

ABNORMAL LOAD SUPER ROUTES – A STRATEGIC INVESTMENT FOR SOUTH AFRICA’S ECONOMY

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ABSTRACT

Because of a lack of inland waterways and the limited capacity of the railway network in southern Africa, the transportation of heavy industrial equipment to and from manufacturing, processing, power generating and other industries, in many cases, has to take place by road. When these large indivisible payloads, together with the combination of vehicles used to transport them, exceed 150 tons, 8 metres in width or 4,8 metres in height they are defined as Superloads and are of paramount interest to highway and traffic officials responsible for preserving the road network, infrastructure and furniture and minimising traffic congestion. The routes that they are allowed to travel are limited by bridge capacity and geometrics, involving mass, height, width and length restrictions. These critical routes are known as Super Routes. Failing to establish and maintain such Super Routes will place unfortunate limits on the South African industry by limiting opportunities for importing, exporting and moving superloads such as large machinery and transformers within the country. The national Abnormal Loads Technical Committee recognised a need to identify and monitor a minimum number of strategic routes that need to be preserved for the movement of Superloads. Short-sighted planning has in the past caused a reduction in the capacity of existing routes by the construction of overpasses with restrictive clearances on particular routes. CSIR Transportek was appointed by the Gauteng Department of Transport to develop a computerised tool for graphically displaying all relevant data related to these Super Routes. The system will be a useful tool for indicating to planning authorities the effect that a particular project such as a new bridge or a cable across a road could have on reducing or improving the capacity of a given route. The primary consideration is to arrest the increasing constraints being placed on existing routes by the encroachment of restrictive features. Route improvement based on favourable cost/benefit ratios will become a reality. The effectiveness of given routes may, for instance, be improved by raising a power line cable or a single bridge.

INTRODUCTION

In many parts of the world, there has been an increased demand for moving larger and heavier machinery and industrial components during the past few decades. On the oceans, many of the 20 000 ton ships of yesteryear have been superseded by supertankers, which may exceed half a million tons. On land, large loads are required to be moved from factories or seaports to various inland destinations. Because of the absence of inland waterways and the limited capacity of the railways in southern Africa, these loads are transported on the road network. These large and heavy loads generally comprise equipment for electric power generation and chemical plants. Demands for such components are economically justified since the potential savings to these industries are vast assuming a useful life of about 25 years. When these large indivisible payloads, together with the combination of vehicles used to transport them, exceed 150 tons, 8 metres in width or 4,8 metres in height they are defined as Superloads and are of paramount interest to highway and traffic officials responsible for preserving the road network, infrastructure and furniture and minimising traffic congestion (Figure 1). The routes that they are allowed to travel are limited by bridge capacity and geometrics, involving mass, height, width and length restrictions. These critical routes are known as Super Routes. During the past few decades, numerous routes in South Africa have been checked, cleared and documented in order to ensure the safe movement of these loads. Since 1994, the number of major road authorities in South Africa has more than doubled. This includes the establishment of five new provinces and the National Roads Agency, the awarding of four 30-year concession contracts (to date) to manage and maintain sections of the national road network, and the re-definition of six metropolitan areas. The national Abnormal Loads Technical Committee recognised a need to identify and monitor a minimum number of strategic routes that need to

be preserved for the movement of superloads. This paper describes the development of an electronic Super Route Map, which can be used to graphically display relevant data related to these Super Routes. The system will be a useful tool for indicating to planning authorities the effect that a particular project such as a new bridge or a cable across a road could have on reducing or improving the capacity and effectiveness of a given Super Route. It will also be used by transportation consultants for preliminary planning of the movement of superloads. The primary consideration is to arrest the increasing constraints being placed on existing routes by the encroachment of restrictive features that reduce the effectiveness of these strategic routes.

NATURE AND PURPOSE OF SUPERLOADS AND SUPER ROUTES

The primary restriction offered by overhead bridges, overhead cables, pipes and road furniture to the movement of large units is height clearance and the flexural and shear strength of supporting structures such as bridges and culverts. **Superloads** may therefore be defined as loads in excess of approximately 150 tons and 4,8 metres in total height. While the width and length may present practical problems, these problems can usually be overcome by using steerable dollies or multiple axle steerable trailers.

The items associated with superloads are normally large specialised vehicles such as mobile cranes and piling machinery, transformers, pressure vessels for the chemical and petroleum industries, precast building units, industrial, mining and earthmoving equipment. In addition, there is also the occasional need for the transportation of yachts and other unusual items such as trees and classic aircraft.

It is self-evident that general limits have to be set for normal daily movement of vehicular traffic on public roads. In South Africa and generally in the southern region of Africa the legal height limitation is 4 300 mm and the maximum allowable gross vehicle mass is a generous 56 tons for vehicles with a maximum overall length of 22 m. Modern bridges normally have a minimum vertical clearance of 5 500 mm. It is generally found that vehicles up to the superloads as defined, encounter few restrictions. When understrength bridges (as a result of deterioration or damage, or dating back to an era when a 20 ton truck was thought to be monstrous and awesome) are encountered, then this restriction on use is usually clearly indicated at the approach to the bridge and well-known and alternative routes can timeously be selected.

It stands to reason that superloads need special roads or routes where the visual physical restraints are not present. These routes are termed **Super Routes**.

GENERAL SITUATION IN SOUTH AFRICA

It needs to be noted that in South Africa there are specific constraints that may not exist in many other countries. Firstly, the use of waterborne transportation is virtually non-existent. For all practical purposes there are no navigable rivers or canals and the only waterborne transportation is coastal, from one sea port to another. This is of limited use for the movement of superloads as the heavy industrial areas are largely situated inland in and around the Gauteng Province near Johannesburg. Certain ports are constrained by suitable crainage (such as Richards Bay harbour) and others may have restricted access to the inland roads (such as Durban harbour).

The other mode of transport that might have been used for superloads, namely rail, has other severe limitations. Firstly the rail network is poorly developed compared to Europe and the United Kingdom with limited access in terms of origin/destination considerations. The other aspect, which is worse, might be ascribed in a devilish way to South Africa's colonial past!

The legacy from British colonial times is a railway system with a three foot six inch gauge which is less than 1 100 mm. There were even some lines installed with a gauge of less than 800 mm! The apparent cost savings that were calculated during the nineteenth century appeared to be based on sound economics at the time but it has rendered the present railway system impractical for the purpose of transporting superloads, due to dimensional and load bearing restrictions.

PROCESSING EXEMPTION PERMIT APPLICATIONS

Any vehicle or combination of vehicles that is in contravention of the legal road traffic restrictions requires an exemption permit in order to operate legally on any public road. All such vehicles are classified as "abnormal vehicles", which operate under previously determined restrictions (and routes in the case of superloads) and need to be in possession of valid exemption permits. These permits ensure that regulations governing dimensions, mass, wheel loads, traction power, signs, escorts and so on, are complied with¹. Permits are normally issued by the Provincial Road Authorities and, if necessary, input is obtained from local and metropolitan authorities.

South Africa has a well-developed and sophisticated system in place for adjudicating and processing applications for such abnormal vehicle exemption permits. Routes and operating conditions can usually be selected even for smaller superloads.

However, there are instances where superloads present major challenges. There are situations in South Africa where transformers have been installed that would be virtually impossible to remove or replace due to the fact that the access routes utilised at the time of their installation have been compromised by subsequent alterations or additions such as overhead bridges.

THE NATURE OF THE PROBLEM

There is a natural conflict of interest inherent in this situation. On the one hand there is a need to transport superloads. SASOL, the oil-from-coal enterprise, the mines and refineries could never have been established on an economic basis if it had not been possible to move large industrial units, pressure vessels and equipment on the public roads. These units have to be imported, exported, moved within the country or moved from coastal ports to land-locked countries to the north of South Africa. Lacking suitable super routes would render these operations practically impossible or exorbitantly expensive.

On the other hand, building and maintaining super routes costs money. Additional funds need to be invested in order to create and maintain the capacity to transport such superloads.

The crux of the matter is that this must be seen as an investment in the infrastructure of a country in order to cope with the need to develop and maintain the heavy industrial sector.

Due to the need to apply limited funds as judiciously as possible, and often through sheer ignorance, existing super routes may be reduced in capacity or rendered useless for the purpose by the construction of a single overhead footbridge or other obstruction.

ROUTE CLEARANCE

Whenever the need arises to find or assess a given route to transport one or more superloads, then a process known as **Route Clearance** needs to be carried out. This is an expensive and time-consuming process that entails a careful inspection, measurement and charting of all obstacles that may obstruct a superload. Because every reserve of structural strength may be used, all load bearing structures are inspected and their load bearing characteristics assessed, taking into consideration their current condition, including signs of damage, crack formation, corrosion and foundation subsidence. Construction drawings often have to be consulted in the case of older bridges that were designed and constructed in accordance with older, less demanding loading codes. In the case of doubt, special supports (normally temporary supports) have to be designed and installed. This, of necessity, is highly specialised and expensive work. Alternatively, the structure may be bypassed, or in exceptional cases, replaced.

The disturbing fact is that the results of these assessments may not be commonly available. Such a route clearance is normally commissioned and funded by a private concern and carried out by a specialist firm who may naturally regard this as intellectual property that may be provided at a price and need not be freely available. This information also has a limited shelf life, as subsequent deterioration, alterations or additions may change the characteristics of the route.

There is therefore a need to establish a mechanism for accessing this information (summaries of the assessments) and to store such information in a central database where it may be available to all practitioners and where it can be updated on a sustainable basis.

This is perfectly feasible and would only need access to the restrictions imposed by the route and not the process or technical details. This information could be made accessible to other users and roads authorities to the common benefit of all concerned. The maintenance and updating of the information would then be the responsibility of the roads authorities.

PROPOSED SOLUTION

The proposed solution to these problems has been the establishment of an electronic **Super Route Map** that will house relevant information regarding the network of super routes (Figure 2).

The first step was to establish a national working committee comprising participants from both the public and private sectors in order to identify the minimum super route network of roads necessary for the purpose. It was necessary to consider the position of the ports for import and export purposes as well as major border posts to neighbouring countries that may wish to import large items either through South African harbours or directly from South Africa. By considering the positioning of heavy industries and industrial users, a minimal network of internal routes was established to form the **National Super Route Network**

The super route map was thus based on this basic national super route network. This map, its potential and its implications will be brought to the attention of all roads authorities from the South African National Roads Agency to the provincial, metropolitan and local authorities. The initial approach was made through the national Abnormal Loads Technical Committee in March 2002 and will be followed by a presentation at the South African Transport Convention in July 2002.

THE SUPER ROUTE MAP

Data regarding the current height, width and load limitations on each segment of the super route network were obtained from provincial road authorities and a consulting firm that has been extensively involved in route clearances for the past 25 years. In order to obtain the maximum benefit from the data and present it visually, the data was captured into ArcView GIS. A layer containing height, width and mass limits was prepared. Power stations, oil refineries and other large industrial plants are also indicated, as they are the most common destination points. The super routes were classified in three groups namely, major cleared routes; cleared routes and routes cleared for height only.

The next step was to obtain more detailed information regarding structures on the super route network. The South African National Roads Agency, as well as most provinces and metropolitan authorities utilise bridge management systems for optimising their bridge maintenance and rehabilitation programmes. Relevant data (and electronic photos) are being imported from these systems for viewing in the super route map (Figure 3). This includes minimum vertical clearances, width between kerbs, load capacities, design codes and other general inventory information such as date of construction and history of strengthening and rehabilitation..

The Super Route System comprises the following components: a GIS map; the Super Routes Desktop system and a Super Routes Website. The Super Routes Desktop System is targeted at the various Road Authorities that need to query data. The system was developed in Visual Basic 6[®] with Microsoft Access[®] as the desktop database. The mapping component used is MapObjects LT[®]. As the user moves the mouse over a route, details such as route number and limits appear. Where photos are available, a thumbnail appears and by double-clicking on the photo, a full photo can be viewed. The GIS file used in the program is the same base file created in ArcView[®].

The website is also being developed to ensure that the relevant roleplayers and stakeholders will have access to the latest information (Figure 4). It will allow the users of the Super Routes System to update their systems on a regular basis. The website will also enable users that do not have the Desktop System to query selected data.

CONCLUSIONS

The road network in South Africa is essential for the movement of people and goods on a daily basis. Certain routes in the country have been upgraded during the past few decades in terms of vertical and horizontal clearances as well as load carrying capacity in order to accommodate large indivisible loads, primarily from ports to inland industrial areas. Because of the strategic importance of moving these large loads in terms of the economic growth of South (and southern) Africa, it is of great importance that these super routes are maintained or in some cases upgraded in order to allow the movement of similar loads in the future.

The Super Route Electronic Map has been developed for the purpose of sharing relevant information with stakeholders in South Africa's road infrastructure, so that when road rehabilitation, upgrading or new construction is being planned, cognisance will be taken of the dimensional and load capacities of existing super routes, with a view to preserving these capacities.

REFERENCES

1. Committee of Land Transport Officials. Guidelines for granting of exemption permits for the conveyance of abnormal loads and for other events on public roads, TRH11, Bloemfontein, South Africa, March 2000.



Figure 1 Typical medium-sized superload motorised by two haulers

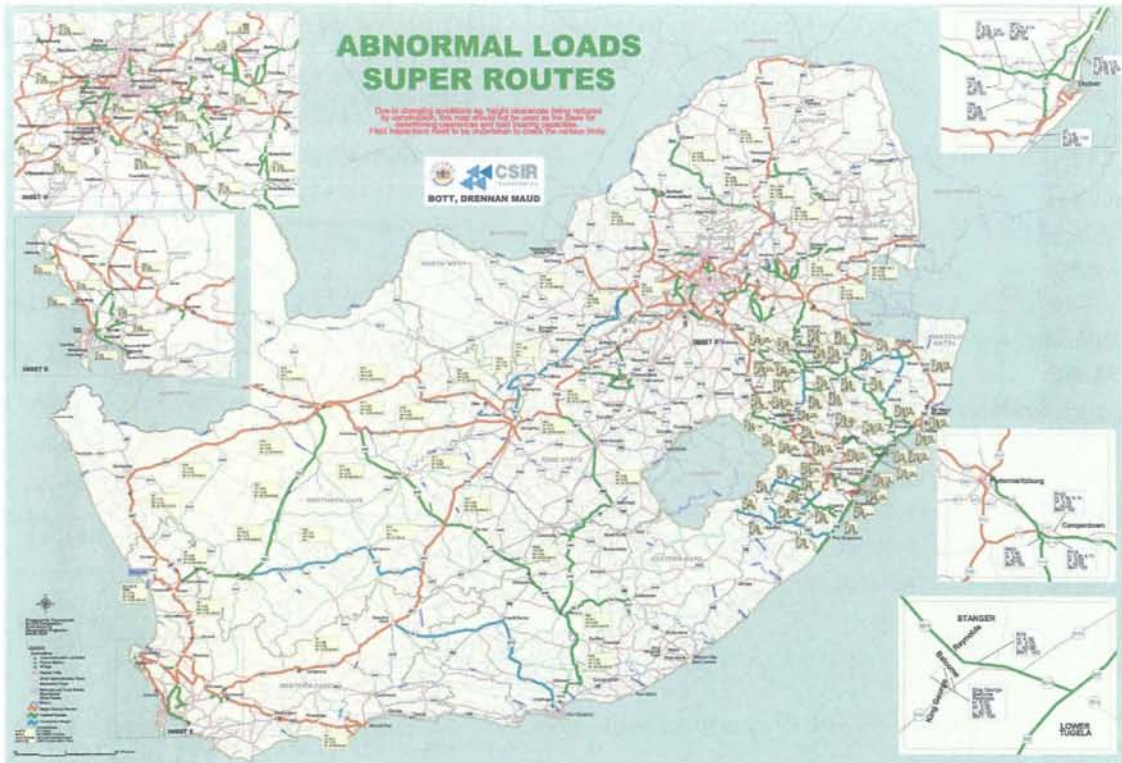


Figure 2 Super Route map



Figure 3 Super Route map showing structure information

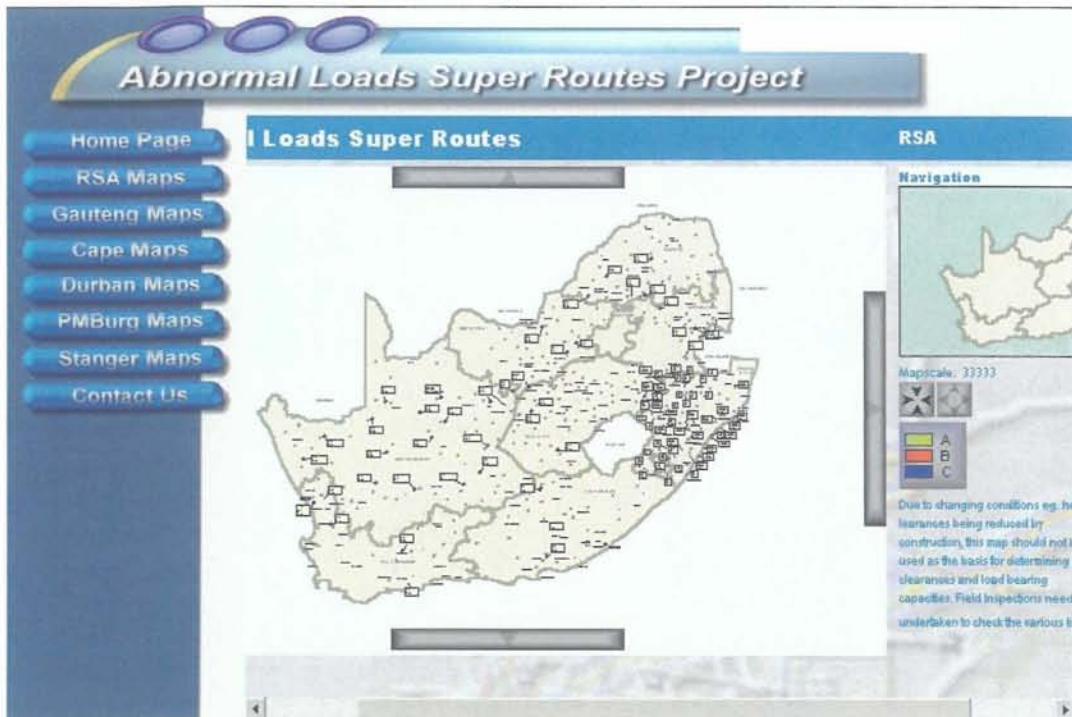


Figure 4 Website home page of Super Route map

