

VEHICLES FOR AFRICA

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Abstract

The majority of modern vehicles are designed for road conditions in Europe, America or Japan. These vehicles often have problems when faced with the rough roads and the harsh environment of the rural areas in Africa. This paper presents a short history of vehicles in Africa and discusses ways in which cars design for the local people in the rural areas in Africa can be improved.

1. The history of vehicles in Africa

Motor vehicles were late in arriving in Africa. One exception was the northern coast then followed by Southern Africa. For most part of Africa, vehicles started to appear around the 19th century and after the Second World War.

An English motoring magazine of October 1899 carries a picture of a Mr. S. E. Guy, proudly sitting on his three-wheeled motor tricycle in a street in Algiers. The magazine does not say whether Mr. Guy was the first 'automobiliste' on African soil but, five months later, in March 1900, the same magazine remarked: "Quite a number of French "chauffeurs" are at present in Algeria. A few days ago M. Archdeacon organised a run from Algiers to Blidah and back. Eight cars and twenty motor-cycles took part in the trip, which was a great success. . ." [1].

Motor vehicles were imported to South Africa for commercial purposes before the end of the 19th century and a few of these found their way into Rhodesia (now Zimbabwe). Cecil Rhodes himself was the owner of a 10hp Wolseley.

By 1902 the press was reporting that "a boom in motor cars has set in" South Africa. But it would be foolish to suppose that this bore any resemblance to the scene today. Vehicles were imported to the coastal towns, such as Cape Town, Durban and Port Elizabeth, and were used primarily for local journeys.

Motoring did develop rapidly in southern Africa, however, to the extent that the Automobile Club of South Africa held its first race meeting on February 1903. [1].

In the years which followed, motor vehicles rapidly found their ways into many parts of the African continent and generally adopted well to the

conditions. In Europe and the U.S. there were still many unsurfaced roads and cars had large wheels and large ground clearance. Vehicles had chassis and it was quite normal to have a special body made to suit the owners' requirements.

For Africa, the ubiquitous "box-body" became popular: a simple, sturdy box structure which was bolted to the chassis. This could be fitted with seats and a canopy, or used purely for carriage of goods. The pick-up was born.

Due to the late arrival of vehicles on the continent, and especially to the rural areas the road network systems were not developed and this impeded their progress. As the road conditions in the more developed countries improved, so the vehicles became less suited to the road conditions of rural areas of Africa. Most of these roads even up to these days are not surfaced. Generally, these are marum roads which are most of the time in very bad conditions.

So, given such a late start, it is hardly surprising that there was little in the way of a road network in existence in the rural areas when the motor vehicles came on the scene. The situation still remains the same except for big cities and towns.

It has to be noted that railways had a much greater impact in the first half of this century, and the development of many African countries can be traced directly to the building of the Iron Way. Many of today's most important towns and cities owe their very existence to the building of railways. Nairobi being a case in mind.

In the wake of development of roads for commercial use, the people themselves became more mobile. Buses, large and small, have become very much a part of the African scene, with many people working in towns and cities during the week and traveling home to their families in the rural areas for the weekends.

Despite the growth in motor transport in Africa, the continent is relatively badly off, for motor vehicles in relation to population. The world average is about one vehicle for every ten people but in Africa is one for every 50 people. Of the estimated 10 million vehicles on African continent, about a third are in the Republic of South Africa. It follows that in some of the least-developed countries, the number of motor vehicles is very small. Such countries can either afford to build good roads, or to import sufficient fuel for the few vehicles they have, yet without them it is difficult to generate the growth they seek to break out of the poverty trap.

Of those vehicles being imported into African countries in recent years, either as built up vehicles, or in kit form — about half are for commercial use. Understandably this is a much higher proportion than in Europe where passenger cars are in the majority. Many of Africa's commercial vehicles are not heavy trucks but pick-ups, panel vans, minibuses and utility vehicles, for it is here where the main emphasis now lies.

For heavy commercial vehicles, the picture is different, with large fleets owned by individual firms or State enterprises. Trucks do huge kilometers in Africa, often on bad roads. They cost a great deal to buy and run, but the rewards can be great if properly managed. The large trucks can be lifeline for a country, as seen at times of famine, when food has to be imported and distributed. The transport of cash crops to ports at the right time can also be vital.

Road transport has helped to bring rapid development to many African countries but it is not without problems as will be seen in the next section.

2. Some major problems facing vehicles imported to Africa

Right from the start when cars appeared in Africa, it was noticed that one of the things which Africa needed was a special make of car and it was mentioned that the car should be dust proof, easy to drive, reliable and capable of being driven through some meter of waters in bad roads. But some of the first designers were naive by suggesting that the wheels of the "ideal" car would be five feet in diameter and should be about eight feet in the air to allow for crossing drifts! But they were right to notice that these cars needed to be equipped well with strong suspension springs.

First we have a look at the suspension problem which is basically the problem with springs and shock absorbers. Eighty-five years after the first vehicle appeared in Africa, suspension problems still pose a great threat to motorists in the rural areas and cities. About 50% of cars which are put out of roads have suspension problem as the major fault and most cars have their life time reduced by half due to the same problem. As road conditions in the more developed countries improved, so the vehicles became less suited to the conditions of African roads and tracks. Africa is a multiclimate continent. If for example you take the roads in central Africa, heavy rain would give problem to maintain them. As a result, most roads have pot-holes, sometimes, up to 0.5 meters deep and in the dry seasons it is common to find big stones on the roads. If one takes the conditions of the roads in the northern part of Africa, one is faced with sand storms and melted tarmac roads due to the heat. So in designing springs and shock absorbers for suspension systems, all these factors have to be taken into consideration.

Soft suspension, design for comfort on smooth tarmac, have insufficient travel to cope with the unsurfaced African roads. Ground clearance, progressively reduced in the interest of cornering, stability and aerodynamics is too little.

So as a solution to this problem, suspension will need to be rated, with stronger springs and shock absorbers. The use of additional springs with different stiffness characteristic and better still leaf-springs is highly recommended.

Getting the most ideal compromise is often difficult, with the result that many imported cars have had to sacrifice a comfortable ride in the interests of strength and stability.

Raising the suspension to improve ground clearance is advisable although this tends to result in slightly worse handling characteristics. In raising the ground clearance care must be taken not to raise the mass point too much as this will reduce stability. The cardan shaft angle must also be kept within limits. A few cars are supplied with a choice of suspension settings, but it is usually the task of the local importer to fit spacers to raise the ground clearance.

In recent years there have been successful experiments with the implementation of active suspension. The use of active suspension could be of great help if it is restricted only to heavy vehicles. Most of the local people in the rural areas do not really need cars with soft springs for comfort rides. But the high cost of vehicles with active suspension would make it very difficult to implement in Africa.

Front-wheel-drive cars are generally unwelcome development in Africa because they put more weight on the front suspension resulting in more stresses on the front of the car every time it hits a rock, washaway, or drift. This results in a damage in the steering system and can put the car off road.

As was mentioned before, many of the roads in the rural areas are un-surfaced and this means much more dust especially in the dry seasons and in the deserts. Things are even made worse because many people use the roads to drive their animals from one area to the other. So this puts air intake as another important area for attention. The amount of dust which can be encountered on African roads is almost beyond the comprehension of a car designer working in Europe, America or Japan. Modified dry, oil, centrifugal and combined filters with long intake tubes could be some of the possible solutions to this problem. Special materials with high filtering capacity should be used and they must be changed regularly.

Abrasive grit sucked into the engine can ruin it in a very short time, and large flying insects will block carburetors if not kept at bay. To keep these insects away, it is advisable to cover the front part of the vehicles with fine net-like wires. This has proved very useful in cars taking parts in African rallies.

Since the majority of the population of the Africans in the rural areas are not educated, a worrying trend is the increasing use of electronic systems and antipollution devices. These systems are difficult to repair for an average owner. The trend towards extended service intervals is also an unwelcome one if it is based on the standards of the West or Japan.

The harsh conditions of excessive heat, dust, and shear wear and tear on components mean that more frequent servicing is necessary. Therefore, cars made for Africa should contain the minimum numbers of electronic gadgets.

Any modern car, built to the normal chassis construction will have no problems being used in African capitals and cities but they need some modification before it can be used in the rural areas. Unfortunately it is difficult to justify major changes to a popular model which is being mass-produced in hundreds of thousands of examples, when just a few hundreds of examples are being exported to Africa and especially to the country sides. The modes, therefore, tend to be confined to "bolt-on" items rather than major components. The idea here is that the rural areas need special vehicles but not a fantastic looking one.

Body protection is another factor which needs more attention. The climate in most parts of Africa is wet and humid. If a car with thin body material is subjected to this condition, then in some few years the body would be corroded away. So corrosion resistant materials with good paints is a must if the body is to stay strong for some time.

Under-body protection is important, particularly if the sump is vulnerable. Here, a sump guard or skid plate at the front can avoid trouble, and additional protection is sometimes fitted beneath exhaust, gearbox systems, fuel and oil tanks. Generally this protection is in the form of a metal sheet welded beneath the fuel and oil tanks and the exhaust system. Quite often such protection is fitted locally. Exhaust systems of modern cars design for use in Europe quickly get damaged when subjected to the conditions in the rural areas.

In designing vehicles for the local population in Africa, we have to take into account not only the technical but the economic aspects too. Today, vehicle industry faces more than the challenge of overcoming all operating conditions. It faces the problem of a harsh economic climate, the need to overcome soaring operating costs and increasing competition, to achieve greater efficiency and profitability. So in designing a range of vehicles to satisfy the needs of the rural population, there is need to increase reliability, component life, fuel economy and ease of maintenance. Fuel consumption and maintaining costs are very sensitive points to consider when dealing with cars meant for Africa. Most African countries are in a very bad economic situation and they can hardly afford to buy the fuel needed for the running of vehicles. Most of the products that earn African countries hard currency (and we must remember that most of the people in the rural areas depend on this product) have lost their value on the world market so you find that most of these countries can not afford the oil. But without vehicles these countries would be even worse off. So the design of cars with low petrol consumption would be a great relief for these poor countries. This is one of the reasons why the Japanese cars have a good market in most African countries. The Japanese vehicles are also relatively cheaper and of course their parts too. This automatically lowers the cost of maintenance, which is also a good development for

the African countries. Another welcome development would be the introduction of cheap fuels e.g. gas and alcohol since most of the African countries are in a position to produce them.

3. Some recent developments in car industries in Africa and abroad

Local assembly of vehicles in Africa which seems to be the only solution to the problem have done very little in doing so. When assembling these vehicles, all the factors like bad road, climate, etc are not taken into consideration. This is basically because most of the vehicle parts are brought ready from abroad and are only assembled in these African countries. As a result these cars are only good for use in the cities and towns. Despite this, vehicle assembly plants can now be found in several of the more industrialised African countries eg. Nigeria and Kenya. But this has its own problems, too. For the African countries which set up their own assembly plants in the relatively prosperous 1970s, it means several things: one is that the vehicles they produce are going to be considerably more expensive than the imported version. Another is that the amount of locally produced components used in such vehicles will remain small. Nevertheless, the vehicle assembly plants in several of the more industrialised African countries are getting on with the job as best as they can. Nigeria, which for a long time was by far the largest vehicle producer outside South Africa, has suffered badly in recent years from its financial difficulties, and is now producing less than it did during the good times. Kenya, however, is currently having a successful time. Associated Vehicle Assemblers produced about 8,500 vehicles in 1987 and reached its 50,000 milestone since it started assembly in 1976. AVA produces two of Kenya's leading makes: Toyota and Nissan. General Motors Kenya assembles Isuzu. For many years Kenya restricted the production of locally-assembled vehicles to "commercials" but demand for passenger vehicles was high and now they have started assembling saloon cars, too. In the long term if African vehicle assemblers are to be successful, there must be a number of assembling plants in strategic countries to assemble vehicles for the whole continent.

Outside companies are also trying to solve the problem of vehicles in the rural areas for example, the introduction of Land Rover at the beginning of the 1950s was of importance to Africa. This was followed by the introduction of 4-wheel-drive vehicles from Japan and Europe. These cars had a tough chassis and leaf springs at the rear and they seem to do well both in the cities and the countryside. To demonstrate how the problem facing the use of vehicle in the rural areas can be solved, we take an example from the agricultural industry. In Europe, America and Japan modern air conditioned tractors with power drives are now being used. These tractors would be good to

use in Africa, too. But for an ordinary repair shop this machine would be very expensive and too complicated to maintain. But a new development in this area has taken place. Workweel Engineering, a subsidiary design and procurement company in Ashford, Kent was set up to design and manufacture tractors for Africa. With engine, transmission and chassis parts from Massey Ferguson, the first two tractors were assembled in Ashford, Kent, England. After tests, they were named "Farmwell".

Workwell's design uses steel wheels and a spring starter which eliminates the need for a battery, alternator and electric starter which need repair facilities that many rural areas lack. Apart from the no punctures quality, the steel wheels provide better grip in wet conditions and have a long life-time of more than five times than that of rubber tyres, while the treads can be rebuilt to provide a further long life. The gear box is simplified, strong, easily maintained and the air filter requires only regular cleaning; no replacement parts are necessary.

Workwell's first customer was Zambia Consolidated Copper Mines who ordered two prototypes for trial in Zambia where they were tested at ZCCM's Margam Valley Farm near Chingola [2].

Within two years, despite foreign exchange problems, the Farmwell has generated great interest in Africa. Out of 105 tractors made so far, 70 have been sold to Zambia through a local company, and a further 100 have been ordered for a waiting market. Orders for tractors have also been received from Zimbabwe. A proposal to set up a local manufacture and assembly production line has been made and further orders are anticipated in the near future to match the market demands.

Workwell Engineering is also able to offer a wide range of alternatives for inclusion in the tractor specification to suit not only basic rural conditions but also those of commercial operations in developing countries — including agricultural and some industrial activities.

Workwell Engineering can produce 50 tractors a month and can provide a consultancy services to help developing countries set up small workshops in rural areas to manufacture and assemble the tractors.

Going back to the problems of using transport vehicles in the rural areas, a number of companies are trying to find new solutions. For example, engineering companies from Britain and Australia have designed a new vehicle for Africa called "Africar". The Africar work is gathering momentum. First there was the test drive from the Arctic circle to the Equator, then the television series and now the book, which tells how the first motor vehicle design for Africa came to light. The full launch of the car itself has been delayed a few months to allow for the development of a new gearbox. The chassis are produced in Lancaster, U. K and the pre-production engines are already ready. By November sample vehicles should be on show. But the gearboxes are cru-

cial. Gearboxes from other manufactures have failed to provide what Africa needs, so it became necessary to design an entirely new gearbox to meet the rugged conditions of the continent. The need to get the gearbox exactly right held up full production for most of the current year.

But Africar will still be produced within its target dates — six years from its initial design to full production. This compares favourably with major automobile firms and is phenomenally quick for a new make, let alone an entirely new concept in motoring. Though the Africar will at first be manufactured in Britain and Australia, the ultimate objective is that it should be manufactured in Africa.

As was mentioned before, suspension problem is the most serious. In trying to solve this problem, much work is being done in Europe, especially in Hungary which is the largest bus producer in the world. They have introduced methods for designing suspension systems [3], [4], to suit different road conditions. This method give a firm basis for further development which could find greater application in Africa.

Educating a local user can also be a big contribution in helping to solve the vehicle problems in the rural areas. People who use vehicles must have some idea of how to maintain them. This educational programme could be done by setting up small “schools” for these people where they could be taught how to drive and maintain their vehicles.

The idea of setting up a repair shop and filling stations, say, a every 50 sq. kilometers would be a great advantage.

4. Conclusion

For vehicles to work normally in rural areas in Africa the designers have to take into account the following factors which are typical of Africa. Road conditions, climate, living standards, economic state of a given country, etc. If not, then the the modern vehicles design for road conditions in Europe, America or Japan will always have problems in Africa. Special attention must be paid to the suspension systems.

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