A brief history of transport infrastructure in South Africa up to the end of the 20th century

Chapter 7: Secondary and tertiary roads

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GETTING OUT OF THE MUD

Secondary and tertiary roads cater mainly for intra-provincial travel and are, in the main, the responsibility of the provincial government.

In the earlier part of the century the four then existing provinces concentrated their efforts on 'getting out of the mud' with a blacktopping programme for the more heavily trafficked roads and a gravelling programme for lesser trafficked (but greater in total length) roads. This policy of differentiating in the improvement process between the different levels of road based on traffic volumes contrasted with Australian practice at the time of opting for a greater length of blacktopping, but with lighter pavements. In hindsight this turned out to be a costly approach in the long term, since the Australian road authorities were later faced with major road repair costs as road traffic grew.

The gravelling improvement approach used by the provinces consisted in the main of providing the road with an adequately wide eight inches thick gravel surface, and cutting mitre drains to drain surface water off the road where necessary. Water flow across the road was eliminated by the provision of pipe culverts. River crossings were generally of the low-level submersible type where traffic could not pass in times of flooding – mostly no more than 10% of the time. The type and quality of the material used for gravel surfacing were of prime importance in its eventual riding qualities, both in dry and wet conditions. During the late 1950s and early 1960s the then Natal Provincial Roads Department carried out research to determine the necessary qualities in the choice of gravel for road surfaces, and devised a handbook for the choice of materials for this purpose. This work was later further developed at the then National Institute for Road Research (NIRR) of the CSIR.

For those roads carrying more than 350 or so vehicles per day, properly engineered blacktop roads were provided – including bridges across rivers. During this period very few, if any, roads reached traffic volumes that required more than a single, two-lane carriageway of 12-feet

lanes with 5-feet shoulders. Departmental design teams carried out all, if not most, of the design and construction work at the time, with the exception of complex bridges. In general, the engineering, by today's standards, was fairly straightforward and largely based on experience in the area.

During this period up to the seventies, the pavement design for blacktopped roads was based on the so-called CBR design method, which related the amount of cover to be applied to a layer to its bearing capacity. Pavements generally comprised a sub-base layer of natural gravel, usually six inches thick, underlying a base layer of crushed stone between six and eight inches thick. Sometimes, although very seldom, a macadam base was provided. The surfacing normally comprised a seal coat of a two-coat surface treatment of crushed stone chips with a bituminous, or occasionally tar, binder. In the Cape Province the well-known Cape Seal was used as the wearing course. This comprised a layer of coarse (three quarters inch) crushed stone chips followed by two applications of a slurry seal (a mixture of bitumen emulsion and crushed stone dust and natural clean coarse sand). This proved to be a very effective surface treatment.

Also at the time experiments in the USA known as the AASHO and WAASHO road tests led to an empirical design approach, which assumed structural equivalents for the various material types in the road pavement. This led to the drawing up of the well-used pavement design manual termed *TRH4* by engineers in the CSIR and the Department of Transport.

CHANGE IN DESIGN APPROACH

The period from the mid-sixties to the early eighties saw a growing awareness of the consequences for the secondary road network of the rapid growth in road traffic being experienced in the country. This era was strongly influenced by developments in road engineering in the USA, but also in England and Europe. Road planning was based not only on an extrapolation of current traffic volumes, but also took into account future development in certain areas or regions, as well as the economic benefits to agriculture and industry of reduced transport costs. The need for road transport of agricultural products such as timber, sugar cane, milk and fruit played an important role in provincial road development programmes. In addition, traffic demands on certain secondary roads in the vicinity of cities were reaching or exceeding a figure of 8 000 to 10 000 vehicles per day, which necessitated the construction of multi-lane arterials and freeways.

Road pavements were designed to carry considerably heavier cumulative traffic loadings, and developments in road pavement engineering included the gradual introduction of asphaltic concrete (USA terminology) or premix (UK terminology) for wearing courses, and later base courses. The development of this innovation had its initial impetus in Natal, where a better seal to the crushed stone base was required because of the heavier rainfall. At that stage the premix was generally of the British Standard BS594 type, or a continuously graded design mix. Further developments in asphalt technology during the following decade or so led to the use of asphalt-treated bases (ATBs), sometimes termed bituminous treated bases (BTBs), of varying strengths depending mainly on the grading of the aggregate. The well-known gap-graded surface course (and later base course) was developed during this period of exciting developments in the pavement engineering sector.

This period also saw the development of stabilising agents of lime or cement being added to sub-bases and base courses in order to increase their bearing capacity, and to render them less susceptible to the effects of the ingress of water into the pavement. Whilst in the other provinces the cement binder content used in the crushed stone bases (CTBs), and sometimes sub-bases, was kept to a reasonably low level, in the Transvaal cement was used in increasing proportions in these layers. The cement content became so high that the pavements of many roads in the Transvaal suffered from extensive shrinkage cracking. While this was unsightly they did not cause structural deficiencies in the pavements, other than increasing the possibility of the ingress of water into the pavement. Unfortunately much unfavourable comment was heard from the public and politicians. This was a major blow at the time to the confidence which had been built up regarding pavement design.

In the early eighties, developments in flexible pavement design led to the adoption of the *rational* or *mechanistic* methods whereby the design was based on the evaluation of the limiting strains and stresses in the specific pavement layers. This move signalled a departure from the empirical structural number concept to a rational/mechanistic design procedure.

ADVENT OF CONCRETE PAVEMENTS

A major development in the field of pavement engineering during the late sixties and the seventies was the advent of the use of concrete pavements on both provincial and national heavily trafficked roads. At that stage such pavements generally comprised an eight-inch thick unreinforced concrete base overlying a cement-treated crushed stone sub-base. Expansion joints were cut into the slab at 14 feet intervals without load transfer dowels between the resultant slabs. This pavement type provided excellent service, up to forty years at times, before requiring rehabilitation. A particular problem was the road noise generated by the cross-tining necessary to provide adequate skid resistance, and much experimentation took place to keep this to a minimum. During a visit to Canada, an engineer from the Department of Transport asked his Canadian counterpart how they handled public complaints in this respect. The answer was that he, the Canadian engineer, asked complainants, "Do you want to die quietly? The more noise there is, the safer the road is against skidding in wet weather."

Towards the end of the century different types of concrete pavements were also developed, including a continuously reinforced concrete pavement used for the first time on the Ben Schoeman section of National Route 1 between Johannesburg and Pretoria as a pavement rehabilitation measure.

The late seventies and early eighties also saw numerous bypasses of rural towns being built, generally at the request of the towns concerned, to eliminate the growth in heavy road haulage through their streets, but also to maintain continuity in traffic flow for long-distance traffic.

PWV ROAD NETWORK

A notable feature of provincial roads planning at the time was the so-called Pretoria/Witwatersrand/Vereeniging (PWV) road network development plan prepared by the then Transvaal Roads Department. This grid of high-capacity

roads, of varying standards and criss-crossing the entire PWV area, was probably too advanced for its time and unfortunately has never come to full fruition, mainly because of funding problems. In hindsight, however, with its transport corridors for road and rail infrastructure and its sophisticated level of planning, the system would undoubtedly have obviated most of the traffic problems facing this area in the early part of the 21st century.

MULTIPLICITY OF ROAD AUTHORITIES

Unfortunately, neither the then Natal Roads Department nor the Cape Roads Department produced any fully integrated plan to handle the flow of road traffic within their burgeoning metropolitan areas during this period. This highlights the problem caused by the multiplicity of road authorities in the country – no single voice to assume responsibility within a developed metropolitan area where urban, provincial and national roads interact and where coordination in the provision of the total road network is essential.

DEPARTURE OF QUALIFIED PERSONNEL

This period unfortunately also saw the large-scale departure of qualified road engineers and construction personnel from the various road authorities – mainly because of the obduracy of the Public Service Commission in not paying salaries commensurate with responsibility and comparable with private sector companies. A notably ill-advised comment by the then Provincial Secretary in Natal at the time was, "Engineers should be on tap – not on top." This remark of course further accelerated the flow of professional engineers from the roads departments.

The situation had changed from the early sixties when most (in excess of 90%) of all road engineering and construction was carried out by departmental personnel and in-house construction units, to 1976 where only 25% of the road engineering and construction was not carried out by consulting engineers and contractors. Towards the end of the century almost all road engineering and construction, and even maintenance, took place through the private sector.

ROADS IN THE TBVC COUNTRIES

During this period the so called SGTs (Self Governing Territories) and TBVC countries (Transkei, Bophuthatswana, Venda and Ciskei) had been established, with authority for roads in their own countries or homelands.

For many reasons this political system was disastrous to a total integrated road network within the boundaries of South Africa. The road systems and administration in these areas took a major step backwards, from which it has not yet fully recovered. In some of these areas more than 80% of the roads budget was spent on salaries, with some roads (carrying 2 000 vehicles or more per day, including a high percentage of buses) still being gravel roads.

BEFORE AND AFTER 1994

While the provincial road system of secondary and tertiary roads was just managing to hold its own in the face of severe financial stringencies up to the mid-eighties, the period from then onwards until the advent of the new government in 1994 was one of disillusionment with the funding support from government, and to a large extent signalled a retreat into inactivity insofar as the road network was concerned. Funds provided were barely adequate for the necessary maintenance needs, and in some provinces, notably KwaZulu-Natal, a decision was taken to rip up some blacktop roads which were in a very poor condition, and convert them to gravel roads because they were cheaper to maintain.

Unbridled and severe overloading by heavy haulage vehicles, which led to major structural damage on certain haulage routes, exacerbated the position. A study by the Department of Transport in 1991 showed that, whereas in 1975 only 17% of the countrywide expenditure on roads was needed for maintenance and improvement, by 1990 the figure had risen to 52%. The situation was considerably worsened by the fact that, in constant rand values, total road expenditure on rural roads in 1975 was more than twice that in 1990. Added to the seriousness of this is the fact that these figures relate to the total road network, including national roads, which in general were financially more favourably positioned than provincial roads (because of the contribution of road tolling).This period up to the turn of the century probably represented the lowest point for provincial roads departments for the past 60 years.

The year 1994 saw the advent of a new government in South Africa. For provincial road administrations the main consequence was a change from four provincial road authorities, plus various SGT and TBVC authorities, to nine provincial road authorities. Unfortunately, in the main these were very poorly staffed in terms of professional roads personnel with experience, and in some instances they were overwhelmed by having to carry the bloated personnel establishments of the old TBVC states.

The period from 1994 to the end of the century, and beyond, saw a paradigm shift in provincial road planning. From a road priority system previously based on traffic demand and economic and agricultural growth potential, the new provincial road planning approach was largely based on providing local road access for the many rural communities in the country.

The philosophy recognised that, in the absence of a road network in deep rural areas, delivery of other services necessary for the social and economic development of rural populations was constrained. The absence of a good road network in these areas, it was held, hindered the development of the social fabric of the area. With the rate of development of new housing projects, it was necessary in the new century to provide road infrastructure to accommodate the transport needs which would facilitate social integration of these areas with the broader community, and in so doing ease the plight of under-served customer segments.

Another facet of the country's road activities that received attention at the time was the need to grow the tourist industry by providing access to tourism facilities, through the provision of adequate road links to the primary network.

As far as the condition of the secondary and tertiary road network at the close of the century is concerned, the *Moving South Africa* transport strategy of 1998 suggested that the condition of 32% of rural roads to farming areas was at the time inadequate, while for rural villages the figure was 82%. Unfortunately, as the 20th century came to a close, the rest of the provincial road network, as well as that of many towns and cities, began to show signs of rapid deterioration in condition, a trend which accelerated during the early part of the 21st century. ◻