Digest

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Mission

Sabita’s plans and actions are consistent with good corporate citizenship to underpin its dealings with government, and to assist its members.

Vision

Sabita will:

• advance best practice in southern Africa with due regard to worker health and safety, as well as the conservation of the environment;

• provide education and training schemes to develop skills and competencies that are sustainable and aligned to national goals and frameworks; and

• engage government to promote the social and economic value of road provision and efficient delivery by state road organisations.
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Preface

Providing a comprehensive overview of the system changes, technological developments and innovations, educational advances and HSE initiatives which ensure that South Africa’s bituminous products industry remains vibrant and robust, Sabita’s annual Digest is a respected publication which has, since its inception in 1998, achieved high esteem both in this country and abroad.

There are positive signs that all tiers of government are recognising and accepting the role of good surfaced roads in stimulating economic growth and social reform. That this recognition coincides with a strong national economy and a healthy Rand bodes well for the growth of our industry and its continuing efforts to entrench global standards of infrastructure delivery and maintenance.

Once again we acknowledge the willingness of industry practitioners to contribute to the Digest and to share their knowledge and experience with others. The submissions provided by these authors reflect the innovative and positive developments which underline the strength of our industry, and which make such invaluable contributions to the infrastructural progress of the southern African region.

Piet Myburgh
CEO
Sabita
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Industry Overview
Corporate Image advert
on film
It is gratifying that the South African public’s attention has lately been riveted (at least between Springboks victories) on major public infrastructure. Along with human capital, such infrastructure is the asset base that makes South Africa the economic giant of the continent; yet we have allowed much of it to deteriorate seriously during two decades of under-investment in its maintenance and expansion.

One of the reasons we are now hearing a lot more about infrastructure investment is a cheerful one: Government has at last committed funds on a level sufficient to reverse the neglect. President Mbeki has made repeated public remarks to the effect that massive new infrastructure investment is the cornerstone of the Government’s poverty alleviation campaign. In February of this year, Trevor Manuel attached specific numbers to this commitment. Counting in a share of private funds that will be attracted by new incentive schemes, the total increased shot in the arm for infrastructure will be R121.8 billion. This impressive quantity of money is driven by a correspondingly impressive set of objectives.

First, there is the objective of ensuring that the infrastructure is adequate to allow SA’s economic growth to keep pace with its potential. At previous investment levels, this was not true of our road network, rail network, energy sector or ports. A second objective, stressed by the President, is to expand employment through making as much of the new investment labour-intensive as is viable. Third, the investment creates a fluid new zone where black empowerment (BE) initiatives can be implemented in a way that is not zero-sum with respect to established commercial interests – since what makes this expenditure investment is that it is not mere re-slicing of an existing pie.

Massive new infrastructure investment is the cornerstone of the Government’s poverty alleviation campaign

Don Ross
Professor of Economics
University of Cape Town
and University of Alabama

On getting our money’s worth from infrastructure spending

Don Ross
Professor of Economics
University of Cape Town
and University of Alabama
Finally, in 2003 the nation promised the world that by 2010 its transport amenities and general utilities would be in shape to host the million-plus visitors who will come for the World Cup – and it thereby also made a promise to itself.

Unfortunately, there is a second reason that infrastructure has dominated recent headlines, and this is less encouraging. In most parts of the country, we are getting less infrastructure investment than we are paying for. This is happening in two main ways.

First, levels of government responsible for allocating and disbursing the investment are encountering capacity constraints that are preventing them from spending substantial parts of their capital budgets. Four provinces spent less than 75% during the last completed cycle, and even Gauteng spent only 85%. At the municipal level, Cape Town spent only 50%-70% of its infrastructure allocation. In rural KwaZulu-Natal, where the Integrated Development Plan (IDP) programme has stalled in the face of restricted capacity, some (mainly rural) municipalities were unable to spend anything from their capital budgets last year, and the President has called for foreign experts to be called in to help them.

Second, there have been serious problems in the awarding and management of procurement tenders. These problems have not merely delayed projects, but have caused significant over-runs on project budgets when procurement decisions have been reversed after work on commissions has begun. Since it is this aspect of infrastructure provision that has occasioned the most vivid recent media attention, it is worth illustrating it by reference to a few specific episodes.

Beginning in March 2005, but producing banner headlines by late July, a company called BTH Construction won a tender to repair and then improve damaged road surfaces in Gugulethu. The company abandoned the project after making so poor a start of it that all of its initial work had to be torn up and re-done by other firms called in to the rescue; it did, however, manage first to damage some roadside residences. The cost to the City of this contract failure was R13.6 million.

**Imbroglio**

In another 2005 Cape Town imbroglio, the firm appointed to repair municipal potholes proved not to have the capacity to do so. By the time this was clear, the summer months in which such work must be done had passed, and the prospect of winter rains meant that when next the potholes are tackled, there will be two years worth of deterioration to deal with instead of one.

The cost of this mistake admits of varying estimates, because it has two components, both indirect. First, marginal costs of road repairs rise with deterioration;
thus, for example, a deep pothole that has been festering for two years typically costs more than twice as much to fix as two potholes that were just one year in the making. Second, there are costs in the form of vehicle damage, increased trip time, and loss of custom to businesses that are not borne directly by government revenues. In a country and city that have already overburdened their transport system, however, such relatively hidden costs are sure to be considerable.

These sorts of difficulties should be set in a wider economic context. The national Government has spent the whole of the first decade of democracy getting itself in a position to launch this large-scale capital investment programme. It needed to be able to do it on a firm revenue base, without triggering loss of confidence in the bond and other financial markets. That is, it had to be able to provide the outlay without negating the intended benefits of that outlay through effects on interest rates. During the ten years in which it made fiscal prudence and establishment of reputation its highest priority, the national Government displayed great patience and fortitude in the face of criticism. Now, at last, the means for direct intervention on behalf of the unemployed have been successfully paid for and the time to intervene has come. Imagine, then, how bitter a setback it would be if we committed our hard-earned and carefully husbanded public resources – and then the benefits did not flow, because it turned out that we could not muster the capacity to spend properly what we had saved. (From a policy point of view, under-spending of capital budgets is not a form of unintended saving. Once revenues are allocated, markets treat them as spent.) Failure to put our best face forward for the World Cup visitors would be the least serious among our set of self-directed complaints.

Under-spending of capital budgets is not a form of unintended saving

As the ANC emphasised at its party congress in June 2005, perceived delivery failures (or mere delays beyond what people feel are their reasonable expectations) have political consequences. I have chosen a preponderance of examples here from the Western Cape because it is in that province that minor riots have recently occurred in which demonstration leaders cited disappointments over delivery as their motivator to action. But we should all remember, when seeing such manifestations of dissatisfaction, that people living around Cape Town are, statistically, well off compared to the rural people of the former Transkei (for example). The latter are less likely to demonstrate because, scattered over the countryside with poor communica-
tions and transportation infrastructure, it is harder for them to physically coordinate the expression of their views. The disenchanted in the Cape, where organisation is maximally easy, are thus serving the function of the proverbial canary in the mineshaft.

What should worry us on the political front, in connection with infrastructure delivery problems, is not that small exhibitions of frustration might swell into some sort of general uprising. The proportion of people who want to actually destabilise South Africa’s new dispensation is tiny. The more disturbing prospect is the damage that stories like the two told above can do to perceptions about black empowerment (BE) policies. It is all too easy for people to read these sorts of stories and then reason as follows:

**Procurement and tendering**

We have repeated errors of judgment around procurement and tendering. These errors are being made, more often than not, by people new to their jobs. Why are all these people in new jobs? Furthermore, firms receiving tender awards on which they then prove unable to adequately deliver receive these awards through processes that mix BE criteria with financial ones. So some providers are also new to their jobs; and perhaps this explains their failure to deliver.

By these simple chains of association, many people may come to the opinion that BE is incompatible with efficient infrastructure provision. A few people may have wanted to believe this to begin with; and now those people have a beguiling argument they can peddle among others who start out better disposed towards transformation.

A bit of reflection, however, reveals dubious background assumptions in this argument. South Africa built the continent’s, and some of the world’s, finest public infrastructure as a means of implementing empowerment for Afrikaners during the early years of the National Party regime. The newly installed public service officials then climbed their learning curve very rapidly. Why should those whose progress to higher responsibilities is accelerated by BE policies not be expected to do the same? Change requires learning and learning inevitably involves mistakes. But new brooms make up for their initial inexperience, more often than not, by more-than-compensating qualities of energy, commitment, and willingness to innovate.

Well, then, the conservative skeptic might retort, the mistakes must be manifestations of corruption. Tendering and procurement, after all, are the primary sites of official malfeasance the world over. This point can then be turned against BE as follows. Since BE introduces increased discretion into tender decisions – officials cannot simply award tenders mechanically to low bidders – it increases scope for corruption. Dark mutterings about
how things are elsewhere in Africa frequently follow elaborations of this argument, like a musical soundtrack for cueing sub-conscious emotions.

There is indeed no office of procurement, anywhere on earth, where some cronyism and bribery do not go on. So of course some of it goes on in SA, and some of the hair-raising media stories are picking up its consequences. The relevant question for us here is: are our corruption levels comparatively high with respect to other jurisdictions? This is an empirical question, for which one needs statistical evidence. Here is another such question: Is corruption actually at play in most of the cases of tender misjudgment and underspend in SA that have been carefully investigated?

All properly assembled and evaluated statistical evidence of which I am aware as an economist gives the following rough picture of corruption in SA. If it were an OECD (“first world”) country its proportion of GDP consumed by corruption would be in the top third of the total sample, but not at or near the top of this band. It seems that, proportionate to its GDP, there are rather lower levels of corruption in SA than in Greece or Italy, and rather higher levels than in Portugal or Belgium.

Proportionate to its GDP, there are rather lower levels of corruption in SA than in Greece or Italy

I spend part of each year in the southern US state of Alabama. All of the soundly collated evidence I have seen suggests that tendering and procurement processes are a good deal more consistently corrupt in Alabama than in SA. Yet we do not hear recurrent tales of unspent budgets or reversals of tender awards after projects are underway – in short, of “delivery crises” – in Alabama or Greece or Italy. Some bribes are paid everywhere, but in most jurisdictions allocations of public investment capital turn into roughly the expected quantity of infrastructure. Thus it seems that the source of our current difficulties in SA must lie elsewhere.

In fact, there is some reason to think that some of our infrastructure delivery problems are caused by scrupulous concern for ethics and transparency, rather than by its absence. Thanks to the institution of the Construction Industry Development Board, potential tenderers in SA can monitor all official projects put out for tender, and the subsequent details of contracts. This is then the informational basis on which they can petition against awards they deem to have been inappropriate for one reason or another. As a diagnostic of the “delivery crisis” I have throughout cited reversals of tender decisions after projects
have begun as one of two main indicators. In almost every case these reversals result from successful appeals made under the auspices of ethical transparency rules. One of the reasons tenders are seldom or never reversed in Alabama is that it is hard for suspicious parties to know what is going on, or to find a mechanism for action in instances where they manage to confirm their own suspicions.

Exploding the myth that SA suffers from a shortage of official ethics goes hand in hand with defeating the claim that BE status is a guaranteed ticket to tendering success. In yet another Western Cape case, this time associated with the current Klipfontein Corridor project, a 100% black-owned firm initially tendered at both the lowest cost and the highest points for BE objectives, yet was not awarded the contract. It appealed, and on its appeal the decision was reversed — after it was underway, and for a deadweight loss of R2 million to the City. (This is the same firm that was called on, with one other, to put right the botched job in Gugulethu discussed earlier. The firm that made the botch was not 100% black-owned.) Perhaps it follows from these reflections that SA should respond to the delivery problems by emulating Alabama and encouraging more corruption. Of course, this is not a serious suggestion. The real point is that both our diagnosis of the problem, and useful ideas for addressing it, must be more alert to evidence — instead of entrenched expectations — and more creative.

We can start to get a better grip on the diagnostic aspect by zeroing in closer on some details of the Klipfontein Corridor case just mentioned.

At the appeal hearing, some City officials defended their failure to award the tender to the firm that scored highest with respect to both cost and BE criteria by invoking a so-called “equity share of work” principle. This principle holds that no firm should win too many tenders while other firms do without work; jobs should be spread about. To an economist this is a most alarming idea, because it implies both failure to reward efficiency, and incentivising incompetent and under-capitalised parties to set up as contractors in hopes of making off with some public monies. Fortunately, it is not a principle incorporated into official policy.

The appeals board in the Klipfontein case dismissed it out of hand; and in another recent appeal case, so did the City’s own legal representative when it was brought to his attention. So, one is apt to wonder, what are officials doing making decisions

Strategic prioritisation can often seem, and sometimes actually is in tension with democracy
according to a principle that has no basis in policy? The answer to this question, I think, brings us close to the nub of our current difficulties.

I started this article by listing the several objectives that motivate the new policy emphasis on infrastructure investment. To recap this, we want:

(a) better and more financially prudent management of our public capital assets;
(b) relief of unemployment through expanded public works, using labour-intensive construction approaches wherever possible;
(c) an expanded zone for BE efforts that is not mainly a matter of competitive transfer between entrenched and new interests; and
(d) economic development (a goal merely symbolised by our World Cup commitment, but equally manifest in our determination to bring foreign investors and other visitors to “world class” facilities).

Procedural principles

Suppose one searched official documents and minutes, at all levels of government, for attempts at strategic prioritisation among these four ambitions. This search would be in vain. All four objectives are good objectives, and they are, at the general level, compatible with one another.

So, indeed, at the highest level where the President and national cabinet exercise their influence, all four objectives are mandated and they collectively inspire generous budgetary provision. However, at the level where very specific procedural principles must guide administrative implementation, strategic planning that translates the broad objectives into practical decision principles are largely absent.

It is in this atmosphere that a misguided (again, from an economic point of view) principle like “equity share of work” emerges. This principle is simply a way of trying to collapse objectives (b) and (c) into one decision rule. It succeeds in doing that, rather elegantly. However, it is utterly at war with objectives (a) and (d) (which is why it is the economists’ hair, in particular, that stands on end when they hear about it) – and so, fortunately, it is not endorsed at the policy level.

Strategic planning

Strategic planning has been relatively absent from infrastructure development implementation in SA for about twenty years. It was not missing during the years of “high” apartheid before 1985 – except that the strategic principles the planning then served were morally odious. (Perhaps this helped to discourage such planning later; strategic prioritisation can often seem, and sometimes actually is, in tension with democracy, especially with so-called “stakeholder” democracy.)

I say ‘relatively’ absent because strategic planning has guided our
“mega” projects – e.g., convention centres in the major cities, Coega, and the modernisation of the mining and automobile industries. However, where ‘everyday’ infrastructure is concerned, we have mainly built and maintained it by dribbling it out on the principle of equal (small) shares for all – an approach to allocation that has exactly the same logic (and the same shortcomings of logic) as “equity share of work” does in procurement decisions.

Since 2001, the Sabita Infrastructure Development Assessment Project (SIDAP), based at the University of Cape Town, has advocated an approach to infrastructure development we call Opportunity Value Assessment (OVA). OVA is a set of economic principles for packaging and sequencing infrastructure investments according to explicit strategic priorities. Some infrastructure packages create more capital deepening, faster, than others. These packages should be delivered first, because they help to create the stable revenue and asset base that can make less economically productive – but perhaps morally pressing – strategic objectives affordable.

**Delivery crises**

We have so far mainly articulated OVA in the rural context, because we wanted to sharpen its principles in circumstances of minimal complexity, before applying it to the more difficult cases of the large urban environments. However, our experience of infrastructure development in areas like north-eastern KwaZulu-Natal and the former Transkei has made us very familiar with the idea of “delivery crises” – and not inclined to blame them on BE policies or corruption. They result from neglect of strategic coordination.

How might we best overcome this neglect so as to make our ambitious nation-wide infrastructure investment programme work more efficiently – thus making BE itself, along with the other three objectives, work more efficiently? At the level of national cabinet government, improved coordination among departments has been achieved by the work of a recently established council of economic experts administratively located in the President’s Office. These experts have been effective partly because they are positioned to emphasise broad strategic vision, but also partly because their role in the executive gives them real administrative power.

**Budget competition**

We can try to replicate the first of these aspects at the level of local infrastructure provision, but we should not try to replicate the second aspect. There are two reasons for this:

(a) strategic coordination at the level of local projects means coordination across infrastructure sectors (roads, power, hydro, housing, etc.) with respect to kinds of objectives, rather than
coordination of physically scattered agents who are already blessed with strategic nous but compete for budget, as at the level of national cabinet;

(b) about the last thing we need where infrastructure roll-out is concerned is another level of bureaucratic administrative authority.

Let me pause to explain this last point – because it is not just an expression of a generic hostility to a proliferation of bureaucracy, but is motivated by another specific aspect of our infrastructure delivery problem.

SA does not suffer from a shortage of development consultants. Rather the opposite: we have too many of them relative to the number of agents who have experience with project implementation.

Consultants are naturally incentivised to try to generate work for themselves. How do they do this? Mainly by emphasising respects in which particular project initiatives fail to ideally capture (for any given report) one of the four objectives listed earlier, or some other, independent, policy mandate such as environmental sustainability. Decision-makers, uncomfortable in the vacuum created by the absence of articulation between high-level objectives and procedural rules implementing priorities, are only too easy to convince that what is needed in a given instance is both more study and another set of recommendations to help spread responsibility more diffusely. This problem compounds itself when different authorities commission alternative consultant studies of the same problem, in ignorance that they are doing so (again, because of general neglect for strategic coordination).

For example, the Ministry of Transport of the Western Cape and the Ministry of Public Works both, several years ago, commissioned studies of road access principles. Both reports made their way into circulation among policy-makers and planners in other provinces and at national level. The reports diverge in important respects. The number of people across the country who realise that there are two competing sets of guidelines on road access design both emanating from the Western Cape Government is probably less than ten. The resulting planning at cross-purposes has seriously delayed more than one road project.

Now, if we tried to achieve improved strategic coordination by establishing yet another level of decision-making authority, a main result would be a new pressure point – indeed, a new bottleneck –
for mobbing by consultants. A new decision-making authority would almost inevitably morph into a new planning bureau. But South Africa does not need more infrastructure development plans. Of those we have an embarrassment of riches. We need more infrastructure development itself — which we should best try to get through improved coordination of the plans we already have. What is thus needed is informational coordination, rather than bureaucratic coordination.

The effectiveness of the Construction Industry Development Board can serve as a model here. Thanks to the information registered with the CIDB, infrastructure contractors can police potential corruption of their industry — both for their own individual good, and for the public good.

**Investment resources**

As suggested earlier, repeated reversals of tender decisions are in the end as much a sign of our doing something right as they are a sign of doing something else wrong. Would we prefer that mistaken tender awards were not reversed? That would imply a (much) larger waste of our precious public investment resources. Bad decisions are regularly corrected in SA — but not in Alabama — because directly interested parties, including the press, can use the CIDB mechanism to see what is going on and to critically evaluate the process. Of course this leads to some nuisance appeals driven by rent-seeking. But this is a price that must surely be deemed worth paying, just as wasting some time listening to the policy suggestions and complaints of the ignorant and the selfish is a price worth paying for democracy.

What I therefore suggest be established to help address SA’s infrastructure delivery “crisis” is the establishment of a national Infrastructure Development Projects Information Bureau (IDPIB). Since most of the infrastructure projects, both planned and implemented, for which strategic coordination is most grievously lacking occur at the provincial and municipal levels, this Bureau might best be a unit of the National Council of Provinces (with representation from national Government and from SANRAL), rather than a direct agency of national Government. The IDPIB should be staffed by policy experts — economists, engineers, urban planners and others — whose expertise would lie in research, analysis and advice, but who would not, as permanently accredited to and salaried by the IDPIB, have incentive to duplicate consulting reports compiled elsewhere in the economy.

**Management tasks**

The following information-management tasks would be assigned to the IDPIB:

- Maintain a registry of nationally commissioned consulting reports and published academic studies
related to infrastructure. All levels of government would be committed to examining this registry prior to authorising payment for any new report or study from their own budgets;
• Maintain a registry of all infrastructure development and maintenance plans (including IDPs) completed by all levels of government;
• Incorporate the registry of the Construction Industry Development Board, so that tender records, project plans and consulting studies of these plans may be cross-referenced for facilitated access by interested parties (including the press).

The principal analytical function of the IDPIB would be to rank projects against the weighted grid of infrastructure investment objectives. These include the four discussed here, and any others that are deemed to be strategic aims as a result of the normal political and governance process. OVA is one possible tool for constructing such a grid; more traditional ones (but not, like OVA, customised to South African circumstances) are available from the World Bank and other development agencies.

As SIDAP has been stressing in its analyses and policy documents for several years, how much capital deepening we can ultimately obtain from infrastructure investment is, to a very great extent, a function of the sequence in which investments are made. At present, such sequencing is carried out within sectorial silos where institutions such as SANRAL (for national highways) and Spoornet (for rail services) exist with mandates to perform it. But there is poor cross-sectorial integration, and such as there is does not reach effectively down to the level of provincial and municipal projects – which is to say, to the level where the majority of newly funded projects are planned and implemented.

At present, when constituencies successfully attract media and political attention to their complaints about delivery, they can be answered only with generic promises or with immediate dollops of investment that is not cross-sectorially integrated so as to efficiently capture multipliers. Since such capture of multipliers is essential for truly transforming communities, piecemeal responses to it are unlikely to assuage local grievances in the medium or long runs.

Given an effectively functioning IDPIB, officials could at least tell communities what plans have been developed for them (or not) and, in light of prioritisation analyses, where they stand in delivery queues and why. This would not always come as good
news to communities, of course. But to the extent that politicians could thereby:
(a) provide concrete information in response to complaints;
(b) attribute some responsibility elsewhere (i.e., to IDPIB); and
(c) justify decisions by reference to clear principles with a rationale applicable to all.

They might find that this both enhances their legitimacy and relieves them of the need to simultaneously promise more than can be delivered in aggregate – something that keeps the dogs from the door in short runs, but provokes worse anger over the longer term. IDPIB analysis could provide truly legitimate “cover” – not merely a basis for spin – to officials who would thereby be able to give substance to President Mbeki’s February 2005 directive that “We must make a determined effort to educate our population that our country does not have the resources immediately to meet, simultaneously, all the urgent needs of our people, especially the poor,” while nevertheless showing, by reference to the objectives reflected in OVA or other prioritisation, that they are sincerely committed to the

President’s immediately succeeding remarks:

“Success in the growth of our economy should be measured not merely in terms of the returns that accrue to investors or the job opportunities to those with skills. Rather, it should also be manifest in the extent to which the marginalised in the wilderness of the second economy are included and are at least afforded sustainable livelihoods. South Africa belongs to them, too.”

The recent headlines about a “crisis” in delivery show some exaggeration, and may, as I have suggested, partly mistake signs of healthy transparency and of the learning aspect of transformation for institutional pathology. We are, like everyone else on the planet, prey to some level of official corruption, which can be controlled but never eliminated.

At the same time, we have waited a decade for the chance to see the fruits of fiscal patience turning into new and improved assets that will in turn take us to a higher growth norm. There are measures we can take to help make sure that this harvest is as large as can be had.
To meet the City of Johannesburg’s objectives of Service Delivery and Poverty Alleviation, the Johannesburg Roads Agency (JRA) adopted the turnkey design and construction concept to improve the pace of service delivery in the provision of surfaced residential streets. A linked objective was community upliftment and poverty alleviation through job creation and the employment of local subcontractors on the programme.

The turnkey contract structure used on this programme provides a quicker and more cost-effective mechanism for delivering services than the traditional client-contractor-consultant relationship. The turnkey structure sees the consultant and contractor forming a consortium or joint venture partnership, which works as a single entity to design and construct the works as required by the client. An independent programme manager carries out the document preparation and tender adjudication, and thereafter ensures that the consortia deliver as contractually required in terms of design standards, safety, quality, job creation, training and the empowerment of local subcontractors.

Further benefits

Further benefits of the turnkey contract structure include:

- Improved delivery and reduced risk to the client through the appointment of more experienced and established contractors;
- Sustainable empowerment and development of local subcontractors through subcontracting of large sections of work by the main contractors;
- Employment creation through the use of local labourers and
other locally available services; Cost savings due to the efficiency in the design and construction as a result of the closer working relationship between contractor and consultant.

The contract structure as detailed in Figure 1, as well as the provision of bank guarantees,

![Figure 1: Typical contract structure](image)

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<td>47 652 164</td>
<td>102 513 311</td>
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<tr>
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<td>27 237 564</td>
<td>11 250 000</td>
<td>114 561 087</td>
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<td><strong>89 680 578</strong></td>
<td><strong>118 763 311</strong></td>
<td><strong>488 664 249</strong></td>
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Table 1: Breakdown of funding

Note:
- CLF = Consolidated Loan Fund
- CMIP = Consolidated Municipal Infrastructure Programme
- MIG = Municipal Infrastructure Grant
parent company guarantees and back to back guarantees, ensures that the client is exposed to a minimum of risk.

Over the three financial years that the programme has run approximately R490m was spent on upgrading gravel roads to surfaced roads, and the provision of associated storm water infrastructure. Table 1, indicates the breakdown of funding according to year and source of funding. It is significant that more than R180m of funding was received from sources external to the city.

**Cashflow**

Figure 2, shows the combined cashflow over the three years of the programme. In total more than 99% of the budget allocated to this programme has been successfully spent.

The expenditure curves for each financial year ending at June can clearly be seen. The 2003/04

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<tbody>
<tr>
<td>Soweto</td>
<td>44.50</td>
<td>112.28</td>
<td>74.32</td>
<td>231.11</td>
</tr>
<tr>
<td>Ivory Park &amp; Kalfontein</td>
<td>3.19</td>
<td>31.63</td>
<td>5.34</td>
<td>40.16</td>
</tr>
<tr>
<td>Orange Farm</td>
<td>10.08</td>
<td>14.34</td>
<td>0.00</td>
<td>24.42</td>
</tr>
<tr>
<td>Vlakfontein</td>
<td>7.76</td>
<td>10.41</td>
<td>0.00</td>
<td>18.17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>65.53</strong></td>
<td><strong>168.67</strong></td>
<td><strong>79.66</strong></td>
<td><strong>313.86</strong></td>
</tr>
</tbody>
</table>

*Table 2: Summary of lengths of roads constructed (kms)*
financial year saw the largest amount of expenditure with approximately R90 million spent within the last three months of the financial year as additional funding was made available.

**Roads constructed**

In total 313 kilometres of roads were constructed in greater Johannesburg. Table 2, summarises the lengths of roads constructed in each area. In addition, short sections of roads were constructed in Alexandra, Poortjie and Diepsloot.

The majority of roads constructed were of 5.0 metres width. Some more highly trafficked roads were built up to 8.0 metres wide and in some areas the roads were built only 3.0 metres wide due to very narrow (5.0m) road reserves.

Figure 3 is a comparison of the cost of the roads constructed in each financial year. Significant cost reductions were noted after 2004, when the JRA set a benchmark figure of R260/m² for the construction of surfaced roads. Further cost decreases were achieved through improvements in efficiency and a more stringent tendering process.

**Community liaison**

Community Liaison was the responsibility of the appointed consortia and they were instructed, prior to the construction of any roads, to liaise with the respective ward councillors. After the initial community liaison meetings which were held with councillors for all the projects, community liaison

![Figure 3: Cost comparison per kilometer](attachment:image.png)
officers (CLOs) were appointed on each contract. The CLO was required to report at the monthly site meeting on all issues related to the community as well as labour sourced from the community.

Throughout the projects good communication between the consortia’s, the CLO and the respective councillors saw to it that good working relationships were established with all the affected communities.

Community retained earnings

It was a target of the contract that at least 25% of the project budget be spent within the affected community through the utilisation of local labour, payment to sub-contractors, local purchasing of material and fuel, etc. At project completion the total retained community earnings as reflected in Table 3 was 25%. The overall target of 25% was met, albeit not consistently over the last three years. The total amount reported as spent within the community was R 119.7 million.

Job creation

The consortia were required to employ as many local labourers as possible. During the contracts local labourers were used for kerb laying, finishing off the road reserve, construction of stormwater infrastructure and all other labour intensive activities. Table 4 summarises the total number of jobs created on the programme. In total 5 358 jobs were created over the last three years. Considering that one job is equivalent to 55 labour days of work, in excess of 294 000 labour days of work were realised.

Considering that on average a

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Budget</td>
<td>369 900 938</td>
<td>118 763 311</td>
<td>488 664 249</td>
</tr>
<tr>
<td>Community retained earnings</td>
<td>99 400 000</td>
<td>20 345 845</td>
<td>119 745 845</td>
</tr>
<tr>
<td>As a percentage</td>
<td>27%</td>
<td>18%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 3: Community retained earnings comparison

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Labour utilisation (Cumulative person days)</th>
<th>Total number of jobs created</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Youth</td>
</tr>
<tr>
<td>2002/2003</td>
<td>23 232</td>
<td>8 395</td>
</tr>
<tr>
<td>2003/2004</td>
<td>79 574</td>
<td>28 036</td>
</tr>
<tr>
<td>2004/2005</td>
<td>60 242</td>
<td>19 948</td>
</tr>
<tr>
<td>Total</td>
<td>163 048</td>
<td>56 379</td>
</tr>
</tbody>
</table>

Table 4: Job Creation Summary
labourer earns R90 per day, this equated to an expenditure of R26.5m.

Figure 4 indicates the number of jobs created per million rand expenditure on the programme for each year. It is interesting to note the increase in the number of jobs created in the 2004/05 financial year. It is understood that this is due to the slower and less plant-intensive rate of production. On average approximately 11 jobs have been created per million rand expenditure on the programme.

**Subcontractors**

Throughout the programme local subcontractors were utilised for the provision of activities not related to the construction of layer works. Subcontractors were typically employed for the following work:
- Site camp, works and personnel security;
- Kerb laying;
- Construction of stormwater infrastructure;
- Concrete and brickwork;
- Truck and plant hire;
- Cleaning and finishing;
- Surveying;
- Materials testing.

In total, 132 subcontractors were employed. Of these 101 or 77% were local BEE subcontractors.

During the 2004/05 financial year V&V consortia, working in Naledi Soweto, established a precast kerbing yard which was operated by a local subcontractor. The precast yard produced in excess of 20 kilometres of kerbing within 6 months.

**Training**

The programme made provision for both informal and formal (accredited) training. The training courses were selected by the
community in collaboration with the contractor’s requirements in terms of demand for special skills for the purposes of construction. Where courses such as life-skills are for the general benefit of the community, the content of these courses was selected by the community. Typical training courses completed included; Community Liaison Officer Training, Health and Safety, Concrete and Brickwork, Kerb laying, Entrepreneurial, Basic Financial Skills and Surveying. The people elected to receive training were identified by the community and their names put forward through the Community Liaison Officer (CLO). All CMIP funded projects received formal training.

<table>
<thead>
<tr>
<th>Financial year</th>
<th>Total number of persons trained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>2002/2003</td>
<td>187</td>
</tr>
<tr>
<td>2003/2004</td>
<td>458</td>
</tr>
<tr>
<td>2004/2005</td>
<td>328</td>
</tr>
<tr>
<td>Total</td>
<td>973</td>
</tr>
</tbody>
</table>

Table 5: Summary of Training
A report presented to the Nelson Mandela Bay Municipality on 14 September highlights a problem which is common to virtually every local authority in the country. It stressed that inadequate funding for road maintenance, resurfacing and rehabilitation in the past had resulted in an ever-increasing backlog. Despite the fact that in the current financial year, the municipality has budgeted R27 million for this purpose, which represents fully a doubling of the R12.5 million allocated in the 2004/05 financial year, the report says that this amount is still not enough to meet the requirements of the road system in the metropolitan area, which includes Port Elizabeth, Despatch and Uitenhage.

The report points out that the replacement value of the surfaced road network is estimated to be R1 921-billion, with roads of metropolitan significance representing R616-billion of this total and the local residential road network approximately R1 305-billion. The current maintenance backlog on these surfaced roads is estimated to be R110-million. For the more underdeveloped areas of the municipality, the estimated cost of upgrading dirt roads to gravel standards is approximately R16-million, while the cost of upgrading gravel roads to surfaced standards is estimated at R800-million.

What is happening in the Nelson Mandela metropole does no more than mirror conditions elsewhere in the country, where the road network has experienced a demonstrable deterioration over several years. Thus, as long ago as November 2002, the Department of Transport’s (DoT) discussion document, Road Infrastructure Strategic Framework for South Africa, reported that in Gauteng the percentage of roads in a healthy state declined from 78% in 1985 to 57% in 2002. Roughly 35% of all surfaced provincial roads were assessed as being in a “poor to very poor” state.

The Port Elizabeth report must necessarily draw attention to a number of problems which confront local authorities in executing their road construction and maintenance mandate. Among these are their perennial difficulty in actually spending their capital expenditure budgets, a dire shortage of skilled and experienced technical personnel,
and a disturbing lack of any classification system. This latter issue is particularly acute in district municipalities, where there is no clarity as to what constitute provincial, district and local roads.

This lack of clarity amounts to more than a mere inter-governmental dispute over the locus of responsibility, as it often results in the non-maintenance of municipal roads which have yet to be classified as either district or local. As the Financial and Fiscal Commission (FFC) has pointed out, only when the classification project has been completed will it be possible to determine which sphere of government is responsible for addressing the backlog in construction, rehabilitation and carrying out maintenance duties.

It has also led to a variety of unsatisfactory ad hoc arrangements, which may well resolve immediate jurisdictional squabbles, but may result in later and more damaging problems when disputes arise as to which sphere of government owns an asset or who is responsible for subsidising whom. Some provinces are already pre-empting the finalisation of a national road classification system by developing their own, as is happening in the Western Cape. But even so, this interim solution remains problematical, as there is no guarantee of uniform classification methodologies among the nine provinces.

The transport competencies of national, provincial, and local government are outlined in schedules 4 and 5 of the Constitution, which identify public transport, road traffic regulation and vehicle licensing as concurrent functions of the national and provincial spheres, while provincial roads and traffic is an exclusive provincial function, and municipal public transport and municipal roads are a municipal function. But this allocation of powers and functions is further complicated by the fact that legislation has assigned to local government a number of functions that are concurrently national and provincial. Further, the funding regime for these assigned or delegated responsibilities is unresolved, since they are not part of local government’s constitutional mandate.

This confusion also raises an interesting legal question, in that the DoT has acknowledged that its road infrastructure framework “recognises constitutional rights”. If the right to a safe and reliable transport infrastructure is held to be a constitutional right, Government may well find itself legally liable for road accident casualties as a result of its failure to upgrade roads.
casualties occurring as a result of its failure to upgrade or rehabilitate neglected roads.

Indeed, the judgement in Graham versus the Cape Town Metropolitan Council the Cape High Court held that “a duty of care towards road users should now apply to the controlling public authority unless there is a valid basis for its exclusion.”

But who, in the absence of a clear classification system and amidst the uncertainty about responsibility, is the “controlling public authority”?

South Africa’s road network is approximately 752 000 km, comprising 532 000 km of classified roads and 220 000 km of unclassified roads, many of them in rural areas where services to impoverished communities have generally continued to be inadequate.

The value of rural road networks is estimated to be about R300 R350-billion, and that of rural provincial roads without drainage representing R205-billion of the total.

Table 1 summarises South Africa’s 752 000-km road network according to the responsible sphere of government. In the 2003/04 financial year, expenditure on roads infrastructure by South Africa’s metropolitan authorities accounted for 50.7% of the total local government budget, as is shown in Table 2.

<table>
<thead>
<tr>
<th>Road Authority</th>
<th>Length (km)</th>
<th>Network Split</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Roads</td>
<td>6 700</td>
<td>1%</td>
</tr>
<tr>
<td>Provincial Roads</td>
<td>357 000</td>
<td>47%</td>
</tr>
<tr>
<td>Un proclaimed rural roads</td>
<td>221 000</td>
<td>29%</td>
</tr>
<tr>
<td>Municipal roads</td>
<td>168 000</td>
<td>23%</td>
</tr>
<tr>
<td>Total</td>
<td>752 700</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 1: South Africa’s road network
Source: Department of Transport, Road Infrastructure Strategic Framework for South Africa: A Discussion Document, November 2002
billion) and electricity reticulation (R1.8-billion).

Moreover, the roads, pavements, bridges and storm-water category, and sewerage purification and reticulation category benefited the most from real increases in expenditure between 2002-03 and 2003-04, at 46% and 68%, respectively.

But there are two concerns that arise: firstly, this level of expenditure remains woefully inadequate. In 2002/03, for example, at a time when the annual need for municipal roads infrastructure was estimated at a minimum of R18-billion, combined provincial and municipal roads expenditure was only R6.9-billion.

Secondly, underspending of roads budgets - by both provinces and municipalities - is probably the major obstacle to a coherent, effective and cost-efficient construction and maintenance regime. Analysis of local government budgets for the 2004/05 financial year reveals that R17-billion was allocated to capital projects. Of this amount, R2.8-billion, or 16%, was directed towards the broad functional categorisation of roads and storm water.

The same analysis shows that actual expenditure against these capital budgets range from 106% in the case of Johannesburg to a mere 22% in

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Eastern Cape</td>
<td>1 315</td>
<td>1 431</td>
</tr>
<tr>
<td>Free State</td>
<td>336</td>
<td>292</td>
</tr>
<tr>
<td>Gauteng</td>
<td>541</td>
<td>523</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>838</td>
<td>1 181</td>
</tr>
<tr>
<td>Limpopo</td>
<td>659</td>
<td>829</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>479</td>
<td>450</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>128</td>
<td>127</td>
</tr>
<tr>
<td>North West</td>
<td>165</td>
<td>265</td>
</tr>
<tr>
<td>Western Cape</td>
<td>598</td>
<td>539</td>
</tr>
<tr>
<td>Metropolitan municipalities</td>
<td>891</td>
<td>1 481</td>
</tr>
<tr>
<td>Other municipalities</td>
<td>1006</td>
<td>1 439</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6 957</strong></td>
<td><strong>8 558</strong></td>
</tr>
</tbody>
</table>

*Table 2: Provincial and municipal roads expenditure*

the case of the Gert Sibande Municipality in Mpumalanga. Every year, the Municipal Demarcation Board undertakes an assessment of the capacity of municipalities to perform their functions. The Board’s report for 2004/05 examined the functions which had been rendered in the three preceding assessment periods and found that approximately 82% of all the local municipalities have performed the municipal roads and refuse removal functions in all three assessment periods with some capacity. It found that only 23% of district municipalities perform the municipal roads function with consistent capacity levels, with none rendering this service in Mpumalanga and the Free State.

Nor are matters helped by the lack of enthusiasm on the part of major local authorities to establish transport authorities for their areas of jurisdiction, as they are enjoined to do by the National Land Transport Transition Act of 2000. To date, only the eThekwini Municipality has gone this route, while in Cape Town, where a metropolitan transport authority was meant to be inaugurated by September 2005, progress has been stalled by disagreement over responsibility for the funding of such a body. As a result, neither the Cape Town Municipality nor the national or provincial transport departments have signed the founding agreement necessary to establish the authority.

At the heart of the dispute in Cape Town is the city’s reluctance to assume another “unfunded mandate” and its insistence that it must be the national treasury’s responsibility to fund some of the transport functions outlined in the legislation. At present, the legislation is largely silent on funding mechanisms and provides only that the relevant province and municipality “can contribute” funding.

These are matters which have been taken up by the FFC in its most recent submission to Parliament on the annual Division of Revenue Bill.

**Under-investment**

In its report the FFC highlighted the following factors:

- There has been considerable under-investment in South Africa’s transport infrastructure over the past two decades, although this is being addressed through the emphasis on infrastructure investment in the 2005 Medium-Term Expenditure Framework.¹
- There is considerable debate internationally and within South Africa about the desirability of “pricing” road usage through fuel levies and user charges.
- The reclassification of some provincial roads as national roads has implications for the provincial equitable sharing mechanism.
- There is insufficient funding of municipal road maintenance in South Africa, in spite of the fact that up to 52% of the road network...
legally falls under the jurisdiction of municipalities.

Against that background, the FFC recommended, among other things, that:

1. Government should ensure that the following is implemented as a matter of urgency:
   - Developing criteria and processes for classifying all roads and assigning each class of roads to the respective sphere of government or category of local government.
   - Assessing the length and condition of all roads, and the estimated expenditure need for rehabilitation and maintenance arising from this.
2. Government should develop a coherent funding framework for roads in South Africa. The framework should consider the role of the provincial equitable share and existing provincial and municipal infrastructure grants.
3. Government should address certain issues that need to be resolved for setting up transport authorities, including funding arrangements and how the authorities’ governing bodies are constituted.

It is difficult to escape the conclusion that under Jeff Radebe and Dullah Omar the national department of transport has lost much of the energy and purpose which characterised the innovative and imaginative policy framework devised by Mac Maharaj and his sorely-missed Director-General, Khetso Gordhan. It requires only a re-reading of the 1996 White Paper on National Transport Policy or the 1999 Moving South Africa, the Action Agenda, to appreciate how far short we have fallen in realising their goals.

South Africa’s deteriorating road network is as much the victim of the current local government crisis as any other sector. The flight of technical and project management skills from municipalities, a failure to plan strategically and fix long-term priorities, and high levels of corruption and mismanagement all contribute to dangerous under-investment in the maintenance and rehabilitation of roads. We are rapidly approaching a point where eventual rehabilitation will amount to exceedingly costly new construction.

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1 The most recent Medium Term Budget Statement stressed the role that an effective road network must play in national economic development and identified increased allocations for road maintenance and the construction of new roads as an area of special attention. Over the 2005 MTEF, public sector capital expenditure increases by an average of over 15.6% a year. The total MTEF allocations for provincial infrastructure and municipal infrastructure grants are R12.7-billion and R18.5-billion respectively, and a portion of this is intended for road infrastructure.
South Africa’s economy and the quality of life of its citizens depend on the supply and efficient management of infrastructure. The bulk of social and economic infrastructure identified in the Millennium Development Goals (MDG) is the domain of the construction industry and the civil engineering profession.

**Service delivery**

Service delivery is at the heart of the South African democracy, and at the heart of service delivery is the civil engineer, whose role it is to create infrastructure. South Africa is blessed with much fine infrastructure, thanks to the work of past and present engineers. Civil engineering has a direct responsibility for water supply, sanitation, roads, health, etc. Where there is no potable water or where systems malfunction people are at risk of contracting waterborne diseases, such as cholera, dysentery, typhoid, etc. It is clear that there is a crisis in capacity and competence that, with the foresight informed by this research, could be addressed. To succeed will however require collective effort involving political will and the cooperation of all tiers of government, the private sector, academic institutions and the civil engineering workforce.

**Supply**

There are approximately 15 000 civil professionals in SA. Over the past 25 years South Africa has, however, lost nearly 6 000 of these professionals. A large number of the civil engineers presently in employ are older than 50 and are nearing retirement. The most acute problem is in local...
government, where vacancies based on current workload are at least 800 to 1 200. Worse still, there is no budget for many of these vacancies.

**Needs**

In total South Africa will need between 3 000 and 6 000 additional civil engineers.

**Table 1: Shortages in the public sector**

<table>
<thead>
<tr>
<th>Authority</th>
<th>Number of authorities</th>
<th>No civil engineering professional</th>
<th>One civil engineering professional</th>
<th>Only civil engineering professional under age 35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local municipalities</td>
<td>231</td>
<td>79</td>
<td>42</td>
<td>38</td>
</tr>
<tr>
<td>District municipalities</td>
<td>47</td>
<td>4</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Given that approximately R200-billion is to be spent on infrastructure in the next five to seven years and that growth will continue after 2010 as expansion of infrastructure, upgrading of basic services and maintenance of the extended network will be required. The challenge is to ensure that there is sufficient professional capacity to cope with the dramatically increased workload. The current drivers on the demand side are Gautrain; the Soccer World Cup of 2010; the Eskom and Transnet expansions; the huge challenges of NEPAD and the MDG; and private sector developments.

**What to do?**

In view of the above expected ‘boom’, the future for built environment professionals is enticing, especially for new entrants. SAICE will be looking at

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*Numbers & Needs: Addressing imbalances in the civil engineering profession* 

Alixson Lawless
developing the new capacity using the wisdom and competence of existing engineering professionals by implementing guided experience programmes.

Possible solutions

Proposals to develop more civil professionals include:

- Increase graduations by increasing the intake and considering all influencing factors, such as improving school mathematics and science teaching (as well as the language of instruction which in most cases is English) to raise the calibre of entrants and thus improve throughput from tertiary institutions. This will only address the need in a minimum of five years, which is too late for immediate relief;
- Improve conditions of employment in the civil engineering industry, particularly salaries, to reduce further losses of engineers due to emigration, and encourage those who have left the industry or the country to return;
- Extend the retirement age and encourage practising engineers to spend time and effort transferring their skills before it is too late;
- Encourage retired capacity back into the profession to train young graduates and manage projects;
- Assist more technikon students to graduate by offering more experiential training opportunities; also, assist more graduates to achieve professional registration and take their place in the industry through dedicated supervision and coaching. Neither of these prerequisites is presently available as those in industry are too busy to participate in such a programme;
- Use of staff in international project teams in the short-term;
- Set realistic equity targets;
- If all the above are not sufficient, it could become necessary to encourage the controlled immigration of civil engineering professionals for a limited period.

SAICE is busy with many initiatives to address these problems, including:

- Contacting civil engineering professionals overseas to encourage their return to South Africa;
- Locating retired engineers willing to work in local government and/or supervise and coach young graduates;
• Assisting with experiential training and job opportunities;
• Leading reform where necessary in terms of deploying civil engineering professionals;
• Career guidance;
• Raising and administering bursaries.

In the book Numbers & Needs: Addressing imbalances in the civil engineering profession, the problems and solutions are discussed in detail, making it clear that industry, government and other stakeholders must take immediate action to manage and avert a more serious situation. The book stresses that "If appropriate interventions are not made now, South Africa’s projected growth will not be achieved and, worse still, continued vacancies in local government will mean that existing infrastructure will be rendered worthless." The protests demanding better delivery could become commonplace!

Issued on behalf of The South African Institution of Civil Engineering
Tel: 011 805 5947/8 Fax: 011 805 5971
E-mail: mashpole@saice.org.za
When most South Africans, who live in cities, speak of “rural SA” they often mean anything with a bit of farmland around it; they might be talking about Paarl or Muldersdrift or Hilton. But there’s rural and then there’s rural. A place that is truly in the hinterland is the village of Kwangwanase (referred to by most locals as Manguzi). In the heart of Maputaland on the far side of the Lebombo mountains, Kwangwanase is the last population centre one encounters on the way to Mozambique. Its 10 000 people live on Zulu tribal land, where real estate cannot be bought and sold. There is no central industry to concentrate employment opportunities, and the land and rainfall will not support the sorts of crops that can generate high agricultural profits.

Thus one might suppose that however well conceived a development strategy were implemented in SA, Kwangwanase would be among the last parts of the country that could experience the fruits of such a strategy - if indeed any development is possible there at all. This was basically the view of the staff of the Sabita Infrastructure Development Assessment Project (SIDAP) when we surveyed possible infrastructure projects for North-Eastern KwaZulu-Natal (District Council 27, Umkhanyakude) in 2002. The original Integrated Development Plans (IDPs) prepared by the District Municipality presumed that for the area as a whole - including parts of it that are close to Richard’s Bay, and thus much less isolated than Kwangwanase - the only growth and development potential lies in agriculture and eco-tourism.

SIDAP’s brief was to examine this potential in the light of micro-economic principles. In particular, we aimed to assess the district as an exercise in what we call Opportunity Value Assessment (OVA). This is based on the notion that if government aims to try to jump-start an area’s growth by...
injecting capital that can bring self-sustaining enterprises into being, it is crucial to coordinate complementary pieces of infrastructure (e.g., roads, utilities, commercial capital assets) that multiply one another’s value, and to sequence investments so that those that might most quickly turn into revenue-generators can then provide flows of funds that expand budgets for the riskier interventions often required by the most deprived sectors of the population.

OVA is ultimately intended to be a custom-designed capital coordinating and sequencing instrument for infrastructure development and enhancement throughout SA. But SIDAP began OVA implementation in Umkhanyakude because of the relative simplicity of that area’s economic base. We needed to test out basic principles and assumptions in circumstances where we weren’t overwhelmed by the numbers of variables, before moving on to the more complex urban environments.

When SIDAP developed more technically detailed IDPs for Umkhanyakude, we retained the view of the previous planners that economic development would have to be focused around agriculture and eco-tourism. In the case of Maputaland, this meant two specific things. First, a paved road connecting Hluhluwe, Sodwana Bay, Lake Sibaya and Kosi Bay via Kwangwanase, and thus linking this whole network to the Tembe Elephant Park, might generate roadside spending from increased volumes of tourist travel to the Park and to the diving sites on the coast. These volumes must necessarily remain small by the standards of SA’s burgeoning tourism industry; but, we supposed, we must make do with such development potential as exists in the region, however unpromising in size.

Second, we designed a scheme whereby people around Kosi Bay who engage in artisanal aquaculture - gathering fish and prawns the way their ancestors have done for generations - could retain larger shares of profits than they presently do through establishment of a cooperative that could exploit the new road to forge a direct link with retailers and thus eliminate transport and warehousing middlemen.

As with the hopes based around passing tourists, this is a modest economic ambition in light of the maximum possible aquaculture yields. This modesty implied that, by OVA principles, Kwangwanase should wait behind other Umkhanyakude centres, such as Jozini to the west, on the project priority queue. Nevertheless, it was SIDAP’s view in 2002 that the identified possibilities in Maputaland justified the new
paved road, making it a potentially sound investment in local development. But we cautioned that this might only be true if, along with the road itself, investment was put into assets necessary for the business capacity enhancements just described.

As it happened, Kwangwanase got the road and not much else. Road M439, now designated National Road S58, was completed in early 2004. It links Maputaland, and its border with Mozambique, into the national paved grid. A community market complex, a multi-purpose physical centre, and some small access roads were built along with the M439, but the aquaculture cooperative has yet to be established.

**Stunning tourist potential**

Accommodations for the wealthier sorts of tourists who go to Tembe and to the diving sites have not been capitalised or built. Pressure from environmental activists has kept access to the stunning potential tourist magnet of Kosi Mouth sharply restricted. (As a result of this, the 3 km stretch from Kwangwanase to Kosi Bay has not been paved). Eskom supplies electricity to the village, but there is still no formal sanitation system. Water is drawn from Lake Shengeze, the Maputa river and boreholes, treated at the local hospital and reticulated from there.

Public infrastructure, beyond the road itself, is limited to three schools (one secondary and two primary), the hospital, some provincial government department offices, a community hall and the police station. This does not mean that the objectives identified by SIDAP have been abandoned, but they have certainly not yet materialised.

Thus it might be expected that Kwangwanase would still be much as it was in 2002, only now with a few cars and lorries whizzing obliviously through it on their way to Mozambique. And what Kwangwanase looked like in 2002 was rural Africa in the full sense of the picture. The market featured people selling hand-picked fruits and vegetables, and far more craft products than local demand warranted, on the verges of dirt tracks that often turned into sand-traps for 2-wheel drive vehicles. There were few physical
shops, let alone standing private service businesses (where, when they exist, lie the truly impressive potentials for profit). This is the scenario that SIDAP expected to find still in place when we visited the village in August 2005.

**Hive of activity**

But it is certainly not what we found. Kwangwanase has become a hive of small businesses, with brightly painted facades and hand-lettered signs announcing original, often funny, identities. The photo reproduced here shows the shopfront of the designer who is responsible for many of the other fronts, and through whose sensibility the village thus gives its main first impression. Each small cinderblock building done up in his style sports a brick façade with three arches, usually painted pink, sky blue or lime green.

Spellings, as in the case of the architects, are frequently experimental. One of many beauty salons calls itself the “Afghanistan Saloon”. There are taverns, clothing stores, car-repair shops, cafes, stores selling household goods, and many cellphone kiosks from which people can place calls. Mixed among it all, but complementing rather than dominating the scene, are representative South African branded chains: Engen, Steer’s, First National Bank and others.

These shops line the new road and the access streets perpendicular to it. On both days of our visit, bustling crowds of pedestrians surged back and forth across the road, leaving no doubt that, however much money there might in fact now be in Kwangwanase, it is circulating vigorously.

**However much money there might now be in Kwangwanase, it is circulating vigorously**

What has happened here? Many towns in rural KZN have been given physical market-places, and we know from experience that this, in itself, does not cause commerce to spring to life. Has the road brought the tourists we hoped for, and have they paused for longer and spent more than we expected? Is increased lorry traffic bearing trade to and from Mozambique part of the explanation? How has a road, and a bit of associated roadside infrastructure, wrought so much apparent economic transformation so far from any major centre of population, industry or commercial agriculture?

Proximity to a border that can now serve lorry traffic seems not to be a significant part of the story. The border post is small and the traffic we observed through it is still light and sparse. This corresponds to what recent statistics tell us about trade volumes between SA and Mozambique: they are growing, but slowly and from a very low base, as Mozambique struggles to supply the technical capacity
necessary to lower established barriers to the free flow of goods.

The hypothesis that the road has brought more big-spending tourists than anticipated also seems untenable. There is, to be sure, a craft market on the most salient corner, offering a mix of non-standard carvings superior in quality and originality to most such stands in SA. The customers for this are surely drive-through tourists. Yet one of the kinds of store in greatest abundance are beauty salons, and their signs and facades announce emphasis on services that are clearly aimed at South Africans: aromatherapy, hair-straightening and other recent local fads. Foreign tourists on their way to go diving or see elephants are not likely to be on the lookout for high-heeled shoes - which are on sale in abundance. As indicated above, one can simply look and see that most of the people shopping are not from abroad - and, for that matter, not in cars. This expresses the puzzle most starkly. Why should a new road stimulate business that appears to be based mainly on pedestrian traffic? The old dirt roads weren’t especially challenging to people on foot.

**Kick-start**

Could it merely be a coincidence that Kwangwanase has suddenly sprung to life as a market at the same time that it was joined to the paved road network? Might our thinking that a road alone has kick-started development in Maputaland just be based on a spurious correlation?

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**Household survey**

We will not be able to be sure that the road has created a new economy until we conduct and analyse a proper, scientifically designed, microeconomic household survey. After what we saw, doing this is now high on SIDAP’s priority list. But formal tests need to be inspired by motivated hypotheses, and, based on something else we observed in the village, we have one.

This hypothesis represents a possible link between rural roads and rural economic development that had not occurred to us until our recent experience of Kwangwanase. On the outskirts of the village, for about five miles in both directions along the new road, substantial houses are either newly built or are under construction. Who is building them?

Again, only a careful household survey can answer this question fully reliably. However, anecdotes suggest the answer. A number of people from the area have found solid careers working for government or for corporations in Durban, Richard’s Bay and Gauteng. As subjects of their indunas, they are entitled to 99-year allotments of land on which they can build houses of a size and repose they could not afford in the urban centres - and which might well not be as significant to them there, away from their family networks, anyway. We conjecture that the service trade we saw in...
Kwangwanase is primarily called forth by demand from the builders of the new houses and the money they bring with them and set into local circulation. If this conjecture is correct, then Maputaland is being developed not by the government, but by its own sons and daughters.

**New sedans**

Of course, this last remark must be qualified in one crucial respect. Had the road not been built, few people would or could have considered a lifestyle involving regular shuttling between Kwangwanase and the cities. On SIDAP’s previous trip to the area, in early 2002, we made a slow and dusty journey in a Landrover; now one can get there by car from Durban in under four hours. Beside most of the new houses we saw new sedans parked - not bakkies or SUVs.

There have often been worries raised in SA - we have sometimes raised them ourselves - that if roads in rural areas were improved in the absence of investment in complementary public infrastructure, the main result would be accelerated migration to the cities of both people and money.

**Value chains**

This concern has been exacerbated by the decline in remittances from mine workers, long a principal source of rural income. (We should note that no one yet has, to our knowledge, successfully measured this decline.) But perhaps we have overlooked a new and different kind of remittance that has become feasible in the new dispensation of democracy and economic empowerment of formerly oppressed groups.

If successful people from Kwangwanase are setting up country homes there, this is likely to be a more productive source of remittance, because it brings to the area not only money itself, but also sophisticated consumers whose complexity of tastes will force local businesspeople to think their way up value chains (i.e., away from middle-transaction goods retailing and toward service provision and proprietary brands). The returners’ knowledge of the so-called ‘first economy’ and its institutions may be expected to demonstrate the importance of formal education to local young people; and the returners will also be in better position than others to counsel young scholars on setting ambitions and choosing subjects. Education and the fostering of well-informed ambitions are probably more central to SA’s development than any other set of factors.

Thus the experience of Kwangwanase may be showing us that, at least under some circumstances, roads alone can be even more powerful development engines than we in SIDAP have been emphasising over the past few years. Up the other path from Hluhluwe to the west, Jozini still has not got the enhanced road that has been planned for it; and it still looks much as it did at the
end of the old regime. Thus the accidents of politics have provided us with something like a controlled experiment on the economic importance of roads. The control group does not appear to be the one a community would wish to find itself in here. We have stressed throughout that we are not here reporting a carefully confirmed result - let alone a quantitatively estimated one - but an hypothesis based on casual observation and anecdote. SIDAP will now round up funds to test the hypothesis. If it is validated, we may be in a position to echo the Beatles, but with less need of license for poetic exaggeration, and say that, at least sometimes, all you need is roads.
New CSIR unit to support built environment

The built environment is a critical underpinning component of socio-economic development in any country, relating to the quality of facilities, shelter, accessibility and mobility of persons, goods and products. Infrastructure, transportation and the related environmental aspects can no longer be seen as distinct but need to be integrated with the whole built environment value chain. Support to the built environment is high on the national agenda.

To spearhead the CSIR’s knowledge generation and application activities in support of this critical sector, the organisation has reconstituted its strategic activities focusing on the built environment as a single new unit. This has enabled the CSIR to create better economies of scale and build more focused competence bases. This is in line with the international trend amongst R&D organisations to create convergent, multi-disciplinary units to better address economic, social and environmental sustainability issues inherent in the domain of the built environment.

Launched on 1 July 2005, CSIR Built Environment aims to provide appropriate technological solutions to enhance the impact of the built environment, infrastructure-related economic operations, transport and logistics, and the construction industry on the sustainable development of South Africa, the southern African region and the rest of the continent.

There is a strong emphasis on the combination of competencies to ensure the delivery of integrated technological solutions at a higher level. This is done in collaboration with both local and international stakeholders and clients, where appropriate.

CSIR Built Environment is expanding its offerings in support of the asphalt industry in southern Africa. Relevant competence areas currently include:

Infrastructure engineering

This is designed to provide practical, innovative, cost-effective R&D-based solutions that address the infrastructure needs and future challenges of the built environment, support sustainable development and asset preservation, and enhance socio-economic impact and industry competitiveness.

This competence area is structured to provide dedicated focus to three sectors of the built environment, namely transport...
infrastructure, port infrastructure, and housing and buildings.

The Transport Infrastructure Engineering research group provides innovative engineering solutions for the design, construction and maintenance of transport infrastructure assets (e.g. roads, streets, airports, railways) based on basic and applied research supporting the provision of a sustainable and cost-effective transport network.

Closely associated with this sector is the Accelerated Pavement Testing (APT) research group, which not only provides the necessary data on the behavioural characteristics and performance of pavement materials and structures when tested under accelerated loading, but also fosters international collaboration in accelerated pavement testing. Other research groups in the infrastructure engineering competence area include:

- Coastal Engineering and Port Infrastructure, which supports the safe and cost-effective development and operation of ports and coastal sites; and
- Housing Technologies and Building Physics, aimed at providing innovative engineering solutions in support of sustainable construction. The aim is to enhance safety and design reliability, and expand the application limits of structural materials, elements and systems.

Research activities in the field of infrastructure engineering are complemented by laboratories and workshops, which provide specialised testing services and develop specific equipment in support of the science, engineering and technology needs of the infrastructure engineering sector.

**Construction**

Supporting both the private and public sectors in South Africa by providing R&D-based solutions, this sector aims to improve the performance and competitiveness of the construction industry. This includes human resource development, as well as the application of S&T in the areas of construction and maintenance methods and materials, and construction industry development.

Researchers are actively involved in the areas of labour-based construction, contractor development and employment creation, contractor incubation, innovative construction materials and methodologies, construction industry performance measurement, procurement, construction skills development, and best
practice in construction quality, health, safety and environment. CSIR Built Environment also houses a number of agency-type functions in support of the asphalt industry. These include:

- **Agrément South Africa**, an internationally acknowledged, independent centre for the certification of non-standardised construction products through technical assessments that verify whether the products and systems are fit for purpose; and

- **The Asphalt Academy**, which aims to coordinate and facilitate knowledge and skills development in bituminous product technology by standardising courses at learning institutions; disseminating information to practitioners and participating in programmes to promote cooperation and efficient development of scarce resources.
The CSIR recently reconstituted its strategic activities focusing on the built environment into the new CSIR Built Environment unit.

The aim of the new unit is to provide appropriate technological solutions to enhance the impact of the built environment, infrastructure-related economic operations, transport and logistics, and the construction industry on the sustainable development of South Africa, southern Africa and the rest of the continent.

Competence areas in support of the asphalt industry in southern Africa include:
- transport infrastructure engineering
- accelerated pavement testing
- construction and maintenance methods and materials
- construction industry development.

CSIR Built Environment also houses agency-type functions in support of industry, such as Agrément South Africa and the Asphalt Academy.

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For some time now many company CEO’s have adopted a “triple bottom line” approach to formulating company policies and business plans. This policy is often referred to as “PPP”, in which the prosperity of the company is put side by side with the needs of the people and the planet.

In other words, prosperity or profitability should not be pursued at the expense of compromising employee wellness and damage to the fragile environment. While this stance may seem a commendable, voluntary commitment, we should make it clear that a responsible approach to worker health and safety, and to environmental conservation, is actually an OBLIGATION – it is no longer a CHOICE.

So, while Sabita will always strive to advance products and services that will improve efficiency, cost-effectiveness and competitiveness, we will continue to promote and entrench work practices that safeguard the health and safety of workers and care for the natural environment.

IARC monograph on bitumen fumes

Currently underway is a €2.2 million study, being carried out by the International Agency for Research into Cancer (IARC), to examine the carcinogenicity of bitumen fumes. The funding is provided by organisations such as Eurobitume, EAPA, TAI and NAPA.

The purpose of the study is to examine the contribution of confounding factors such as past exposure of workers to coal tar fumes and vapours, and lifestyle factors. The aim is to corroborate the findings of past research which found that there is inadequate...
Evidence that bitumens alone are carcinogenic to humans (IARC Monograph Vol. 35, 1985, p. 39).

Nested case control and cohort studies form the backbone of the work to be carried out by IARC. To underpin an objective and accurate outcome of the study, the global bituminous product industry has requested the American Conference of Government Industrial Hygienists (ACGIH) and MAK to host a symposium to be held in Dresden in 2006, where expert scientists would present peer reviewed papers on, for instance, epidemiological and inhalation studies.

It is believed this will assist IARC to incorporate current knowledge into a monograph on bitumen fumes. It is the intention of Sabita to contribute to the costs of the international health symposium for two reasons:

- the findings may well impact on the bituminous product industry in SA; and
- to demonstrate its support for global efforts to ensure that the wellness of workers is safeguarded.

**Bitsafe course**

Sabita has developed a safety training course for the handling of bituminous binders. The course has been designed in a modular format in order to:

- accommodate all levels of employees given the diversity of our local cultures;
- allow for short interventions of one to two hours therefore minimising the impact on production.

The course consists of 13 training modules which cover all the activities normally associated with the handling of bituminous binders, namely:

- Module 1: Understanding the industry that you work in;
- Module 2 (a): Hazards: general;
- Module 2 (b): Hazards: fire prevention;
- Module 3: Health and safety awareness;
- Module 4: Reducing risk;
- Module 5: Treatment of bitumen burns;
- Module 6: Our environment;
- Module 7: Loading of liquid bitumen;
- Module 8: Transport of bitumen;
- Module 9: Sampling and testing;
- Module 10: Storage;
- Module 11: Disposal of bituminous waste;
- Module 12: Application of bituminous binders.

**Implementation**

The implementation of the Bitsafe course will be done through the recruitment and training of selected member employees as trainers. The trainers, once they have undergone comprehensive training, will be required to conduct the training at their respective places of work. The successful implementation of the Bitsafe course will largely depend on the trainers, and it is essential
that the selected trainers have, *inter alia*, the appropriate work experience and skills to relate the theory to practical situations.

The trainers will have the support of training material consisting of:

- Trainers manual covering all the modules;
- PowerPoint presentation or overhead slides;
- Introductory video.

Each member company will be expected to train all their employees within a certain time period. All learners will be required to be assessed on-the-job by the trainer to ensure that they have a clear understanding of and are competent to conduct the respective activity in a safe manner. On completion of all the modules, Sabita will issue certificates to all the successful candidates.

*Load Accreditation Programme (LAP)*

Sabita has formed a steering committee to investigate the implementation of a load accreditation programme for the transport of hot-mix asphalt from the plant to point of use. LAP is a cooperative venture involving the consignor, transporter and consignee, with potential economic benefits such as improved road safety, driver wellness, infrastructure preservation through overload control and improved vehicle payload efficiencies.

LAP is an initiative of the National Department of Transport to encourage self-regulation in the transport industry. With weighings on some of our national and provincial roads recording up to 40% of heavy vehicles being overloaded, LAP is seen as a key strategy in effecting overload control.

**LAP in the asphalt industry**

The implementation will be modeled on the successful implementation of LAP in the forestry industry. The plan is to implement the programme firstly as a pilot project in the Western Cape before going countrywide.

The implementation of LAP is not seen as highly problematic, given that the tippers are loaded and weighed on assized weighbridges at the premix plant before transporting their loads to sites. Tippers which have been accredited by the LAP will be exonerated from making time consuming detours to provincial weighbridges. This will obviate the possibility of the asphalt arriving on-site too cold for placing, and the probable need for it to be
dumped — which in itself creates an environmental problem.

The LAP implementation steering committee consists of representatives from:

- **Government Bodies:**
  - NDoT, PGWC, SANRAL;
- **Service Providers:**
  - CSIR;
  - National Productivity Institute;
  - Transport Consultant;
- **Sabita;**
  - More Asphalt;
  - Much Asphalt;
  - Tipper transport operators.

Sabita has also been invited to sit on the National LAP Steering Committee, along with other industries including ASPASA and C&CI.

**Replacement of tar**

Sabita has embarked on an awareness programme to discourage the use of coal tar binders in road construction due to the hazards posed by tar products to worker health and the environment. Certain road authorities like SANRAL, PGWC and Gautrans have heeded the call by prohibiting the use of tar based products on their projects.

These products were used mainly for priming bases and precoating road stone. Initially some concern was expressed that tar based products were unrivaled in their performance, and that the alternatives were not as cost-effective.

However it was not long before alternative, safer products and construction practices evolved. Who ever said ‘necessity is the mother of all inventions’ was not wrong!

**Stone precoating**

Precoating of road stone is primarily done to improve the adhesion between the stone and binder. In the case of a highly viscous binder like bitumen rubber, it helps to breakdown the surface tension and, in the case of quartzitic aggregates, it helps reduce dust generation. There are also some added perceived benefits such as producing a more uniformly blackened surface so that the line markings will stand out more distinctly.

Nevertheless, practitioners have opted to increase the use of diluted cover sprays in conjunction with bitumen based precoating fluids in the construction of seals. In the case of new construction and where possible on reseals, the road has been kept closed to traffic overnight until adequate binder/stone adhesion has been achieved.

Other practices include the use of bitumen emulsions in the tack, and penetration sprays which negate the use of precoating fluids altogether. The industry will need to pay more attention to the cleanliness of the aggregate, minimising the distance between the sprayer and chipspreader during construction to minimise the risk of stone "whip-off".
**Priming of bases**

While cutback bitumens and inverted bitumen emulsions have been used for priming bases, tar primes were preferred in some cases as they were:

- quicker drying, especially in colder weather; and
- could penetrate better, especially in wet conditions, as a result of their higher densities (1.1 kg/litre vs 0.9 kg/litre for MC 30.)

This is particularly the case when priming very dense surfaces like G1 bases in moist/cold environments. Research work is currently underway by suppliers to develop cutback primes which are quicker curing with more effective penetrating power. It is hoped that once this research work is completed, the SANS 308 specification for cutback bitumen will be updated to incorporate these latest developments.

The prohibition of coal tar products has resulted in changed work practices and seen the development of alternative, more user friendly products. It is hoped that these practices, which are being incorporated into project specifications, can be included in the TRH 1 manual: *Prime coats and bituminous curing membranes* when it is eventually updated.

The progressive replacement of tar products with healthier, safer and more environmentally friendly products is a big step on the road towards making our industry a safer and friendlier environment in which to operate.

**Incident reporting**

For the effective implementation of an industry safety training programme like Bitsafe, we need to monitor the occurrence and type of workplace incidents relating to worker safety and health. Only then will we know the true extent and nature of the dangers associated with the various activities. The collection of this information is vital if we are to determine trends and update our safe work practices to avoid future incidents.

Any event which results in or could reasonably have caused injury, illness, exposure above legal occupational limits, damage to property, fire, explosion or product spillage must be reported. Each incident must be investigated by an investigating team and documented. To successfully address any particular problem we need to know the route cause of that problem. This demands that the underlying causes be accurately identified, and steps taken to prevent further events of the same nature from occurring.

**While incident reporting may seem onerous at the outset, it must become a mindset**

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**Implementation**

Each member company must appoint a person to report and coordinate the investigation of incidents at the various work sites. Incident reports must be forwarded to Sabita, and must include preventative and corrective actions. The incidents will be recorded for statistical purposes, and a register of lessons learnt will be compiled and circulated to all members.

This information will become the cornerstone on which Sabita will update its Bitsafe training course material and Safety File on safe work procedures and risk assessments. While it may seem onerous at the outset, it must become a mind set which we actively cultivate to make people more safety conscious. For this objective to have any chance of succeeding, it has to be recognised as a priority by the CEOs of member companies. In other words, the implementation of a functional incident reporting system must be seen not as an option, but as a non-negotiable requirement for the effective operation of business.

**Bitumen waste disposal**

During 2003/2004, Sabita applied to the Department of Water Affairs and Forestry (DWAF) for the delisting of penetration grade bitumen as a hazardous waste. Delisting was granted for disposal at permitted sites under certain conditions. These conditions include permit application, and once the permit has been issued, the site must keep accurate records of date, volume and type of bitumen disposed of, and inform DWAF on a quarterly basis. Only landfill sites fitted with a leachate detection system qualify for such a permit.

**Site availability**

Sabita has investigated the availability of suitable permitted general waste disposal sites throughout South Africa for disposal of delisted penetration grade bitumen. The objective is to manage and control the disposal of small quantities of unused or disused bitumen. Once in place, this new dispensation is expected to promote the legal disposal of certain bituminous products in designated and permitted landfill sites.

Nineteen such sites have been identified and are currently being approached for permits. These include:

**KwaZulu-Natal:**
- Bisasar Road  GLB+
- Empangeni  GMB+
- Eshowe  GSB+
- Hammersdale GMB+
- Hilton  GSB+
- Pinetown South  GLB+
- Richards Bay  GLB+

**Gauteng:**
- Sebokeng Zone 16  GMB+
- Verref Rietfontein  GLB+
- Springs  GLB+
- Goudkoppies  GLB+
Western Cape:
Bellville South  GLB+
Coastal Park    GLB+

Eastern Cape:
Second Creek   GLB+
East London    GLB+
East London    Regional GLB+
Grahamstown    GMB+
Koedoeskloof   GLB+

To facilitate a practical distribution of suitable landfill sites countrywide, the following sites with limited leachate control are also being investigated:

Sites requested to permit:
Bloemfontein North and South  GLB-
George                     GLB-
Arlington, Port Elizabeth  GLB-

There are no indications of how long it will be before the selected sites become available, but DWAF head office has informed all the regional offices about the process and good cooperation is expected to facilitate the process.

Sabita Safety File

Sabita has initiated the production of a comprehensive Safety File designed to assist its members in the compilation of a statutory Contract Safety File as stipulated in the Occupational Health and Safety Act (OHS) (Act 85 of 1993) and the various regulations promulgated in terms of that legislation.

The document is intended as a guideline for all companies and practitioners involved in the construction of bituminous surfacings and layer works, and details general and statutory requirements for compliance with the OHS.

The opening section of the guideline gives examples of a typical safety management structure, and outlines the specified contractual and safety management responsibilities of all companies engaged in construction operations. Personnel appointments, and the specific duties and responsibilities of all persons appointed to safety management positions in terms of the OHS Act, are also specified.

Pro-forma appointment forms for the various levels of safety personnel are also included in a series of appendices.

The main section of the guideline addresses recommended risk assessment and safe working procedures for a comprehensive range of construction operations and plant usage related directly to the handling and application of bituminous products.

The Sabita Safety File is scheduled for publication early in 2006.
Power Construction advert
on film
Half page centred
Very early during the period under review, the composition of Council suffered a tragic loss, with the sudden passing of Philip Kuun, the Chairman of the Southern Region. Graeme McGregor courageously stepped into the breach and took over this portfolio, handling the duties of running a region with courage and distinction.

Council agreed to a slight restructuring in the manner in which the Society is managed with the formation of an Executive Committee (Exco) comprising of the President, The Honorary Secretary and the Honorary Treasurer. This has streamlined the handling of the detailed business side of things, leaving the Council to deal with the strategic and regional activities, such as encouraging regional activities, promoting the image of SAT (eg the website), membership growth, marketing the aims and objectives of SAT, ensuring the continuity of activities with the Asphalt Academy, financial transparency and stability, promotion of SAT in sub-regions.

Elzbieta Sadzik continues to exert firm control over the finances of the Society, often operating under very stressful conditions when funds are short, whilst Duncan Mason manages the business in terms of his duties as Honorary Secretary.

The team of four regional chairpersons, Craig Bradley (East), Graeme McGregor (South), Basil Jonsson (Central) and Duncan Smith (North) has been enlarged to accommodate the formation of a new region, the Eastern Cape, run by Renaldo Lorio. The purpose of this is to service those members who traditionally fell under the Southern Region but were not able to attend activities and functions due to distance.

Administration

The two ex-officio members (Piet Myburgh and Les Sampson), remain unchanged and make up the balance of the Council.

The day to day administration of the Society has been taken over from Pat Loots by Vanessa Mason. Vanessa has stepped into the breach with amazing enthusiasm and aplomb, considering the boots she was asked to fill. And on that note SAT thanks Pat Loots profusely for the incredible work she has done for the Society during her tenure as secretary. Her efforts were nothing short of amazing when one considers that...
she was heavily involved with CAPSA, as well as her Asphalt Academy duties. We are eternally grateful to Pat for her hard work for the Society.

**Regional reports**

**Eastern Region**  
*Chairman*  
Craig Bradley

The thirteen-strong committee of the Eastern Region, comprising representatives from consulting engineers, the contracting industry and client bodies, has been actively involved in the organisation of seminars for its members as well as other interested parties. The committee meets every six weeks or so to plan and coordinate seminars for the region of which five have been programmed for 2005 — approximately one every second month. At the time of writing four of these have been successfully held with the final seminar and Regional AGM planned for mid-November 2005.

**Membership**

The Eastern Region has a strong membership base of 130 members made up from representatives of all sectors of the industry. The focus of activities this year has been broad based to offer something for everyone. The seminars attract between 40 and 50 attendees each of which the majority are members. New membership is encouraged and is reflected in the numerous requests for applications after seminars.

This heightens the perception that SAT has a valuable role to play in the dissemination of industry developments and happenings, both in our region and on a national level.

**Seminars**

The yearly activities kicked off with the first seminar being held on 5 March 2005. Three guest speakers presented interesting talks on the rehabilitation of the M4 Southern Freeway, a major arterial linking eThekwini (Durban) with the airport. The design aspects of the project were covered by Stuart Anderson, and Wynand Nortje highlighted some of the interesting aspects relating to the construction of the asphalt base and surfacing. Francois Bornmann concluded the session with a talk on the development of a plastomer modifier in the asphalt modifier, which was used on this project.

The second quarter seminar was held in May of this year and included well-received presentations on the use of slurry bound macadam surfacings in low volume roads by Johan Hattingh, the use of the MMLS and gyratory compaction by Hennie Loots, and an overview of HMA production by John Onraët.

July 5 saw the launch of SAT’s *Hot-Mix Asphalt Trouble-shooting Guide*, produced as a hands-on pocket guide which was put together by leading practitioners in the asphalt industry in South Africa. The committee was fortunate in being able to arrange

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a talk by Julian Wise, the compiler of the guide, who took delegates through the history, compilation and functionality of the guide. A very well received presentation by Joe Grobler on common problems in asphalt complimented the launch of the guide superbly.

After a three month break, the fourth seminar was held in October and focussed on surfacing seals. Deon Pagel gave a presentation on the development of a manually operated chip spreader suitable for labour intensive surfacing seals, which is produced locally. The TRH3 Seal Design manual came under the scrutiny of Corne Roux during his presentation on a very useful seal design software programme, which he developed, demonstrated and made available to the delegates.

The concluding seminar for this year is planned for mid-November where Prof. Fred Hugo will talk on developments of the MMLS and may also include a demonstration of the unit by Hennie Loots.

Southern Region
Chairman
Graeme McGregor

It has been a successful, although difficult year for SAT Southern Region, with the passing away of our chairman, Philip Kuun, last December. Our condolences are extended to his family and colleagues. He left a large void which has been difficult to fill, both technically and from a continuity point of view. However, with an extremely self-motivated committee consisting of an excellent cross-section of suppliers, clients, consultants and contractors SAT Southern Region’s performance has been highly satisfactory.

The highlight of the year was the launching of our Hot-Mix Asphalt Trouble-Shooting Guide. We were especially proud that this workshop was presented by Julian Wise, the compiler of the guide, and Dave Wright, a reviewer. This seminar was extremely well received, with an attendance so good many members were forced to sit in the aisles.

Positive feedback

A great deal of positive feedback was also received. We must not forget to mention that the guide was a SAT Southern Region initiative which grew into a SAT National project. Thank you to all those who contributed to what has been a most successful booklet as well as SAT National for their vision.

Thanks also to Sabita for providing this opportunity, through the Digest, to acknowledge Julian Wise, whose competence, diligence and tenacity have become synonymous with the successes of SAT Southern Region.

The year started off, albeit slower than envisaged, with an informative cocktail hour presentation by Piet Plantema of Vela VKE on the rehabilitation of the N1 in Cape
Town using *inter alia* an Ultra Thin Friction Course (UTFC). This has whetted the appetites of the SAT members, and a full seminar on UTFC’s is planned for the latter part of the year or early next year. We also thank the Milnerton Life Saving Club for the use of their clubhouse.

The cocktail hour was followed by a workshop on Bitumen Modifiers for Hot-Mix Asphalt, presented by a cross-section of the industry including eminent presenters from up country. The cross-pollination of expertise from other regions provides excellent information transfer so vital to the success of SAT.

The second cocktail hour for the year was held in October, addressing the new specifications and methods to measure rideability, ie. International Roughness Index (IRI).

**New blood**

The Southern Region, I am pleased to say, has benefited from all the above over the past year. We have an excellent database of committed and loyal members who have supported the organisation and the activities of the region. SAT Southern Region strives to reach all corners of the asphalt industry and to broaden its membership base to include and encourage contractors and new young blood. The popularity of this policy is evident in the excellent attendance records both of members and new-comers. The committee thanks them sincerely and looks forward to their support in the future. It is you, the members and our sponsors, who have helped the committee to establish a healthy bank balance and hence improved the cash flow of SAT nationally.

**Central Region**

*Chairman*

*Basil Jonsson*

Our Central Regional Committee was pleased to welcome several new young members, including Bruce Morton, Ron Berkers, Alex Weideman and Jannie Grobler. These additional members have added a new injection of drive into the committee. Now that the new committee has settled down, a more focused and driven SAT Central will move into 2006.

**Structured approach**

The Central Region regrettably said goodbye to Rob Brown who resigned from SAT to move “down under”, looking for greener pastures. He had a long-standing relationship with SAT, serving as Central Regional Chairman and then National President, preceding our current President, John Onrået. Ron Berkers has been appointed to the secretarial position, replacing Rob Brown.

The seminars held during the year were well attended by SAT Central members, with an average of 85 people attending each function.

It was decided by the committee to have a more structured approach in 2006, in order to share the fundamentals of road
construction, component materials and asphalt knowledge with a broader spectrum of the road building fraternity i.e. the younger engineers and technicians, as well as to present the latest advances in the subject of asphalt to all who would be interested and would benefit therefrom. The following activities have taken place during the 2005 year:

- 9 June 2005 - Site visit to Bethal/Kriel in situ foamed bitumen contract;
- 11 August 2005- Coldmix Asphalt Seminar at which nine companies presented their products at the Gautrans Laboratory in Pretoria.
- 7 September 2005 - Modified Binders Seminar held at Tswane University of Technology
- 17 November 2005 - Site visit and technical presentation on asphalt manufacture at Much Asphalt’s Roodepoort operation.

Overview
John Onraët, President

It is widely known that the Society has experienced some serious economic woes this year, mainly as a result of unpaid membership subscriptions due to movement and untraceability of members in a volatile industry. Unacceptably high levels of outstanding subscriptions had to be written off as a direct result of this problem. This situation was compounded by the fact that a heavy financial obligation was due to the Receiver resultant from regions operating as if they were not VAT registered. The problem was resolved by employing KPMG at significant cost, which depleted our reserves even further. It is pleasing to note that SAT is now de-registered as a VAT vendor.

Cash flow has been a problem, but I am pleased to advise members that, due to increased regional activities and the sales of the Trouble-Shooting Guide, we are slowly but surely winning the battle. However, activities in the regions must continue to generate revenue, and members must be encouraged to pay their subs as soon as possible.

The Council is seeking ways and means of keeping up this momentum of recovery, and austere cost cutting measures, as well as increased subscriptions, can be expected in the 2006 year.

My thanks go to the members of Council who have supported me in my presidential activities, to Vanessa for her diligence, and my congratulations go to the regional committees for offering their time and efforts voluntarily to keep the Society alive. May 2006 see substantial growth in SAT.
2

Education and Training
A
s part of the Asphalt Academy’s (AsAc) ongoing analysis of road industry needs, road authorities, consulting engineers and other practitioners have raised concerns about the lack of knowledge in pavement engineering shown by newly graduated civil engineers and civil engineering technicians.

As a consequence, organisations have to spend considerable time and resources before the new entrants into the road sector can be effectively utilised.

Although various institutions present courses either on demand or as part of continuing education programmes, there is a feeling that the content of the courses is fragmented, the courses are not held on a regular basis and often have insufficient practical content. Various universities and universities of technology offer semester block courses in transportation engineering or urban engineering either as a part of a postgraduate qualification, or simply for individuals to gain further information. However, actual lecture time is relatively short (eg a total of 20 hours for the semester block course at the University of Pretoria) with the remainder of the learning accomplished through self-study and on-the-job training. The end result is that several years pass before newly graduated engineers have sufficient knowledge to contribute significantly to his/her organisation’s workload.

Therefore, AsAc has initiated the development of a flexible pavement engineering block course to provide the necessary theoretical and practical training for new civil engineers and technicians entering the roads sector.

Overall theme

In an initial investigation, a course program was proposed that has been discussed and revised at
## Module 1: Materials Investigation and Materials Design

### Overview
- Effects of geology, hydrology & climate
- Site investigation/centre-line survey
- Materials testing linkages & principles durability
- Characterisation and classification
- Mix design
- Quarries and crushing techniques/borrowpits
- HSE & EIA issues
- Performance models & application in pavements
- Linkage to project assignment

### Contents
- Brief history and needs for roads
- Overall concepts to road design & construction
- Urban vs rural
- Plant vs labour
- Outline of project structure & approach
- Project planning
- Geometrics & project alignment
- Balance of earthworks

### Duration
1 week

---

## Module 2: Materials Investigation and Materials Design

### 2a: Unbound materials
- Stabilising agents (bitumen (emulsion & foam), cement, lime, others)
- Recycled materials
- Materials testing linkages & principles durability
- Characterisation and classification
- Mix design
- Performance models and application in pavements
- HSE & EIA issues
- Linkage to project assignment

### 2b: Stabilised materials
- Component analysis (bitumen (unmodified & modified), aggregate, filler)
- Recycled materials
- Materials testing linkages & principles durability
- Characterisation and classification
- Mix design
- Performance models and application in pavements
- HSE & EIA issues
- Linkage to project assignment

### 2c: Asphalt materials and seals
- Component analysis (bitumen (unmodified & modified), aggregate, filler)
- Recycled materials
- Materials testing linkages & principles durability
- Characterisation and classification
- Mix design
- Performance models and application in pavements
- HSE & EIA issues
- Linkage to project assignment

### Duration
1 week

---

**Table 1a: Modules 1 and 2**
### Module 3 to 7

<table>
<thead>
<tr>
<th>Module 3: Structural Pavement Design</th>
<th>Module 4: Tendering &amp; documentation</th>
<th>Module 5: Construction &amp; Techniques</th>
<th>Module 6: Maintenance &amp; Asset Management</th>
<th>Module 7: Final Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a: New Construction</td>
<td>3b: Rehabilitation</td>
<td>Tendering procedures</td>
<td>Compaction</td>
<td>Principles of maintenance management</td>
</tr>
<tr>
<td>Principles of pavement design</td>
<td>Pavement evaluation techniques (FWD etc)</td>
<td>Targeted procurement</td>
<td>Plant techniques</td>
<td>Site inspection/ modes of failure</td>
</tr>
<tr>
<td>Traffic categorisation</td>
<td>Principles of rehabilitation design</td>
<td>Document compilation &amp; submission</td>
<td>Constructability</td>
<td>Management systems</td>
</tr>
<tr>
<td>Effects of traffic and climate</td>
<td>Traffic categorisation</td>
<td>Specifications</td>
<td>Application &amp; construction of HMA</td>
<td>Life-cycle costing</td>
</tr>
<tr>
<td>Design methods</td>
<td>Effects of traffic and climate</td>
<td>Standard specifications</td>
<td>Quality control</td>
<td>Maintenance techniques</td>
</tr>
<tr>
<td>Empirical mechanistic catalogue</td>
<td>Approaches (TRH12 etc)</td>
<td>Project specifications</td>
<td>Materials testing</td>
<td>Labour-based vs plant</td>
</tr>
<tr>
<td>Linkage to test results</td>
<td>Design methods</td>
<td>Contract documentation</td>
<td>Stochastics</td>
<td>Selection criteria</td>
</tr>
<tr>
<td>Stochastics</td>
<td>Empirical mechanistic</td>
<td>GCC, FIDIC</td>
<td>Contract</td>
<td>Asset management principles</td>
</tr>
<tr>
<td>Linkage to test results</td>
<td>Linkage to project assignment</td>
<td>Materials utilisation document (mass haul)</td>
<td>administration</td>
<td>Systems</td>
</tr>
<tr>
<td>Stochastics</td>
<td>Pavement evaluation techniques (FWD etc)</td>
<td>Pricing principles</td>
<td>Site establishment</td>
<td>Data collection</td>
</tr>
<tr>
<td>Linkage to project assignment</td>
<td>Principles of pavement design</td>
<td>Bills of quantities</td>
<td>Certification and payment</td>
<td>Performance indicators</td>
</tr>
</tbody>
</table>

**Table 1b: Modules 3 to 7**
advisory meetings attended by AsAc, CSIR, the universities and the universities of technology. It was decided that existing courses should be used as far as possible. The proposed course structure (shown in Table 1 with the proposed length of each of the seven modules) is being developed to include an overall project theme for the design and construction of both a new road and a rehabilitated road that will be carried through all the modules and evaluated as part of the course on completion. The process should ideally be suited for partial fulfilment of professional registration requirements.

Currently, an assessment is being made of available course material, identifying gaps in existing course material, planning and development of the course and assistance with the finalisation of the material. The objective is to ensure that a viable course is available in the first half of 2006.

The expected benefits of the course will be the fast tracking of technology transfer in the area of flexible pavement engineering to recently graduated civil engineers, technicians and technologists employed by road authorities, consultants and contractors.
PROMOTING AN INFORMED AND KNOWLEDGEABLE BITUMINOUS PRODUCTS INDUSTRY

Courses:
- Introduction to Bitumen
- Application of surfacing seals
- Application of Hot Mix Asphalt
- Design of surfacing seals
- Design of Hot Mix Asphalt
- Asphalt testers Course
- Quality Management of Bitumen
- Flexible Pavement Engineering (June '06)

Publications:
- TG 1: The use of modified binders in road construction
- TG 2: The design and use of foam bitumen treated materials
- Knowledge transfer
- Ad hoc, best practice workshops and seminars (see web site for details)

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A SABITA/CSIR JOINT VENTURE
Maintaining and expanding the bituminous knowledge base at South African educational institutions

Barry Pearce
Lecturer
Cape Peninsula University of Technology

Many years back, or so it seems, Prof Martin van de Ven, then head of the Sabita Chair of Asphalt Pavement Engineering at the University of Stellenbosch, held a workshop for lecturers from all South African tertiary institutions, known at that stage as technikons and universities. The purpose of the workshop was to look into the content and quality of the subject matter relating to bituminous materials within the courses presented. It was also an opportunity to meet other lecturers who worked and lectured in similar fields.

One of the objectives was to disseminate the latest knowledge in the field of bitumen and related road building materials to all lecturers in South Africa, as well as to make an assessment of the level of “expertise” or knowledge of the lecturers about bituminous materials. I was surprised to hear during the workshop, in both group discussions and individual conversations with colleagues from other institutions, that the technikons and universities covered very little on bitumen and related materials in their course content. Another startling point was the number of lecturers that where presenting courses on bituminous related matters, but had little if any understanding of how the materials behaved under given circumstances, or even the most basic knowledge of bituminous terminology.

Compare notes

I believe the course itself was of great benefit to all who attended and should be resurrected. I feel that it could also be held regularly, say every two years, to update and used to bring all the bituminous lecturing staff in the country up to the same level. It would also give those lecturing in such subject matter time to compare notes in an organised and controlled environment. This would ensure a more uniform coverage and incorporation of bitumen and related topics into the relevant courses countrywide.

At this point there are only a handful of lecturers employed in tertiary institutions who have a fair working knowledge of bitumen. I believe it is imperative to retain the existing knowledge base through various incentives.
and initiatives to ensure that the students qualifying have sufficient knowledge of this important road building material. I also believe that all graduates involved in the roads industry should understand the basics of what this special material can and cannot do. After all it is the final riding surface that everyone sees and uses.

Research

To assist in resolving this matter of retaining and expanding the knowledge base at educational institutions, I propose that Sabita look at possible means of retaining knowledgeable people (those who know more than just the difference between tar and bitumen) as well as attracting new stock into the educational arena through a subvention programme.

Research would be one of the main pillars supporting the programme. By conducting research, possibly only at selected institutions where there is a sufficient knowledge base and equipment for this purpose, this subvention programme would be made available so as to create centres of excellence in this specialised field.

The funding would be allocated based on a proposal submitted by each lecturer wishing to participate in the subvention programme. The motivation would outline the proposed research that they intend undertaking for the following year. These proposals would be evaluated on various criteria and the money allocated accordingly.

An annual report on the outcomes, with measurable objectives as well as the following year’s proposal, would be required from the researcher at the end of the each funded year. This report would be used to evaluate and allocate funding for the following year. Measurable items would be in the form of conference papers, journal articles and technical reports produced during the year or over a period of a time, say a two or three year cycle. Should one not meet the required objectives, the funding can be withdrawn for the year or reduced, pending better performance the following year when it can be reassessed.

This is a proposal to ensure we lose no further educational staff to other countries or back into industry, where they can be lured by very competitive remuneration packages. This could be a way of retaining and possibly attracting lecturing staff to take up research in the field of bitumen and related fields to the benefit of the entire industry.
A rising from reports of premature distress of hot-mix wearing courses placed in the Gauteng area dating back to 1999 and perceptions in the road industry that linked the quality of SA bitumen to these limited occurrences, it became evident that there was a less than perfect understanding of bitumen quality related to performance characteristics.

These perceptions, accompanied by concerns about whether bitumen complying with SANS 307 was indeed fit-for-purpose, accentuated the need to develop an improved interface between users and manufacturers of bitumen to foster a better understanding of the needs, on the one hand, and meeting those needs, on the other.

The pressing necessity for this contact between various sectors of the industry was articulated at a meeting of the bitumen specification task group of the Road Pavements Forum (RPF) on 26 August 2004, convened to review the current SANS 307 for penetration grade bitumen.

Key aspects that needed to be addressed were:

- Problems encountered with the premature fracture of hot-mix asphalt being readily ascribed to inferior bitumen quality;
- Speculation on whether the quality of bitumen was compromised by processes aimed at optimising the higher end, high-gain products at refineries.

The task group concluded that, to counter the “low level of understanding of refinery processes”, an effort should be made to inform users of bitumen and their advisors of typical processes at refineries (globally and in SA) geared to ensure the consistent production of fit-for-purpose bitumen.

**Bitumen quality course**

Given the drivers above, the key components of the course were identified as:
A definition of quality and how it is incorporated in specifications and procedures;
- A comprehensive description of processes aimed at meeting quality standards - from crude assessment and selection through to storage and distribution.

Consequently the programme was developed to cover:

- Contextualising the bitumen stream in terms of overall strategic refinery objectives;
- Crude assessment/selection processes;
- Production routes;
- Description of quality and quality management processes;
- Performance expectations;
- Relating specifications to performance expectations;
- Worker health and environmental protection (quality and profitability can not be achieved at the expense of this);
- Performance boundaries between conventional and modified binders;
- Storage and distribution;
- Sample management.

Based on the above criteria, a course was organised by the Asphalt Academy under the auspices of Sabita. The course was held in Durban from 28-30 September 2005, and was attended by 51 delegates.

We were very fortunate to have secured the support of two well known European experts to give us a world view on the topic and to bring us up to date with developments elsewhere on the planet. They were André Stawiarski, former Technical Director of Eurobitume, now with Total France, and Simon Watkins, Bitumen Manufacturing Specialist Advisor to BP Bitumen International.

This event was focussed on Europe to strengthen our position to juxtapose developments in both continents and to distil them to suit our conditions.

All this would be to no avail if not properly contextualised to the SA environment. For this purpose we were fortunate to secure the

Course presenters (l-r) André Stawiarski, Simon Watkins, Mike Zacharias and Les Sampson.
services of Mike Zacharias, Fuels and Bitumen Products Manager, Shell Oil Products Africa, and Kobie Rajmakers, former Chief Chemist of Natref. The course was facilitated by AsAc CEO Les Sampson. The course was facilitated by AsAc CEO Les Sampson.

Quality control

While the test requirements in SANS 307 are still based on empirical measurements, they nevertheless ensure a tight control, inter alia, over the consistency properties of penetration grade bitumens, from ambient to the application temperature range i.e. 25-135°C before and after assimilated short term aging. (See Figure 1 for a graphical illustration of the specification limits at the various temperatures). This ensures that the bitumens produced have consistent rheological properties and that their temperature sensitivity is controlled in the elevated in-service temperature range, where asphalt deformation is the common mode of failure.

Although the bitumen is produced to meet SANS 307 specifications, additional measures and steps are taken by the refineries to ensure ‘fit for purpose’ binders for use in roads.

Some of these measures include:

- Using crude types which have proven track records for producing good bitumen and adhere to strict protocols when changing crude types;
Utilising production routes and feedstocks which render consistent high quality fit-for-purpose end products;

- Regular monitoring of well known performance yard sticks like penetration index PI, BTS diff, T diff etc. (See Figure 2 for a graphical illustration of these performance parameters on a Bitumen Test Data Chart).

The prime feedstock used by the local refineries in the manufacture of penetration bitumen is vacuum distilled residue, which is further hardened by air rectification and/or the addition of propane precipitate bitumen (lube refinery extract), or softened by fluxing with vacuum distillate. No thermally cracked material is presently used in the manufacture of bitumen in South Africa.

The two Durban oil refineries have the benefit of having lubricant refineries which allow them more flexibility in choice of bitumen feedstocks, and also ensure consistency and quality e.g. only low wax content crudes are processed to meet the high base oil specification needs. The other two refineries operate dedicated crude production runs to produce suitable feedstocks for optimal end product quality.

Sabita has prepared a guideline to help identify best practice in the handling and transport of bituminous binders.
All bitumen grades are sampled and tested in accordance with their ISO 9001:2000 management system, and their laboratories are accredited in terms of ISO 17025. Samples of each batch are retained for periods of up to five years in case of a dispute arising.

At the same time it should be appreciated that the quality of the bitumen at the place of use is influenced by the way it is handled from the time it is loaded, transported, offloaded and stored before final use. To this end Sabita has compiled a guideline document, Manual 25 - Quality management in the handling and transport of bituminous binders, to help identify best practice and procedures to address any problems that may occur in the handling of bitumen.

Performance-based specifications

In any move towards a more performance based binder specification, the ideal situation would be to have tests and specification limits which predict the long term performance of the binder on the road.

This was the intention of the American SHRP binder specifications, which were promulgated in 1995 as a “binder blind” specification. Ten years down the line some serious shortcomings have been identified. These are, inter alia:

- Suitability of the DSR to measure elastomeric modified binder performance;
- Suitability of the PAV in predicting long term aging.

Countries making up the European Union on the other hand have concentrated their efforts on harmonising their binder specifications, which are currently based on empirical test methods.

Work has just recently been commissioned by Comité Européen de Normalisation (or Committee for European Standardisation) to develop a more performance based specification by 2010. Binders are never used in isolation, but always in conjunction with other materials to perform as a functional layer. In this case Agrément product accreditation schemes offer an alternative option to performance based binder specifications.

Given our situation in South Africa we have to consider the following factors before embarking on a new specification regime to emulate American and European trends:

- The predominant use of binders in seals vis-à-vis asphalt;
- The high proportional use of modified binders as a result of the latter;
- The bitumen market size and affordability of the testing equipment.

The way forward

The proposal by Prof van de Ven et al to classify our bitumens in terms of their expected in-service temperature conditions holds some promise of utilising existing
test equipment, and is under further investigation. (Refer to Digest article A performance classification framework for South African bitumen by Prof Kim Jenkins, page 127).

This project must be pursued with interest to achieve a workable classification system by 2010, to assist practitioners in making the correct binder choices for the application, traffic and climatic conditions under which the road is to perform. All efforts must be made to avoid a proliferation of grades which could impose further restrictions on existing refinery tankage etc.

This project will focus on identifying tests which better measure functional properties of the binder to reflect how the binder behaves in the final application e.g. asphalt. This will require a validation process to measure how the binder contributes to the performance of the final product under known conditions.

As an interim measure it was proposed by the delegates that we develop guidelines, based on the current specification test battery, for the selection of the appropriate binder type and grade given the traffic and environmental conditions under which the binder is expected to perform. This guideline should also go as far as defining the performance boundaries between when to utilise conventional bitumen versus a modified binder.

This interim step would also allow us time to assess and evaluate the outputs from both America and Europe in their search for finding a replacement for the DSR and PAV tests, as well as a measurement for assessing adhesion. This will go a long way towards helping to close the gap in our pursuit of a measure for controlling lower in-service temperature performance of binders in the short and longer terms.

### Table 1: Summary of proposed actions

<table>
<thead>
<tr>
<th>Action</th>
<th>By whom</th>
<th>By when</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amend SANS 307 to tighten ageing limits</td>
<td>SANS</td>
<td>Dec 2005</td>
</tr>
<tr>
<td>2. Publish Quality management in the handling and transport of bituminous binders guideline</td>
<td>Sabita</td>
<td>Jan 2006</td>
</tr>
<tr>
<td>3. Review TG 1: The use of modified binders in road construction</td>
<td>AsAc</td>
<td>Dec 2006</td>
</tr>
<tr>
<td>4. Publish binder selection guideline</td>
<td>Sabita</td>
<td>Dec 2006</td>
</tr>
<tr>
<td>6. Collect data and complete validation process</td>
<td>Bitumen Specification Task Team</td>
<td>2009</td>
</tr>
</tbody>
</table>
Clearly we do not want, or can not afford, to reinvent the wheel, but should rather optimise the specifications which are promulgated in the rest of the world and adapt them for use on the African continent.

Conclusion

The abovementioned are all steps to help bring us closer to ensuring a better understanding between what the civil engineering professional’s needs are, and what the refinery must and can produce to meet the demand for a ‘fit for purpose’ binder. It is clear we can take comfort in the fact that our bitumen producers are committed to manufacturing quality road bitumens, as demonstrated by their openness to divulge information on their crude types and manufacturing processes which, until 10 years ago, were considered a state secret by law! So it is hoped that with the increased transparency demonstrated on this course, it should:

- Lead to improved cooperation between producers and users;
- Increase the confidence in the ability of the refineries to produce a quality bitumen;
- Help reduce the inclination to always blame the bitumen whenever an asphalt or seal failure occurs.

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3

Innovation
Engen advert on film
It probably all started with the “mother of all planes”! The plane I’m referring to is the new Airbus A380. You must have seen the recent high stakes first flight of this colossus on CNN from the airport in Toulouse, France. CNN broke away from their monotonous Middle East and Iraq coverage to devote their entire prime time run that day on that historic flight. This is clearly the European Union’s best against the best of the USA, Boeing.

You may also have seen other TV programmes dealing with the complex logistical and technical problems faced by the European Airbus consortium to make this prototype marvel of a super jumbo aircraft a reality. It came off with a bang and now it is all systems go to get the actual production models on order and delivered.

When this “mother of all planes” takes off or lands it becomes a mother of a pavement structural problem. This extra heavy aircraft created a flurry of structural strength and bearing capacity recalculations of airport runways, taxiways and aprons all over the world. This awakened the “mother of innovation”, namely necessity, and in the process created a flurry of research and technology transfer activities to develop better materials which can carry such heavy wheel loads and tyre pressures.

95% of this macro load is carried by the unique and large fuselage triple bogeys and wing double bogeys
The Airbus A380 is set to land in South Africa for the first time in 2008. In a current rehabilitation investigation, the need to strengthen the runway and taxiways of the Johannesburg International Airport (JIA) was put in this new lofty design bracket when it was deemed necessary to check whether the JIA pavement facilities will be able to carry this colossus.

It was soon discovered that the traditional airport design methods, based primarily on empirical design principles, don’t really cater for such high loads. (Bilal, 2004). Various mechanistic/empirical analysis tools had to be consulted to determine what needs to be done to ensure this big bird will land and taxi safely on the JIA runways, taxiways and apron. In the search for what has been done before to cater for special design and materials needs of this colossus, the path led straight to the French.

**Special binders for a special plane**

Blame it on the French! They are at the eye of the storm surrounding this Airbus A380 development in Europe. They had to come up with some solutions quickly, and in our search for similar solutions for JIA we “stumbled” on papers delivered by the French at the 2002 Federal Aviation Administration (FAA) Airport Technology Transfer Conference (Pititjean et al, 2002). In this paper the French authors report how they built various experimental flexible pavement structures on different strength subgrades at a taxiway of the Toulouse Blagnac airport, and tested it with a heavy aircraft landing gear simulator developed by Airbus. Limited field test results were available at that stage, but considerable progress was made with a move towards mechanistic analysis techniques and software development to help model the pavement structures.

However, in a follow-up paper at the 2004 FAA Worldwide Airport Technology Transfer Conference in Atlantic City, Bilal and Rey referred to the use of a generic High Modulus Asphalt Concrete (HMAC) as well as a proprietary PHMAC from Colas, France.

This research and development work was in obvious response to the “mother of all planes” soon to be landing at the Toulouse and Paris airports. Their work involved “the application of a high performance asphalt mix” as used on the above-mentioned experimental sections. The dramatic increase in elastic moduli values for the various materials they tested is shown in Table 1.

The aggregate used was standard French grading of a 0/14mm
Only the RBAC was polymer modified, but in spite of this, it did not compete with the HMAC and HMRBAC mixes. What is significant is that the strain at which comparable fatigue testing was done was significantly higher than for the RBAC standard mix.

The PHMAC proprietary binder and mix was the focus of their further studies and by their definition "(it) is a composite hot asphalt mix. It offers all the advantages of the bitumen polymer-modified asphalt binders, such as high fatigue strength and resistance to cracking at low temperatures. It is exceptionally resistant to punching and rutting, thanks to a tailor-made mix design and special selection of additive agents. In addition to its mechanical characteristics, the product is highly resistant to the chemical agents that attack pavements such as fuel, de-icing salts, jack oil, etc."

The mechanical performance characteristics of the various asphalt mixes used by them are summarised in Table 2.

The Accelerated Pavement Testing (APT) device of the Airbus A380 Pavement Experimental Programme (PEP) was used to apply 5 000 passes of the bogey assembly to the experimental sections on one of the taxiways of the Toulouse airport. This

### Table 1: Indicative mechanical characteristics of bituminous materials
(Bilal and Rey, 2004)

<table>
<thead>
<tr>
<th>Material</th>
<th>Elastic moduli (15°C, 10 Hz) (MPa)</th>
<th>Fatigue tensile strain value (10°C and 25 Hz for 1-million cycles in micro-strain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airfield Asphalt Concrete (AAC)</td>
<td>5 400</td>
<td>100</td>
</tr>
<tr>
<td>High Modulus Asphalt Concrete (HMAC)</td>
<td>12 000</td>
<td>100</td>
</tr>
<tr>
<td>Road Base Asphalt Concrete (RBAC)</td>
<td>9 300</td>
<td>90</td>
</tr>
<tr>
<td>High Modulus Road Base Asphalt</td>
<td>14 000</td>
<td>130</td>
</tr>
<tr>
<td>Concrete (HMRBAC)</td>
<td>14 000</td>
<td>140</td>
</tr>
<tr>
<td>Proprietary Product (PHMAC)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Typical values obtained on various asphalt mixes
(Bilal and Rey, 2004)

<table>
<thead>
<tr>
<th>Tests</th>
<th>PHMAC</th>
<th>AAC</th>
<th>HMAC</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue resistance at (10°C, 25 Hz) (micro-strain)</td>
<td>&gt;150</td>
<td>100</td>
<td>100</td>
<td>NF P 98-261-1</td>
</tr>
<tr>
<td>Complex Modulus at (15°C, 10 Hz) (MPa)</td>
<td>14 000</td>
<td>5 400</td>
<td>12 000</td>
<td>NF P 98-260-2</td>
</tr>
<tr>
<td>Resistance to rutting at (60°C and 0.6 MPa after 100 000 cycles) (in %)</td>
<td>2.2</td>
<td>10</td>
<td>5</td>
<td>NF P 98-253-1</td>
</tr>
<tr>
<td>Anti-K resistance (r/R after 7 days in kerosene)</td>
<td>0.66</td>
<td>0.05</td>
<td>0.06</td>
<td>NF P 98-251-1</td>
</tr>
</tbody>
</table>
assembly represents medium to heavy traffic of Boeing B777s, B747-400s and A380 Airbus planes for such a type of airport. Using a sophisticated analysis and monitoring approach Bilal and Rey (2004) concluded as follows:

"Compared to the conventional AAC, a PMAC wearing course would make it possible to multiply by 4 the number of A380 super jumbo movements that the pavement can bear. In addition to the improved quality and comfort of the pavement, the structural reinforcement provided by Multicol-AC will allow airport companies:

- To rapidly adapt existing airport pavement to large aircraft (B777, B747-400, A340, A380) at lower cost; or
- To prolong the service life of the pavement by reducing the costs of maintenance and reinforcement."

Bilal and Rey (2004) also concluded that to date no defects have been observed on the pavement section of the taxiway. They further added that all the material used is recyclable or reusable without restrictions, making this a definite environmentally friendly solution.

**Notching it up with polymer modification**

As could be expected, the next step was to add some polymers to really push the EME type mixes into an even higher bracket. Ballié (2004) reported, "The use of an adaptive bitumen grade, highly modified by polymers and some special additives, gives the mix some mechanical characteristics that are notably superior to those of bituminous concrete of high modulus."

This is a proprietary Colas development where a SBS polymer was used to modify a low-penetration bitumen (Pen 20/30 at 25°C). The binder end product has a 60% elastic recovery at 10°C. The binder is therefore little affected by temperature; has high viscosity at high temperatures and high resistance to cracking at low temperatures.

Total set out and made a high performance composite 0/14 to 0/20 mm road base asphalt concrete and a high performance asphalt concrete for overlays from a composite 0/10 to 0/14 mm aggregate mix (Ballié, 2004). Over and above the normal laboratory tests to demonstrate the superior mechanical and physical properties of these super mixes, rutting tests and fatigue tests were also done with great success.

Rut resistance proved to be superior to high-performance French and European Union specified high-modulus asphalt concretes. Fatigue testing also provided superior behaviour. "In particular, the new composite road base asphalt concrete mix has admissible fatigue deformation of about 160 microstrain after a million cycles, and is thus particularly suitable for reinforcing fatigued or particularly heavily loaded pavement."
A 0/14mm composite asphalt concrete was tested with the Fatigue des Bétons Armés Continus (FABAC) (Continuously Reinforced Concrete Fatigue) test track in France (Ballié, 2004). It is as if enough confidence was built up to go and challenge the ever threatening concrete pavements in their own back-yard to prove that this was now literally like black concrete! The tests confirmed the superior resistance to rutting as found in the laboratories. "In addition, there was no aggregate stripping and no sign of fatigue - particularly of cracking - after this severe test which equates to about 10 years of real traffic."

Where did it start?

The development of these high modulus asphalt concretes did start some way back and was first properly reported at the 1999 AAPT conference. Maia et al (1999) reported on the pioneering work done by Shell France and the Laboratoire Central des Ponts et Chausées (LCPC) at Nantes in the early 1990s on the development of what they called "hard bitumens" and their behaviour under accelerated pavement testing (APT). This obviously was taken up by the airports engineers as the ideal solution for the A380 problem and was developed further as reported above.

Other role-players were not idle and, Didier et al (2000) from Total France, reported on the "Development of a concept of very high modulus bituminous macadam for pavement base courses". By this time it had already received a generic French term Enrobé à module élevé (EME) meaning high modulus asphalt. The EMEs have been developed and come into widespread use according to Didier et al (2000), to the extent that it was taken up in the AFNOR Standard NFP 98-140. Didier et al states: "These bituminous materials are made using hard bitumens and their stiffness modulus are between 14 000 and 16 000 MPa at 15°C-10Hz and can exceptionally, reach 18 000MPa"

However, Didier et al (2000) reported that further development took place to create very high modulus macadams. This development was also done in cooperation with the LCPC fatigue test track facility at Nantes. They coined the acronym "EMTE" for this concept of very high modulus macadams. They stated clearly that "...The aim of very high modulus macadam (>21 000MPa at 15°C - 10 Hz) is to achieve a structural capacity which is near to that of a cementitious binder while at the same time retaining the potential for deformation which results from the viscoelastic nature of the bitumen".

Audacity

So again you see the audacity to take the concrete pavements head-on in the development! Laboratory tests done on this special binder developed are summarised in Table 3 to follow. The conclusion reached by Didier et al (2000) was that it had low thermal and mechanical susceptibility and high consistency.
at high temperatures combined with a considerable elastic recovery. It also had sufficient rigidity to provide for high moduli values at 15°C at 10 Hz.

The EMTE pavement structure that was tested with the APT of LCPC had a structural and pavement profile as shown in Table 4. The characteristics of the EMTE mix tested at the LCPC facilities at Nantes are summarised in Table 5. It is interesting that in subsequent pilot test sites at Chartes (Rn 123) and Deauville (Rn 177) the elastic moduli measured were both 21 000 MPa. These EMTEs were made of a special Pen 0/10 binder. Construction was done with ease with minor adjustments to standard construction equipment at laying and compaction temperature around 185°C. These road experiments have obviously increased the confidence in the use of EMTEs or EMEs. It can be mentioned that initially they laid it on experimental sections at about

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Test Method</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration at 25°C (1/10mm)</td>
<td>NFT 66-004</td>
<td>6</td>
</tr>
<tr>
<td>Ring and ball softening point (°C)</td>
<td>NFT 66-008</td>
<td>87.0</td>
</tr>
<tr>
<td>Pfeifer Penetration Index</td>
<td>RLB-1-1964</td>
<td>+1.0</td>
</tr>
<tr>
<td>LCPC Penetration Index</td>
<td>Total 763</td>
<td>+1.6</td>
</tr>
<tr>
<td>Kinematic viscosity at 170°C (mm²/s)</td>
<td>ASTM D2170</td>
<td>592</td>
</tr>
</tbody>
</table>

Table 3: Characteristics of the special binder (Didier et al, 2000)

The EMTE mix varied between 80 to 90 thickness (mm) with modulus (MPa) 25 000

<table>
<thead>
<tr>
<th>Materials</th>
<th>Thickness (mm)</th>
<th>Modulus (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMTE mix</td>
<td>Varied between 80 to 90</td>
<td>25 000</td>
</tr>
<tr>
<td>Sand asphalt mix</td>
<td>20</td>
<td>4 700</td>
</tr>
<tr>
<td>Granular material</td>
<td>300</td>
<td>200</td>
</tr>
<tr>
<td>Cement-bound sand</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Soil</td>
<td>4 000</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 4: Pavement profile tested under the circular APT of LCPC (Didier et al 2000)

The characteristics of the EMTE mix (LCPC-Nantes Trial) are summarised in Table 5. It is obvious that initially they laid it on experimental sections at about

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Test method</th>
<th>EMTE (Nantes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyratory compactor test</td>
<td>NFP 98-252</td>
<td>11.0</td>
</tr>
<tr>
<td>Void V10 (%)</td>
<td>NFP 98-251-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Void V100 (%)</td>
<td></td>
<td>4.4.5</td>
</tr>
<tr>
<td>Gradient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duriez test (r/R ratio)</td>
<td>NFP 98-253-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Rutting test at 60°C (30 000 cycles) (%)</td>
<td>Total 762</td>
<td>25 000</td>
</tr>
<tr>
<td>Stiffness modulus at 15°C and 10 Hz (MPa)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Characteristics of the EMTE mix (LCPC-Nantes Trial) (Didier et al, 2000)
200°C, but had to wait after initial rolling with the pneumatic rollers to cool off sufficiently for them to smooth out all undulations caused by the pneumatic roller with no cracking or any other problems at all.

Various tests were done with the circular APT of LCPC and up to 3 million repetitions of a 6.5 tonne dual wheel assembly was applied. The analysis showed that the EMTE offered a significant reduction on the benchmark bitumen-bound granular material (called “GB” in the AFNOR standards) (Didier et al, 2000). Calculations were done to show the theoretical thicknesses required for EMTE vs GB layers and are shown in Table 6. A reference or common subgrade condition was used in these calculations. This led Didier et al (2000) to conclude that the use of EMTE could reduce the total pavement thickness with as much as 50%.

It is clear that a truly High Modulus Asphalt, generically called EME or EMTE, were developed by the various French roleplayers over a period of more than 10 years. The best of concrete pavements, resistance to rutting, was successfully blended into the best of asphalt pavements, flexibility!

These EMEs or EMTEs were increasingly used because of proven performance based on laboratory results, field test trials, APT, ease of construction and above all the recycling friendliness.

And what about SA roads?

The N12-19 route passes not more than 10 km south of the Johannesburg International Airport (JIA). Like the JIA it also has a “mother of a problem”! The section of the road carries probably the highest traffic volumes in the country with a high truck traffic component. Cumulative equivalent standard axles (E80s) are calculated as high as 90 million over a 30 year design life.

<table>
<thead>
<tr>
<th>Number of load applications</th>
<th>1 000 000</th>
<th>5 000 000</th>
<th>10 000 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB Thickness (mm)</td>
<td>176</td>
<td>220</td>
<td>244</td>
</tr>
<tr>
<td>EMTE Thickness (mm)</td>
<td>102</td>
<td>131</td>
<td>144</td>
</tr>
</tbody>
</table>

Table 6: Theoretical thicknesses for different load applications for GB and EMTE layers on similar subgrade conditions (Didier et al, 2000)
These high volume road scenarios are on the increase in SA and solutions need to be found. No wonder that SANRAL looked at innovative alternatives like the ultra-thin high strength (UTHS) proprietary concrete layer which was constructed on an experimental section at Heidelberg on the N3 weigh station. Admittedly, there are some constructability issues that still need to be cleared up, as well as questions around the anchoring of the dense steel mesh and questions as to what will happen with bow waves generated by faster moving vehicles.

This exciting development is clearly trying to achieve the reverse of what the French achieved with their EMEs. With the UTHS concrete layer the best of concrete is mixed with the best of flexible pavements, accommodation of flexibility. SANRAL plans to have the next phase of monitored technology transfer by building a longer experimental section on the N11 and have some coal trucks do the performance testing. So the jury is still out on this one!

A stop-over at Delft University revealed what the Netherlands have done with their national innovation programme, Wegen naar de toekomst (Roads to the future). Delft University was involved in evaluating a number of these innovations, among which were tests on the EME technology transferred from France. Various proprietary EME binders were tested in the Delft laboratories and under the Lintrack. As early as 1998 a first EME pilot project was done on the slow lane of the A6 motorway near Almere of the Rijkswaterstaat Directie in the IJsselmeergebied as the first application of EME in the Netherlands.

As much as 25% reduction in base layer thickness was achieved vs standard asphalt base layers. This EME was made of a 15-25 Pen hard binder, had a softening point of 60-72°C, a binder content of 5-6%, voids less than 5% and voids filled with binder of 70-85%. The EME base layer was 175mm versus the traditional asphalt base of 230mm.

It is clear that considerable confidential work was done subsequently for various proprietary products at Delft University. Considerable enthusiasm developed for EMEs in the Netherlands as one of the successes of this national innovation programme. Over and above the superior mechanical and physical properties mentioned before, the technology transfer from the French was considered a huge success. Additionally the Netherlands are very impressed by the recycling friendly aspect of this technology.
Needless to say the EME base forms a perfect platform for the use of single and twin layers of porous asphalt to make their roads even more environmentally friendly. Subsequent development and inclusion of national specifications (NEN-EN 12591, 1999) for such hard bitumen binders were superseded by the inclusion in the European Standards (2003).

**So where to from here?**

The French have shown the way to address this high load and tyre pressure situations by solving the rehabilitation and upgrade needs for airports which can accommodate the “mother of all planes”, the Airbus A380, with success. Concrete pavements did not feature in their approach as the only solution, but it set some standards. Constructability, recycling, friendliness, resistance to gasoline spillage, and use of existing construction equipment of taxiways, runways, roads, etc are obvious issues that drove their search towards the development of the high modulus asphalt mixes, called EMEs.

**High elastic moduli**

The development of such EMEs in France was driven by industry needs, intellectual property issues, proprietary issues and commercial forces to solve a major problem. The improvement of the EMEs took it to very high elastic moduli values where it actually started to compete with concrete, but with improved rut resistance as well as improved fatigue life. The Dutch showed how technology transfer can be done to prevent the re-invention wastage to the point that such EMEs are now part and parcel of the European Standards!

The closest thing we have in SA to an EME is our home grown Large Aggregate Mix Base (LAMB). LAMBS have been used with success on motorways, taxiways etc in the past. The constructability and good performance of such bases were the main drivers. However we now are faced with a “mother of a problem” which may need more innovative approaches and developments. We need to do a similar innovative technology transfer project as done by the Dutch. The conversion of the French EMEs to a truly South African high modulus asphalt (HiMA) can be such an innovation.

Industry and road authorities should come to the party and create opportunities like the Dutch innovation project "Roads to the Future” to develop a South African HiMA. As a first challenge to the role-players we should ask “Who can make something like this here in SA?” Once we have some takers, let us take hands and do...
the innovative cooperative SA thing and make it work!

In short, a mother of a problem needs a mother of a road base, high modulus asphalt, HiMA!

References


Pititjean, J Fabre, C and Balay, JM (2002) A380 flexible pavement experimental programme: Data acquisition and treatment process, First numerical simulations and material testing. Presented at the 2002 Federal Aviation Administration Airport Technology Transfer Conference.

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The 2010 bid was successful! In less than six years South Africa will be hosting the soccer World Cup, and the eyes of the world will be on us to see how we perform.

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Holcim
Customer Service: 0860 141141
www.holcim.co.za
Since 1996 approximately 350 km of gravel roads have been surfaced with a semi-priming modified binder covered with a graded crushed stone aggregate. The graded aggregate was spread using mechanical chip spreaders or buckeye attachments to tipper trucks. With the recent emphasis on optimising the utilisation of labour in construction to create employment opportunities, a manually operated chip spreader has been developed with the goal of converting this mechanised method of road surfacing into a labour based operation.

**Self-priming modified binder**

The high cost of continuous gravelling and re-gravelling of low volume rural roads, and the associated depletion of non-renewable gravel resources, has led to the development of several permanent low cost bitumen seals as a cost-effective alternative. Most of these seals use 150/200 penetration grade binder, MC3000 or even dust palliatives, covered with either coarse river sand, crusher dust or single sized aggregates. These seals however showed certain limitations, mainly attributable to the fact that prime was usually omitted, binder application had to be limited to prevent bleeding, and the maintenance-free life span of the surface was usually not more than about two years.

The development of semi-priming modified binder covered with graded stone aggregates largely overcame these problems for the following reasons:

1. There was improved penetration of the binder into the gravel surface, resulting in improved adhesion between the new surfacing and the base;
2. In the event of any weakness in the base the seal was less prone...
to fatigue cracking due to the enhanced elastic properties of the modified binder;
3. The graded aggregate allowed for a higher application of binder without the risk of bleeding, thus improving the durability of the seal;
4. The binder was able to migrate through the stone matrix under traffic over time, thus requiring minimal compaction at the construction stage;
5. The binder was not sensitive to low road surface temperatures or high moisture conditions;
6. The use of marginal aggregates, which could be placed by hand.

Although the aggregate used is based on the Otta Seal grading, the percentage of fines passing the 2mm sieve size is limited. This is to ensure improved wetting and retention of the coarser aggregates in the newly constructed seal.

**The chip spreader**

In the early stages of development of the manually operated chip spreader, it was soon realised that due to the time delay that could occur between application of the binder and stone, only certain binders would be suitable.

The autogenous nature of the semi-priming modified binder made it an obvious choice for labour based application of stone aggregates, since there was a limited risk of adhesion failure between the binder and stone chips in the event of delays in application of the stone onto the binder.

Other binders that were identified were modified emulsions which could also be hand-sprayed directly out of a drum mounted on a trolley. However, it is likely that these binders would be more appropriate for re-sealing and maintenance type work.

**Three units abreast**

In converting the mechanical operation of constructing the graded stone type seal to a labour based method, it was necessary that widths of not less than 3.6m would have to be covered using a mechanical binder distributor if the operation were to remain cost-efficient, mainly due to the high daily cost of the distributor. Several combinations of ratios between mass, volume, width, ease of operation, ease of loading and people employed had to be considered. Several prototypes were developed and ultimately a width of 1.2m with a volume of ± 250 litres was found to be most practical.

This meant that three units could be pushed abreast behind a distributor spraying at a 3.6m width. The total labour component for the complete process, including sweeping of the road surface, watering, chipping, back chipping and compaction, ranges between 55 and 65 people, depending on how site logistics are arranged. Production rates of between 4 000 and 6 000 m² are readily achieved once the initial training has been carried out.

**Even spreading**
One of the biggest advantages that the manually operated chip spreader has brought about for labour based construction is that it ensures that the stone chips are evenly spread and at the correct application rate, resulting in finishes and costs equal to that of mechanised methods.

**Case study**

Construction of a graded crushed stone seal using a manually operated chip spreader:

**1. Contract details**

The Mpumalanga Department of Roads and Transport called for proposals to upgrade three sections of rural gravel roads in the north western part of the province to a surfaced standard, whilst using the existing in-situ gravel material for the base.

Submissions were made using a graded crushed stone seal, placed on a modified binder with medium curing cutters and using a manually operated chip spreader for the stone application.

The proposal was well received as this method of construction would create employment opportunities and meant that a much bigger portion of the revenue generated on this contract would remain in the local community (about 60 labourers would be employed for more than a month, as opposed to perhaps 5 or 6 people for a few days.)

The Department selected a 15.1 km section of road between the villages of Senotielelo and Marapiyane, and construction of the cement-stabilised base began in December 2004. The graded crushed stone seal section of the contract was completed at the end of March 2005, and created work for 59 people from the local community for a period of 28 working days.

For the whole contract, a total of 78 local people were employed from the local communities (drawn from 3 villages), of which 87% were below the age of 35. The proportion of women in the surfacing team was 27%, all of whom were under the age of 35. The proportion of women in the surfacing team was 27%, all of whom were under the age of 35. The

In addition, a further 14 staff members (permanent key staff) were employed, bringing the total to more than 90 people with the inclusion of site management.

Over and above the construction of the graded stone seal, the contract included the cement stabilisation of the existing in situ gravel wearing course after the addition of an average of about 50mm of gravel from local borrow pits. Prior to this however, the existing gravel material was bladed off and windrowed, allowing for roadbed preparation to a depth of 125 mm.
2. Construction

To break the surface tension and prevent ‘pin holing’, the newly constructed base was broomed and then dampened with water before the binder was sprayed. Following the light moistening of the base, the modified binder was sprayed at a temperature of 130°C at an application rate of 1.8 litres/m². Due to the high application temperature and high percentage of solvent in the modified binder, a mechanical distributor was used so as not to endanger the safety of the workers. The binder was then allowed to penetrate the base for at least 20 minutes before the graded crushed stone was applied.

3. Stockpiles

Prior to the commencement of surfacing, the aggregate was placed along the road shoulder in smaller stockpiles approximately 50 m apart. Not only did this speed up production but also prevented unnecessary fatigue among the workforce. From these stockpiles, stone was loaded manually into wheelbarrows, pushed to where the chip-spreaders where working, and then tipped into the spreaders. Three manually operated chip spreaders were used to cover the full 3.6 m width of freshly sprayed binder. Each chip spreader was propelled by three labourers and a guide, with the bulk of labour
involved in loading, pushing and tipping of stone into the chipspreaders. The stone was applied at 80 m²/m³ and compacted with a 5-ton ride-on roller. The nature of the modified binder and graded stone aggregate seal is such that an aftercare period of approximately two to three weeks is required. During this period, loose aggregate was swept back into “wheel tracks” and areas that appeared to be “rich” in bitumen.

Because a fair amount of traffic was using the road, the surface settled quickly and excess loose stone was swept off after about two weeks. The seal was then covered with a diluted anionic stablemix emulsion (60%) sprayed at net binder rate of 0.13 litres per square metre to render a black finish to the final surfacing.

4. Resources/Costing

Table 1 summarises the equipment required for the construction of the graded stone seal over a period of approximately 28 working days. It must be noted that the bitumen distributor is not reflected as part of the equipment since this was outsourced to the binder supplier and no local staff was required as part of the binder spraying.

Table 1: Labour and equipment requirements for constructing the seal

<table>
<thead>
<tr>
<th>Activity</th>
<th>No of workers</th>
<th>Equipment required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic control</td>
<td>2</td>
<td>2 Stop/Go signs, flags</td>
</tr>
<tr>
<td>Sweeping the base</td>
<td>9</td>
<td>9 Brooms</td>
</tr>
<tr>
<td>Wetting the base</td>
<td>2</td>
<td>1 Water bowser</td>
</tr>
<tr>
<td>Loading aggregate</td>
<td>9</td>
<td>9 Shovels</td>
</tr>
<tr>
<td>Pushing wheelbarrows</td>
<td>18</td>
<td>18 Wheelbarrows</td>
</tr>
<tr>
<td>Operating chip spreaders</td>
<td>12</td>
<td>3 Chipspreaders</td>
</tr>
<tr>
<td>Back chipping</td>
<td>6</td>
<td>2 Wheel barrows, brooms and squeegees</td>
</tr>
<tr>
<td>Rolling</td>
<td>1</td>
<td>1 5-ton roller</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Costings for labour, equipment and materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>59 workers @ R85/day (total cost to company)</td>
<td>R 5 015/day</td>
</tr>
<tr>
<td>Equipment</td>
<td>3 chip spreaders</td>
<td>R 250/day each</td>
</tr>
<tr>
<td></td>
<td>1 X 5-ton hand-operated roller</td>
<td>R 650/day</td>
</tr>
<tr>
<td></td>
<td>1 binder distributor</td>
<td>R 7 500/day</td>
</tr>
<tr>
<td></td>
<td>1 water bowser hand tools</td>
<td>R 1 100/day</td>
</tr>
<tr>
<td></td>
<td>hand tools</td>
<td>R 400/day</td>
</tr>
<tr>
<td>Binder</td>
<td>1.8 litres/m²</td>
<td>R 3.25/litre</td>
</tr>
<tr>
<td>Aggregate</td>
<td>80m²/m²</td>
<td>R 340/m³</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4 000m²/day</td>
<td>R 14.54</td>
</tr>
</tbody>
</table>
Table 2 shows the typical costs based on an average production rate of 4 000m² per day.

It must be noted that the chipspreaders used on this contract were still prototypes, and that modifications have since been made. Although some delays and inefficiencies did occur, daily production rates of up to 6 000m² were also achieved.

The above costs are net direct costs and site establishment costs. Overheads, P & G, mark-up, and allowances for wastage are excluded.

Summary and conclusions

The use of the manually operated chip spreader enabled the contractor to undertake the surfacing work while maximising labour through the employment of 59 instead of 6 workers at the expense of incurring costs for hiring a mechanical chip spreader.

This technology at the same time creates opportunities for emerging contractors to enter the surfacing market without having to make a large financial investment in chip spreading equipment. Furthermore the development of the manually operated chip spreader has raised labour intensive methods from demeaning, backbreaking procedures to fit-for-purpose methods.

The application of graded crushed stone using the manually operated chip spreader on the semi-priming modified binder allowed for the optimal use of labour for surfacing a gravel road without compromising the quality and performance of the final surfacing.

This project demonstrated that the surfacing of gravel roads in a semi-urban environment can now be successfully done using labour based techniques without having to pay a premium vis-à-vis conventional surfacing equipment.

The remaining challenge to further optimise the use of labour in the construction of this type of seal is to develop a semi-priming modified binder with similar performance properties which can be sprayed by hand without putting the safety and health of the workers at risk.

Overall, the success of the initial implementation of the manually operated chip spreaders has resulted in more than 250 000 m² of seals being constructed in this manner. The application of the chip spreader is not limited to graded stone seals only, but can be extended to the construction of single, double and Cape seals. In this instance, the use of emulsion binders can allow for their application using hand sprayers.
and one chip spreading unit made up of smaller teams of about 20 workers. Such teams would be able to surface 1 000 to 2 000 m² per day.

The concept of seal construction using these methodologies has brought about a completely new dimension that not only fits in with the objectives of the EPWP (the creation of job opportunities) but also offers opportunities for emerging contractors to become fully fledged surfacing contractors with minimal capital investment. One new hand sprayer and a manually operated chip spreader have a combined value of less than R 35 000.00 and if repaid at a rate of R1.00 per m², it is apparent that the equipment can be fully paid for over a relatively small contract.

The development of the manually operated chip spreader has been welcomed by many role players in the roads industry and the Sabita Award for Excellence in Asphalt Technology for 2005 was awarded to Deon Pagel of Tarfix, who originally developed the machine and the concepts relating to surfacing of roads by means of labour utilisation.
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Recent years have witnessed significant developments in the chemistry of road binder technology.

Fischer-Tropsch wax, the latest addition to the new generation of modifiers, was exclusively developed to enhance the properties of bitumen. This modifier is produced by the unique Fischer-Tropsch wax process located in Sasolburg, and is exported to a number of countries. The South African product is well known in Europe and China, and a number of major airport runways have been constructed using this material. Among the best known of these are those at Frankfurt, Munich, and Hamburg as well as the Airbus A380 runway, the Eurogate Container Terminal and the Shanghai freeway.

Trial section

The successes in Europe have initiated the launch of the product in South Africa with the first trial section in 1997 under the auspices of Gautrans on the Jean Avenue on-ramp onto the Ben Schoeman Freeway. The trial section was a huge success and has kick-started the marketing of this wax in South Africa. Numerous trials have subsequently been conducted, and this modifier has now outgrown its trial section phase and rightfully taken its place as one of the preferred bitumen modifiers for use in hot-mix asphalt. It was also incorporated into the Gautrans Asphalt Base and Surfacing Specification (B4201) in 2004.

The product compares favourably with current modified products and has a number of additional benefits. The most advantageous property is the increase in the plasticity range of the binder (temperature range between Fraas Breaking Point and its Softening Point), an advantage which cannot be ignored in South Africa’s severe climatic conditions. The addition of as little as 3% to the mass of the bitumen has favourable effects on both the penetration and softening point of the bitumen.

The process does not require sophisticated equipment and the binder can be blended with a paddle mixer for a couple of minutes. Modification of the binder in hot-mix asphalt applications will increase the construction window, and facilitate achieving satisfactory compaction. The minimum recommended compaction temperature is as low as 90°C.
Before rapid stiffening of the mat occurs with the concomitant drop in temperature.

Air traffic and container shipping are modes of transport that are growing at an enormous rate globally, mainly as a result of the economic and tourism growth. The existing airport and container port infrastructure in most countries predate this exploding development, which will automatically result in an increase in the traffic count on all major access roads to these port facilities. The majority of these roads were not designed for the additional capacity demands, resulting in pavement deformation and other related problems.

A realistic and demanding test method for measuring resistance to permanent deformation of a pavement is the MMLS and the Hamburg Wheel Tracking Test. The latter differs from the MMLS in that the asphalt specimen (SMA) is exposed to a standard load-bearing wheel passing 20 000 times over the exact same specimen area submerged in a water bath at 50°C. The rutting depth recorded with conventional bitumen was 6.5mm, but this was reduced to 2.3mm with the addition of just 3% Fischer-Tropsch wax. The MMLS of Specialised Road Technologies recorded a mere 1.14 mm after 100 000 cycles. (Medium continuous grading type “Mix D”).

The following graphs depict the test results from both laboratories.
The largest full-scale project in which Fischer-Tropsch wax has been used in South Africa to date is in phases 2 and 3 of the rehabilitation of the M4 Southern Freeway in Durban. Construction of the asphalt layers took place at night during the KwaZulu-Natal winter. The Fischer-Tropsch wax-modified asphalt rendered an increase in the compaction window even compared to conventional bitumen. This is due to the Fischer-Tropsch wax modified binder having a lower viscosity \textit{vis-à-vis} conventional bitumen at temperatures above 90°C. This phenomenon is best shown in the graph below.

This paper does not allow for extensive elaboration on all the advantages of Fischer-Tropsch wax. Readers may feel free to contact the author for additional information if required.
The ever-increasing basket of Sasol Wax products on offer to the road and related construction industries include:

**SASOBIT®**
“Experience the difference” in improved
- Bitumen Plasticity Range (lower Fraas brittle point & higher softening point)
- Reduced bitumen Viscosity for improved coating of aggregates, easier handling with a wider window for transport and faster compaction.
- Much reduced volatile emissions during handling and compaction
- Lower Compaction temperatures (>90°C)
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Most suited for:
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- Container depots
- Airports
- Warm mix asphalt
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Tailor made SASOBIT®-SBS co-modification, amplifying all the benefits of both, suitable for:
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- Eliminate the detrimental effect of some other release agents on the bitumen matrix

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- Suitable for Stone Mastic Asphalt

For further information contact:
Francois Bornmann : cell phone +27 83 250 0167 or e-mail to francois.bornmann@sasol.com
http://www.sasolwax.com/
Paving fabrics were first used in the 1930s when cotton sheets were installed as reinforcement to asphalt layers in roads in North Carolina, USA. Since the early 1980s the concept of geotextile reinforcement of surfacing seals has been used successfully internationally with hundreds of millions of square metres installed worldwide.

Nonwoven needle punched geotextiles have been used in South Africa for reinforcing and waterproofing chip seals and asphalt overlays since the late 1970s; however, the use of low strain, high strength geosynthetic materials has only recently (since 1997) made its mark in the reinforcement of asphalt overlays.

Although some earlier trials were carried out, no real impetus was achieved in the industry, and the most recent developments and successes have been with glass fibre grids and composites thereof. The design and installation of these types of materials has to date been based on overseas experience and early trials carried out in South Africa, dating back to the early 1980s. Generally, monitoring and performance records have been limited, and it was felt that some coordinated structure had to be introduced.

The Road Pavements Forum (RPF) passed a resolution in 2003 to form a technical group to investigate the development of a national guideline or code of practice on asphalt reinforcement interlayers (ARI). Members of the group were selected from various sectors of the industry, namely research, academic, road authorities, manufacturing, construction and design sectors.

**Perceived need**

The perceived need in the field of asphalt reinforcing was defined as a toolbox that could be used by new entrants in the field, and a best practice document for both designers and construction staff. The scope of such a document was defined to include all types of reinforcing materials (including geosynthetic and steel fabrics but excluding fibres) used as an interlayer between asphalt layers (not surfacing seals) to provide strengthening and/or reduce reflection cracking and rutting.

Initially the focus would be on the possibility of developing a national guideline document applicable to
the southern African environment. This would later be used as the foundation for a code of practice.

**Actions undertaken**

In order to move towards the compilation of a guideline document, the following actions were initiated:

- A review and summary of international documents to determine what, if any, similar guideline documents or specifications are available. These included:
  - The Handbook of Geosynthetics published by the Geosynthetic Materials Association (GMA, USA);
  - The draft ASTM Standard Specification for Inorganic Paving Mat for Highway Applications (USA);
  - Cost Action 348 Reinforcement of Pavements With Steel Meshes And Geosynthetics; Work Package 4: Selection of Design Models and Design Procedures.
  - A review of recent conference proceedings and research projects to obtain relevant information that could be incorporated in an ARI guideline document. These comprised:
    - Cost 348 Research Project http://cost348.zag.si/;
    - EU REFLEX Research Project http://www.vti.se/reflex/;

- Fifth International RILEM Conference, France, 5-8 May 2004 http://www.rilem.org/index.html;
- RILEM Technical Committee: Cracking in Asphalt Pavements http://www.rilem.org/tc_cap.php

- The compilation of an ARI project database with information that could be used in the development of a guideline document and as a basis for further research on the subject.

**ARI guideline**

A draft guideline is being compiled with valuable contributions from experienced players in this field. The chapter headings include:

- Introduction;
- Functions and benefits of asphalt reinforcement inter-layers;
- Types and selection of reinforcement product;
- Evaluation of existing pavement condition;
- Design methods;
- Specification of materials;
- Practical construction issues;
- Quality control and material testing;
- Database of projects;
- Research;
- References;
- Document details.

Some of these chapters have information outstanding to complete the draft.
**ARI project database**

The project database has been developed and compiled to provide practical, local information on the performance of ARI in southern Africa. The objective of the database is to provide a structured source of information that would help to understand the factors that contribute to the successful use of ARI in projects.

A questionnaire has been designed to record, *inter alia*, where ARIs have been used, reasons for using ARI, conditions prior to application of ARI, problems experienced during insulation, and performance with time. The questionnaire consists of four sections:

- Essential data to be completed for each project;
- Additional data where available;
- Performance data - information relating to the long term performance evaluation of ARI application;
- Comments - any proposals to improve the long term monitoring.

The database is hosted at the CSIR Built Environment in Pretoria. Standardised questionnaires for data collection have been compiled and are being distributed in South Africa to start the project data collection process.

Information submitted on projects will be forwarded to all the parties involved in the project (client, consultant, contractor and supplier) for comment to ensure that the views of all are obtained where possible. The database will be open to all interested stakeholders.

To date some 29 projects have been entered onto the database.

**Conclusions**

The Asphalt Reinforcement Interlayer Guideline will provide a toolbox that may be used as a best practice document for both designers and construction staff in the field of asphalt reinforcement. These ARI products continue to be designed and installed where highly stressed pavements require additional reinforcement. A guideline will formalise procedures to be followed in the future.

The ARI technical working group plans to publish the first draft by mid 2006. The contributors are hard pressed to finalise their contributions, as most have to deal with work pressure while formulating their input.

Three major actions will continue to make sure that the compilation
of the ARI Guideline for southern Africa is relevant and up to date. These include:

- Review and evaluate international literature and research for relevance;
- Grow the database of ARI projects to provide information on experiences with ARI projects (both success and failures);
- Advancing the ARI Guideline to a Code of Practice document.

The success of the project depends largely on the cooperation of the wider industry in contributing valuable industry experience and information to the documentation process.

The work of the members of the Asphalt Reinforcement Working Group is gratefully acknowledged: Philip Joubert, Rob Brown, Marco Pauselli, Garth James, Cobus Venter, Mias Wiese, Peter Conway, Wynand Steyn, Chris de Jager, Joe Grobler, Julian Wise.
With Kaytech’s Sealgrid, you can overcome structural damage to asphalt roads. Increased traffic volumes and thermal loading play havoc with their structural strength, but Sealgrid is the clear-cut alternative to the high costs of pavement upgrades.

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4

Best Practice
The trends within Europe and the United States regarding the linking climate, traffic volumes and loading rate to the selection of binder for asphalt formulation have led to reappraisal of the South African bitumen specification system.

In the past 15 years, bitumen specifications have seen dramatic changes from simplistic, empirical tests to fundamental, visco-elastic and damage characterisation methods. Changes in specifications are motivated by various factors, for example increased binder modification and a need for systematic processes to analyse PMBs. The consequences of such changes can be significantly beneficial, provided the process is carefully considered and managed.

The investigation would rely predominantly on a review of local and international experiences.

The direction followed in the first world, appraised by Professors Bahia of University of Madison-Wisconsin and Van de Ven of Delft University of Technology in collaboration with University of Stellenbosch and the Asphalt Academy, using workshops as well as CAPSA initiatives, has given impetus to the proposal for review of the SA binder grading system.

Scope and objectives

The main objective of the review of international binder grading systems is to ascertain whether South Africa could benefit from some of the new developments elsewhere, and how this should be implemented. To this end, the Road Pavements Forum (RPF) reconvened the Binder Task Group, with a working group represented by binder producers, suppliers and industry, to guide the investigations and drive any initiatives.

The purpose of this working group is to assess the feasibility and practicalities of implementing a performance grading system for binders in South Africa.
The scope of the working group’s activities was defined in the first meeting including:

- Aim to appraise and possibly develop PG grading specifications for asphalt and seals, even though seals were considered less in need of specifications improvements. Possible variation in the specification limits for asphalt and seals, was recognised;
- Although unified specifications would be ideal, the inclusion of polymer modified binders at the initial stages, is too ambitious. PMBs are known to exhibit more complex behaviour and will therefore be excluded from the initial study with a view to future inclusion;
- The investigation is not intended to involve any major research. It would rely predominantly on a review of local and international experiences, literature and trends, with guidance from international experts;
- The time frame for review, development and possible implementation is medium to long term i.e. 3 to 5 years;
- New initiatives e.g. test procedures under development elsewhere, would not be included in the South African specification if inappropriate i.e. too expensive or over-sophisticated, or still considered to be under experimentation. Modification of existing test protocols will be considered first, failing which appropriate new tests will be investigated.

**Initiating the Study**

At the outset, certain "rules of the game" were identified by the working group:

- South Africa does not want a proliferation of different binder grades i.e. a balance should be maintained between technical requirements for grades definition and practical production considerations in SA dictated by the scale of the industry;
- The CAPSA paper of Van de Ven et al provided examples of possible boundaries for PG grades for SA, based on conversions from the SHRP Superpave gradings using simple empirical SA binder tests (Penetration and the Softening Point, related to in-service temperatures and the Newtonian viscosity related to mixing and compaction temperatures), Shell nomographs and assumptions. The gradings and correlations should be investigated further using actual SHRP tests. Unless
poor correlations are achieved, simple rheological tests on binders should not be discounted; A fingerprinting exercise of current bitumen supplied by the refineries of SA should be carried out. To this end, Prof Kim Jenkins will transport SA binders to the USA and spend part of his sabbatical involved in binder testing at the University of Wisconsin-Madison (UW-M), with Prof Bahia.

In addition to the standard SHRP tests for fingerprinting, Profs Jenkins and Bahia have identified other possibilities for SA binder specification development i.e. testing of the binders using the new procedures developed in the research programme at UW-M. This includes creep-recovery tests, dissipated energy considerations from hysteresis loop analysis etc. This would allow the SA bitumen to become part of the database of results being analysed at UW-M in development of new appropriate binder characterisation. Many of the new protocols are mainly applicable to PMBs and have only limited applicability to unmodified binders.

The need for a longer term ageing protocol for SA binders, as identified by Profs Bahia and Jenkins, can be explained in the figure below. Currently the SA specification only provides for short-term ageing i.e. plant and construction ageing, using the Rolling Thin Film Oven Test (RTFOT). It is clear from the example provided that this protocol is inadequate, in many cases, to identify binders that could experience cracking through premature ageing. The identification of an appropriate long-term ageing protocol for SA,

![Figure 1. Conceptual ageing simulation to identify binder suitability](image-url)
therefore, is one of the objectives of the study.

A full range of standard grades of SA bitumen, from each of the refineries, will be tested using SHRP and extended experimental procedures at UW-M. With the assistance of Professor Bahia, critical analysis will be made of these results, and recommendations will be made to the RPF Binder Working Group. The snapshot of binder results will require more extensive testing and validation in SA, before the working group would consider embarking on an implementation phase. The next few years promise to be an exciting period for growth in binder technology for South Africa.

Table 1: Example of performance grading for South Africa

<table>
<thead>
<tr>
<th></th>
<th>High temperature grade (HT)</th>
<th>PG58</th>
<th>PG64</th>
<th>PG70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low temperature grade (LT)</td>
<td>-10</td>
<td>-16</td>
<td>-4</td>
</tr>
</tbody>
</table>

Performance related property | Performance criteria
--- | ---
For workability | 0.12 < \( \eta < 0.65 \)

For rutting resistance

<table>
<thead>
<tr>
<th>Estimated creep Stiffness (unaged) @ HT, KPa</th>
<th>( S(0.015) \geq 100 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>S8</td>
<td>64</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated creep Stiffness (RTFI-aged) KPa</th>
<th>( S(0.015) \geq 250 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>S8</td>
<td>64</td>
</tr>
</tbody>
</table>

For fatigue resistance

<table>
<thead>
<tr>
<th>Estimated creep Stiffness (PAV-aged), KPa</th>
<th>( S(0.015) \leq 75 000 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated PI value (PAV-aged)</th>
<th>PI &gt; 0.0</th>
</tr>
</thead>
</table>

For thermal cracking resistance

<table>
<thead>
<tr>
<th>Estimated creep Stiffness (PAV-aged), KPa</th>
<th>( S(60) \leq 400 000 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>-6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated creep rate (PAV-aged)</th>
<th>( M(60) \geq 0.310 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>-6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elongation at break from Shell Bitumen Handbook (1991) (OAV-aged)</th>
<th>( \lambda (60) \geq 0.02 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>-6</td>
</tr>
</tbody>
</table>

For slow traffic (10km/h), \( S(0.015) \) limit should be multiplied by a factor of 10
For high traffic volume, \( S(0.015) \) should be multiplied by a factor of 10

Note: Assumptions of an order of magnitude (10X) difference between slow vs average speed and heavy vs normal traffic volume.
The Heavy Vehicle Simulator (HVS) has been testing South African roads for the past 27 years and it is easy for those of us who have worked with the machine for many years to accept and understand its important contribution to the advancement of South African pavement technology that is recognised throughout the world. However, there are newcomers to the industry both in a technical and decision making role that are unaware of the history and current activities of the HVS technology development programme for whom this article may provide a useful background.

History

In the 1950s the AASHTO road test and its impact on the pavement design methodology prompted South African interest in accelerated pavement testing (APT). It led to the development of a fixed facility on the CSIR campus in the 1960s, and then development of three mobile full scale accelerated testing machines by 1978. The “new generation” HVS Mark III belonged to the CSIR National Institute of Transport and Road Research, Department of Transport and former Roads Department of the Transvaal Provincial Administration now Gauteng Department of Public Transport, Roads and Works (Gautrans).

In 1994 two of the three HVS Mark III machines were refurbished and sold to the California DoT in the USA. The Gautrans HVS Mark III was in operation until 2002, and was then replaced with the newer model Mark IV. Taking into consideration the fact that the Gautrans HVS became the only full scale accelerated testing facility in South Africa, other road authorities and private sector have been invited to join forces in the HVS technology development programme.

Recent HVS Testing

Pavement-vehicle interaction: Stress in motion (SIM) measurements were performed on the HVS wheels to improve the understanding of pavement-vehicle interaction. Contact stresses and strains were measured for different loading and tyre inflation pressure. This information will be used for setting appropriate loading conditions in
the future HVS testing as well as for better characterisation of load in the pavement design.

**Cold in situ recycling:**

Three Long Term Pavement Performance (LTPP) sections were established in Gauteng on roads with emulsion and foamed bitumen treated materials. The data will be used together with other forensic testing to validate structural design of emulsion and foam treated materials.

It is planned that the TG2 Interim Technical Guideline for The Design and Use of Foamed Bitumen Treated Materials will be replaced in future by a bitumen stabilisation guideline which will include all South African experience in foam and emulsion treatments. This project has already started and is managed as a partnership between Sabita and Gautrans. In the process, issues related to the mix design, structural design and construction are going to be reassessed.

**Present HVS Testing**

At present HVS is testing reinforced thin concrete pavements at Heidelberg Traffic Control Station. Objective of the testing is to evaluate the structural performance of concrete slabs constructed on three different supporting structures:

- On top of a weak support (deflection on asphalt = 1.2mm);
- On top of a medium support (deflection on asphalt = 0.6mm);
- On top of a strong support (deflection on asphalt = 0.3mm).

This project is funded mainly by SANRAL.

**Future HVS Testing**

Performance of hot-mix asphalt (HMA) was identified as one of the focus areas by the HVS Steering Committee. Although the HMA Design Guidelines published in 2001 advanced our knowledge on the design of HMA for South African conditions, several issues...
still remain unresolved. The HVS technology development programme will address some of these unresolved issues.

The project objectives are:

- To develop improved test protocols and associated acceptance criteria for the assessment of permanent deformation and fatigue;
- To understand implications of the contact stress magnitudes and distributions on the behaviour and performance of HMA wearing courses;
- To investigate reliable test methods that can assess the durability of HMA;
- To produce revised HMA design guidelines.

This very important project will hopefully be carried out in a partnership with Sabita and other road authorities.

**HVS Management**

Although the HVS machine belongs to Gautrans, it is seen as a national asset and is managed with the advice of the road industry by means of a steering committee. The steering committee consists of representatives from the industry, academia, consulting engineers and road authorities. The task of the committee is to determine research needs, identify gaps in knowledge and to identify projects to address these gaps.

The committee was involved in development of the HVS Strategic Plan for 2004-2007, and the steering committee members also give comments on the work proposals and reports. In the time of budget constraints it is very important that all road authorities and the private sector join efforts in technology development. We have record of a good collaboration on the HVS projects with Sabita.

**Benefits of the HVS development programme**

Many people in the past have tried to identify the major benefits of the HVS. A study done in 1992 showed a cost-benefit ratio of 12.8. In the time of increased pressure on road budgets, it has become essential to define and quantify the benefits of the HVS programme. Therefore, Gautrans initiated an independent investigation into the benefits arising from the HVS technology development work. Fritz Jooste from Modelling and Analysis Systems developed a methodology that can now be used to evaluate any technology development project or programme.
A pilot project to assess the methodology and evaluate the benefits of crushed stone G1 base pavements technology developed from the HVS testing showed the following:

- The overall benefit cost ratio varies from 2.4 to 6.1;
- For Gautrans, the estimated direct benefit derived between 1980 and 1990 from the HVS investigation on G1 base pavements is between R2.2 and R14.8-million. Taking into account the contribution made by Gautrans to the funding of HVS investigation on G1 pavements, this results in a benefit cost ratio of 1.4 and 3.6 depending on the discount rate and contribution ratio selected;
- For SANRAL, the estimated direct benefit is between R3.4 and R25.2-million. This results in a benefit cost ratio of between 4.2 and 10.2. This cost-benefit ratio is higher than that realised by Gautrans, mainly because of the greater scaling of benefits provided by the larger SANRAL pavement network.

Other benefits resulting from the HVS investigations on G1 base pavements, which cannot easily be converted to economic savings, yet are sure to impact positively on the Gautrans and SANRAL budgets, include:

- Calibration of the SA mechanistic-empirical design methodology;
- Technology transfer to local and international practitioners which raised the technical competence of designers working for Gautrans and SANRAL;
- Improved understanding of the system behaviour of granular base pavements, and particularly the interaction between the granular base and cemented subbase;
- Improved understanding of the behaviour of cemented subbase layers under loading;
- Capacity building for the local industry.

**HVS Information**

All reports related to the HVS technology development programme and description of the past and future testing are available on the website www.gautrans-hvs.co.za
Premix trucks, our achilles heel?

Johann Krüger
Director
More Asphalt

Shortage of trucks when they are most needed. Trucks breaking down on the way to the site or leaking diesel/hydraulic oil. Frequent delays whilst waiting for trucks. High turnover in regular transport sub-contractors. Inexperienced truck drivers. Having to accept single diff trucks because there are insufficient double diff trucks available.

If this all sounds familiar, chances are you are in the South African road paving industry. Are there solutions to these problems? The writer believes there has to be, if our industry hopes to operate at anything like the efficiency levels achieved in first world countries.

This article endeavours to highlight some of the factors that contribute to the current situation and to suggest some changes that can improve the productivity of our industry and promote safety on our roads. It is hoped that the role players will be stimulated/prodded into action to effect the changes that will improve matters.

Erratic market

Lack of delivery from both local and provincial government departments is one of the reasons for the erratic demand for premixed asphalt. The situation is aggravated by the recent trend of some local and municipal councils to take six to nine months of their financial year to award annual tenders before trying to spend their budgets in the last three months.

Coordination

There also seems to be a complete lack of coordination or planning between the various institutions responsible for the maintenance of our roads. The result of all this is that it is either feast or famine in respect of contracts going out to tender. Unfortunately the truckers that have waited out the famine are frequently unable to recoup their losses during the feast because:

- lack of funds has resulted in their trucks being poorly maintained and frequently breaking down;
- demand now dictates that more trucks must be sourced from outside the industry.

Add to the above the seasonal influence of the weather, especially in the Western Cape, and it is understandable why the better trucking contractors leave this sector of the market to look for greener pastures.

Another, and even more serious, aspect of this situation is that...
during the feast poorly maintained trucks and over-tired drivers represent a danger on our roads.

Communication

To optimise turnaround times between plant and paver, there has to be good communication between the paver foreman and the plant despatch clerk. In an ideal situation the paver should not have stoppages, but surely the answer is to try to match the delivery rate to the paving rate, and not by waiting until there is a line of trucks in front of the paver.

This is wasted time for both the paver and the trucks, and tends to bunch the trucks so that they arrive back at the plant in a group, causing further delay.

Despatch clerks should advise the paver foreman when the first truck leaves the plant, the rate of despatch and the number of trucks being sent. This will enable the paver foreman to be ready to start paving once the first truck arrives on site and to match his paving rate to the delivery rate.

The paving foreman in turn should advise the despatch clerk whenever there is a slowdown in the paving operation, for whatever reason, so that he can adjust his delivery rate and divert some of the trucks to other jobs.

Trucks vs paver

Paving crews need to lay a minimum tonnage per day to break even. Trucks need to do a minimum kilometre tons per day to break even. It is an easy enough calculation to keep one or the other party happy, but almost impossible to keep both happy (unless the site is close to the plant or the plant is able to rotate trucks between different sites).

With better coordination between paver and trucks it should be possible to give the paver the tonnages and the truckers the kilometre tons each requires to meet their daily minimum requirements. However, this can only be achieved if the coordination between the two parties is improved to achieve optimum utilisation for both.

This may sound easy but it is going to require a change of mindset by all concerned. If we carry on in the same way as we have been doing to date, nothing is going to change.

Incentives

In the present set-up the asphalt manufacturers pay the standing time costs to the cartage contractors. It must be realised that this is a real cost that forms part of cartage costs and is factored into the cartage rates charged.

There is no apparent incentive for the paving teams to minimise standing time
This might be a flaw in our present set-up, since there is no apparent incentive for the paving teams to minimise standing time on site. If they are contracting to lay only, the main contractor picks up the tab, and if they are contracting to supply and lay, they are paying a fixed rate for the delivered product. If there was some readily identifiable monetary saving for them in minimising standing time there would be an incentive for better utilisation of trucks. The answer could be for the pavers and the suppliers to agree on an acceptable number of standing time hours for each paving job beforehand, with penalty payments or performance refunds being made at the end of the job.

In closing, we should not lose sight of the fact that ultimately the end user picks up the tab, and with provincial and local government being the most lucrative and reliable source of work, this funding comes from the taxpayers’ pockets. By improving productivity, we are ultimately benefiting our own pockets.
Striving for excellence in service and products
The road user and the road authority have different needs and expectations concerning the performance of road surfacings, especially in developing countries, where the road authority's budget constraints are generally high. User requirements focus on safety and comfort while the road authority requires low cost and long-term durability. This translated into a complex series of engineering properties to be addressed by the road designer, including adequate low speed and high speed skid resistance, low noise production from vehicle tyres, smooth ride, minimal spray, good visibility of road markings and low construction and maintenance costs.

The concept of "separation of layer functions" argues that the load bearing capacity of the pavement can be met by the structural layers, while the surfacing layers design can meet the functional engineering requirements. This concept has given rise to the new class of thin and ultra thin surfacings.

The design of thin asphalt friction courses is still, world-wide, a relatively new field (+10 - 15 years experience in countries like France, UK, Australia, and Denmark). Some countries use proprietary mixes with performance specifications (that are based on European standards) while others use volumetric and compositional specifications similar to conventional asphalt mixes (Australia etc.). In South Africa a market drive to shift from generic specifications or detailed specified mixes to the use of Agrément accredited mixes (with verified performance and compositional properties) is in process.

Compositional design of thin and/or ultra-thin (asphalt) friction courses (TFC’s or UTFC’s) is essential in order to provide a functional layer which can deliver the preferred surfacing characteristics (i.e. macro-texture, inter-connected voids, etc.) that ensure optimal skid resistance, spray elimination and also noise reduction.
An integral part of the TFC design is the sealing membrane (tack) design. Both the product type and the application method determine the efficiency of this layer. The purpose of the membrane is to act as a sealing layer and also to bond the TFC to the substrata.

Layer thickness design is also important — excessively thin layers (less than 1.8 x maximum aggregate size) seem to be more prone to closing-up and layer thickness above 3 x MAS may become unstable.

**Compositional design**

In essence, TFC’s are open graded asphalt (OGA) mixes similar in appearance and composition to conventional OGA’s (popcorns). They function similarly in terms of providing a surfacing with adequate macro-texture (surface texture of 1 - 3 mm) and inter-connected internal voids (20 - 30%) — however they are less efficient (thinner layer, lower percentage field voids per volume and therefore a smaller drainage reservoir), but then again more affordable.

They differ essentially from OGA by providing an added sealing (thick tack membrane) function over and above the conventional surfacing functions (skid resistance, etc.).

Various types of TFC’s can be utilised that depend upon the required surface properties desired. Typically the 13.2mm and 9.5mm max aggregate mixes provide the best macro-texture and the most efficient water dissipation (via surface and inter-connected voids) under wheel loads. This can be verified *in situ* by assessing water spray generation under vehicles or by testing constructed sections with the LCS permeability apparatus. The 6.7mm mix is mostly applicable to lower speed or residential roads; its macro-texture and water spray reduction capability is somewhat limited, but the noise reduction is still good.

Some of the key design considerations for optimum mix design include:

- A minimum of 75% to 80% of the single size(s) maximum aggregate is required to ensure efficient VMA in the grading structure;
- The fraction on the minus 2.38 mm fraction is essential to ensure the balance between functionality and durability;
- Higher ALD’s and stone with good PSV’s (45 to 50) increases basic functional properties (skid resistance etc.);
- The minus 0.075mm fraction to be between 4.5% and 7.0% to optimise long term durability of these thin layers (unlike OGA’s which is typically lower);
- Similar binder contents as for OGA’s is applicable, film thickness of 10µm typically indicate adequate aggregate coating to maximise long term durability;
• Mixes with field voids of 20 - 30% (Marshall VIM's of 12% - 18%, OGA method) typically have adequate in situ inter-connected voids (12 - 25% in LCS Permeability apparatus) to ensure effective internal (and surface) water dissipation for spray elimination and to maximise high speed friction;

• Specialist mix designing is required to optimally balance all these properties and parameters as well as applicable binder types into a fit-for-purpose site mix.

Sealing membrane design aspects

Similar to seals (and in contrast with conventional asphalt) the design of the sealing membrane cannot be separated from the compositional design of TFC’s. The migration of excess tack into the open graded TFC layer is the single greatest risk to the functional performances of TFC’s. Both the type of sealing (tack spray) and the application rate (net binder) determine whether it will fulfil its purpose; excessively low contents (or too stiff types) will result in the long term sealing and durability of the layer being jeopardised; excessively high binder content (or types that are too soft) can cause binder migration into the TFC layer resulting in flushing/closing-up of the open-graded structure.

The design of the sealing membrane cannot be separated from the compositional design of TFC’s

The typical binder quantity in a square metre of TFC layer is in the order of 1.7 litre (at 4.5% binder content); for each excess of 0.10 litre/m² of (net) bitumen (tack) which migrates into the TFC, the effective mix binder content increases by 0.35% and the VIM’s/field voids decrease by + 3%. Mixes typically start to close up or flush at 14% field voids. Therefore, migrating tack quantities above 0.15 litre/m² can become detrimental to the functionality of the mix (i.e. causing closing-up due to a loss of inter-connected voids and surface texture).

Also, tack types with softening points that are too low (for the conditions where it is to be utilised) can result in excess migration of binder into the thin asphalt layer, resulting in closing-up/flushing of the mix.

Future performance based design aspects

TFC mix design is still a relatively new field in South Africa, and a lot of experience-building and future innovative methodologies must still follow. However, until such time, some of the client bodies (driven by SANRAL) have indicated that they would prefer or demand mixes accredited by Agrément, with reference to its fit-for-purpose (including selected
In addition, an industry drive to research and define applicable and representative performance properties and testing methodologies for these mixes is currently being initiated at University of Stellenbosch by stakeholding parties.

It is foreseen that the following specialist tests and properties may become the main performance criteria for future design (and accreditation) purposes:

- MMLS APT for long term functional property verification (closing up resistance, inter-connected voids and macro-texture);
- In situ macro-texture and inter-connected voids (after construction and 1 or 2 summers later);
- MMLS APT for durability (binder stripping, ageing and aggregate loss);
- ACV and PSV for aggregate durability.

**The way forward**

A special technical committee has been appointed to prepare Agrément accreditation documentation (reported on at the previous RPF and in previous Sabita newsletters by Dennis Rossmann.) Some road authorities will take the route of requiring all future mixes to be accredited (end 2006 target for implementation thereof).

Others may consider detailed specifications, which could be refined and, over time and when proven, become part of standard specifications for inclusion in SABS and COTO etc. documents. Both processes, or a combination thereof, may be advantageous to the industry to ensure innovation and long term inclusivity for this product (especially in the light of future BEE contractor development).
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Then you can look at the bottom line, because by balancing efficiency with quality, Much Asphalt is able to deliver value for money solutions better than anyone.
Emulsified bitumen treated materials have been used successfully in South Africa for many years. Foamed bitumen is a newer technology that has not been as widely used in South Africa. Both the foamed bitumen and emulsion treated materials technologies provide a rehabilitation alternative that can recycle and improve existing pavement layers, or that can improve marginal imported materials for use in pavement rehabilitation. When used in appropriate situations, these technologies can offer significant benefits that not only relate to cost-effectiveness, but also to optimal utilisation of available resources and protection of the environment.

Since 1992, several guidelines have been published to assist practitioners with the design and use of bitumen emulsion and foamed bitumen treated materials. These guidelines include Sabita Manuals 14 and 21 (both pertaining to emulsion treated materials, and released in 1993 and 1999, respectively) and the more recent TG2 - Interim Technical Guideline: The design and use of foamed bitumen treated materials of 2002 (dealing with the design and use of foamed bitumen treated materials).

The widespread use and success of the existing guidelines have highlighted the importance of keeping the guidelines up to date. This need was given more urgency by a significant amount of new knowledge that has become available over the past decade on the behaviour and performance of foam and emulsion treated materials.

This new knowledge stems partly from several Heavy Vehicle Simulator (HVS) tests undertaken on these material types at various times since 1992. In the case of foamed bitumen materials, an opportunity now also exists to evaluate the field performance of several projects that have been
constructed using this relatively new technology.

In response to the need to keep the available guidelines for bitumen emulsion and foam treated materials up to date, Sabita and Gautrans initiated a project aimed at developing an updated and combined guideline document to assist practitioners in all aspects of the design and use of bitumen emulsion and foamed bitumen treated materials. This project is being jointly executed by Dr Fritz Jooste and Dr Fenella Long of Modelling and Analysis Systems (MAS), and by Prof Kim Jenkins of Stellenbosch University.

Owing to the ambitious scope of this project, it has been structured in various phases, as shown in Figure 1. The first phase of the project comprises an inception study which is currently in progress and will be completed in January 2006. The inception study will focus specifically on mix and structural design. These two elements were earlier identified as being those for which the most new knowledge is now available, and are thus most urgently in need of being updated.

**Structural Design**

A key element of the project approach is an emphasis on the utilisation of the observed medium and long term performance of pavements that incorporate bitumen emulsion and foamed bitumen materials. To achieve this, the inception study has as its primary objective the gathering of all pertinent and available behaviour and performance data for these pavement types. The study will then analyse and summarise available data, and identify key deficiencies in the available information. Any deficiencies so identified will then be addressed in later phases of the project.

To date, more than 50 projects have been identified in which either bitumen emulsion or foamed bitumen treated materials were utilised. These projects were identified from published literature and through the generous assistance of client bodies and consultants who are experienced in the use of these two technologies. The project efforts are now focussed on collecting all available construction and performance data for these projects.
Since some of the identified projects are less than five years old, while others no longer exist, not all of the identified projects will be of use to this study. However, it is expected that useful construction and performance data can be obtained for enough of the identified projects to assist in the identification of key behaviour and performance trends. These long term trends will then be evaluated in conjunction with available HVS data and other published information to facilitate the development of updated structural design guidelines for pavements that incorporate bitumen emulsion and foamed bitumen treated materials.

**Materials Design**

The materials design component of the inception study will focus to a large extent on the improvement of materials testing and evaluation protocols. The inception study includes an in-depth study of available information relating to the curing of samples and the evaluation of material durability. In addition, the study will investigate the incorporation of tests to evaluate material flexibility and stability using strain-at-break and triaxial test protocols which will be developed in later phases of the study.

**Later Project Phases**

As shown in Figure 1, the inception study outcome will be used to refine and finalise the planning of later project phases. Each of these phases will address a different aspect or chapter of the combined guidelines for emulsion and foam treated materials. These phases are:

- **Introduction and Selection Criteria**: this phase will focus on aspects related to material selection, advantages and disadvantages of the two technologies and generalised rules on expected behaviour;
- **Mix Design**: this phase will address all aspects related to the selection of an appropriate material configuration. Aspects covered will include: (a) curing; (b) determining optimum binder content; (c) durability testing; and (d) shear strength testing. Another outcome of this phase will be an updated material classification system for emulsion and foam treated materials;
- **Structural Design**: this phase will address aspects related to the structural design of pavements incorporating emulsion and foam treated materials. As noted earlier, the study will seek to utilise not only HVS test data, but also observed long term performance data. It is envisaged that the outcome will include updated criteria for use in the South African Mechanistic Design Method, as well as a simplified first level design procedure;
- **Construction**: this phase will focus on aspects related to the successful construction of emulsion and foam treated materials. It is envisaged that
the updated guidelines will contain improved and expanded sections dealing with *in situ* recycling, labour based construction and project specifications.

As funders for this project, Sabita and Gautrans hope to guide practitioners to make cost-effective decisions on the optimal use of roadbuilding materials. This will in turn contribute to reducing project costs (through optimal materials and pavement design) as well as to a lower incidence of costly premature failures.
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Towards a self-regulating calibration scheme for binder distributors

A project to establish a self-regulating calibration scheme for binder distributors was initiated at the Road Pavements Forum (RPF) in May 2002, when a task team was formed to address industry concerns relating to binder distributors. Early developments were described in the 2003 Sabita Digest report entitled Update on RPF’s task team on Binder Distributors.

The formation of the task team arose mainly as a result of:

- Use of outdated specifications and standards;
- The increased usage of modified binders in seals to perform under high traffic conditions.

After a series of meetings and investigations the task team, made up of representatives from all major stakeholders in the industry, reported back to the RPF with firm proposals to resolve the above issues.

Recommendations

After deliberation by the members of the RPF on the task team proposals, agreement was reached on the following issues:

1. Spray rate tolerances: The maximum acceptable tolerance would be the larger value of:
   - +0.06 litres per m²
   - +0.05% of the target spray rate prescribed

   The minimum lot size for consideration would be 1 500 litres.

2. On-site test for measuring transverse distribution: A standard test method was developed for the 'bakkie' test and the following tolerances were agreed:
   - Conventional binders - Penetration, cutback and emulsions: ± 5%;
   - Polymer modified binders: ± 7%;
   - Bitumen rubber: ± 10%

   All distributors to keep a register of 'bakkie' tests performed.

3. Calibration certificate: It was agreed that the validity period for a calibration certificate would be 12 months. This would be supported by on-site tests and checks.

4. Health and safety: Sabita published Manual 8 — Guidelines for the safe and responsible handling of bituminous products which established, inter alia,
protocols for testing and flushing spray bars on-site.

**All the above recommendations have been incorporated into SANRAL’s special project specifications for all their contract documents.**

**Self-regulation**

There was generally a 'lack of confidence' in the current calibration system and ability of the state to continue to conduct the testing to ensure that the distributors were 'fit for purpose'. At the November 2002 meeting the RPF passed a resolution that the Task Team should investigate a system for self-regulation and that controls should be in place to ensure that the binder sprayed would be:

- done at the correct application rate;
- with uniform transverse distribution;
- within acceptable tolerance rates;
- handled in a responsible manner with respect to worker health, safety and the environment.

This should be done by reviewing the existing system which is based on the outdated TMH 2 document published in 1979.

A meeting was held in September 2003 with representatives of all major stakeholders, including all the provincial road authorities, to discuss a new calibration scheme for binder distributors. Barry Dumas was subsequently tasked to investigate, and at the November 2003 RPF he proposed a new accreditation scheme based on the Australian model. The premise of the new scheme was that the calibration testing should be carried out under the auspices of an accredited body. How the scheme would work is best illustrated in Figure 1.

**Figure 1:** Proposed accreditation scheme
The following actions were seen as two essential steps towards achieving self-regulation, and in ensuring that adequate controls are put in place to promote confidence in the spraying of binders in South Africa:

- Development of certified methods for calibrating a sprayer to replace the existing outdated TMH 2;
- Implementation of a calibration scheme which would be supported by an external accreditation body like SANAS.

**New guideline**

Sabita appointed consultants Vela VKE in November 2004 to capture best practice in determining the requirements for binder distributors to ensure that binder distributors are properly calibrated, and that there is a high probability that the binder will be applied correctly. A draft guideline has now been produced to replace outdated TMH 2.

The procedures proposed essentially include:

- Calibration of the binder distributor at a dedicated facility on an annual basis;
- On-site checks and tests to ensure that the distributor performs within acceptable limits.

The document contains the test methods for calibrating a binder distributor at a fixed pit facility as well as tests and checks to be conducted on-site. Before the document can be considered for review, the following still need to be finalised:

- Formatting the test methods so that they are compliant with TMH 1;
- Developing a stepped function programme to improve the correlation between the fixed pit transverse distribution and the ‘bakkie’ test.

The assistance of Dave Wright and Barry Dumas respectively has been sought in addressing these outstanding needs.

**Implementation**

As there are only approximately 75 sprayers which are calibrated for use in South Africa every year, it would hardly make economic sense to privatise the operation in its entirety. A better solution would be to make use of the existing three calibration facilities which are centrally located at:

- Pretoria (Gautrans);
- Pietermaritzburg (KwaZulu Natal DoT);
- Port Elizabeth (Eastern Cape Provincial Administration).

It is envisaged that a national service provider would be used to obtain ISO 9001 certification, and would eventually seek SANAS accreditation. The intention is that the provincial road authorities would make their existing facilities available to the industry, and that the national service provider would conduct the tests in accordance with the requirements of the
guideline document to ensure the binder distributor meet the required standards.

The national service provider would issue the calibration certificate to the owner of the distributor, and Sabita would publish a list of all the calibrated distributors on their website as a live record.

**Way forward**

A meeting was held in September 2005 with representatives of KwaZulu-Natal DoT and Specialised Road Technologies to explore the above proposal. Possible issues and concerns facing the client and service provider with the outsourcing of the testing were identified.

At this meeting it was decided to inform the Road Materials Committee of the intention to implement the new scheme on a pilot project basis in KwaZulu Natal before extending the scheme to the other existing two provincial binder distributor testing facilities.

All stakeholders will be kept abreast of the developments through the Road Pavements Forum to ensure that there is support for the new scheme within the industry.
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Thin bituminous surfacings (also termed ultra-thin friction courses) are defined (in South Africa) as being less than 25 mm thick, with the primary purpose of rectifying the functional properties of pavements. Various proprietary systems developed in Europe more than a decade ago, have also been used in South Africa. Potential benefits of these layers over seals include improved riding quality, reduced noise levels, no risk of early stone loss and longer seasonal application periods.

Manufacturers of proprietary thin bituminous surfacing systems generally claim excellent performance of their product for a variety of uses. The real performance potential of these systems for a given project may, however, be difficult to assess for clients due to a lack of objective information. Users are thus in need of an objective evaluation system to determine the suitability of a specific product for the required purpose.

The formal evaluation of the performance (in terms of defined fit-for-purpose criteria) of these products leading to certification by a recognised independent body will do much to improve confidence in the use of these products.

An industry task team set out to develop a certification procedure for thin bituminous surfacing systems. This team is made up of:

- Mervyn Henderson (Provincial Government Western Cape);
- Kim Jenkins (SANRAL Chair, University of Stellenbosch);
- Piet Myburgh (Sabita);
- Basie Nothnagel (SRT);
- Paul Olivier (Jeffares & Green Consulting Engineers);
- Derick Pretorius (Arcus Gibb);
- Dennis Rossmann (South African National Roads Agency Ltd);
- Elzbieta Sadzik (Gautrans);
- Gary Swart (BCP Engineers)
- Benoit Verhaeghe (CSIR Built Environment);
- Julian Wise (Martin & East)
Certification body

Agrément South Africa was selected as the certificating body and assigned the development of the technical guideline to a project team comprising of representatives from CSIR Built Environment and the University of Pretoria. The guideline is based on the British Board of Agrément (BBA) publication, Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways.

The project team initially adjusted the BBA document to be more appropriate to the South African context. A number of functional and structural parameters suitable for the meaningful assessment of thin bituminous surface systems were identified. The thin surface courses to receive certification are predominantly intended as functional layers, and therefore performance against functional parameters carries most weight in the certification process. Testing of key functional parameters, as well as some structural parameters, will be mandatory to receive certification. Where the applicant claims enhanced performance under any of the optional parameters in the guideline, this performance can be verified and included in the certificate. The data required in the accreditation process originate from three sources:

- The first is the description of the production process provided by the applicant. In order for the certificate to be of real value it must cover the entire production chain. To cover the manufacturing and construction separately could lead to responsibility issues between contractor and manufacturer. The guideline therefore requires the applicant to assure the quality throughout the production process until final application, through a comprehensive quality management system;
- Laboratory information on the performance of the product is the second source of information. In determining the test methods the aim of the guideline document is to provide the applicant with alternatives for each parameter. The test methods in the original BBA document have been assessed for their applicability under South African conditions. Some British test methods have been replaced with standard test methods used in South Africa, while other more suitable or innovative ones have been maintained in the document as an alternative to locally available tests. Final performance criteria for these tests will be decided on by the Industry Task Team;
The third source is the field performance of the product, in which satisfactory performance on a minimum of three sites has to be demonstrated. Agrément South Africa will monitor the production process and performance of the product on one site. The field trials will span a period of two years during which Agrément South Africa may opt to provide a temporary certificate for systems that have shown acceptable performance during the laboratory test phase.

**Evaluation**

Where a system has already received certification through another certification body which is a member of the World Federation of Technical Assessment Organisations, the outcome of that process will be evaluated by Agrément South Africa to determine specific further requirements for South African certification. Such additional information will typically focus on those areas where differences exist in parameters such as traffic and the environment between the country where the original certificate was issued and South Africa.

The draft guideline is in the process of being evaluated by the industry task team. Once a final guideline document has been approved, the process of application for certification of bituminous surfacing products will be initiated. It is believed that this process should lead to most of the major producers of these proprietary products to apply for, and receive, certification for their respective products.

Through this process the road owner should have a more impartial and objective indication of the fitness for purpose of available products.
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In September 2002 the SAT Southern Region committee came up with the idea of producing a Trouble Shooting Guide (TSG) as a useful and educational tool for the asphalt industry. It is vaguely based on a similar NAPA publication.

So many problems crop up and for so many different reasons; but when faced with them, even an experienced asphalt practitioner will find it hard to come up with, say, 30 relevant reasons for poor compaction, or 20 for poor rideability. The TSG provides a "check list" format, compiled from the experience of many leading practitioners, which facilitates a process of elimination in identifying the possible causes of problems. A glance at the list of the industry leaders, whose contributions to the TSG are acknowledged on page 3 of the booklet, gives it a lot of credibility. The booklet deals with a wide range of problems, from common to rare, focussing mainly on continuously graded asphalt.

The layout

- Column 1: The PROBLEM is described in simple terms;
- Column 2: POSSIBLE CAUSES are listed.
  - They are grouped to be able to investigate different areas of the asphalt process. For example, causes of compaction problems are grouped under headings such as Base-course condition and preparation,

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SAT’s new Hot-Mix Asphalt Trouble-shooting Guide

Julian Wise
Director
Zebra Bituminous Surfacing cc
Asphalt mix properties, Weather conditions and Rollers and rolling techniques.

- Problems are very often caused by a combination of factors. Flushing, for example, may be the result of hot ambient temperatures plus too early traffic. Eliminate just one and the problem may disappear;
- Another common occurrence is that the root cause may be masked by other less relevant causes. For instance, the root cause of poor rideability may be the unevenness of the base layer; but what may be more visible is stop/start paving.

- Column 3 (red): the PROBABILITY of the problem’s occurrence is indicated i.e. how often it happens. For example:
  - Compaction problems on thin mats in cold weather - high occurrence (H);
  - Vapour pressure causing blisters is rare - low occurrence (L).

- Column 4 (blue): The IMPACT of the problem on the finished product is indicated, e.g.:
  - Low compaction has high impact (H);
  - Roller drum edge marks have low impact (L).

- Column 5: SOLUTIONS proposed are generally preventative, to obviate a reoccurrence of the problem. These can be used for anticipating what is likely to go wrong before paving starts.

Case Study

A quick look at a problem will make it clear how easy this guide is to use. Let’s look at Rideability
PROBLEM: Unsatisfactory riding quality (due to wavy or bumpy surface).

POSSIBLE CAUSES: are grouped under headings of:
Base layer: two high probability causes are:
- Base has poor rideability;
- No levelling layers to correct this.
- Asphalt mix: a high probability cause is deformation of a very thick mat under the rollers;
- Paver: here is where most rideability problems originate, and there are a lot of causes associated with the paver. Two principal causes are:
  - Varying head of asphalt in front of the screed - The USA ranks this as their No.1 cause;
  - Stop/start paving - ranked No.2 in USA;
- Level control system. The purpose of this is to produce a smoother mat than the paver can accomplish by itself, or than the screed operator can accomplish manually.
  - Is a suitable, correctly adjusted, level control system being used?
- Rollers: choice of breakdown roller is important. A high probability cause is the use of a pneumatic roller immediately behind the paver. The thicker the mat, the worse the problem.

Suggested solutions:
I invite you to obtain a copy of SAT’s Hot-Mix Asphalt Trouble-shooting Guide, and to read the proposed solutions for yourself. The booklet has been designed to fit comfortably into a shirt or jacket pocket, and to be readily available anywhere on site.

Most of us actually get a lot of satisfaction solving problems. So keep the Trouble-shooting Guide handy when you are next involved with an asphalt contract. Some problem is bound to happen.
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TG2 Interim Technical Guidelines: The design and use of foamed bitumen treated materials

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HSE — Health, Safety and Environmental Guidelines for bitumen and coal tar products
CEP — Councillor Empowerment Programme
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**Bitumen**
- AV-1 Penetration test / Softening point (ring and ball)
- AV-2 Spot test / Rolling thin film oven test
- AV-3 Brookfield viscosity / Ductility

**Bitumen Emulsion**
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- AV-5 Sedimentation value of emulsions / Residue on sieving
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