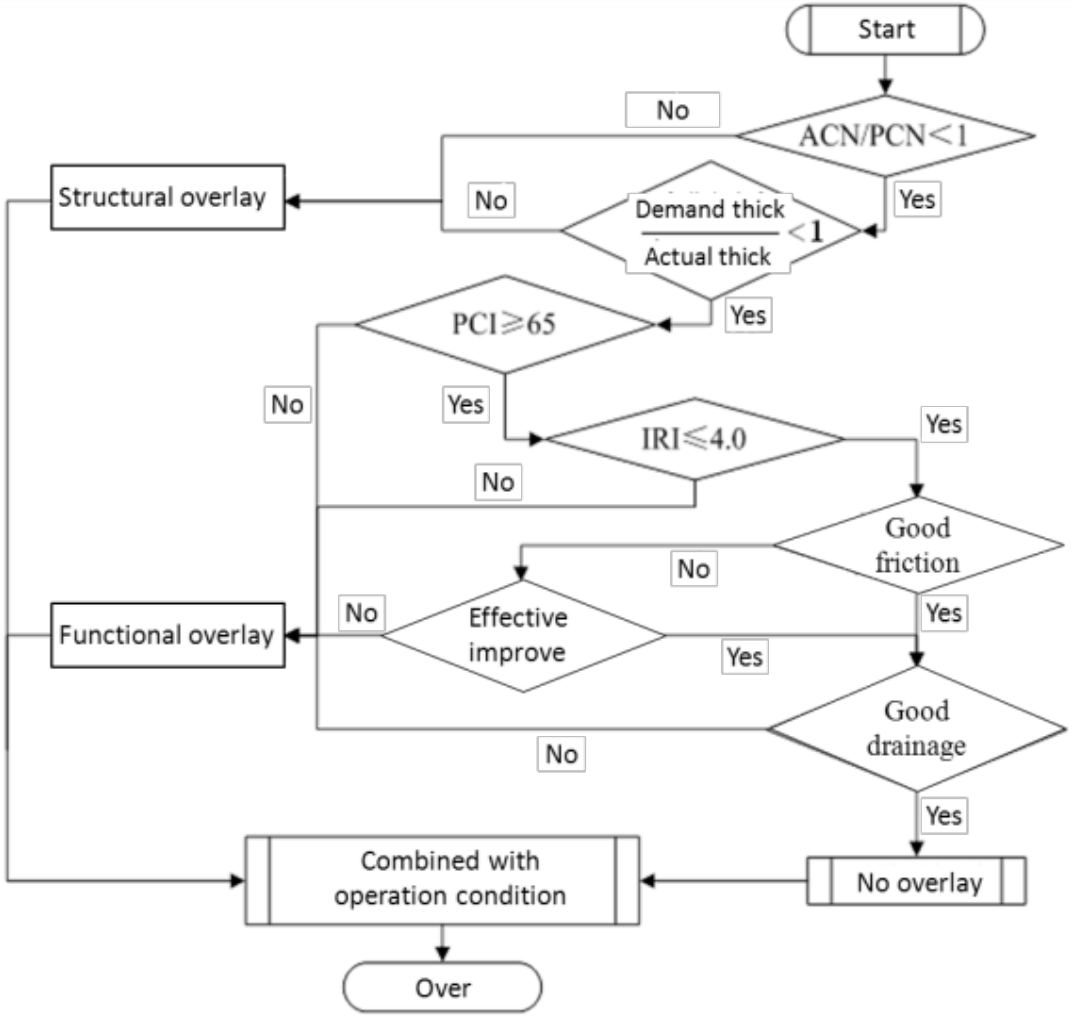
Overlay decision

- Structural overlay
- Functional overlay

Process

Factors

- ✓ **Technical level**
  - Bearing capacity
  - Damage condition
  - Roughness
  - Skid-resistance
  - Drainage capacity
- ✓ **Management**
  - Maintenance funds
  - Non-suspending
  - Runway upgrade
  - General planning
  - ……



Structural overlay design

Empirical formula:

- $t_j = 2.5 \times (F \cdot h - C_b \cdot h_e)$

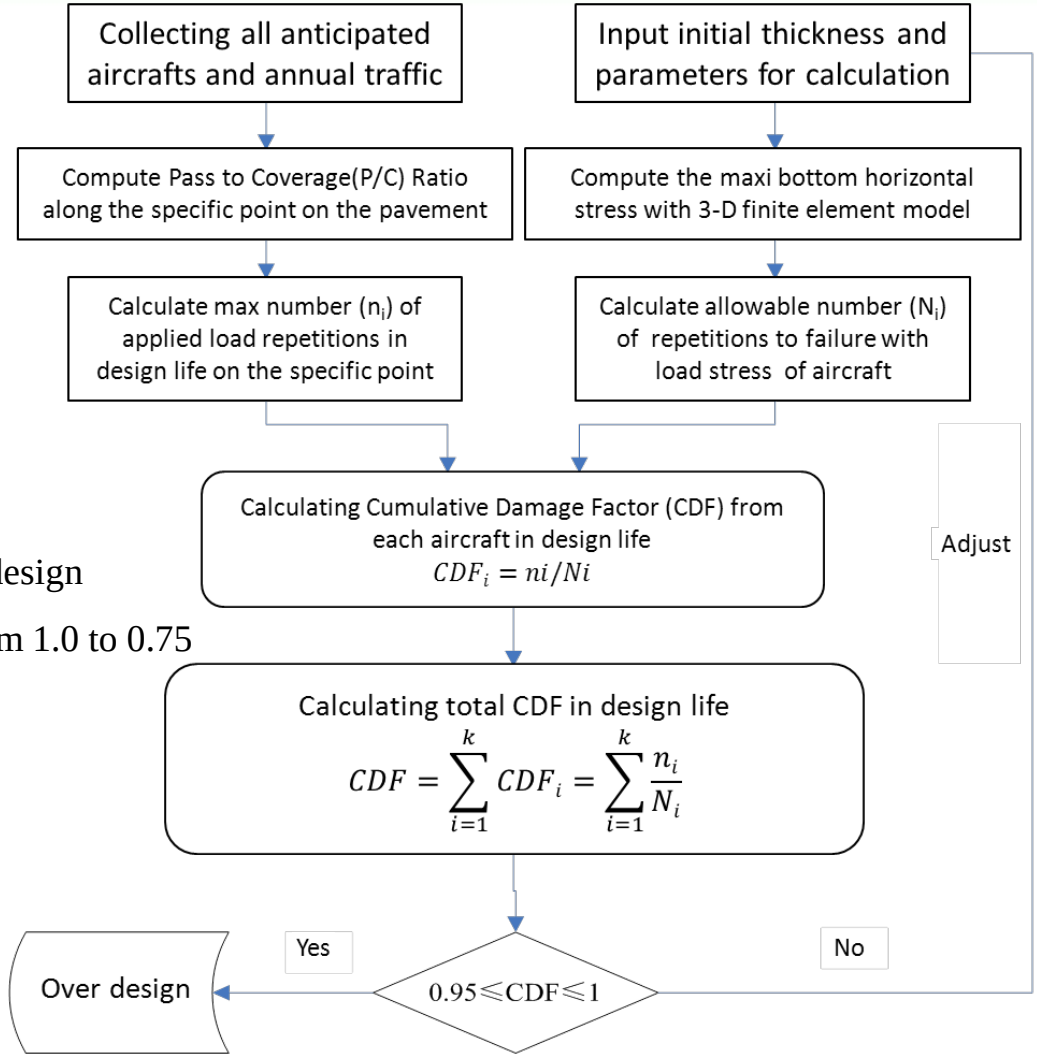
t_j: Thickness of bituminous overlay

F: Factor which controls the degree of cracking

h: Single thickness of rigid pavement required for design

C_b: Condition factor for base pavement ranging from 1.0 to 0.75

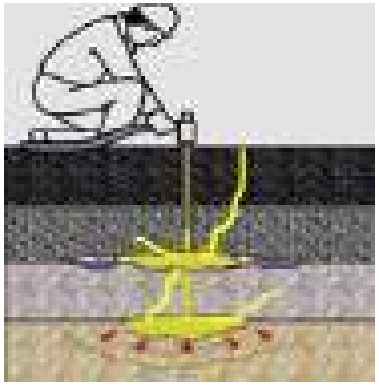
h_e: Thickness of existing rigid pavement

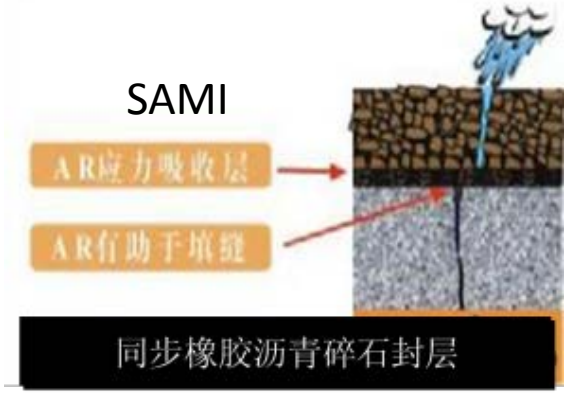


Other Consideration

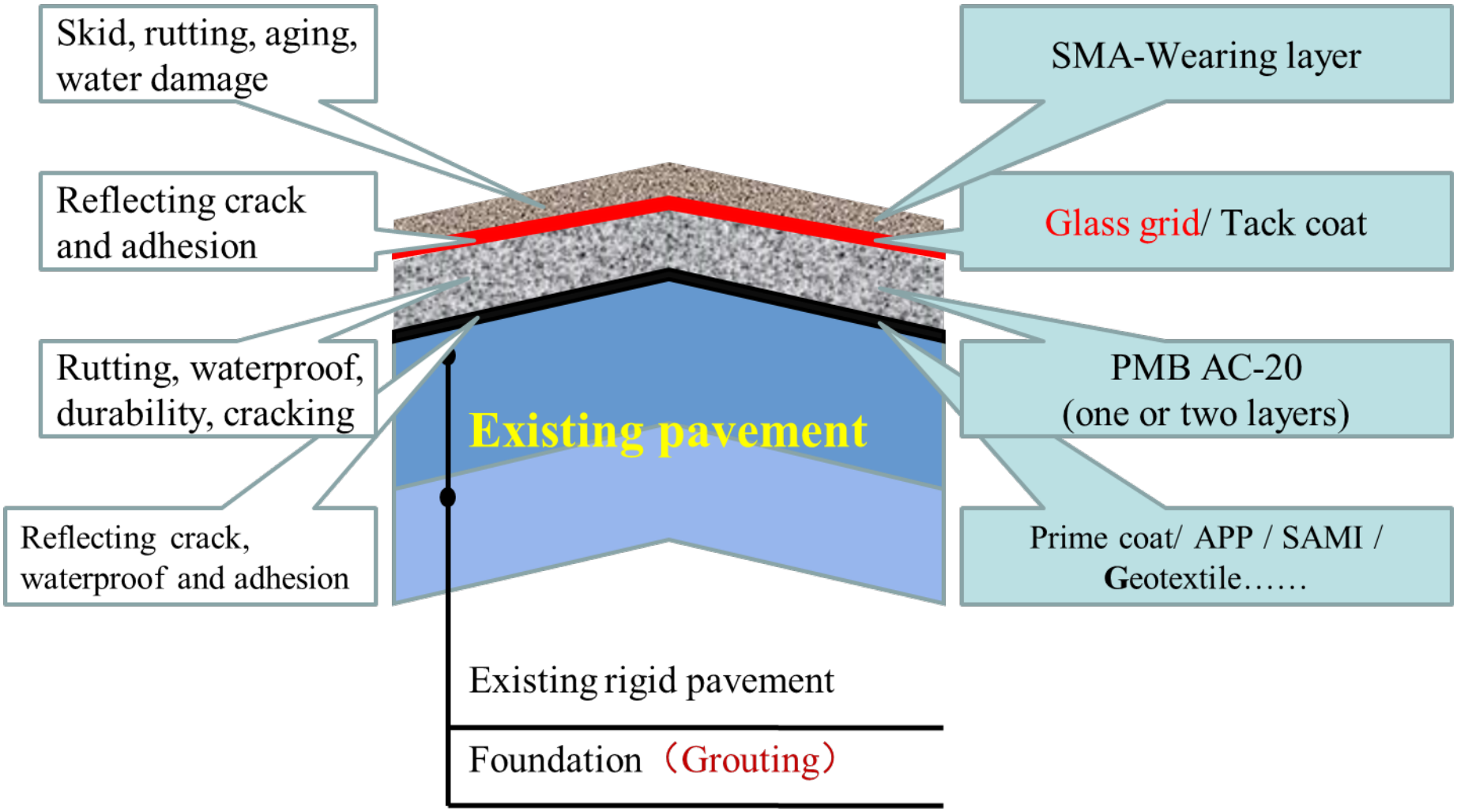
1	Base treatment	2	Prevent reflecting cracks	3	Non-suspending construction

- Repair the old pavement
- Stress absorbing layer, geotextile, PMB felt……
- Proper thickness
- Cutting between pavement and shoulder
- ……





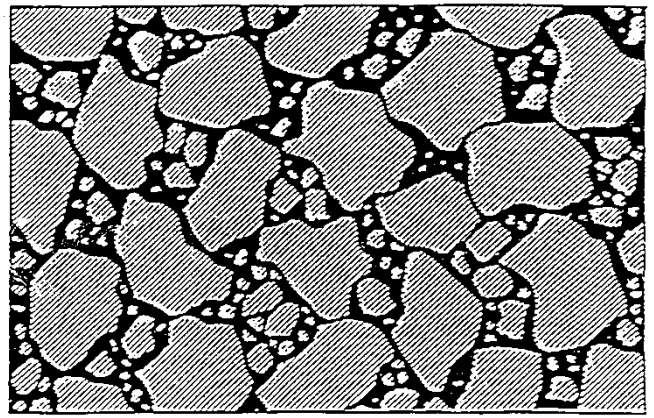
Typical overlay structure



Contents

SMA in China Airport

- **Ray Brown(NCAT): “China is the leader in the use of SMA on airfields.”-AAPTP 04-04 ,NCAT**
- **Applied to the Eastern Runway of Beijing INT’L Airport successfully in 1996**
- **Widely used in airport overlay**
  - **Over forty airport cases (Beijing, Harbin, Qingdao, etc.)**
  - **The mainstream of asphalt surface for good performance**



Filled Stone Matrix Asphalt Mix

Different from Highway

1. Different load features

Highway	Civil aviation
Low tire pressure, light load, large number repetitions, channel traffic, low speed……	High tire pressure, heavy load, high speed, impulse effect, mix traffic, little fatigue damage, unfavorable loading in waiting area……

2. More restricted demands for skid, roughness and Foreign Object Damage

Material Demands

Binder	Highway: Climate partition, PI, Dynamic viscosity at 60℃, Remained ductility, Softening point, Weight loss, Remained penetration
PMB	Airport: Equivalent softening point and Fraass, Ductility at 10℃, viscosity at 60℃ Highway： PI, Ductility at 5℃, Kinematic Viscosity at 135℃
SMA Mixture	Range of air voids, Min allowable asphalt content, Marshall Stability and Flow, Leakage, Dynamic rutting stability and Tensile Strength Ratio, etc.

Performance Requirement of Airport

- Adaptable to high stress fatigue load
- Excellent cracking resistance
- High shear strength
- Compact, skid resistant, smooth surface

Contents

Typical Cases

- **Beijing Capital Airport**
- **Chongqing Airport**
- **Lhasa Airport**

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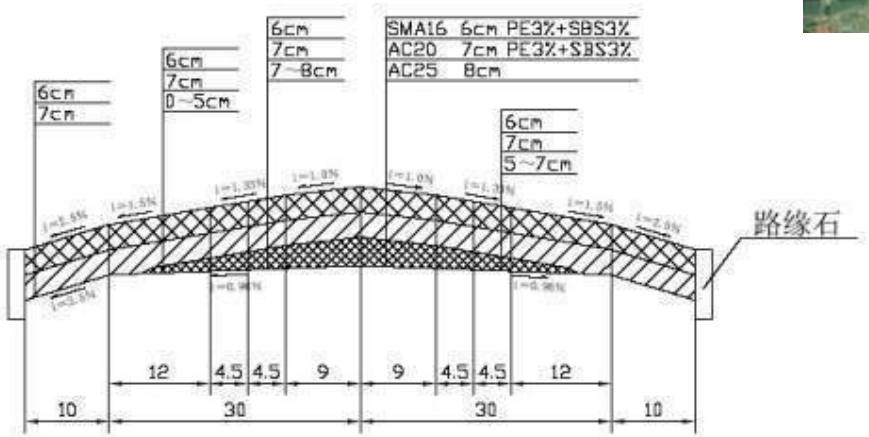
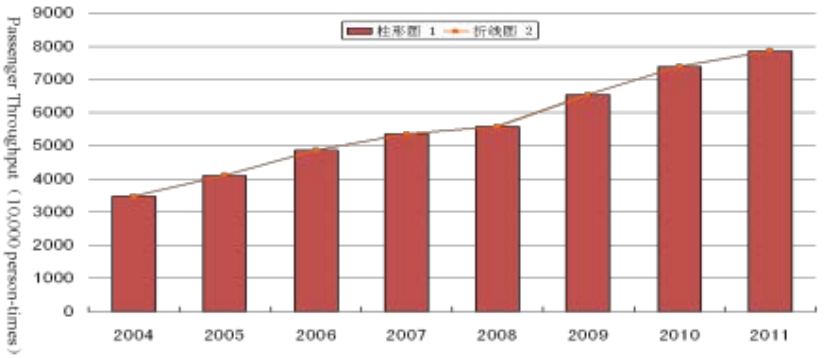
Beijing Airport Eastern Runway

Background

- ✓ Built in 1954
- ✓ 3800m×60m
- ✓ Asphalt overlaid in 1996
- ✓ Performs well under heavy load





Beijing Airport Eastern Runway

Success Experiences

- Preventing reflection cracks
  - ✓ Repairing old pavements
  - ✓ Use APP modified asphalt felt
  - ✓ Proper thickness
  - ✓ Joint cutting between pavement and shoulder
  - ✓ ……
- SMA asphalt mixture design
  - ✓ Material selecting
  - ✓ SBS + PE composite modification
  - ✓ Addition of Fibers （JRS—VIATOP 66,0.3%）
  - ✓ Gradation design
  - ✓ Mixture performance testing
  - ✓ ……

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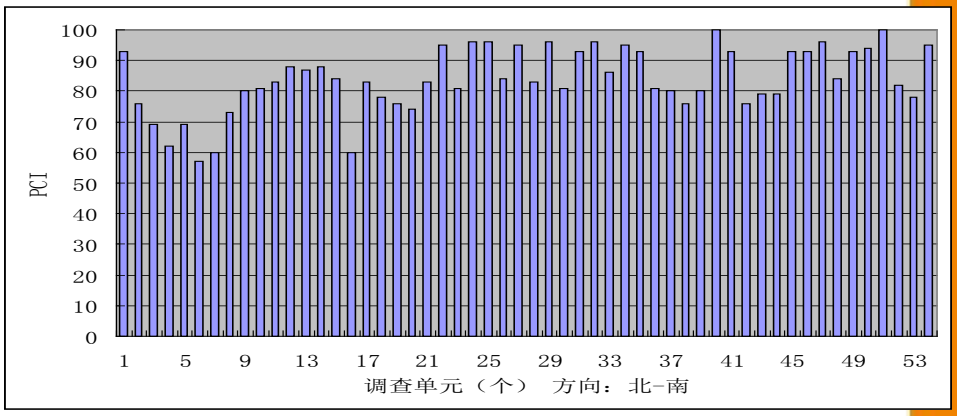
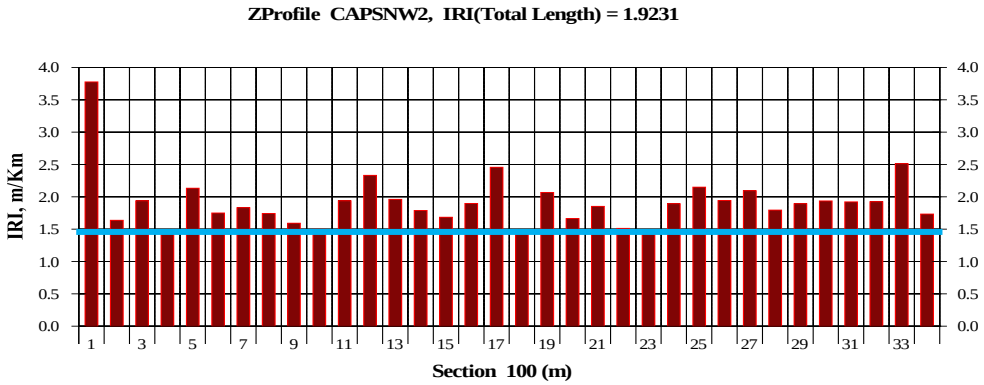
Beijing Airport Eastern Runway

Evaluation Results of 2007

- PCI: Excellent except the north end
- IRI: 1.84 mm
- ISM: Except the north end
- Performance of Mix：Perfect
- Structural life：9years





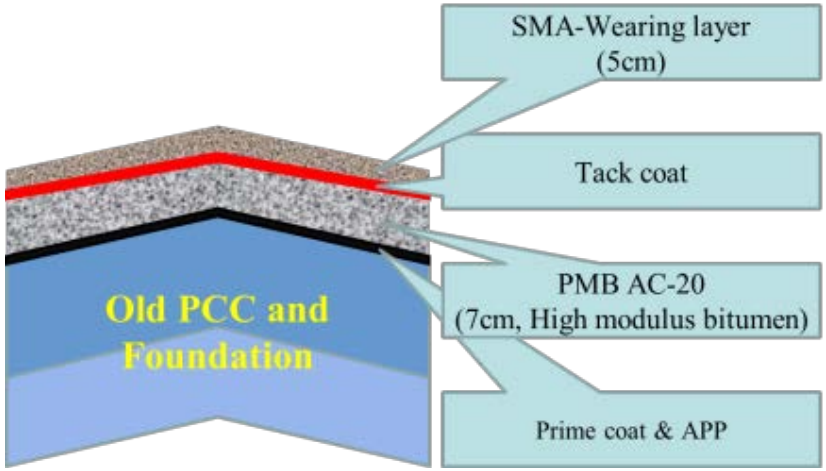
Cantabro Abrasion Test

Position	No.	Before test (g)	After test (g)	Damage (%)	Average
North end	5#	1233.4	1116.5	9.5	34.8
	6#	1125.6	874.6	22.3	
	7#-1	1201.0	328.8	72.6	
	5#	1215.2	1062.3	12.6	20.7
	6#	1214.9	454.5	62.6	
	9#	1226.0	1179.3	3.8	
	10#	1233.2	1188.1	3.7	
Middle and South end	14#	1112.6	1049.2	5.7	4.1
	22#	1260.7	1230.8	2.4	
	24#	1263.7	1211.0	4.2	
	20#	1245.9	1201.6	3.6	3.3
	21#	1262.6	1222.5	3.2	
	22#	1263.4	1223.2	3.2	

Chongqing Airport

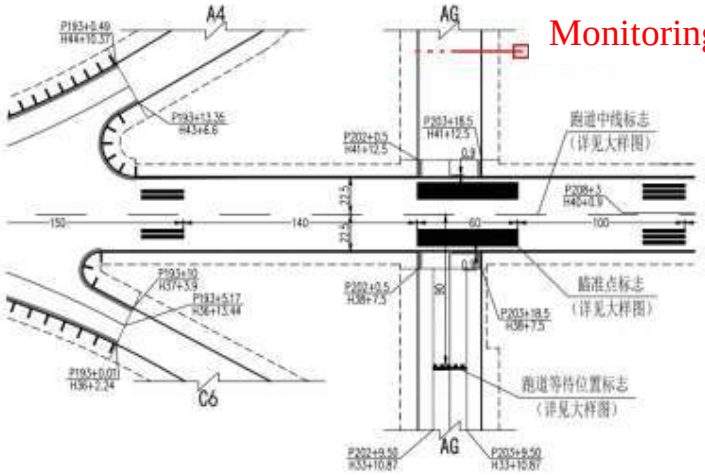
Background

- ✓ Built in 1985
- ✓ 3200m×60m
- ✓ Asphalt overlaid in 2013
- ✓ Performs well under high temperature climate

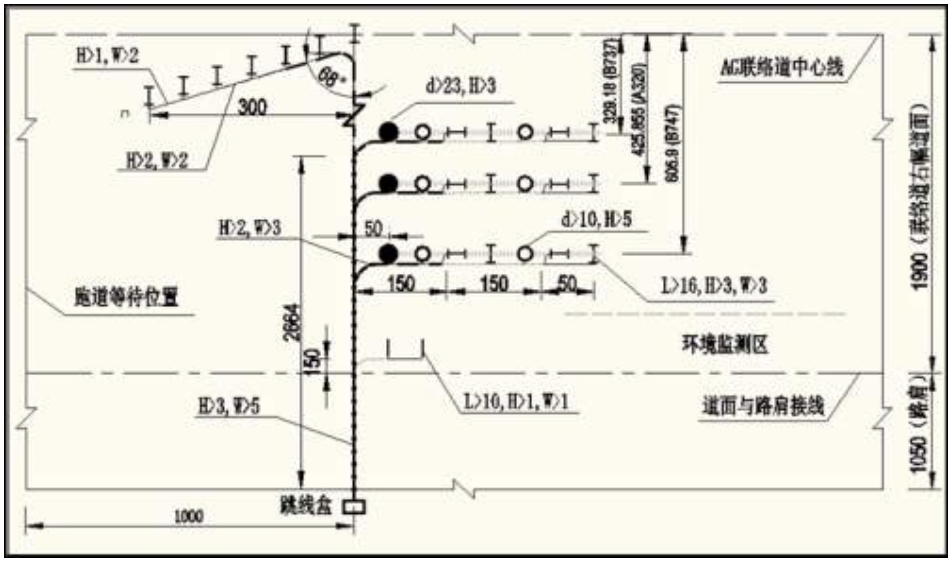


Chongqing Airport

Related Research



Monitoring system

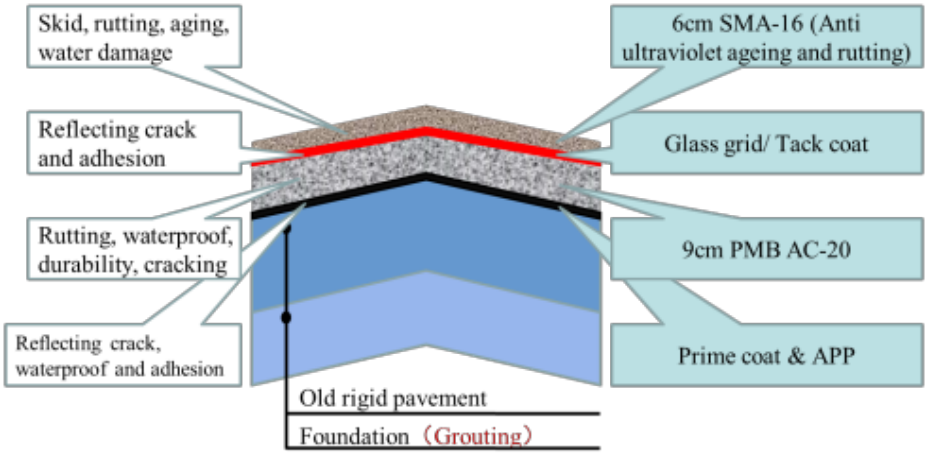


Data collection, detection and transmission system

Lhasa Airport

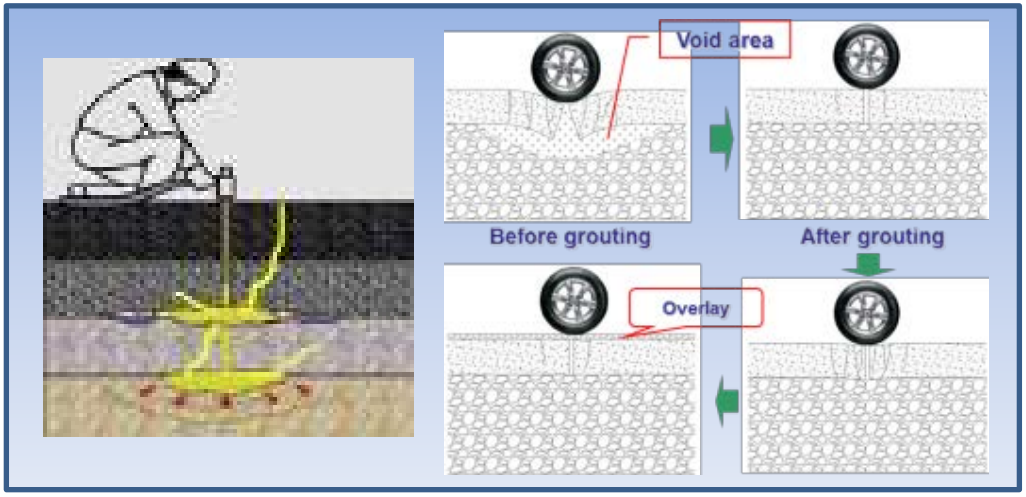
Background

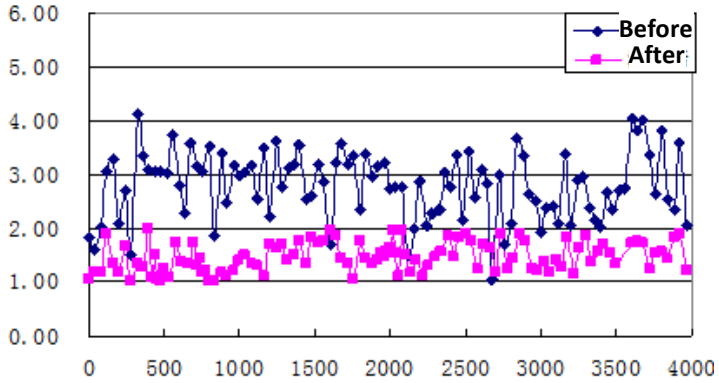
- ✓ Opened in 1990
- ✓ 4000m×45m
- ✓ Asphalt overlaid in 2010
- ✓ High plateau airport with strong ultraviolet radiation



Lhasa Airport

Related Research



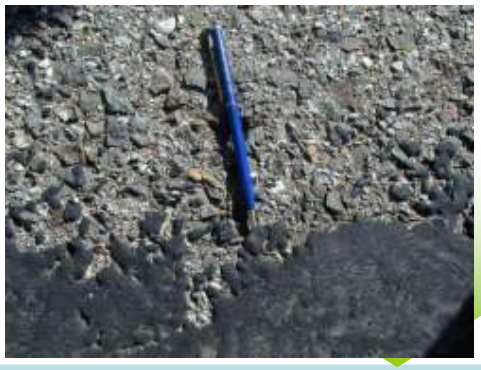


Foundation void changes

- **The importance of grouting**
  - To avoid further deterioration of pavement
  - The requirements for guaranteeing flight safety
  - Reduce the pavement maintenance and repair workload
  - Necessary work before overlay……

Lhasa Airport

Related Research



The serious problem of technology in plateau area

01 **Temperature performance**

02 **Adhesion property**

03 **Ageing-resistant performance**

Lhasa Airport

Accelerated Simulation Experiment

Performance Evaluation

- Different asphalt, modified agent and anti-aging additives
- Comparison of fatigue performance, adhesion performance, rheological property and low temperature cracking
  - ➢ The preferred choice of modified asphalt
  - ➢ Suggestions on the selection of light stabilizer can capture free radicals……

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Thank You!