



# RBI Grade 81

**An overview of the cost-effective, environmentally friendly technological breakthrough in soil stabilization for road construction and waste-binding**

# Table of contents

<b>SECTIONS</b>	<b>Page</b>
1. Introduction	3
2. Brief history of RBI (Marketing) Netherlands B.V.	6
3. Superiority of RBI Grade 81	9
4. Benefits of RBI Grade 81 – Financial benefits	12
5. Benefits of RBI Grade 81 – Environmental benefits	14
6. Application methodology	16
7. Select case studies	18
8. Conclusion	27

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## Section 1:

### Introduction

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# Introduction: RBI Grade 81

## New and improved technology in the field of road construction

***Delivers an economic and cost effective solution capable of providing rapid infrastructure development ...***

- An advanced, cost effective and environmentally beneficial technological breakthrough in soil stabilisation
- An inorganic chemical stabiliser that modifies the engineering properties of soil
- Development of the technology was internationally coordinated by Road Building International since 1990
- The aim was to develop a soil stabiliser that could be effectively used in the construction of roads using both in-situ, recycled and waste materials, offering the following:
  - Environmental benefits: Avoids the depletion of natural resources
  - Cost efficiency: Savings of up to 50% of the costs of conventional road construction
  - Irreversibility: No maintenance required during the life of road
  - Applications: Applicable under all temperature conditions and soil types
- Overcome the challenges and shortcomings of conventional road construction and soil stabilisation

***...avoiding the environmental burdens associated with conventional road construction***

- 
- This presentation sets out:
    - Brief history of RBI Grade 81
    - The challenge of conventional road construction and the solution in RBI Grade 81
    - Benefits offered by the technology
-

# Indian application (2008) – unskilled female labour was used to construct durable, impermeable road using RBI Grade 81

- In-situ soil material typically does not meet standards required for road construction
  - Typical removal requirement of 1,400 x 30 ton truck loads per km of road when using conventional methods
  - Soil material transported to dumping area
  - Replaced with new soil obtained from commercial site all at significant cost
- Results in inefficient use of construction equipment which remains idle during this process, and significant traffic disruption
- In the Indian application shown below:
  - 3 x 30 ton truck loads of RBI Grade 81 was used to stabilise a mountain pass road
  - vehicular traffic of several hundred vehicles per hour
  - Unskilled female labor was used from surrounding communities
- As compaction was completed, the road was opened to traffic immediately – traffic was never fully stopped during the application



After road surface compaction, the road surface was immediately opened to traffic



Final road surface

## Section 2:

### **Brief history of the company**

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# History of RBI Grade 81

**RBI Grade 81 a proven and tested technology, internationally patented...**

Timeline	Company history
1990-2000	<ul style="list-style-type: none"> <li>RBI Grade 81 goes through research and development, irreversibility and durability tests, and tests for performance-over-time</li> </ul>
2000-2004	<ul style="list-style-type: none"> <li>Holding company RBI Marketing (Netherlands) B.V. formalised and launches international patent on every continent</li> <li>Patent applications went completely uncontested and approved as a “unique and novel concept”</li> </ul>
2003-2004	<ul style="list-style-type: none"> <li>RBI Marketing (Netherlands) B.V. sells its patent rights to the technology in America, Africa, Australia to Anyway Solutions (<a href="http://www.anywaysolutions.com">www.anywaysolutions.com</a>), who achieved a number of key accolades in a very short space of time, including               <ul style="list-style-type: none"> <li>The approval of the product to the United Nations Development Program (“UNDP”)</li> <li>Approval of product by International Labour Organisation (“ILO”)</li> <li>The Prix D’Excellence award in Africa (2007)</li> </ul> </li> </ul>
2005-2006	<ul style="list-style-type: none"> <li>RBI Marketing (Netherlands) B.V licenses Readers in the United Kingdom, a division of Langley Holding PLC, a multinational engineering group, rated by HSBC as one of the UK’s top 250 company’s, to produce RBI Grade 81</li> <li>European Investment Bank confirms co-operation for future implementation of RBI in infrastructure and environmental projects</li> </ul>
2004-2010	<ul style="list-style-type: none"> <li>On-going certification and research includes, amongst others:               <ul style="list-style-type: none"> <li>Pavement Technology, Harriot Watt University: <i>“...the RBI Grade 81 stabilized layer can perform as a foundation layer for any layer of the road within Western Europe...”</i></li> <li>Ministry of Transport in Portugal: <i>“...incorporate RBI Grade 81 in terms of road specifications for Portugal...”</i></li> <li>Dorservice Institute, St Petersburg: <i>“...GOST standards approval on all pavement layers and under severe permafrost conditions...”</i></li> <li>South Africa, CSRI / SA Bureau of Standards: <i>“...RBI Grade 81 specified for incorporation into road design...”</i></li> <li>Polytechnic university of Bari, Italy: <i>“...approved for use in Italian road design...”</i></li> <li>Virginia Polytechnic Institute, USA: <i>“...RBI Grade 81 was more effective in increasing the strength of soils tested...”</i></li> </ul> </li> </ul>
2008-2010	<ul style="list-style-type: none"> <li>RBI targets India as the Asian market entry point, given the regional potential and scope for use               <ul style="list-style-type: none"> <li>Government 5 year budget of US\$1 trillion for repair of existing infrastructure and new road construction</li> <li>The technology is currently being manufactured under ISO: 9001</li> <li>Repeatedly utilised by the Indian army</li> <li>1<sup>st</sup> specification in government tender of Andhra Pradesh (2009)</li> </ul> </li> </ul>

**...gaining wide-spread acclaim in India with the specification in government road construction tenders**

# Anyway Solutions: Distributor of RBI Grade 81 in Africa

## Property developments in Africa using RBI Grade 81

- Anyway Solutions significant impact in the African road and property market
- Projects in the space of low cost housing, brick making and general infrastructure development

*RBI Grade 81 used in Madagascar development at the presidential La Vitrine...*



- Compressed stabilized earth block (“CSEB”) production
- Mandated by the president of Madagascar in his presidential La Vitrine
- CSEB’s manufactured using only manually-powered machinery
- Justice Ministry of Madagascar requested funding to build 3 prison camps with RBI Grade 81

*...build low cost housing in South Africa as part of the South African Rural Community Development Plan (“RCDP”)*



- RBI Grade 81 used in the Rural Community Development Plan (“RCDP”) in South Africa
- Collaboration with the Gauteng Economic Development Agency (“GEDA”)
- All activities were done with the active participation of the local community
- Beneficiaries included the community of Simunye, located in Gauteng
- Project involved brick manufacture, house construction and road construction to community

*...stabilised in-situ soil for the construction of the 2010 FIFA World cup stadium in Durban*



- FIFA World Cup 2010, South Africa
- In-situ soil could not support stadium load and construction equipment
- RBI Grade 81 used to stabilise in-situ soil materials facilitating construction of stadium
- Designed to carry extreme loads indefinitely



## Section 3:

### **Superiority of RBI Grade 81**

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# RBI Grade 81: Next generation of soil stabilisation technology

Offers benefits over all methods of road construction which are limited in their fields of use

*Applicable on all soil types, avoiding the otherwise necessary exchange of soil commonly associated with conventional road construction*

- Conventional products are limited in applicability, highly expensive and costly
- RBI Grade 81 can be successfully applied to all soil types

## Cement

## Lime

## Bitumen

## RBI Grade 81

Used in the following soil Types

✗ Fine clay (<0.0006mm)  
 ✗ Coarse clay (0.006-0.002mm)  
 ✗ Fine silt (0.002-0.01mm)  
 ✗ Coarse silt (0.01-0.06mm)  
 ✓ Fine sand (0.06-0.5mm)  
 ✓ Course sand (0.4-2.0mm)

✓ Fine clay (<0.0006mm)  
 ✓ Coarse clay (0.006-0.002mm)  
 ✓ Fine silt (0.002-0.01mm)  
 ✗ Coarse silt (0.01-0.06mm)  
 ✗ Fine sand (0.06-0.5mm)  
 ✗ Course sand (0.4-2.0mm)

✗ Fine clay (<0.0006mm)  
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 ✗ Fine silt (0.002-0.01mm)  
 ✗ Coarse silt (0.01-0.06mm)  
 ✓ Fine sand (0.06-0.5mm)  
 ✓ Course sand (0.4-2.0mm)

All soil types

Yes: No need to replace in-situ soil

No

Offers environmental and social benefits

No

None required

Allows for use of in-situ soil

Rare: in-situ soil needs to be replaced

Rare: in-situ soil needs to be replaced

Yes: No need to replace in-situ soil

Yes: No need to replace in-situ soil

Exchange of soil required

Yes – high cost

Yes – high cost

No

No

Climate and environmental impact

Negative impact on environment

Negative impact on environment

Negative impact on environment

Offers environmental and social benefits

Does temperature effect stabilisation

Yes

Yes

Yes

No

Required maintenance over life of road

High

High

High

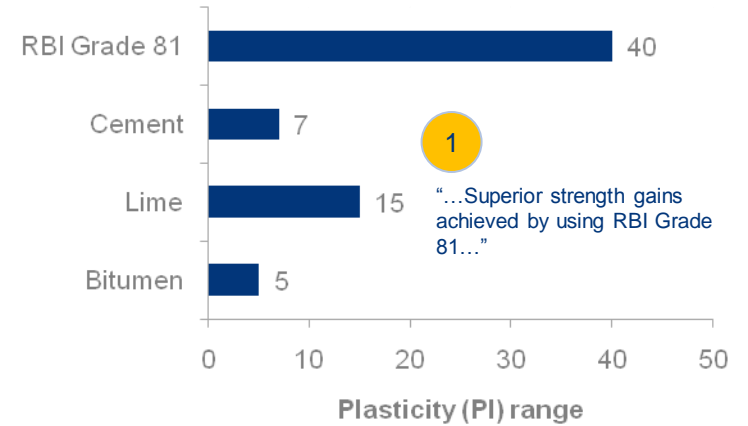
None required

# RBI Grade 81: Superior performance on all measures

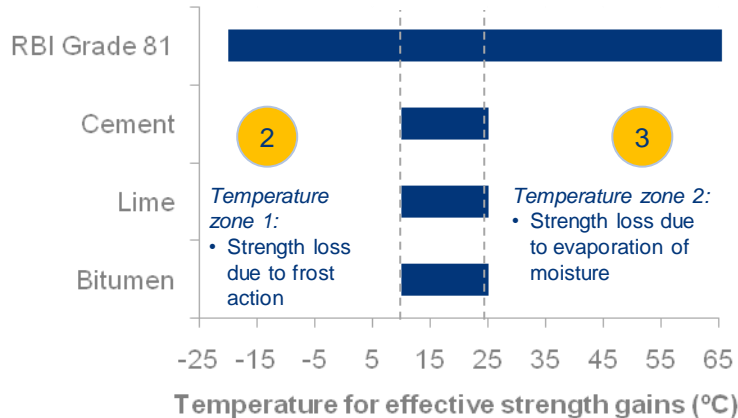
*Significantly enhanced strength gains using RBI Grade 81...*

- RBI Grade 81 superior to conventional methods
  - **Strength:** Performance under traffic
  - **Temperature:** Temperature and moisture impact
  - **Durability:** Resistance to cracking and deformation
- RBI Grade 81 improves the engineering properties of soil
  - Bearing capacity (CBR)
  - Compressive strength (UCS)
  - Plasticity and elastic modulus (stiffness)
  - Frost resistance, impermeability and sensitivity to moisture

## Strength effectiveness



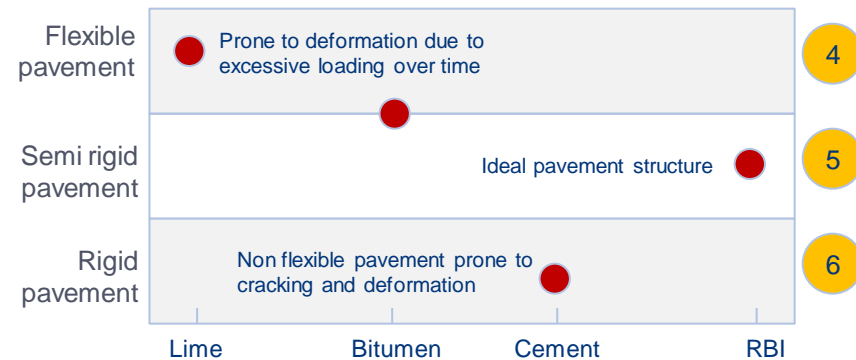
## Temperature effectiveness



*...offering versatility across temperature ranges...*

*...with considerable longevity and durability increases*

## Durability over time



## Section 4:

### **Benefits of RBI Grade 81 – Financial benefits**

# Cost efficacy of RBI Grade 81: Savings of up to 50%

- The economic savings attributable to the use of RBI Grade 81 are in the following categories:
  - 1 The ability of RBI Grade 81 to stabilise all in-situ soils avoiding the otherwise necessary replacement of in-situ material
  - 2 Saving on labour costs, contractor cost, engineering cost, equipment costs and raw material costs
  - 3 The increased productivity of the construction site, projects completed well ahead of schedule
  - 4 Complete elimination of on-going maintenance costs under all weather conditions
  - 5 A reduction in vehicle damages

## Results: Bangalore-Hoskote-Mulbagal section, National Highway 4 in state of Karnataka under NHDP Phase III A

Area of cost saving	Achievement	Savings
<ul style="list-style-type: none"> <li>• <b>Saving in construction time:</b> <ul style="list-style-type: none"> <li>— Conventional method time requirement for 1 km length: 30 days</li> <li>— RBI Grade 81 time requirement for 1 km length: 15 days</li> </ul> </li> </ul>		<b>50.0%</b>
<ul style="list-style-type: none"> <li>• <b>Saving in aggregate material:</b> <ul style="list-style-type: none"> <li>— Aggregate required by conventional method for 1 sqm area: 0.4 cum</li> <li>— Aggregate required by RBI Grade 81 for 1 sqm area: 0.06 cum</li> </ul> </li> </ul>		<b>85.0%</b>
<ul style="list-style-type: none"> <li>• <b>Saving in truck trips (40 ton trucks)</b> <ul style="list-style-type: none"> <li>— Trips required for 1000 sqm in conventional method: 320 trips</li> <li>— Trips required for 1000 sqm using RBI Grade 81: 50 trips</li> </ul> </li> </ul>		<b>84.3%</b>
<ul style="list-style-type: none"> <li>• <b>Direct cost saving in construction cost</b> <ul style="list-style-type: none"> <li>— Cost per sqm using conventional methods: Rs1001.41</li> <li>— Cost per sqm using RBI Grade 81: Rs 845.00</li> </ul> </li> </ul>		<b>15.6%</b>
<ul style="list-style-type: none"> <li>• <b>Saving in maintenance</b> <ul style="list-style-type: none"> <li>— There is no maintenance cost to a road built using RBI Grade 81</li> </ul> </li> </ul>		<b>100%</b>

*The use of RBI Grade 81 reduces the collective associated costs of road construction by up to 50% when compared to the equivalent projects completed using conventional methods, taking into account the savings in:*

- *raw and aggregate material costs*
- *construction costs*
- *time to construction*
- *maintenance costs*

## Section 5:

### **Benefits of RBI Grade 81 – Environmental benefits**

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# Benefits of the technology: Environmental burden reduction

## Environmental benefits attributable to the use of RBI Grade 81

- The environmental and social benefits of using RBI Grade 81 are significant
- RBI Grade 81 is certified under BS EN ISO 9001:2000

*RBI Grade 81, in addition to reducing the depletion of natural resources, offers significant environmental benefits over conventional stabilisation methods....*

Construction stage	Specific saving
Pre-construction phase	<ul style="list-style-type: none"> <li>• RBI Grade 81 facilitates the use of in-situ soil material, avoiding the conventional need for sourcing quarry materials</li> </ul>
	<ul style="list-style-type: none"> <li>• Reduction in raw material requirements in terms of stabilisation materials, fuel, labour and construction time</li> </ul>
	<ul style="list-style-type: none"> <li>• No requirement for prospecting and the creation of new borrow-pits</li> </ul>
Construction phase	<ul style="list-style-type: none"> <li>• Reduction in requirement for non-renewables in energy consumption and soil materials</li> </ul>
	<ul style="list-style-type: none"> <li>• Minimisation of energy consumption in the construction phase</li> </ul>
	<ul style="list-style-type: none"> <li>• Waste materials from steel works and coal fired power plants a component of RBI Grade 81</li> </ul>
	<ul style="list-style-type: none"> <li>• Complete elimination of waste dumping to landfill, RBI Grade 81 facilitates the use of recycled soil material</li> </ul>
	<ul style="list-style-type: none"> <li>• Significant carbon offset in savings achieved during road construction phase</li> </ul>
	<ul style="list-style-type: none"> <li>• Allows for the recycling of asphalt, stabilising the sub-layer of soil</li> </ul>
Use of road	<ul style="list-style-type: none"> <li>• Eliminates leaching of bitumen and harmful chemicals due to integrity of sub-layer treated with RBI Grade 81</li> </ul>
	<ul style="list-style-type: none"> <li>• Prevention of soil erosion</li> </ul>
	<ul style="list-style-type: none"> <li>• Minimisation of dustiness of gravel roads avoiding the contamination of vegetation of crops</li> </ul>

*...creating employment and general community upliftment opportunities to surrounding communities*

## Section 6:

### **Application methodology**

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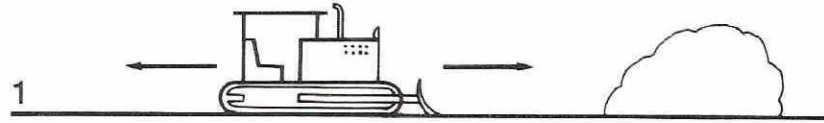
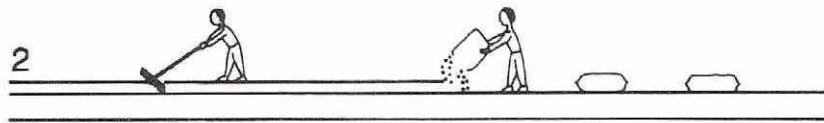

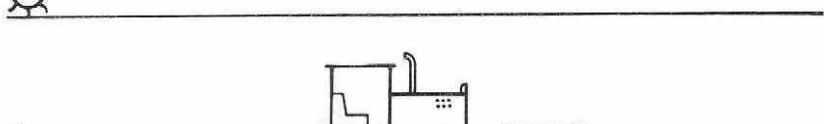
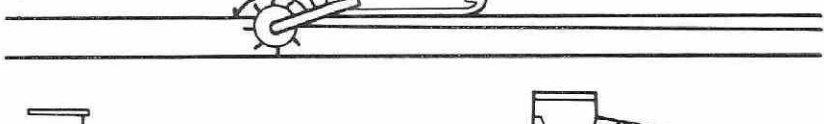
# Application methodology: A 5 step process

*Application of RBI Grade 81 is a simple 5-stage process...*

*... with the simple addition of water as an activator, RBI Grade 81 acts to stabilise in-situ material creating an impermeable layer, resistant under all weather conditions*

*Rainfall has been found to increase bearing strength improving the quality and durability of the road surface...*

*...road can be opened to traffic almost immediately*

Description of methodology	Methodology
<p><b>1</b> Stage 1: Scarifying</p> <ul style="list-style-type: none"> <li>Creation of a homogeneous layer</li> </ul>	 <p>1</p>
<p><b>2</b> Stage 2: Application</p> <ul style="list-style-type: none"> <li>Application of RBI Grade 81 powder at a pre-determined dosage</li> </ul>	 <p>2</p>
<p><b>3</b> Stage 3: Activation</p> <ul style="list-style-type: none"> <li>Application of water to moisten material and activate RBI Grade 81 chemical reaction</li> </ul>	 <p>3</p>
<p><b>4</b> Stage 4: Mixing</p> <ul style="list-style-type: none"> <li>Mixing of the moisten material and RBI Grade 81 in preparation for compaction</li> </ul>	 <p>4</p>
<p><b>5</b> Stage 5: Shaping and compaction</p> <ul style="list-style-type: none"> <li>Shaping the road to final level and camber and final compaction</li> </ul>	 <p>5</p>

## Section 7:

### **Select case studies**

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# Indian runway (2009) – “...ground breaking runway construction...”

## Milestone achievement

- Runway built in Himalaya mountains
- Significant strategic military importance
- Quoted as “...groundbreaking...” in local newspapers
  - 2.75 km runway, 45 m width, Stabilised to a depth of 0.25m
  - 37,500 square meters stabilised
  - Stabilised at an altitude of 16,000 feet
  - Temperature ranges from: - 5° C to - 25° C

### 1 During construction



### 2 On completion



### 3 Certification

  
विशेषज्ञ मर्यादा सैन्य, पी एस एम  
मुख्य अभियन्ता  
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पिन - 988514  
ग्रह 56 ए सी 301  
Headquarters 14 Corps  
Pin - 988514  
C/o 56 APC

Oct 09

#### CERTIFICATE

This is to certify that the Sub-Grade of Runway at Nyoma Airfield, Ladakh (J&K) was stabilized by RBI Grade 81. The length of ALG is 2750 M and width is 45 M. Total stabilized area is 1,37,500 SQM up to a depth of 0.25 M. The quantity of RBI Grade 81 supplied by M/S Legend Surface Developers Pvt Ltd is about 2400 MT.

Stabilization was completed in approx. 3 months. The work has been completed in a professional manner, to exacting specifications and well within the time frame projected.

On stabilized surface, IAF did a successful landing & takeoff by AN-32 aircraft on 18<sup>th</sup> September, 2009 at 0625 hrs.



# Italian application (2006) – RBI Grade 81 used to recycle waste material from quarries as well as degraded asphalt

- Part of the challenge of road construction, is the creation of unsightly and environmentally unfriendly stockpiles of dilapidated asphalt, removed from the surface of roads in refurbishment and extension applications
- In this application, 5% of RBI Grade 81 was used to recycle this asphalt layer, typically dumped as waste material
- The cost savings of this application, from the recycling of in-situ asphalt, in comparison with the conventional methods of road construction, which would have required the removal and dumping of asphalt, and production and application of new asphalt to the road service, was in excess of 70%

### Asphalt stockpile



### Loading stockpile



### Paver equipment



### Apply and compaction



### Final compaction



### In-situ core



### Road open to traffic



### Road 2 years later



# RBI Grade 81 used in the construction of a road in Hermanus, South Africa, a city renowned for whale watching

- As part of this application, in-situ material was treated directly by RBI Grade 81, with minimal disruption to traffic
- The pictures presented below consist of the road during application in 1997, as well as images taken in 2008
- **No maintenance has been required on this road during this time, with no maintenance anticipated for the foreseeable future**

**1 Powder being spread (1997)**



**2 Mixing (1997)**



**3 Final compaction (1997)**



**1 Road surface (2008)**



**2 Road surface (2008)**



# India (2010) – Preparation for the Commonwealth Games

## Rapid infrastructure development ahead of the Commonwealth Games

- Development of in-city roads required ahead of Commonwealth Games
- Significant amounts of work required in order to meet road standards for hosting Games
- Only RBI Grade 81 can offer the speed to infrastructure required to meet deadline
- Road illustrated below completed in Delhi over night, and opened to traffic the following morning

### 1 Before



### 2 After



# Romania (2009) – New road accessing communities

Conversion of a rural road to a surfaced road using RBI Grade 81

## Challenge

- Secondary road provided access to small Romanian town
- In-situ soil highly problematic, and did not meet road construction standards
- There were insufficient resources available to build a road using conventional methods, which would have required the costly and cumbersome replacement of soils

## Solution

- At low cost, with no disruption to traffic, a road became feasible for the first time using RBI Grade 81
- Creating a route through a previously inaccessible town at a fraction of the cost of conventional methods, to the significant benefit of local community

### 1 Before



### 2 During



### 3 After



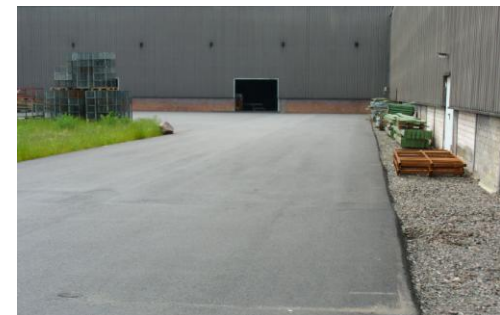
# German application (2007) – RBI Grade 81 used to stabilise sub-standard in-situ material which had been contaminated by surrounding industry

- In this application, the surrounding area had heavily contaminated soils as a result of the surrounding chemicals industry of the area
- This application involved the construction of a road that would lead to a new storage facility near Frankfurt international airport, and accompanying yard
- The constraints of this application involved the especially low quality of the soil, as well as the durability of the pavement layer as a result of the heavy load anticipated from long-haul trailers and trucking vehicles to and from the storage facility

## 1 Pictures taken during application in 2007



## 2 Pictures taken one year later in 2008





# RBI Grade 81 used to recycle waste material from quarries (exhibit 1), as well as recycle degraded asphalt (exhibit 2) in 2006

## 1 Quarry dust recycled into highly durable road surface – Final road presented below



- Quarries all over the world produce a waste material from grading the various gravel sizes
- This ground powder is useless as it does not meet any standard, and presents considerable airborne environmental hazards as it blows in the wind like ash
- However, mixed with a small amount of RBI Grade 81, waste quarry material can be recycled and converted into a durable, cost effective road surface – the cost of the above road was 30% of conventional methods

## 2 Rehabilitation of existing asphalt road – Final road presented below



- Resurfacing of Italian secondary roads resulted in cost savings of 80% in application shown above
- In this application, RBI Grade 81 was used to recycle the asphalt layer which had become dilapidated after neglected maintenance

# RBI Grade 81 has received numerous international accolades

## RBI Grade 81: Global recognition



Pavement Technology, the commercial arm of Harriot Watt University completes extensive testing of the technology recommending its use in its operating jurisdictions



Ministry of Public Works and Transport, Cambodia, recognises the use of RBI Grade 81 as a “*standard of best practise*”



Polytechnical University of Bari (Italy) has qualified RBI Grade 81 as a unique and novel technology with “*a certainty to change the international road construction industry*”



Serbian Highway Institute report states, “*the exact increase in CBR with RBI Grade 81 was not possible to establish, as the resulting CBR of soil mixed with RBI Grade 81 exceed the measuring range of standard equipment*”



Against standards required by the Norwegian Public Roads administration, SINTEF, Scandinavia's largest independent research organisation, recommends the use of RBI Grade 81 in extreme climate and permafrost conditions



Road institute of India recommends the use of RBI Grade 81, citing, “*all tests carried out on soils using RBI Grade 81 have shown substantial improvements in strength properties*” and further recommends its use in specific applications in the region



Indian Institute of Technology, Transportation Engineering Division, Civil Engineering Department state RBI Grade 81 is “*suitable for soil stabilisation, modification and rehabilitation without the use of new aggregate materials*”



AI-Futtaim laboratory report (Dubai), carried out on desert sands state, “*soil strength, as measured by load on the penetration piston, exceeded measuring capabilities of equipment after the application of RBI Grade 81*”

## Section 8:

### Conclusion

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## Conclusion

RBI Grade 81 offers tremendous benefit to all stakeholders including investors, beneficiaries, government and community

- RBI Grade 81 is of national importance to any country
  - Set to replace conventionally cumbersome road construction methods
  - Significant savings in cost and reduction in environmental impact
  - Stimulates entrepreneurship and contributes to upliftment of local communities
  - Application in all infrastructure related sectors of the economy
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## Confidentiality

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