ANALYSIS OF THE SCIENTIFIC ASPECTS RELATED TO MINIBUS TAXI COLLISIONS

R Govender and D Allopi

Department of Civil Engineering & Surveying, Durban University of Technology
P O Box 953 , Durban , 4000 Tel: (031) 2042892 / 2042310 Fax : (031) 2042816
ronnie@dut.ac.za and allopid@dut.ac.za

ABSTRACT

A study recently done by the Automobile Association of South Africa recorded an annual total of 70 000 minibus taxi crashes which indicates that taxis in SA amount for double the rate of crashes than all other passenger vehicles. Detailed accident data is not available for this category of vehicle, so there is insufficient evidence to support a clear cause for the number of fatalities in minibus taxi accidents. Any crash results from a combination of circumstances converging to a point where the driver does not have the skills or the options to avoid the crash. Systematic investigation is necessary to identify patterns of failure resulting in a crash. This could be associated with driver behaviour, road conditions or/and vehicle features.

This paper is a follow up of the paper presented at SATC 2006 and will examine police records and case studies of minibus taxi accidents to scientifically identify any trends and factors causing these accidents. Crucial new evidence has emerged during this investigation.

1. INTRODUCTION

The reporting system used by the Police when attending a crash is based on all available data on the incidence and causes of crashes. However the system is designed to identify factors in relation to enforcement issues. It is not intended as the basis for research into the causes of crashes nor for the collation of data on crash trends. There are a number of specific disadvantages for motorists that arise from the limitations of the crash reporting system. Perhaps most importantly, the system does not allow for a comprehensive assessment of the contribution of other factors such as road condition, driver behaviour or vehicle features in crashes. Police who attend a crash site make written notes from which they subsequently enter details into encoded fields in the Accident Report form which is then captured into the National Accident Register which forms part of the National Traffic Information System (NaTIS). While there are mandatory fields that must be completed, these relate to location, driver information, vehicle and casualty details - provision is available for more narrative detail to be entered into other optional fields.

Police tend to complete only the mandatory fields and leave the rest blank. The blank field is a weak point in the system as the level of detail required is the specifics in a particular collision. If provided, this usually varies from one officer and crash to another. In addition the text is then subject to interpretation at the point of data entry by the National Traffic Accident Database.

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Of particular concern is the suggestion that incidents involving ‘faulty brakes’ and 'tyre bursts' may be generally interpreted as 'maintenance' problem and coded accordingly even though overloading may have been the primary cause. This has a huge bearing on the outcomes of that crash, and may obscure the causes of the crash and repeated over a large number of crashes create misinformation about the nature and causes of minibus taxi crashes. Also the high percent of “unknown” is cause for concern. This simply means that the reporting mechanisms are flawed and needs to be improved if a clear cause for any accident is to be established (Govender and Allopi, 2006).

1.1 Objective

The objective of this phase of the study is to assess the type of data currently available, compare it with that needed by investigators and researchers in order to identify the factors and circumstances that are present in minibus crashes, and make recommendations if any for improved data. A major aim is to determine elements needed to identify factors contributing to minibus taxi collisions.

1.2 General Approach

- Determine how crash information is collected for minibus taxis.
- Identify any limitations in the existing practices
- Formulate if needed, a guide that can be used by police officers for capturing more meaningful data for minibus taxi collisions.
- Identify methods for coding of minibus taxi collisions.
- Make recommendations for improvement.

1.3 Data Sources

The data reviewed for this study were collected from police accident reports and verified from site investigation and interviews.

2. CURRENT STATUS

Detailed analyses of road accidents are essential if the causes of the accidents are to be fully understood. At the present time the police prepare a report for the accidents that they are aware of, accidents involving single vehicles are not normally reported by the drivers, however a vague report may be lodged to acquire a AR number if the owner intends making an insurance claim. Minor collisions involving multiple vehicles or pedestrians are not usually reported if financial agreement is reached.

Although all accident reports requires the precise location of the accident, details of the people involved in the accident, details of vehicles involved in the accident, details of the environment and road conditions at and near to the location of the accident, these are mainly provided in fatal or serious collisions. This seems to be a daunting task for the officers on the field since they are not trained to do this work.

3. ROAD ACCIDENT DATA QUALITY

Accident reports present various limitations, which restrict their use and comparison. Since effective road accident analysis can only be conducted if it is based on reliable and compatible road accident data, the quality of these data is one of the most important issues to be examined. Some basic limitations are prevalent with the current AR form to capture minibus taxi collision data.

One of the main problems of the accident reports covered by this study is that not all injury accidents are reported to and recorded by the Police. Underreporting varies according to accident severity, vehicle type and casualty age. Generally, underreporting is more frequent in the following types of accidents: single-vehicle accidents, pedestrian accidents and often accidents involving multiple vehicles where a financial agreement is reached, while the underreporting rate is the largest for accidents that are characterised by a combinations of these aspects (Govender, 2005).

4. CASE STUDY

Seven people were killed in a minibus crash when the taxi they were traveling in collided with a truck just outside Empangeni. The driver of the truck tried to avoid another heavy vehicle that had broken down and encroached onto the oncoming lane. The truck collided into an oncoming minibus taxi, killing the driver and six passengers instantly. The seriously injured were taken to the Empangeni hospital.

4.1 Initial Investigation

The police recorded the cause of this accident due to reckless and negligent driver and the driver of the truck was charged for 7 counts of culpable homicide and released on bail. However simply blaming driver behaviour is not the answer either, but a better understanding of the circumstances that trigger a critical incident would help to determine the means to avoid them. Vehicle dynamics were first investigated. An analysis of the trucks tachograph yielded that the truck was travelling within the posted speed limit and the braking system seemed to be functional since the deceleration just prior to the collision was $4m/s^2$, which is within the acceptable range. An investigation into the road geometrics / condition then had to be carried out. The narrow shoulder meant that any broken down vehicle would have to encroach onto the riding lane. This situation is acceptable if there is adequate sight distance so that any approaching vehicle can make any evasive action in time. The next step was to assess the stopping sight distance. An analysis of the stopping sight distance showed it to be sufficient in terms of the geometric design standard. An interview with the truck driver revealed that he only noticed the broken truck when he got too close to it since the direct sun was strong and had obscured his vision. Although he tried braking when he notice the broken vehicle in front, its was too late and he instinctively swerved to the right to avoid crashing into the vehicle and in doing so collided with the minibus taxi. A sight investigation did confirm that during certain times of the day, the sun was blinding but however this doesn’t absolve drivers of the responsibility to drive carefully or slow down. Further investigations need to be carried out to see if this environmental shortcoming warrants any remedial measure, possibly widening the emergency lane / shoulder.

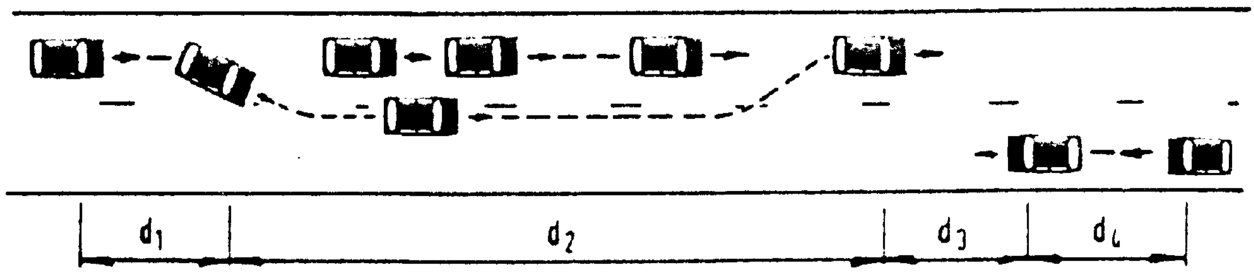
Dynamics of the minibus were calculated. The police report indicates that a skid mark 13m long was present. Based on this and a sled test to determine the road/tyre friction, the vehicle speed was calculated to be within the posted speed. But something didn’t add up, if this speed and the position of the vehicles was correct, then this collision would have been avoided based on a geometric design criteria referred to as passing sight distance.

4.2 Overtaking / Passing Sight Distance

Sight distance is a fundamental criterion in the design of any road, be it urban or rural. It is essential for the driver to be able to perceive hazards on the road, with sufficient time in hand to initiate any necessary evasive action safely. On a two-lane two-way road it is also necessary for him/her to be able to enter the opposing lane safely while overtaking. In multi-lane roads, the application is slightly different from its application in design for the open road but safety is always the chief consideration

4.3 Design Passing Sight Distance

Passing sight distance is the length required to safely complete a passing manoeuvre.



Elements of total passing sight distance requirements on 2-lane roads

P.S.D.=d1 + d2 + d3 + d4

Where;

d1 = Preliminary delay and perception time.
d2 =Overtaking distance - i.e. distance travelled by overtaking vehicle in carrying out the actual passing manoeuvre.
d3 = Safety distance - distance between opposing vehicles at the end of manoeuvre.
d4 =Distance travelled by the oncoming vehicle at the design speed of the road while the actual overtaking occurs.

4.4. Calculating Passing Sight Distance

For the posted speed, a distance of 262 m was needed for the heavy vehicle to do a safe overtaking manoeuvre. Detailed analysis in the vicinity of the accident, revealed that the actual distance was 305m during the manoeuvre. This simply means that if the minibus taxi was travelling within the posted speed of 100km/h then the collision could have been avoided.

More site investigations were conducted and it emerged that the skids marks for the minibus taxi was 13m long as reported by the police but a crucial piece of information was missing, the skid mark was intermittent and 37m from the point of impact, citing that there may have been brake malfunction in the taxi just prior to the crash. Our investigation started to focus on the minibus taxi's braking system. The braking mechanism was inoperative. However further investigation revealed this to be damaged in the collision.

5. DEFECTIVE BRAKES

The safe operation of any motor vehicle is dependant on an efficient and reliable braking system. Minibus taxis, being the most popular mode of public transport in South Africa, are subjected to much more severe operating conditions than the average passenger car. Minibus taxis frequently operate at speeds higher than the limit to cut travel time in order to secure more loads or passengers . While operating at these speeds, usually overloaded , the stopping distance of these vehicles change considerably from the design , usually resulting in fatal consequences. The ability to stop the vehicle safely in any traffic condition is vital to ensure the safety of commuters and the general public as well. The most important components that affect the stopping performance of these vehicles are the brakes. Most commercially available brake pads and linings are tested with normal everyday driving in mind. This however, could be greatly under estimated when fitted to the South African minibus taxis, which operate under severe conditions. While these brake pads and linings are perfectly acceptable for the average motorist, these components can have potentially dangerous consequences when installed on the minibus taxi (RMI, 2002).

6. DRIVER PRESSURE

Furthermore, the pressure is on the driver to meet strict daily requirements of numbers, both in trips made and passengers ferried. This in turn impacted on his/her earnings. In the ultimate event of brake pad or lining replacement, the driver would purchase the cheapest available as this has a direct bearing on his wages. Because the minibus taxi industry has grown rapidly in the last decade in South Africa, numerous replacement brake pads and linings are available which are manufactured locally or imported. The cost of the product is generally proportional to the quality. In most cases the original manufactured braking components that came with the chassis is used only until the maintenance plan .

7. ROAD TRAFFIC ACT

The RTA (Road Traffic Act of 1996) states that any vehicle used to transport public, in addition to the driver having a valid PDP (public driving permit) must obtain a CRW (certificate of roadworthiness) every 12 months. Vehicle testing stations issuing CRW's should do so in accordance with SABS 047, "The testing of motor vehicles for roadworthiness," Ed 4 ,2000.

Braking performance test may be conducted on vehicles presented laden or unladen. The tests should be carried out in two stages , the first using a brake roller testing machine or actual road test to determine the brake efficiency , which should be a maximum stopping distance of 14m, minimum deceleration of 4.4 m/s^2 with a minimum equivalent braking force of 4.4 N/kg travelling at a speed of 35km/h. The second involves roller brake force readings on any axle and the difference between left and right should not exceed 30% (SABS, 2000)

<u>7.1. Testing</u>

Due to the extensive damage to the vehicle, the brake material was removed and only laboratory tests on a dynometer were conducted based on – ECE R 90 and VC8053

<u>7.2. Compliance</u>

ECE R90 is a European standard for brake components that requires brake manufacturers to conform and guarantee to the original equipment standards as far as performance and quality is concerned. Products complying with this standard carry an "E" mark on products and packaging. In Europe brake pads cannot be used or sold unless they carry this mark proving that they are performance and quality standards compliant.

Most countries around the world are following suit by setting standards to which brake pads have to comply.

Regulation VC8053 is minimum specification published in the Government gazette No. 22014 of 2 February 2001, to which brake lining assemblies in South Africa has to comply and this specification is regulated by the SANS (South African National Standards).

The tests for both these regulations consist of laboratory and road tests:

Brake pad road tests:

1. A series of 0-type standardisation tests – braking suddenly under different conditions of vehicle speed and load with the aim to test the correct response in emergencies, parking and different braking situations.
2. Loss of efficiency when warmed up – In the first test the brake is used 15 times in succession to test its performance under different conditions. In the process, the brake warms up. In the last instance its performance is measured and checked for correct operation after which the results are compared to brake performance when the brakes are cold.
3. Speed-sensitivity test – The pressure is identified in the previous test to obtain a deceleration of 5m/s2. The same kind of test is repeated at 65 km/h, 90km/h and 135km/h in order to check that the brake's deceleration is maintained irrespective of the speed at which the vehicle is travelling.

Brake pad laboratory tests:

Once the road tests are completed, mechanical laboratory tests are done:

1. Compressibility test – the compressibility of the brake pad should not exceed 5% of its thickness at 400 deg. C.
2. Resistance to brake seizure – this test simply determines the adherence of the friction material to the metal support.

Once the tests are completed an approval number is issued and it is compulsory that the brake pads and packaging contain the specific number. Packaging should be tamper proof and contain instructions in the local language where the product will be sold.

8. FINDINGS

Friction test were done in the laboratory and this proved to be substandard compared to the standards laid out by the SANS. The brake pads where identified as a cheap import "referred to as the yellow box" favoured by taxi operators in the area. Brake failure did contribute to the accident but not because of a mechanical failure but as a result of the substandard parts which caused brake fade, a phenomenon which occurs when friction material exceed its temperature range and become totally ineffective.

SANS had no knowledge of the product being registered or tested for conformity. DTi (Department of Trade and Industry) also confirmed that no application has been documented to bring the material into the country.

9. CONCLUSION

Minibus taxis plays a central role in South African societies. At least 65% of all commuters use minibus taxis on a daily basis. Collecting road accident data is not just "form filling", because it provides the essential information that needs to tackle one of the most widespread and serious problems that South Africa faces. Thus, the primary recommendation of this research is that all involved should recognise the seriousness of the problem of minibus taxi accidents, in terms of the human, social and economic consequences. They should also recognize the essential role of collecting high-quality data for these accidents in order to measure the scale of the problem and to devise effective countermeasures. This recognition should extend from the national authorities to local authorities, and the police officers and all those who carry the principal responsibility for recording details of minibus accidents. Collecting good quality data on crashes can be expensive, but these data are essential in order to calculate accident risks reliably and then to develop optimal policies for reducing these risks.

10. RECOMMENDATIONS

It can be seen that the current reporting lack details that may be crucial in identifying collision trends. Police personnel, should be provided with some training in the basic assessment of minibus taxi crash data. Appropriate and accredited specialized training should be considered for SAPS members as part of the overall police training and initiation process. Furthermore, a dedicated section/division within the SAPS could be established to handle accident related reports/investigations given the high social and economic impact accidents have on the country and families. Accident data collection should explicitly be accepted as a very important task for police officers and all those involved in the process, not something that they are implicitly expected to do in addition to all of their other responsibilities. Regular studies on underreporting are needed, this applies particularly to single vehicle and damage only accidents. When there is no information about these crashes, it is impossible to interpret trends properly and decide whether a reduction in the number of accidents reported by the police represents a genuine safety improvement. Electronic systems have great potential to reduce the burden on the police work and speed up the data collection process. This task would be that much easier if the details of the vehicles stored on the vehicle register, details of the drivers stored on the license register and road details stored on digital plans and maps were readily accessible. If these basic data could be brought together in a comprehensive database, the police report could give more attention to the causes of the accident.

The study is still in progress and a comprehensive checklist will be drawn up that will assist to improve the quality of information obtained for minibus taxi collisions.

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