CONCRETE BLOCK PAVING FOR LABOUR BASED CONSTRUCTION OF ROADS – A SOUTH AFRICAN STUDY

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Summary

On April 27, 1994, South Africans went to the polls in the first democratic elections in the country's history. The events of 1994 were nothing short of a political miracle. But to the approximately 4,5 million unemployed people, real change will only come when there is a significant change in their standards of living.

With the new government came a Reconstruction and Development Programme (RDP). This is aimed at addressing the inequalities of the past and uplifting the masses by providing jobs, education, housing and infrastructure on a scale never before seen in South Africa.

Many authorities are now focused on concrete block paving (cbp) for roads as it provides employment, help empower people and provides an appropriate and desirable level of infrastructure.

Using cbp for labour based construction is not new for South Africa. There are a number of projects which have been successfully completed and well over a million square metres laid. However, there is a new sense of urgency.

This paper looks at the history of these projects and what has been learnt from them and make recommendations for future projects.

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Introduction

In 1994, South African went to the polls in the first democratic elections in its history. The events of 1994 was nothing short of a political miracle. Sanctions were lifted and South Africa once again took its rightful place in the world arena.

However, the elections in 1994 were the start of a process, not the end. South Africa has a high rate of unemployment, a high number of illegal immigrants from neighbouring countries, low level of skills amongst the majority of the people and a high population growth rate.

The South African demographics are as follows:

- The Development Bank of Southern Africa (DBSA), in its report, "Socio economic enhancement of development projects"[1], estimates that the part of the labour force without formal employment opportunities was about 8,3 million in 1990. It is estimated that between 4-5 million people are without any employment at all.
- There is a decline in the labour absorption capacity of the formal sector, as shown in Figure 1 below.
- The average age of South Africans is lower than other countries. See Table 1.
- The South African population is 43,8 million and is growing at a rate of 800 000 persons per annum and added to this there is an estimated 8 million illegal immigrants from neighbouring countries.

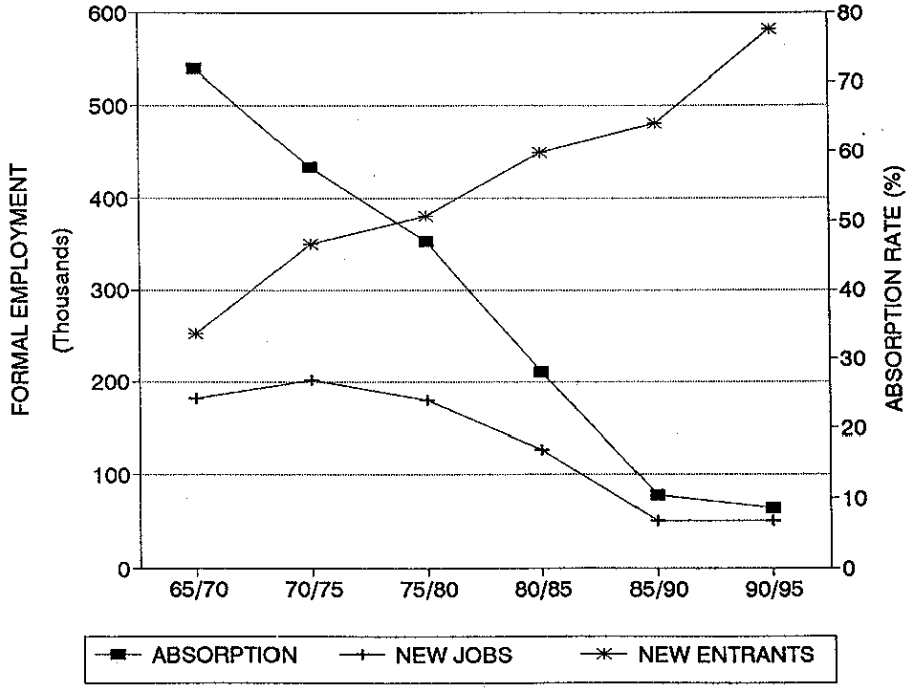


Figure 1. Marginal Absorption Capacity of the formal economy. 1965-1995 [1]

Table 1. Median age of South Africa and other countries

Country			Median Age * (years)
Scandinavia			54 - 55
China			33
South Africa	-	Total	19,7
	-	White population	42 - 43
	-	Black population	17,9

* Median age - 50% of population above/below

A further problem for the economy is that a cultural of non-payment for services exists. A refusal to pay for services was one of the strategies used to challenge the apartheid system. Unfortunately the political changes achieved do not appear to have resulted in a willingness to pay. The situation is complicated by the results of a recent survey that indicates that 53% of the population are in fact unable to pay for municipal services.
While the South African economy has at last started to grow, the growth is taking place in relatively sophisticated, export concentrated industries which can expand their capacity and profitability without significantly increasing employment.

In these circumstances, it is obvious that for the foreseeable future the formal sector (particularly the private sector) will be unable to absorb the large number of people entering the job market each year.

Reconstruction and Development Programme (RDP)

These facts have been recognised by the new Government of National Unity, which has responded by launching the Reconstruction and Development Programme (RDP), a programme designed to address the inequalities of the past and to try and uplift the masses.

The following are some excerpts from the RDP [2] book which relate specifically to infrastructure:

"2.3.2 In the short term, the RDP must generate programmes to address unemployment. These measures must be an integral part of the programme to build the economy, and must also relate to meeting basic needs.

2.3.4 All short term job creation programmes must ensure adequate income and labour standards, link into local, regional and national development programmes, and promote education, training and community capacity and empowerment.

4.6.2 The infrastructural programme must ensure an integrated approach to the provision of various services, so that we upgrade our infrastructure in a manner that both meets basic needs and enhances new and effective economic activity."

A basic principle of the RDP is that any construction being funded by Government monies

should provide employment, training and entrepreneurial opportunities for members of deprived communities.

The job creation potential in using concrete block paving for road construction means that cbp roads can satisfy many of the aims of the RDP. As this fact became more widely recognised, there was an upsurge in interest in the use of concrete block paving in labour intensive road projects.

One development organisation recognised the potential of cbp for construction and development and has been prominent in promoting the use of this paving medium. The Development Bank of Southern Africa (DBSA) have for many years been responsible for providing finance for projects for the socio-economic upliftment of disadvantaged communities. Policies and strategies for promoting development in South Africa are arguably as important a product of the DBSA as its loan finance and technical assistance programmes.

In the past, development projects in South Africa were undertaken to meet only the physical needs of the recipient community. DBSA recognised that South Africa's changing social and economic environment demanded that such projects be executed in a manner that would ensure that the community's other needs were also addressed and that to achieve this, projects must be structured so that opportunities for employment and the development of skills and entrepreneurial abilities were maximised.

Concrete block paving in South Africa

Concrete block paving is well established in South Africa. Although the first installation in South Africa were only some 35 years ago, the growth has been fairly strong and the estimated annual turnover is now estimated at 8 million square metres. Figure 2 below shows the trend in sales over the last decade. Since the election, there has been a significant growth indicating a renewed level of confidence in the business sector.

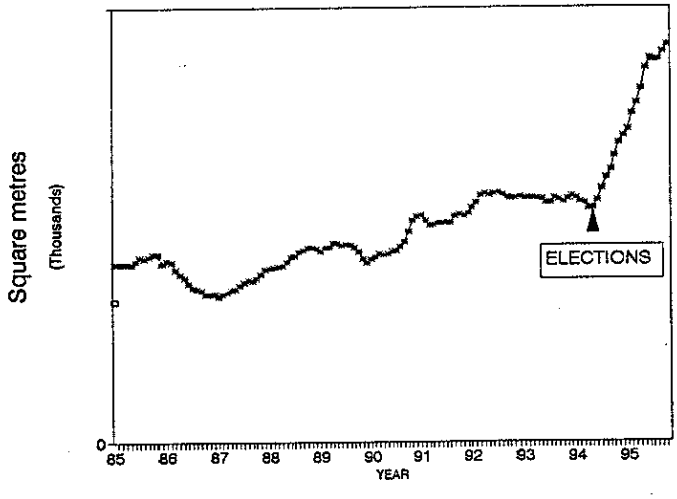


Figure 2. Cbp sales in South Africa (12 month moving average)

Mechanised laying of pavers has not been introduced into South Africa, and indeed, would not be encouraged. The fact that block paving is labour intensive is seen as a distinct advantage in many sectors.

Concrete block paving for labour based construction of roads is also not new. To date, there have been over 20 projects completed, some projects exceeding 100 000 m^2, with a total well over a million square metres laid. Since the elections and with the introduction of the RDP programme, it is expected that the number of these projects will multiply rapidly.

Benefits to the community

The construction of roads using concrete block paving provides benefits to the community that extend much further than the provision of a road and the creation of employment. It develops a sense of pride and ownership amongst the community. This was particularly notable in Belabela, where, after the roads were completed, the sidewalks were grassed, houses painted and the entire area uplifted.





Photographs 1 and 2. Belabela - immediately after paving and two years later

Labour based construction

Labour based construction entails machinery being replaced by labour. It should not mean a "lowering of standards" or an "increase in cost". There are cases where the standards may well have to be modified to make them more "appropriate", but standards must not be compromised.

It must be accepted that certain tasks and the provision of certain services are achieved more efficiently by means of mechanised construction. If this is the case, then labour based construction should not be considered. A typical example is the construction of the earthworks. It is highly unlikely that a labour gang will achieve the degree of compaction required for the subbase layers, hence mechanical compactors should be used. Labour based construction should only be considered where the same standard of product can be achieved at approximately the same cost or less than that of conventional construction.

Creation of employment opportunities

The use of concrete block paving for the construction of roads is particularly suitable for labour based construction, due to the fact that it is already labour intensive. It does not have to be modified to become so.

A road project in Qwa Qwa which included approximately 120 000 m² of paving resulted in the creation of almost 80 000 man-days of work and channelled approximately R2,0 million (U.S.$ 500 000) directly into the community. This has resulted in numerous secondary industries developing.

Watermeyer and Band [3] estimated that the man-hours required to surface roads are as laid out in Table 2 below.

Table 2. Productivity on labour based roads [3]

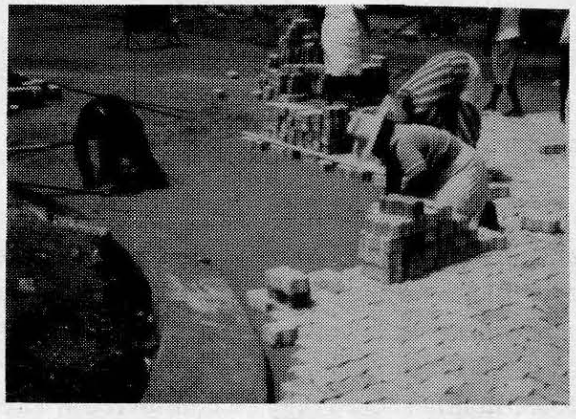
Surfacing		Man-hours in respect of materials and construction (Man-hours/m²)	
Type	**Thickness**	**Plant-based**	**Labour-based**
Slurry	15 mm	0,110	2,011
Asphalt	25 mm	0,140	1,170
Concrete blocks	60 mm	0,930	2,120

Note: These figures apply to the surfacing of the road only.

The National Economic Forum estimate that, of the amount of money spent on road construction, 5 - 15% is spent on labour. For labour based construction, this figure is currently between 20-25% and it is estimated that it could be as high as 50%.
In the commercial market, a work gang of eight will lay approximately 200 - 300 square metres per day.



Photograph No. 3. Qwa Qwa



Photograph No. 4. Belabela

Experience gained and lessons learnt

Although a number of such projects have been successfully completed and over a million square metres of segmented paving laid, South Africa is still on the learning curve. Most of the projects have been reasonably successful, but there have been some unsuccessful projects and lessons can be learnt from these. However, the following experiences have evolved which could be a guidance for future contracts:

Cost of project

The DBSA [4] have executed a number of road contracts out to tender. On such contracts, the tendered price for cbp surfaced roads ranged from 98% to 113% of that of a conventionally constructed asphalt road. This means that cbp is competitive with asphalt, especially when one considers the lower maintenance, the salvage value and life cycle costing.

Manufacture of blocks

The issue of whether to manufacture blocks on site as part of the project, or to buy from a commercial supplier is one of endless debate. Most on site manufacturing plants are fairly rudimentary and to achieve high strength pavers on these plants requires excellent quality control and management and these skills are generally not available on such projects. It can be done, but careful and regular monitoring is required.

No Engineer should allow the circumstances that occurred on one contract where the supervising engineer had to resort to removing blocks from a section of ostensibly finished roadway to ascertain their compliance or otherwise. The appearance of the road indicated that many of the blocks did not comply. Tests confirmed this, but almost a kilometre of cbp road was laid and more than 350 000 blocks had been cast and stockpiled in the manufacturer's yard before this confirmation was obtained. [5]

The following facts should be considered when assessing whether or not to manufacture on site:
Existing plant Is there an existing manufacturing operation in the vicinity? It does not make economic sense to duplicate manufacturing capacity
Long term viability What is the long-term viability of the plant, after the project is completed? Can the plant be altered to manufacture other products?
Availability of aggregates What is the availability of aggregates? Normally, for economic reasons, block plants are situated close to the source of aggregates, rather than close to the market. This gives the plant flexibility with regard to the marketing of the product. A suitable compromise is to set up a joint venture with an established manufacturer and the community. This will ensure the availability of technical expertise and management skills as well as long-term viability and sustainability. On one of the projects where the community was insistent on the manufacture of blocks on site, a small manually operated block machine was set up to manufacture the masonry units for ancillary works, while the pavers were manufactured by an established manufacturers. This arrangement ensured adequate quality of both products.

Community involvement

It is absolutely essential for the community to 'buy into' the project. The community must agree with the need for the road, the progress of the work and the payment.

The need for the road It is important that the community understands and agrees with the need for the road. The long term economic benefits of good access to an area are not always obvious to locals who have no means of transport. If they perceive that the road is low priority, then they are less likely to support the project and be committed to it.

The rate for work Labour based jobs should be based on payment for an allocated task. Payment on a time basis has been shown to be inefficient. Dividing the project up into equitable and even tasks is one of the key elements the project manager must establish correctly if the project is to succeed. The 'task' is the amount of work which an individual or group must complete before payment is made. The task should be so calculated that it is readily attainable and be such that with real effort, more than the set task can be achieved. The task must also be designed so that all the workers are equally busy and that all are fully occupied.

Although it is important to aim for maximum productivity, the tasks set must be sustainable and attainable i.e. attainable consistently over the period of the contract, taking into account breakdowns, stoppages etc. If the tasks are too onerous, the community will attempt to achieve them and upon failing, will resort to nominal productivity. Revision of task levels can sometimes be viewed as failure by management. Hence, it is important to ensure that the task levels are realistically set at the outset of the project and agreed with the communities.

It is also critical to ensure that all the factors affecting the production are considered. The workers cannot be expected to achieve a particular task if a certain essential component is missing - such as cement for the manufacture of pavers. This has happened, and the workers were penalised due to the poor management of the project managers.

Rate of pay The rate of pay per task is also a key issue. Although the community may agree on a fixed rate at the beginning of the project, aspirations change and it is possible that this rate may need to be reviewed during the course of the project and provision made for this in the project funding. A number of projects have experienced labour problems relating to the pay issue which have arisen during the project.

Agreement has been reached in South Africa between labour and the industry to pay wages below the minimum statutory wage. This only applies to projects which are specifically aimed at the creation of employment.

Shrinkage

In most projects, where the community have been involved and are committed, very little theft of pavers or equipment has taken place. In fact, in some cases the community have aggressively protected "their" assets. There are however, cases where the commitment of the community has not been nurtured and in these cases, theft has take place.

Training

Training is a fundamental aspect of any RDP project. The transfer of skills via training and experience will be of value to the recipients after the project is complete, for the skills learnt can be used for a variety of building operations.

Absenteeism

Regular absenteeism for a period of days and a high turnover of the labour force has caused problems on certain projects, particularly where the missing persons carried out key function. It is therefore suggested, that a number of persons be trained for any particular task to ensure availability of skilled labour.

Sequence of construction

Most road contracts (and other civil works) are planned so that work starts on the major section of roads. The objective of labour based projects is to employ inexperienced local labour and to provide training. This means that the project manager by definition will start off with an inexperienced gang, who will learn as the project progresses. Under these conditions, one should expect teething problems and it is recommended that construction should always begin on a minor road, taxi rank or sidewalk where small imperfections are more acceptable.

Project Managers

Labour based projects require far more management involvement and commitment than conventional projects. It is just as important that the project managers "buy into" the projects, as it is that the community does. Labour based construction is a growing industry and more consulting engineers are becoming involved. However, many are not experienced or committed to this type of construction and this is reflected in the success/failure of the projects.

There is debate as to whether consulting engineers or contractors are better suited to act as project managers. It is generally felt that contractors are better suited since that they are more experienced with dealing with a large labour force and are better structured to take on the risk. However, some contractors feel that the client should share this risk.

Many consultants are not as familiar with block paving as they should be. This has resulted in over design of certain roads where the consultants have ignored the structural contribution that cbp can make. It has also resulted in poor attention to detail such as excessive use of insitu concrete infill and the use of kerbs that are too light to adequately restrain the edges of the paving.

Appropriate standards

With limited resources in South Africa and a tremendous backlog of services and infrastructure, it is important that appropriate standards are used. The project should be well constructed to ensure long life and low maintenance. However saving can be made by using

appropriate standards for the geometrics. A case in point is Ntuzuma, Kwazulu Natal, where many of the smaller access crescents were constructed as a 2,5 m wide one way road. For the expected traffic on this section of road, this is an appropriate standard. On another projects, narrow roads were built, but widened at the intersection.

In many cases, the existing gravel roads which have been consolidated under years of traffic, are suitable as a subbase for the concrete block paving. Concrete block paving adds an additional structural element to the road and although a surfaced road will attract more traffic, additional earthworks may often be unnecessary. All that is needed in such a case is to grade the road, construct the edge restraints and lay the paving. This was achieved in Makwassie in Western Transvaal.

However, there are some instances where the engineers has rigorously enforced first world standards. On a provincial road in Kwazulu Natal (with an average daily traffic of 500 vehicles) which was to be surfaced by concrete block paving, primarily to create employment, the road was realigned both vertically and horizontally and widened to provincial standards. The cost of earthworks eventually overshadowed the benefits obtained from the creation of employment.

Sustainability and continuity

Projects should ideally be planned so that they run back to back and provide continuity of employment. For rural roads this may prove difficult, but for local government it is relatively easy. The annual budget is simply spread over the year, and the rate of construction tailored to meet with available funds.

Problems have been experienced on certain projects in trying to motivate the work force as the projects draws to a close. Understandably, people are not keen to work hard and finish off a project if they realise that there is no work for them at the close of the projects.

Visibility

Although it is vital to upgrade all infrastructure, it is also important that whatever work is carried out has high visibility. This is important to satisfy communities that something is been done for them. This change in perception is necessary if the trend of non-payment for services is to be reversed. Roads are highly visible and a focal point of community living.

Recommendations for future projects

* The community must be involved in the planning as well as the execution of the project. Their commitment is fundamental the success of the project. The rate of pay and productivity must be agreed upon before the contract begins.

* Quality of earthworks must be maintained.

* To ensure the supply of quality pavers on site, manufacture should only be considered if there are no established manufacturers in the vicinity.

* These projects require a higher level of management skills and commitment and expertise in this type of project is essential.

Conclusion

Concrete block paving has grown in use in South Africa and is now acceptable for almost all forms of paved surface. Concrete block paving is ideally suited for labour based construction of roads and it satisfied many of the aims of the RDP. Only two years ago, there was a negative perception by black communities towards concrete block paving. They felt that if cbp were being offered to them, it must be inferior to what the white communities were given. Fortunately today, that perception has changed dramatically as the communities now realise the benefits with regards to job creation and reduced long term maintenance costs. Communities are also becoming aware that the appearance of cbp is attractive and can enhance the value of the surrounding properties. Now there are communities which are actively demanding block paving, in preference to bituminous surfacing. It is expected that as the RDP becomes a reality, construction of roads using cbp will become a way of life in every municipality.

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