bigger ≠ better
Thicker = stronger
A man walking on the moon?

No ways!
concrete = rigid?
innovation = flexibility
Join us on the road to innovation ...
Inspired ideas
It all started...
Inspired ideas

In the USA: Iowa

- **Showcase:** Road consisting of 100mm both un-reinforced and reinforced pavement
- **Results:** After 15 year performance, mesh reinforced pavement showed excellent results (1 100 vpd 4 – 4,5 % heavy)

In RSA: Gauteng

- 60mm concrete slab of the first floor slab of an old house, lightly reinforced with steel wires
- CSIR test section at access road to Roodekrantz Quarry
Our subject?
UTRCP: Ultra Thin Reinforced Concrete Pavement (50mm)
Layerworks: Ultra Thin Reinforced Concrete Pavement (UTRCP)

Typical Cape Seal Design
- Cape Seal
- 150 mm G5 imported subbase compacted to 95% mod. AASHTO
- 150 mm In-situ layer compacted to 93% mod. AASHTO

UTRCP Design
- 50 mm UTRCP
- 150 mm In-situ layer compacted to 95% mod. AASHTO
Track record – HVS testing

Design repetitions: 300,000 E80’s

No failure at 2,000,000 E80’s repetitions (166 days, 900 mm rainfall)

Failure after 2,346,920 E80’s plus 24/7 water drip (equivalent to 2,000 mm rainfall)
Application
Residential

Alternatives
Cape Seal
Asphalt
Block Paving
Lessons

Learned ..........
Lessons learned

Communities

- Communication programme to create **understanding** of concrete roads and the benefits thereof – **BUY-IN**
- Opportunity to **create more jobs** compared to similar surfacings
- SMME contractors can be **employed**
- Supervisors **trained** in concrete and LIC skills
- Community **training** in concrete skills
Lessons learned

- Reduced layer works – **limit damage** to existing underground services
- Fly ash, **waste product** can be used
- Less **cut and spoil**
- Less **borrow** from borrow pits
Lessons learned

- Local small **maintenance teams** (work with concrete)
- **Savings** in terms of lower life cycle costs
- Currently **grant incentives** can be claimed under EPWP-2
- **Job creation**
Lessons learned – Job Creation

Asphalt

Block paving

Cape seal

UTRCP

1

4

5

15
Lessons learned

SMME Contractors

• **Training** in technical skills crucial (especially concrete and LIC methods)
• Establishing **balanced teams** (workers and equipment)
• Site **administration** and record keeping
• **Quality Assurance** systems
Lessons learned

**Construction**

**PREPERATION OF ROAD BED**

- Shaping – preferred final **shaping by grader**, tolerance ± 5 mm
- Alignment – provide levels at **10 m** intervals
- **Compaction** – recommend 95 % mod AASHTO
- **No ETB used**, apply 1:8 diluted emulsion
- Stabilize material with **high PIs**
Lessons learned

Construction  SHUTTERS

• Must be **robust** to withstand handling on site
• 50 mm box sections in 2 m **(max)** lengths
• **Securely fixed** to carry vibrating beam/spin screed
Lessons learned

**Construction**

**FIXING SHUTTERS**

- **3 lugs** per shutter to hold in place
- Straight edge across shutter
- Vertical and horizontal **alignment** of joints
- Use **clean** 1mm x 300mm wide galvanising sheet strip on existing concrete as shutter
- Pegs through lugs to **secure shutter**
Lessons learned

**Construction**

**MESH REINFORCEMENT**

- Sizing, fixing and *transporting* on flat truck
- Protecting while placing concrete, *use bridge*
- Sufficient *overlapping*
- Use *factory sizes* – 2.4m x 6m
- Position in *centre* of slab
Lessons learned

Construction CONCRETE

MATERIALS, PROCESS AND QUALITY CONTROL CRITICAL

• Mix design – use same type and source of cement
• Batching and mixing – method and controls
• Testing – slump and cube strengths
• Placing asap after mixing, steel squeegees
• Screeding and finishing
• Texturing – light broom
• Covering and protecting with canopy
• Curing asap, secure plastic and cleaning
Lessons learned

CONSTRUCTION PROCESS AND FINISHING

- Vibrating beams sagging and breaking – *spin screed* more durable.
- Proper *spreading* of concrete prior to screeding.
- **End of day** joint, prevent leaching.
- End beams when *delays* are experienced.
- **Method specification** for:
  - road markings; and
  - speed humps
Lessons learned

**Construction** ADD MIXTURES

- Reconstituted *bottom dump ash* from SASOL (continuous grading)
- **Plasticizer** (currently being considered)
Lessons learned

Trenching and repairs

REPAIRS TESTED WITH HVS

- **Trenching** for services with backfill and compaction by hand
- **Potholes** at failed sections were cut, cleaned, mesh replaced with overlap and filled with concrete
Lessons learned

Quality assurance

**MATERIALS**

- **Mix design** must be finalized before construction starts:
  - Type of Cement is to be specified or agreed upon by means of mix-design.
  - No changes without new mix design and approval
- A very accurate **site diary** must be kept to record:
  - Where concrete was placed
  - Weather conditions of that day
  - Slumps and cube testing details
Lessons learned

Quality assurance MATERIALS

- **Curing** is a critical element in the development of concrete strength
- Samples must be kept on site at all times to allow the consultant *regular inspections*
- Close supervision on the use of materials. Should materials require change, a **material grading** must be done and submitted to the engineers for approval
- All materials used must be **clean** of all types of contamination
- Slump tests and cube **testing**
## Lessons learned

### Costing

#### PAVEMENT COSTS (R/m²)

<table>
<thead>
<tr>
<th>Material</th>
<th>Construction costs</th>
<th>Life Cycle Costs (25 yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>R 156</td>
<td>R 181</td>
</tr>
<tr>
<td>Block paving</td>
<td>R 256</td>
<td>R 257</td>
</tr>
<tr>
<td>Cape seal</td>
<td>R 128</td>
<td>R 171</td>
</tr>
<tr>
<td>UTRCP</td>
<td>R 139</td>
<td>R 140</td>
</tr>
</tbody>
</table>

* Excluding storm water & ancillary work
# Lessons learned

## Costing

### PROJECT COST DISTRIBUTION AND JOBS CREATED

<table>
<thead>
<tr>
<th>Description</th>
<th>Soshanguve</th>
<th>Mamelodi (Section 6)</th>
<th>Atteridgeville</th>
<th>George</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Project Cost (inc VAT)</strong></td>
<td>R 8 913 085</td>
<td>R 4 389 277</td>
<td>R 6 471 803</td>
<td>R 3 909 681</td>
</tr>
<tr>
<td>% Cost of UTRCP &amp; layer works in relation to total project cost</td>
<td>18 %</td>
<td>29 %</td>
<td>26 %</td>
<td>8 %</td>
</tr>
<tr>
<td>Jobs created with UTRCP &amp; layer works</td>
<td>4 448</td>
<td>2 802</td>
<td>4 480</td>
<td>588</td>
</tr>
<tr>
<td>Construction cost per job created with UTRCP &amp; layer works</td>
<td>R 360</td>
<td>R 375</td>
<td>R 468</td>
<td>R 503</td>
</tr>
<tr>
<td>% Cost of UTRCP &amp; layer works to labour *</td>
<td>19.5 %</td>
<td>15 %</td>
<td>18.7 %</td>
<td>20 %</td>
</tr>
</tbody>
</table>
Lessons learned

% COST OF UTRCP = Total Project Cost

UTRCP - Mamelodi (Section 6)

- P&Gs & Ancillary works: 26%
- UTRCP & Layerworks: 29%
- Stormwater: 21%
- Kerbing: 8%
- Sidewalks: 11%
- Roads signs and traffic calming: 5%
Tshwane Status Quo
4.4 km UTRCP roads completed
Excellence

Recognitions
Excellence

Fulton Commendation Award
Unique Design Aspects

“The innovative thought processes that this design team applied........is impressive....

The skills transfer processes, opportunities for the upliftment of local communities, as well as promotion of BEE contractors as a result, is applauded.”
Excellence

SAICE National Award

Most outstanding Civil Engineering Achievement in the Community-Based Category

ULTRA THIN REINFORCED CONCRETE PAVEMENT

DEMONSTRATION ROAD, SOSHANGUVE
THE MOST OUTSTANDING CIVIL ENGINEERING ACHIEVEMENT IN THE COMMUNITY - BASED CATEGORY
2008

AWARDED BY
THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING
## Conclusions

### Approach
- Based on observations
- Engineering principles and experience

### Research
- Extensive tests by University of Pretoria
- HVS tests by Gauteng DPTRW
- Guidelines developed by CSIR

### Application
- Based on present knowledge and experience.
- Suitable for urban streets and bus routes – 3 000 vpd with 5 – 7% heavy vehicles
Thank you