ULTRA THIN REINFORCED CONCRETE PAVEMENTS (UTRCP) – INNOVATIVE TECHNOLOGY WHICH OFFERS COST AND SOCIO-ECONOMIC BENEFITS FOR INFRASTRUCTURE PROVISION

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ABSTRACT

Ultra Thin Reinforced Concrete Pavements (UTRCP) have successfully been used in a number of roads in the country to provide permanent durable surfacing for bus routes and residential streets. When comparing a new and innovative pavement type, such as this, with established labour intensive pavement choices, factors other than just the initial construction cost should be considered. Maintenance cost, pavement design life, and thus life cycle costs, as well as functional characteristics should be considered. With the critical social and economic challenges that South Africa faces, in terms of unemployment and education, choices of pavement types are also affected by the potential for job creation and development of our people. The use of UTRCP thus has a number of advantages, i.e. increase of labour content, suitable for emerging/small contractors, skills acquired (e.g. concreting can be applied in other sectors), lower whole life cycle cost for comparable designs, existing sub grade and alignment can be used, ideal for upgrading existing deteriorated roads by overlaying and environmental benefits by using local materials.

1. INTRODUCTION

South Africa needs to provide infrastructure and create jobs for all the people, while using resources wisely. These, in addition to difficulties in implementation of government policies, pose significant challenges to organisations on a daily basis.

Recent successes with the implementation of Ultra Thin Reinforced Concrete Pavement (UTRCP) technology were experienced by the Gauteng Department of Public Transport, Roads and Works (GDPTWR) in constructing various UTRCP roads in the City of Tshwane (CoT). The challenges of upgrading residential roads in a sustainable manner consistent with Government policies, while placing large emphasis on the utilisation of local resources, development of small scale contractors and job creation were achieved. Innovative technology was used to address the above needs.

The first UTRCP projects were introduced as a possible solution for these problems. UTRCP consists of a thin layer (50mm thick) of standard concrete (30 MPa) lightly reinforced with nominal steel, constructed on top of the in-situ unsurfaced road with minimal preparation (shaped and compacted). Many benefits of UTRCP have been praised, but the question was often raised about the structural and functional characteristics of UTRCP, the life cycle costs and how does the engineer decide upon the appropriate surfacing for his/her application.
2. BACKGROUND

UTRCP technology evolved after the 1979 low-volume roads conference in Iowa, US. In a follow-up visit to Iowa in 1979, delegates of the Council for Scientific and Industrial Research (CSIR) and the Cement & Concrete Institute (C&CI) inspected 1 250 km of concrete roads and made the following observations:

- The reinforced concrete roads outlasted the conventional concrete roads,
- Joint failure appeared to be a major problem,
- Quarter point failure due to shaping round gravel roads into flat sections resulted in the fill from cut-to-fill not being adequately compacted which led to ¼ point concrete failure.
- Mud spot failure resulting from inadequate support due to poor drainage / standing water on high PI support material, also resulting in concrete failure.

This has led to the following reasoning:

- If detailed attention were given to the support layers and the drainage and ingress of water into these layers, quarter and mud spot (i.e. structural) failures could considerably be reduced,
- If the concrete was laid continuously without joints using limited steel mesh the following might be achieved:
  - No joint failures,
  - Limited ingress of water at the cracks,
  - No pumping,
  - Possible reduced loading / better spreading of the wheel load,
  - Thinner, more flexible slabs.

Following this reasoning, the following pilot projects were constructed:

Roodekrans Quarry access Road

During 2002 the CSIR and the Cement and Concrete Institute (C&CI) facilitated an experiment on the existing lane of a quarry access road at Roodekrans, near Krugersdorp, Gauteng. Three sections of thin Continuously Reinforced Concrete Pavement (CRCP) with concrete thicknesses of 50mm, 75mm and 100mm reinforced with 200x200x5.6 mm welded wire mesh were constructed. Seven years and more than 900 000 equivalent 80 kN axle loads (E80s) later the 50mm UTRCP is still performing well.

Streets in Tembisa Township

Various streets in Tembisa Township, Gauteng, were constructed in 2002 by ripping, shaping and re-compacting the in-situ material (CBR>20) and placing a 100mm thick CRCP reinforced with 200x200x4 mm welded mesh on top. The streets are all performing very well.

Mthatha Quarry access Road

As a result of the performance of the 50mm section of the UTRCP on the Roodekrans quarry road, the CSIR was appointed to apply the concept to the construction of a 2.4km access road to a quarry in the vicinity of Mthatha, Eastern Cape. This road provides access to the quarry for approximately 400 heavy vehicles daily. All indications are that the road is performing very well, with minor defects due to exposed steel.
Heavy Vehicle Simulator Tests

Towards the end of 2008 the CSIR in association with the C&CI and the GDPTRW embarked on a programme of Heavy Vehicle simulator (HVS) testing on 50mm sections of UTRCP. Up to date three sections have been tested with results of 1.65 million, 1.24 million and 1.36 million E80s equivalent loadings, respectively, on the 50mm UTRCP with the pavement showing no signs of failure.

University of Pretoria Tests

In addition the CSIR in collaboration with the University of Pretoria (UP) and undertook a series of tests on various thicknesses and strengths of the UTRCP to assess its performance when an 8 ton axle load is applied to the 50mm UTRCP at a single point. More than 2 million repetitions later the pavement showed no signs of failure.

Twenty Township Roads Upgrading Project

The Gauteng Department of Public Transport, Roads and Works (GDPTRW), in partnership with the City of Tshwane, initiated the Twenty Township Roads Upgrading Project, which is one of Gauteng Government’s flagship interventions to improve the living environment of thousands of residents in townships by addressing the infrastructure backlogs.

Soshanguve Township

Road 36.11 in Soshanguve, a bus route of 7.2m wide and approximately 1.2km long, was identified as a demonstration project for the introduction of the 50mm UTRCP technology to the road construction field. Moses Rampeng, one of the learner contractors, was appointed to construct the UTRCP demonstration project at Soshanguve. In addition, it was decided to include 16 supervisors assigned to the 11 learner contractors, to attended NQF4 Supervisor Skills programmes in Labour Intensive Construction Methods and also to attend the Cement & Concrete Institute training in concrete technology. All the learner contractors and supervisors personally performed all the construction activities during the initial stage to gain first hand experience. In total 230 days of training were provided to 68 persons.

Atteridgeville and Mamelodi Townships

After the successful implementation of the demonstration project, tenders were launched for the construction of 17 urban streets totalling 4.7km in the townships of Atteridgeville and Mamelodi using 50mm UTRCP. The process consisted of an established contractor being responsible for the rip, shape, stabilisation (where necessary) and compaction of the in-situ material, using conventional machine based methods. The learner contractors (from the Soshanguve demonstration project) were then used for the construction of the UTRCP, kerbing, stormwater drainage and sidewalks. 50mm UTRCP of 30 MPa strength were used, reinforced with 200x200x5.6 mm mesh.

Over a period of two years, the learner contractors completed road construction projects in these three townships to the value of approximately R 100 million.
3. STRUCTURAL AND FUNCTIONAL CHARACTERISTICS

The structural design of the UTRCP pavements is still under development and the design of pavements constructed to date was based primarily on past experience.

Roodekrans Quarry access Road

As indicated the continuously reinforced sections had thicknesses of 50 mm, 75 mm and 100 mm. The 28 day cement cube strength was between 31 and 42 MPa for the continuously reinforced sections, with the reinforcing consisting of 200 x 200 x 5.6 mm steel mesh. The base consisted of no or a thin (25 and 50 mm) emulsion treated base (ETB) layer on a 125 mm G5 material stabilised with 2% cement (UCS of about 1.95 MPa) on a strong subgrade for the 100 mm, 75 mm and 50 mm slabs, respectively. The base had a stiffness of about 750 MPa and the subgrade of 180 MPa. The FWD deflections were between 0.55 and 0.63 mm on the continuously reinforced sections (50 and 75 mm thick). The following conclusions were drawn from the assessment of the performance at Roodekrans:

- The thin concrete layers are only part of a pavement structure that contributes to the performance of the concrete. The support system also plays an important role.
- Relatively thin concrete surfacing can be used effectively to carry heavily loaded vehicles, if the concrete is supported adequately in the pavement.
- A critical thickness appears to exist for the concrete layer above and below which the effect of the support stiffness is less critical than at the critical level (75 mm in the case evaluated).
- Slab support was deemed crucial for the performance of the sections under traffic.
- The best performance was obtained from sections with ETB or asphalt below the slab.
- Slab curling increased the risk of failure, especially at slabs with longer joint spacing that were on top of a stabilized layer.
- Reinforced very thin slabs (< 75 mm) performed as well as thicker non-reinforced slabs (> 100 mm) on the stiff bases.
- All the thin concrete sections performed exceptionally well.

Heavy Vehicle Simulator Tests

50 mm thick UTRCP were constructed on the R80 in Tshwane for testing with the Heavy Vehicle Simulator. Normal and ash concretes were used, while the support consisted of 50 mm ETB or no ETB layer on a 150 mm imported aggregate base on a 150 mm 3% lime stabilised subbase and no subbase. The testing is still ongoing and some sections have carried more than 1 million standard axles to date. Some pertinent findings are:

- The UTRCP is prone to curling and warping. Separation of more than 3 mm between the bottom of the slab and the base along the longitudinal edge was recorded. The permanent upward warp at one point was recorded as 2.3 mm, the daily curl of 0.3 mm up and 0.7 mm down, and the total daily elastic curling movement of 1.5 mm. This meant that the initial bond between the slab and base had been partially lost.
- The elastic surface deflection varied between 0.4 and 1 mm.
- The mechanism of failure was described as:
  - Transverse cracks develop as a result of shrinkage or at construction joints
  - Wheel loading when crossing the joint causes high tensile stresses to develop at the bottom of the slabs about 450 mm from the crack and between the wheel loads on top of the slab, as well as compressive stresses at the top of the crack. The greatest tensile stress is at the bottom of the slab 450 mm from the crack or point, where additional cracks will develop.
The slab stiffness is reduced at the crack effective increasing the deflection and vertical stress on the supporting layer. The compressive stresses on the joint or crack also increase, causing the joint or crack to spill.

Water entering the spalled joint or crack softens and erodes the slab support causing a loss of bond and voids, which in turn increase the stresses in the slab.

- More than 1 million equivalent standard axles have been carried before failure by the introduction of water.
- The reinforcement consisted of a 200 x 200 x 5.6 mm steel mesh and the average 28 day concrete compressive strength was 37.5 MPa for the conventional concrete and 25.7 MPa for average the ash concrete. The untreated base had a CBR of more than 25 (G6).

### Tshwane projects

The 1.2 km bus route and number of residential streets in Soshanguve and Atteridgeville were constructed using a 50 mm concrete continuously reinforced surfacing as described earlier. The base consisted of localised repaired asphalt, 50 mm ETB, 100 mm lime stabilised subbase on the bus route and a 150 mm lime stabilised subbase on the residential streets. The concrete had average compressive strengths of 34 MPa and 30 MPa for the bus route and residential streets, respectively. The coefficient of variation was around 10 to 15%. The pavements are performing well with no signs of premature structural failure. The riding quality and macro texture were measured on these roads. The riding quality, expressed as International Roughness Index (IRI), was found to range from about 2 to 6 mm/m and macro texture from 0.6 to 1.4 mm. As comparison, roads with 30 mm asphalt or Cape seals in the vicinity had IRI values of 1 to 4 mm/m and macro texture depths of 0.4 to 0.9 mm.

### 4. DESIGN APPROACH

Ultra thin reinforced concrete pavements (UTRCP) are defined as roads built with a very thin (<75 mm) concrete layer. There are two types being used in South Africa (Kannemeyer, 2008):

- High strength concrete (120-140 MPa), heavily reinforced (50x50 mesh, Ø4mm to Ø8mm steel) which is used mainly on National, high volume traffic roads.
- Normal concrete (30 MPa) nominally reinforced with steel (200x200x5.6mm mesh) which is used mainly for urban and low volume roads. Its application for Provincial roads with medium volume traffic depends on circumstances. (Also known as Ultra Thin Lightly Reinforced Concrete Pavement (UTLRCP).)

This paper concentrates on the latter type. Testing with the HVS is continuing and from these tests and the existing pilots and other projects, more data are accumulated in order to finalise a design methodology as indicated earlier. The design approach should take note of:

#### General

With the concrete only 50mm thick tolerances are critical and the success of the UTRCP is dependant on attention to detail. This also applies to all of the other design aspects of concrete strength, placing, curing placing of steel mesh and the layer supporting the UTRCP. Competent site staff is needed during construction to verify and control the process.
Application

UTRCP can be considered in the following areas:

- Surfacing of new or for the rehabilitation/upgrading of existing roads/streets;
- Low volume roads/streets with traffic less than 2,000 vpd and 5% heavy vehicles;
- Areas of steep grades and stop/start traffic;
- Areas where effective maintenance is unlikely.

Design of Support Layer

The UTRCP behaves differently from a conventional concrete pavement due to the combination of thin concrete and steel reinforcement spanning equally in both transverse and longitudinal direction and resulting in a high percentage of steel (1% for high strength concrete and 0.5% for UTLRCP). The modes of failure are thus different and conventional design procedures will have to be adjusted to cater for UTRCP. UTRCP should be more suited to be constructed on marginalised in-situ materials. However, the pavement design for each project will have to be designed on merit. As a guide:

- Material with a minimum CBR of 35 and a PI of less than 6 will be considered suitable for the support layer.
- Where highly expansive clay is present cover must be provided.
- For urban bus routes or roads with more than 2,000 vpd a 35 mm ETB should be added below the UTRCP.
- In all instances the surface of the layer should be treated with a 1:8 diluted stable grade anionic emulsion to provide a clean, neat platform and prevent water loss of the concrete.

<table>
<thead>
<tr>
<th>Typical Design</th>
<th>UTRCP Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape seal</td>
<td>50 mm UTRCP</td>
</tr>
<tr>
<td>150 mm G5 imported subbase compacted to 95% Mod. AASHTO</td>
<td>150 mm In-situ layer compacted to 95% Mod. AASHTO</td>
</tr>
<tr>
<td>150 mm In-situ layer compacted to 93% Mod. AASHTO</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Comparison of a typical urban pavement design with the UTRCP

Width of pavement

The mesh with which the pavement is reinforced is supplied in panels of 6 meters by 2.4 meters wide. This must be taken into account in determining the width of the road pavement to prevent wastage of material, i.e. pavement widths based on mesh widths of 2.4 and 1.2 meters. Panel widths shall also not exceed 3.7 meters to facilitate screeding of
the concrete. Care should be taken to avoid the case where the longitudinal joints between mesh panels fall under the wheel path of heavy vehicles

**Starter and end beams**

“Starter” and “end” beams must be provided for the thin concrete pavement at the commencement and end of the paving, and changes in horizontal and vertical alignment.

**Intersections/ bellmouths**

It is proposed that intersections are designed as a separate unit. Mesh must be continuous in all directions in the bell mouth while at the same time it must be possible to screed the concrete in the bell mouth.

**Concrete mix design**

The concrete mix design should be carried out by an accredited laboratory. The concrete mix design should provide for minimum cube strength of 30 MPa at 28 days. The concrete mix design must be such that it can be placed by worker using a vibrating beam screed but at the same time the amount of water must be controlled to limit shrinkage cracking. A slump of 75 mm and Cement: Water ratio of 1.83 is recommended.

## 5. LIFE CYCLE COST OF SURFACINGS

Principle of life cycle costs is taking not just initial outlay of the product/project into consideration, but also other costs that will be incurred during the life span of the product/project. According to TRH4 the “Life Cycle Strategy (LCS) for any pavement design incorporates the predicted maintenance and rehabilitation programme for that pavement based on its anticipated behaviour under the prevailing conditions. It is considered that the design process is the first step in the life cycle of a pavement. Not only will the final pavement design have an influence on the behaviour of the pavement but it also lays the foundation for the maintainability (i.e. frequency and type) and salvage value of the pavement when it has to be rehabilitated or reconstructed. Thus the LCS considers the overall performance of the pavement both structurally and economically over its structural design period and analysis period.”

“The Analysis Period (AP) is usually equal to the functional period for which the road will have to deliver its functional service as determined by management through the service objective.” TRH4 also suggests that alternative pavement designs should be compared on the basis of the present worth of the life cycle costs. The cost analysis should be regarded as an aid to decision-making. It does not necessarily include all the factors leading to a decision and should therefore not override all other considerations. The main economic factors which determine the cost of a facility are the analysis period, the structural design period, the construction cost, the maintenance costs, salvage or residual value and the real discount rate.

The procedure to determine the Net Present Value of present worth of cost (PWOC) as set out in TRH4 has been used in the analysis of the UTRCP. The total cost of a project over its life is the construction cost plus maintenance costs plus road user costs minus the salvage value discounted at the appropriate rate. The total cost can be expressed in a number of different ways but, for the purposes of this document, the net present value (NPV) approach has been adopted.

Typical designs for low volume roads would include a Cape Seal (most widely used in Tshwane in recent years for labour intensive roads construction), 30 mm Asphalt concrete and block paving and now also UTRCP.
Construction cost of surfacings

Current construction costs of typical low volume road construction projects in Tshwane, typical Tshwane soil conditions and typical Tshwane low volume road designs were used in the analysis as shown in Table 1.

Table 1: Pavements analysed

<table>
<thead>
<tr>
<th>Surfacing</th>
<th>Cape Seal</th>
<th>50mm UTRCP</th>
<th>30mm Asphalt</th>
<th>Block paving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>150G5</td>
<td>150G6</td>
<td>150G5</td>
<td>150G5</td>
</tr>
<tr>
<td>Subbase</td>
<td>150G7</td>
<td>150G7</td>
<td>150G7</td>
<td>150G7</td>
</tr>
<tr>
<td>Subgrade</td>
<td>G9</td>
<td>G9</td>
<td>G9</td>
<td>G9</td>
</tr>
<tr>
<td>Category</td>
<td>UC</td>
<td>UC</td>
<td>UC</td>
<td>UC</td>
</tr>
<tr>
<td>Max E80s</td>
<td>300,000</td>
<td>&gt;500,000</td>
<td>400,000</td>
<td>500,000</td>
</tr>
<tr>
<td>Initial cost (R/sq m)</td>
<td>128</td>
<td>156</td>
<td>139</td>
<td>256</td>
</tr>
</tbody>
</table>

Assumptions

- The analysis period is often related to the geometric life of the road. If the road alignment is fixed, a period of 30 years should be used. In the case of an uncertain or shorter geometric life, in a changing traffic situation, a shorter analysis period may be used. TRH4 suggests an analysis period of 20 years for category D and 30 years for category C. Seeing that most low volume roads fall in category D and some like bus routes in Category C the average analysis period of 25 years was used, even though testing of the UTRCP with the HVS indicated the life span of the UTRCP to be much longer.

- The salvage values were assumed to be zero for all, even though there would still be some value regained in most pavements and especially more retained in the UTRCP and block paving.

- Road user costs for UTLRCP were considered to be negligible due to the following reasons: This paper concentrated on low volume roads, typically township roads, with very low traffic volumes. The half width method of construction still allows vehicles to use the other half of the road. Curing of the concrete does delay the usage of one half of the road, but those sections are opened after seven days and are sometimes used after only three days.

- It was assumed that the pavements with UTRCP and block paving would have a design loading of 500,000 E80s, the 30 mm asphalt of 400,000 E80s and the Cape seal of 300,000 E80s.

- The real discount rate was assumed as 6%.

Maintenance of surfacing

TRH4 indicated that there is a relationship between the type of pavement and the maintenance that might be required in the future. When different pavement types are compared on the basis of cost, these future maintenance costs should be included in the analysis to ensure that a reasonable comparison is made. Suggested maintenance schedules in TRH series were used in the analyses. The analysis model included that a Cape Seal would be maintained with emulsion rejuvenation at 5 and 18 years and reseal at 12 years. Asphalt would be maintained with a Single seal at 11 and 24 years. Recent repairs at failed sections of HVS testing on UTRCP, indicated that the cost of 1m² repair for UTRCP would be R 360 and it was assumed that 10m² per km would be repaired at 5, 12 and 18 years. It was further assumed that the maintenance for UTRCP would be the same as the maintenance for block paving.
Life cycle costs of surfacings

Table 2 and Figure 2 below present the NPV of these surfacings compared to the initial construction costs for 2 cases – the one in which the varying bearing capacities are not considered and the other in which the costs are expressed in terms of Rand per E80. In both cases the UTCRP has the lowest NPV (at a real discount rate of 6%).

<table>
<thead>
<tr>
<th>Surfacing</th>
<th>Construction R/m²</th>
<th>Life Cycle Cost R/m² (25 yr maintenance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>156</td>
<td>181</td>
</tr>
<tr>
<td>Block paving</td>
<td>256</td>
<td>257</td>
</tr>
<tr>
<td>Cape Seal</td>
<td>128</td>
<td>171</td>
</tr>
<tr>
<td>UTRCP</td>
<td>139</td>
<td>140</td>
</tr>
</tbody>
</table>

Figure 2: Life cycle costs of low volume roads

Sensitivity analysis

The sensitivity analysis has shown that local soil conditions (and need for stabilization) and local construction costs (e.g. rates for cement, steel, pavers etc) strongly influence the NPVs, but that salvage value has a small effect on the NPVs. To date the NPV for UTRCP has always been the lowest; it is just the % difference in initial construction cost that varies. Cape seal has consistently been the lowest initial construction cost, with the block paving been consistently the most expensive surface to construct.

Cape Seal has the lowest construction cost and has been the popular choice of surfacing for labour intensive construction of low volume roads. The life cycle cost of a Cape Seal is however higher when compared to that of UTRCP. The life cycle cost analyses indicated that UTRCP are more durable, which reduces maintenance costs and therefore has a lower whole life cycle cost against comparable designs.
6. JOB CREATION OF SURFACINGS

The job creation potential of other surfacing has been documented in many publications due to the experience that has been gained on so many previous labour intensive construction projects not just in South Africa, but also in the rest of Africa. The following values were used: Cape Seal: 5 m per person per day (Source: CIDB), 30 mm Asphalt: 0.14 person hours/m² (Source: CIDB), Block paving: 100 – 120 m² by 7 people per day (industry standard, does not include manufacture of pavers as appearing in CIDB calculations). The job creation potential of UTRCP also had to be gathered from practical experience in the projects mentioned above and from determining production rates, also gained from experience. The UTRCP teams consisted of 23 persons and produced 100 m² per day and 3 persons could seal 150 m joints in a day. Thus it has been determined that 1 km of UTRCP surfacing can be constructed in 1124 person days. This rate will increase if a slower production rate is obtained. Job creation was only calculated for each surfacing type and not for all the pavement layers or any peripheral work, because that remains the same, regardless of what surfacing will be chosen. Job creation was expressed in terms of person days per km, which is an easier term to explain to politician than the typical rate of say 0,6 m²/h (see Figure 3). The job creation for the entire project will therefore be even greater, when all the pavement layers and all the peripheral work that can be done labour intensively, are taken into consideration.

![Job Creation of Surfacings per km](image)

**Figure 3: Job creation of surfacing per km**

7. BENEFITS

The direct benefits of the UTRCP technology in terms of significant increased labour content and life cycle cost benefit has been discussed above. Other benefits also exist and are as follows:

- Ease of construction by either trained teams or emerging contractors using simple tools and equipment;
- The technology is labour friendly and can easily be applied by local contractors without the need for a huge investment in plant;
- Trained contractors will be locally available to undertake new contracts as well as maintenance of these roads;
• The concrete technology knowledge as gained can be used on a number of other non-road areas like buildings and civil works, which not only ensures sustainability for the learner contractors and supervisors, but can also be applied by the workers;
• Reduced layer works required, which reduces the amount of work to be carried out by plant;
• Reduces depth of layer works (box cut), which limits damage to and need for relocation of existing underground services;
• In most instances, the existing subgrade and alignment can be used;
• Ideal for upgrading existing deteriorated roads by using the UTRCP as an overlay;
• Environmental benefits by local materials – reduced reliance on imported materials (bitumen), no or limited need for gravel borrow pits or spoil sites;
• Requires less lighting energy where streetlights are provided (due to reflectivity of the light concrete surface);
• Investment in equipment fairly low (low barrier to entry for emerging contractors);
• Absorbs less energy and therefore emits less heat (possibly less impact on global warming), and
• The community structures played a crucial role in the construction process and were also the ultimate beneficiaries.

8. TRAINING, DEVELOPMENT AND IMPACT ON COMMUNITY

Training and capacity building
Eleven emerging contractors and 16 supervisors (concrete skills, team balancing and quality control of concrete) have benefited from a Construction Contractor Learnerships and were involved in constructing UTRCP roads in Tshwane. The community were trained in concrete skills (site preparation, shuttering, placing reinforcing, mixing, finishing), Community Liaison Officers (CLOs) were trained and all workers received training in Occupational Health and Safety (OHS).

Gender equality
The projects have recorded an average of 26% women representation as workers, 31% as supervisors and 36% as learner contractors.

Impact on community and socio-economic benefits
Impact can be defined as both the direct result of the project as well as the indirect effect on the social, economic, environmental and other consequences of the activity. These projects positively impacted on the livelihoods of the residents of Soshanguve, Atteridgeville and Mamelodi in various ways. The “new” technology was positively accepted by all and they will enjoy the long term benefits long after the end of project. The learner contractors, supervisors and workers were able to be empowered though training and the income earned remained in the area.

Employment opportunities created and financial benefits
During the course of the three projects, a total number of 680 persons were employed for 28,970 days. The implementation of the UTRCP technology positively impacts on the socio-economic aspects of development and upliftment of the country. In terms of the labour intensive work framework, it is technically feasible, takes cognisance of the technology and institutional capacity and allows for economic efficient use of labour. In addition, because it is a technology that can be easily implemented by contractors on a Learnership, the sustainability and long term involvement of the contractor on a Learnership is more certain.
9. ACHIEVEMENTS

Concrete Society of South Africa – Fulton Awards

The UTRCP technology has won a Fulton Commendation Award in the category of Unique Design Aspects in June 2009, with the Judges’ citation of “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.”

The judges’ citation read: “The innovative thought processes that this design team applied in order to address various pertinent issues in the Southern African context is impressive. On the forefront of these are green construction techniques and processes developed as well as the low long term maintenance requirements, resulting in a more sustainable solution to low volume township and similar road construction. The skills transfer processes, opportunities for the upliftment of local communities, as well as promotion of BEE contractors as a result, is applauded.”

South African Institution of Civil Engineering – Project Excellence Awards

The UTRCP technology has also won recently, October 2009, the Award for Community-Based Projects at the National SAICE Project Awards for Civil Engineering Project Excellence for 2008.

10. CONCLUSION

UTRCP has many benefits over other surfacing types generally used for low volumes roads constructed labour intensively. The UTRCP technology has a lower life cycle cost compared to other surfacing types and creates significantly more employment when compared to other surfacing types. The implementation of the UTRCP technology positively impacted on the socio-economic aspects of development and upliftment of the country. It is a technology that can be easily implemented by small scale contractors, the sustainability and long term involvement of the learner contractor can be more certain. The functional characteristics of UTRCP are better understood as more and more roads are constructed and can be tested in various ways, the HVS being one of them.

The structural design procedure is still being refined, but sound design principles (e.g. drainage, proper support and special measures on clays) remain relevant and important, as are proper construction and monitoring.

11. REFERENCES


Department of Transport, 1996. Structural design of flexible pavements for interurban and rural roads. TRH4


