DEVELOPMENTS IN TRAFFIC CRASH INVESTIGATION. NEW ZEALAND POLICE

During period 1 JULY 1992 to 31 MARCH 2005

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1. ABSTRACT.

Over the last decade there have been major changes within New Zealand Police in Serious Traffic Crash Investigation. This paper discusses the changes, some of the problems and techniques used by encountered by Investigators and concludes with a short discussion on the next round of changes.[i].

2. INTRODUCTION.

My starting point is 1 July 1992 when the Traffic Safety Service, was amalgamated with New Zealand Police.

Overnight Police underwent a dramatic change.

The **first** major issue encountered was that administration and funding for of road safety[1] is controlled by a joint government programme that specifies service delivery and performance measures. The document sets out the requirements for all Traffic Enforcement including Crash Investigation. The publicity on the police enforcement programme is driven by our response to the Government's requirements.

The second major issue flows from the funding stream.

[1] NZ Road Safety (Administration) Programme 2004/2005, jointly prepared by MOT, Police and the former LTSA, is signed off by the respective Ministers. It funds all road safety measures including police enforcement.

All crashes are serious, but Police do not have the resources or funding to investigate all traffic crashes in depth.

We are aware that fatal crashes have the highest public interest and conclude with a Coroners Court hearing. With the ability of the Coroner to make recommendations to prevent accidental deaths, if we can determine the causes of these crashes correctly, improvements in road design, enforcement or education to prevent future fatalities, will also reduce the incidence of other crashes.

By 1992, three Ministry of Transport staff had been trained in USA to use the latest emerging techniques of technical crash Investigation[2]. Police have built on that knowledge base. The widespread introduction of scientific precision and methodology is a tribute to the advanced thinking of Police Managers and an indication of their commitment to thoroughly discharge the task.

The aim of the Serious Crash Investigator is to identify the causative and related factors that caused a traffic crash and report those facts to the appropriate authority, which may be Road Constructors, Road Controlling Authorities, (RCA's), Safety Authorities, the Judicial or Coronial courts. It is NOT the duty of the Investigator to decide or recommend criminal charges. Simply to identify the factors that contributed towards a crash.

3. ORGANISATION

Police are divided into 12 autonomous geographic districts.

Policy is determined at the Office of the Commissioner, with the District Commander directly responsible to the Commissioner for delivering the operational function. A National Adviser, attached to the Commissioner's office supplies advice to the National Road Policing Manager and tries to co-ordinate districts to a common theme. The role does not have operational or line control over field staff.

Photograph 1Wellington District SCU Vehicle

Within the local district, the Serious Crash Units, (SCU) generally report to the Road Policing Manager. Frequently they are attached to the Highway Patrols and share their livery. The majority of districts operate a range of specialist vehicles.

4. MANAGEMENT OF CRASH UNITS

Since the early 1980's the Traffic Safety Service (TSS) had been investigating and reporting all Traffic Crashes. As time moved on, police officers lost this skill or were promoted from front line duties. By integration date, police did not have any staff trained specifically to investigate crashes using modern scientific procedures. Former TSS staff continued the role. Budget cuts in the early 1990's stopped all Crash Investigation training and skills were being lost. Assistant Commissioner Phil Wright, travelled to the UK and Europe during 1995. He returned and submitted a paper

[2] Superintendent Gyde (Retd) , Inspectors Brown and Kelly. Northwestern Uni. Illinois USA

stating that New Zealand was falling behind its peers in this specialist area and that improvements were needed.

This paper was the catalyst that lead to the present situation. With the support of the Assistant Commissioner and my Region Commander, I was fortunate to obtain a Churchill Fellowship and travelled overseas for additional specialist training[3]. On my return, I was instructed to establish a training system using modern techniques in the then Region Four.

From this small start and with key support from top management, over the next nine years three District Management systems evolved.

The first Management type is the most popular.

Centralised: This model was first established in the Waikato District, which was the first to create a Serious Crash Unit based at a central location. These units have at least three fully dedicated Investigators. The maximum number currently is eight. They may be controlled by an NCO and usually have fully dedicated vehicles. The unit provides a 24/7 service. It is normal for the on call staff to take a marked vehicle home as this reduces call out response times. An example is the Auckland North Shore Unit, based at the former administration complex of the Auckland Harbour Bridge. This unit investigates all fatal crashes on the Auckland Motorways and the North Shore district. They operate the full range of police equipment and have the only photogrammetric unit in the country. Other Centralised units are based at Northern District (Whangarei) Auckland City, Counties/Manukau, Waikato, Central (Palmerston North), Wellington and Canterbury. With the exception of Northern, Central and Canterbury a Sergeant controls the each unit.

Within this group there are approximately thirty-two full time crash Investigators.

Dispersed: Units in this model are based in Tasman, Southern, and Bay of Plenty. Within these districts are a number of individual staff who have a full time role investigating serious traffic crashes. Because of geographic placement, the investigators normally report to a non specialist Sergeant – usually from the Highway patrol. Examples are Invercargill, Dunedin, Nelson, Blenheim, Taupo and Greerton. The model works best where crashes are relatively few ie no more than 40 or so a year.

The Bay of Plenty District which includes Tauranga, Rotorua and Taupo is managing a change from the dispersed to a centralised model.

In these districts the plan is that all crashes will be investigated by one of the full time specialist.

This group has nine staff. Some are full time investigators, others probably between 70%and 80% full time equivalent investigation duty. The numbers tend to vary according to the crash rates.

Portfolio. This is where a General Duties officer, or a Highway Patrol member has had the specialist training and investigates crashes on a part time basis. Only Eastern District, based at Napier/Hastings adhere to this model.

Generalist staff.

In addition there are approximately another 20 staff, trained to the higher levels, not necessarily Forensic Mappers, who will investigate crashes and submit reports using the standard methodology. These members may attend only one or two crashes a year and are generally found in the more remote locations.

[3] Texas (A&M) Uni, College Station, Texas.

5. PROVENANCE

Traffic Crash Investigation is based on the Laws of Motion set out by Sir Isaac Newton. I am aware that some scientists challenge the validity of some of the laws, but at the speeds attained by motor vehicles and within the confines of Sir Isaac's theories, they work very well. Lets keep it simple!

By introducing scientific precision, the successful investigator has a basis for understanding the crash sequence. To do so there will be a combination of various disciplines, some of which are academic qualifications in their own right.

- Art – (photographs diagrams etc). It helps to be able to draw.
- Mechanics – How things "work" or happen.
- The Law Legal requirements, restrictions etc.
- English – To communicate the results.

For all Traffic Crashes there are two basic facts.

First, the principle of Conservation of Energy tells us that the faster we go – the longer it takes to stop – or the bigger the crash.

Second, Sir Isaac's first Law of Motion is that all objects move in straight lines – unless affected by some external source.

If the Investigator keep these two principles in mind, it is possible by carefully noting and recording the scene evidence, to eliminate conjectures, to untangle the usually conflicting stories and theories as to the crash cause.

6. TRAINING.

With twelve autonomous districts one of the bigger challenges is in ensuring that staff are properly trained, supervised and producing a uniform result.

The training is based on a US University syllabus, now delivered by an ex Christchurch City Traffic Officer, now a full time Sergeant in the Queensland Police.

New Zealand police are one of the very few police organisations to have a regular training system based around a standard syllabus.

The New Zealand training structure follows a tiered process.

Level One is that given to recruits during their initial training at the Royal New Zealand Police College by our "in house" staff. This is little more than Crash Reporting.

Level two is that of the Scene Investigator. Here the focus is on getting the reporting mechanisms correct. To have accurate Traffic Crash Reports and a hand prepared plan that is legible. The investigator is given some technical training in dynamics, sufficient to at least enable the individual to be alerted when an erring driver presents a statement that is at variance with the facts. The primary focus is on collecting and documenting the forensic evidence in a manner which can withstand later examination. These courses, of two week duration are delivered by district based police staff at a frequency that meets the local need.

Level three is a two week specialist course delivered by the outside service provider to the US curriculum. Staff must have completed level two to be accepted for this training. There is also an expectation that they will be involved in attending and investigating traffic crashes. Here the basic conservation of momentum techniques are taught plus a close investigation of vehicle and occupant dynamics. Plan drawing is NOT taught at this level. Most applicants come from Highway Patrol Groups with the balance coming from the General Duties Branch (GDB). Normally police provide two of these courses each year.

Forensic Mapping a two week training course with in house instructors. It sits between Levels three and four. One of the entry qualifications for Forensic Mapping is the requirement to have completed the level three training. We have the view that a Mapper needs to have a close understanding of what is critical to the investigation and is able to differentiate between the various types of evidence. The course has been designed by our staff, to meet our needs. The team who built the programme include members trained to NZCE standard, as survey technicians as Draughtsmen and as computer experts. The measurement and instrument accuracy requirements have been developed in conjunction with the Otago School of Survey.

Level Four is also a two week training course, delivered by the outside service provider. It is heavily classroom orientated and is based almost solely around the principles of conservation of momentum. It includes elements of revision from Level Three. This course is offered once each two years and all prospective attendees MUST have completed level three training.

Specialist Courses. These are restricted to police staff who have completed Level Four and Forensic Mapping. If there are insufficient nominations level three investigators may be accepted. These five day courses specialise in one aspect of the Crash Investigation training in detail. There is usually a full day set aside for practical work to test and report on the methodologies taught Examples are Motorcycle, Pedestrian, Cyclist and Truck Crash investigation.

None of the elements taught on the specialist courses will be new to the experienced investigator. With more time, greater attention to detail, the more obscure facets of an investigation can be covered. During May 2005, for the first time in New Zealand a training course in speed estimation based on vehicle post impact profiles will be conducted.

To attain all of the qualifications, a police staff member will have attended thirteen weeks of specialist training. This amounts to over 480 tuition hours with pass fail, examinations for levels two and above. It is our aim to have this training spread over about 4 – 5 years after recruit graduation. This gives time for the theoretical lessons to be followed up by practical work and the lessons consolidated.

7. PROFESSIONAL RECOGNITION.

Police Investigators ultimately have their work reviewed in the Courts. This is a somewhat harsh environment where police managers cannot afford to have mistakes or omissions exposed.

We use several methods to obtain quality control.

Peer review is a popular medium. Generally this is by other police staff although the use of retired police or University professors is not uncommon. As a policy maker I am rarely asked to peer review files. Instead, I tend to be asked to assist with the more complex ones and provide specialist evidence. This then gives me a problem in having my work “Peer reviewed” Outside reviewers have an advantage in that they are isolated from internal pressures.

My plan is to obtain **NZQA recognition** of our staff’s expertise by the establishment of a Diploma in Crash Investigation. Something that has never existed in New Zealand and at University level is still rare overseas.

To this end, we have registered NZQA qualifications in Forensic Mapping, Report Writing and Level Three Crash Investigation. Attainment of these unit standards will produce a Certificate in Forensic Mapping.

NZQA UNIT STANDARDS.

- 20281 Demonstrate Knowledge of Forensic Mapping
- 20282 Set up survey instruments.

- 20284 Produce a computer generated plan.
- 20285 Advanced illustrative mapping of a traffic crash scene.
- 20286 Identify causative factors in a traffic crash.
- 9685 Write an analytical report.

It will have 41 credits and will count towards a diploma. More importantly the certificate will require renewal each 12 months. The Unit Standards comprise an introduction to Forensic Mapping, all the requirements of setting up a total station, then the various aspects of preparing and printing a plan that meets specified requirements.

To obtain NZQA recognition has taken a large amount of time. In addition to designing the unit standards, we re-wrote our Forensic Mapping training course and have created the support systems and documentation to meet NZQA standards. We also had to convince staff of the benefits of the process.

A major benefit of that process has been the requirement to set standards. While the training accords with recognised standards, they are not necessarily documented in New Zealand. To promote uniformity I have established Best Practice Guides for;

- Traffic Crash Reporting,
- Operation of Accelerometers,
- Crash Scene Photography.

Final sign off has just been obtained approving guides for

- Total Station operation and
- the duties of Forensic Mappers at Crash Scenes

Others are planned.

These guides are a long way in advance of what in the Transport Department days we referred to as “The Traffic Officers Manual”

Another major benefit has been that the Forensic Mapping Certificate, must be renewed annually. After the candidate attains the Forensic Mapping Qualification, they will need to produce at least 2 plans per annum for assessment and renewal of the qualification. This will directly lead to uniformity of standards, enhancement of peer review and increased standardisation of mapping standards.

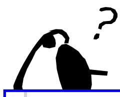
As the movement towards the Diploma continues, the same requirements will be set for all other levels of Crash Investigation and will include the specialist courses. By adding in management papers, focussed at NCO level, and a research topic, the required number of Unit Standards will be readily attainable.

By this means professionalism and credibility of staff will be enhanced.

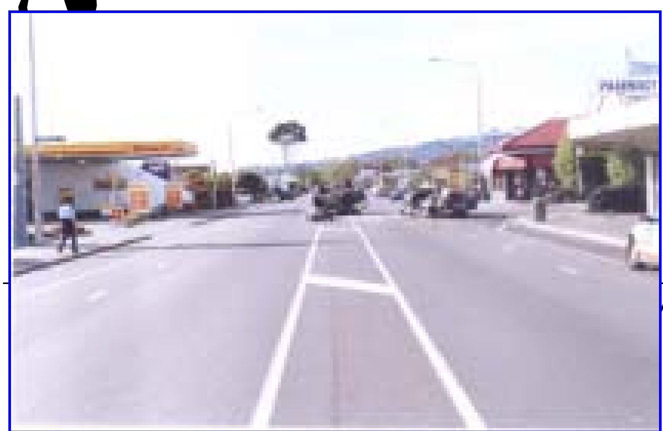
I view this as change as a major achievement within our integrated service.

8. EQUIPMENT.

This is an area of highly visible change. If the Investigator is to collect accurate and reliable evidence there is a need for precision. The earlier that precision is introduced into an investigation, the more reliable the answer.



While technical equipment is important, nothing replaces the alert and inquiring mind of the unbiased investigator.



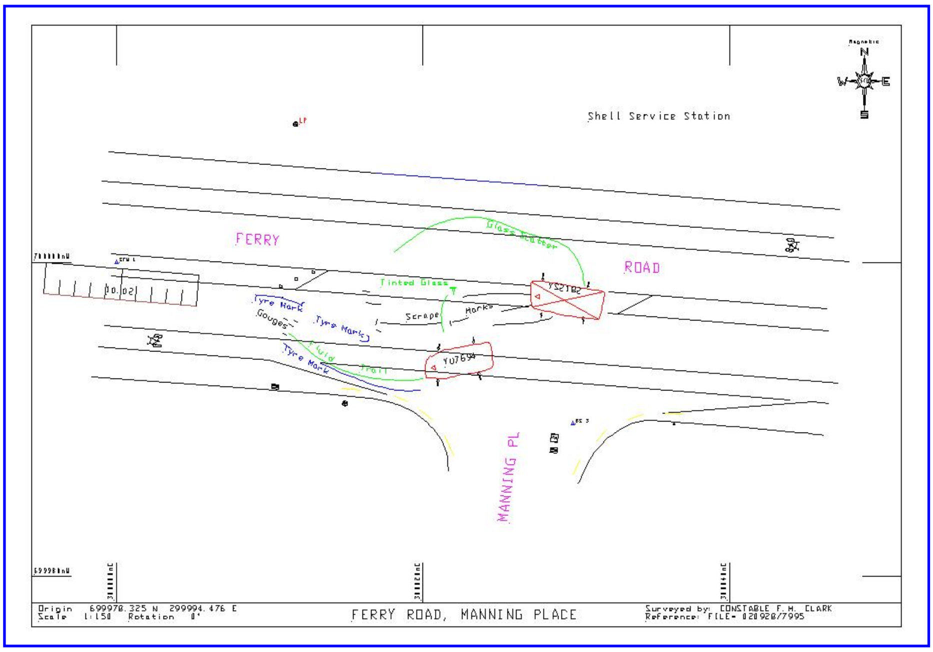
Police Crash Units use surveyors total stations to obtain the scale scene measurements and a simplified plan view. All districts have at least one of these units. The scene information is converted to a simplified overhead type view from which the essential mathematical information can be extracted. CAD techniques are used to plot the path of a vehicle. While the courts place a great deal of reliance on the scale plan produced, that plan is actually a side issue.

The use of the Total Station is principally to obtain reliable, standard scale, scene data for the investigation. We have considered the use of Laser Scanners. At this stage we see the best use of our scarce financial resource in re-equipping with reflector less total stations. Further developments on photogrammetry will occur.

We have found that unless source information is accurate any detailed scene analysis will be difficult. Alternative and competing theories may be advanced - and without adequate scene investigation, refutation may be impossible.

Photograph 2 Crash scene. Christchurch city

The investigator will take a crash situation, such as shown in photograph two and produce a plan. By production of a series of plans or by using simple animation within MS Power Point it is possible to show the simplified movement of vehicles.



Plan One. Crash scene plan. Ferry Road. Christchurch

9. THE ROAD SURFACE.

Police work on the basis that the best brakes in the world will not stop a vehicle as quickly on wet grass as on dry asphalt; that it is the road surface which determines how quickly a vehicle stops. I doubt this basis will surprise an engineer.

We have a variety of mathematical approaches but the most common in effect states;

> *The distance it takes to stop a vehicle is directly related to its initial speed and the road surface grip factor. In effect the principle of conservation of momentum*

A term used in crash investigations/reconstructions is drag factor. Frequently almost interchangeably with the term Co-efficient of friction. Drag factor is defined as the force required for negative acceleration in the direction of negative acceleration divided by the vehicle weight. Drag factor and coefficient of friction will be equal only in cases where all wheels are locked and sliding on a level road surface.

While this ignores wind resistance, for routine speeds, under the maximum speed limit this is sufficiently small to be able to be ignored.

It is also somewhat convenient to be aware that gravity acts equally on all objects.

The base equation for negative acceleration is $Vi- = \sqrt{Ve^2-2ad}$. Units m/s/s/

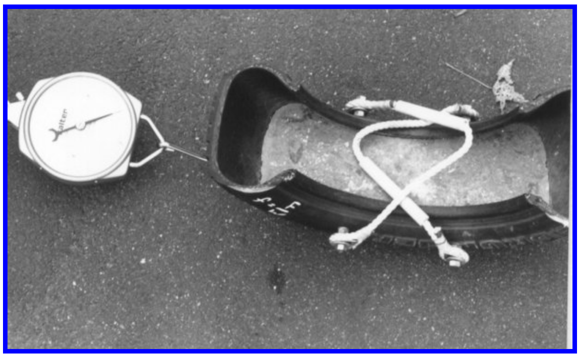
Engineers may recognise the formula as $V_s = (2*g*d*f)^{0.5)} *3.6$ Units km/h

Another popular formula is $S = \sqrt{254df}$ Units km/h

Engineers will be aware of a range of other ways of expressing the same concept.

In the first equation *a* is acceleration in units of m/s/s and is the product of gravity times the road surface co-efficient of friction ($g * f$).

Hence if the investigator has a tyre friction mark of a given length, (*d*) and knows the speed of the vehicle at the end of the mark, it is possible to determine the speed at the start of the friction mark. All that is needed is the grip ratio for the road surface at the location where braking was being carried out.



Photograph 3 Concrete filled drag tyre plus spring scale

As the coefficient of friction is simply the horizontal drag force divided by the object's weight when the object is sliding across a surface, measurement systems utilising a dragged test tyre have been devised. A simple technique is to use part of a tyre filled with concrete dragged with a spring scale as shown below. The angle of pull is parallel to the surface.

Commercial drag sleds, are also available providing different tyre tread patterns and suggested reduction factors to account for the fact that at typical skidding speeds the tyre heats up. Both measurement techniques are often criticised because the load on the test tyre is considerably less than what a normal passenger car tyre will be carrying and also the test tyre may not necessarily represent the tyres fitted to the incident vehicle.

Photograph 4 Commercial drag sled

Photograph 5 Clamped drag tyre.

A clamp system can be used to create a drag wheel from the incident vehicle, as shown in photograph 5, and the same test methodology followed. While the drag wheel overcomes some of the alleged shortcomings of the drag sled/concrete filled part tyre, the problems of light load and needle fluctuation on the undamped spring scale remains.

Furthermore, the drag wheel test is time consuming and frequently requires the crash investigator to be exposed to moving traffic. The time delays and exposure to moving traffic is no longer acceptable to modern investigators. The readings need to be manipulated to correct for the angle effect of the drag frame

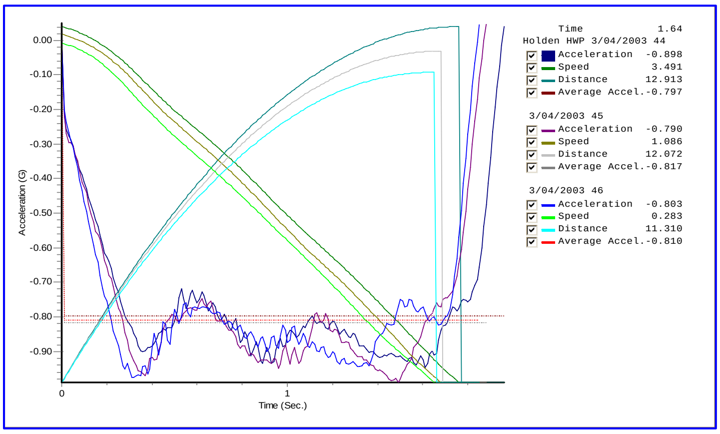
Crash Investigators now prefer to measure the grip factor – the coefficient of friction - with an accelerometer from which acceleration graphs can be compiled. The device is suitable for our purposes, accurate and gives a consistent result that we term the co-efficient of friction.

The measurement device most commonly used is the Vericom™ VC3000, a single accelerometer device manufactured in the USA (refer photograph 6). This device records the braking forces electronically. It is mounted on the test vehicle windscreen and can be activated externally from the brake lights or internally by the braking force of the test vehicle. The braking force time history can be retrieved and viewed to allow corrections for such matters as peak force, wheel spin down and mechanical lag. A typical braking force time history obtained from three tests with the VC3000 is shown in Chart two.

Our tests, conducted in the area where the driver would have been braking and or taking evasive action do not differentiate between wheel tracks. This means that the investigator needs to be careful that the test is properly replicating the action of the incident vehicle. One advantage of our procedure is that we are closely replicating the real world incidents. We use common cars, common suspension systems and common tyres. We slide the tyres over the road surface; loose stones and other surface

Photograph 6. VC3000 mounted in truck cab.

contaminants present or not. This test includes all the variables that an engineer would control for when determining that theoretical amount of grip on a road surface. We think it is a "*real*" test in the "*real*" world. One that a Judge or Jury can relate to. After all if our test shows that 50 km/h leaves a friction mark of 14.5 metres, and the incident driver claims 50 km/h from a 25 metre friction mark – even if all else fails – the inconsistency is plain.



However, one difficulty is the requirement that all four wheels have to be locked. This means that the anti-lock braking system (ABS) has to be disabled. Therefore, during the test, as the four wheels are locked, the vehicle is directionally unstable, adverse tyre wear occurs and if the road has a cross slope or camber, some interesting situations may

Chart Two Multi run Vericom braking test result. .

arise. For this reason, our policies restrict the tests to a maximum speed of 50 km/h.

The data from three acceleration runs have been overlaid onto a single chart. This shows that the average braking acceleration is about .8 of one *g* (the force of gravity). The tests show consistency in their results.

The jagged lines are the braking forces, with peak force occurring as the front suspension becomes fully compressed and the front wheels are at incipient lock up. A second peak occurs when speed drops below about 5 km/h. The other two sets of lines show that as speed decrease, distance increases.

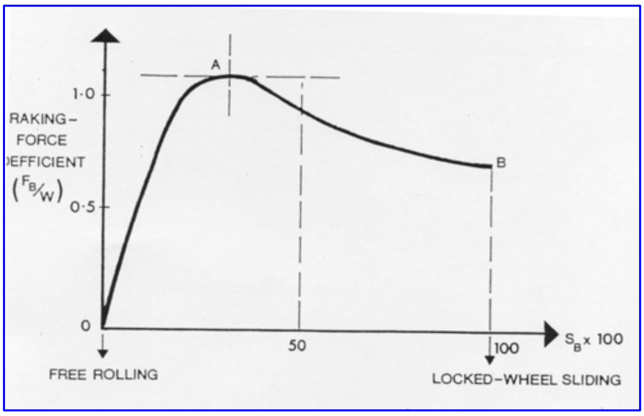
The coefficients of friction fall off as speed builds if the road surface is wet. Therefore, caution must be exercised when projecting wet weather tests performed at 50 km/h to incident vehicle speeds.

The factor we derive is NOT the same as the friction factor measured by a SCRIM machine, or a British Pendulum, Grip Tester, ROAR or other specialist device. Peter Cenek of Opus Laboratories in Wellington has addressed this issue[4]. His conversion formula is complex, site specific and requires careful interpretation. When I have used it I have found it to be reliable and able to withstand Judicial scrutiny.

One reason for the difference in co-efficient values is that our tests are based on a locked wheel technique generally on a dry road. The specialist machines generally uses a wet surface and has a sideways force operating on a rolling tyre.[ii]

For our purposes, if the incident vehicles did not have at least one of the wheels locked it is a challenge to determine the amount of braking force being used by the driver.

Police now have at least 20 of the Vericom units stationed around the country.



A common friction curve for a vehicle is similar to this chart. As the brakes are applied the force rapidly increases up to the point where the wheel locks. There is then a marked decrease in the braking effect, which when once past the initial lockup holds to an almost constant line.

Although expressed somewhat differently, in effect both charts are reporting the same effect.

Chart Three Typical friction curve for braked tyre.

Neither Vericom's or Total Stations were in use prior to Police/Traffic Integration.

10. ACCURACY.

As with all specialist equipment and data that may be used to support a criminal prosecution, there is a need for total confidence in its accuracy. The accelerometers are called into Wellington once per annum and bench tested for compliance with the manufacturers specifications.

Our total stations are serviced annually. Land Information New Zealand have modified the Evans Bay Base Line to bring it to International Standards Organisation (**ISO**) standard. We are commencing a procedure to have every station checked against that base line at least one a year, or immediately after any adjustments have been made. The accuracy verification procedures will be carried out by our ISO certified laboratory and staff who will then seal the unit.

Both devices have their own Best Practice Guide which sets out the operating standards and procedures required to check accuracy on a daily basis.

11. SOME OF THE PROBLEMS INVESTIGATORS ENCOUNTER.

Tyre marks

Tyres are sometimes blamed for causing a crash. This is unfortunate as modern tyres, less than seven years old are highly reliable. The damage to the tyre surface and the

[4] Refer reference at end of paper.

related marks on the road are important to the investigator. Training includes how to recognise the different damage types that occur with tyres. In this regard we are fortunate to have full co-operation from South Pacific Tyres of Upper Hutt and Firestone based in Christchurch.

The length of tyre marks can be deceptive. Photograph seven shows lock up tyre friction marks created at about 50 km/h. The longest single mark is from lock up of a motorcycle rear wheel. The curves in the mark as the motorcycle wobbled show the machine was unstable, indicating that the rider was not using the front brake. The shorter mark is again from the locked rear wheel. This time the mark is virtually straight, showing high stability indicating the rider was using high front brake effort.

Photograph 7 Brake marks Motorcycle and car.

While many will claim that a motorcycle will out-brake a car – two considerations have to be kept in mind. Few riders have the skill to lock the front wheel and not fall off, or even bring the front wheel to incipient lock up. Most will progressively apply the front brake and only reach full braking force when speed has been remarkably reduced. With a modern high performance motorcycle it is possible to lift the rear wheel off the ground while using high front brake effect. In such a case rear wheel lock up will not be recorded and again the final "stoppie" is usually at relatively low speeds. It is not uncommon to find shattered plastic and metal gouges a few metres downstream of the "stoppie"

Animation.

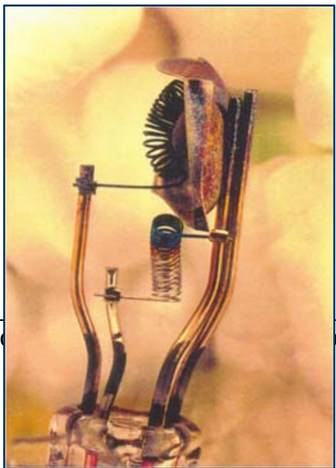
Car drivers on the other hand, with ABS ability are able to almost instantly bring all four wheels to incipient lock up. This means they are applying maximum braking force at high speeds. This is where they gain on most motorcyclists. On this occasion, the car driver consistently stopped in a shorter distance that the motorcycle when car ABS was used, and marginally shorter when the car ABS was disabled.

Vehicle condition.

Photograph 8 Modified vehicle suspension spring.

Photograph 9 Modified coil spring

Some drivers carry out modifications to their vehicles. Inspection not infrequently reveals springs missing or brutally modified. These examples are of coil springs recovered from a vehicle post crash. were modified with a hack-saw. In this case the driver was under the impression that the lowered, "*sporty*" look was the "*in*" image, claiming improved handling because of a lowered centre of mass. In each case control was lost while cornering and occupants died.



Lamps.

A careful inspection of the lamps will assist the investigator to determine if the lamp was ON or OFF. This will be of importance at night for opposing direction or intersection type crashes. In this example the driver was utilising dip beam when impact occurred and the quartz globe was shattered.

The hot dip beam is distorted by the impact forces and discoloured by the presence of oxygen. The high beam filament has only discoloured where closest to the heat source.

Photograph 10 Damaged headlamp

Windscreens.

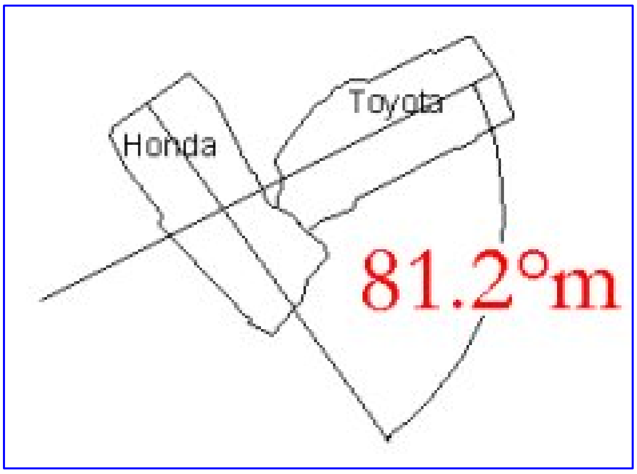
Laminated windscreens do not shatter or become opaque when broken. Adequate forward vision is retained. They also assist to retain occupants inside the vehicle when seat belts are not used. In this example a carpenters hammer has penetrated the windscreen. Apart from localised damage around the impact area, the remainder of the screen provides acceptable vision.

Photograph 11 Damaged laminated screen.

These screens can be re-assembled to allow an understanding of the events being studied. The shape and alignment of the fractures can enable the position of the victim to be determined at impact. In this case the driver claimed that a stone shattered the windscreen and lead to a loss of control. No evidence of such an impact could be found. All other damage to the screen could be explained by cross reference to the pedestrians injuries.

Photograph 12 Reassembled laminated screen

12. PRESENTATION.



Plan 3 Vehicles at Initial Impact alignment

To assist others to understand how a crash occurred, overhead photographs can be beneficial. The alignment of the vehicles at engagement can be shown or even placed into sequence as they approach, collide, rotate and depart. This illustration is of a collision alignment and is part of the process towards ascertaining the various vectors of the collision forces. Further, by placing this scale diagram over the impact marks and ensuring a perfect match, the investigator can then determine the approach paths of both vehicles. This diagram suggests a full engagement, one where both vehicles for a brief moment attained a common velocity.

13. AN EXAMPLE OF OUR INQUIRIES AND AN ENGINEERS RESPONSE.

The sequence of photographs are of a rural highway. In this incident the female driver was travelling in the direction of the camera view. She had travelled about 15 – 20 kms at highway speeds, negotiated several curves and at least 2 right angle intersections. The road was dry, it was early evening, there was little traffic and the driver was relaxed. She was a stranger to the immediate area and was talking to her passenger

Photograph 13 Line Road

We suspect was driving on the subliminal clues of a long straight road with continuous overhead power lines.

There are warning signs clearly erected. Research has claimed that when drivers are not fully concentrating there is at least a 40% chance that warning signs may not be seen, or if seen and the reason is not clearly apparent, immediately forgotten.

Abruptly the driver realised there was an intersection ahead. A car was coming from her left. She braked, the brakes were hopelessly faulty and a fatal collision occurred. The innocent driver died. A tragedy for which the erring driver was duly convicted.

Photograph 14 Line Road Intersection.

The tyre marks in this photograph are NOT related to the incident, but serve to suggest there is a “history at this location.

Photograph 15 Intersection today.

The location today has fewer advance warning signs, but a prominent Give Way sign right in the drivers line of vision. I understand the crash rate has been markedly reduced.

This was largely as the result of a recommendation from the Coroner. The RCA in this case needs a thank you for a practical solution at this intersection.

14. EXAMPLES OF PROBLEMS.

If we continue to allow roadside furniture close to traffic lanes we can expect to have crashes. This illustration, hopefully we agree is ridiculous. Surely we would never do this? The hazards are obvious. Yet if you watch aircraft landing they always keep on the concrete area where they are meant to be.

Photograph 16 Airport runway.

So why do we allow the example on the below? The builders have even doubled up one of the poles – just to make sure it is NOT frangible. Why can we not fix their mistake? The politicians who created the Law, The engineers who designed the system, and the workers who built this trap are now all dead. Somewhere, sometime some one is going to get a bright idea and move these poles. They have only been at this location since at least the late 1940's.

Photograph 17 Provincial Highway North Island.

The next two photographs illustrate another of our frustration's. The apparent reluctance of Road Controlling Authorities to act when a hazard is identified. Some one had accepted that the road would be icy and slippery in the winter.

Photograph 18 Ice warning sign.

Photograph 19 Power Pole.

The Road Controlling Authority erected a sign. The road has sufficient camber that any loss of traction will send a vehicle into the grass – where of course a power pole waits. Why was the fence not simply cut? The authority has the power to do so. Today the fence is still not trimmed and winter is approaching.

As engineers you will be aware that obstructions in the middle of a road are a hazard. This tree was apparently so dangerous it required 6 protective bollards. The guy wires could be a suggestion of recent impacts. Perhaps I am naïve – but a chain saw at ground level would soon improve safety.

Photograph 20 Road tree

Just in case you accept that Engineers will act if a life is lost and fix the problem – look at this one. A gentle curve. Nice and flat with a power pole just past the apex. That crashed vehicle resulted in a death.

Do you suggest better signs and camber will overcome the problem?

Photograph 21 Power Pole Canterbury.

In case you suggest that decent signs will overcome the problem I refer you photograph twenty two. Camber is improved, signs are good – and the deadly power pole is exactly post apex ready for the red car in which another person died. Surely by now someone would have got the message that drivers do make errors, that none of us are perfect and power poles at or near the apex of a curve are a tragedy waiting to happed.

Photograph 22. Power Pole Canterbury.

This is the same location as photograph twenty one. History has repeated itself. The second death. Still no changes but lets replace the power pole exactly where it has always been and ready for the next one.

I repeat how many more must die before responsible engineers decide to act? In other countries someone would have been sued by now. My information is that a minor re-alignment of the power line will reduce the amount of wire required and remove the pole.

The point is that Police are pursuing the Governments Road Safety Target of less than 300 deaths by year 2010. We are *"doing our bit"* and are not necessarily being supported or appreciated by the public. Enforcement is no substitute for lousy engineering. What are our RCA's, you as Engineers and Highway Constructors doing to help reduce the road toll? We have a society wide problem. It needs a society wide answer. Enforcement alone is NOT the answer to reducing the road toll.

15. THE FUTURE.

New Zealand Police are concluding a tender process for the purchase of new highly specialised Traffic Crash Investigation software. As well as reducing the complexity of plan drawing with total stations and having an integrated mathematical component, the new software offers specialist animation facilities.

Many traffic crashes have a simple sequence, yet are complex to explain. In the sequence you are to be shown, a driver commences an overtaking movement while approaching the crest of a rise. Another car appears, evasive action occurs and a driver dies. The arguments centred around speeds, who made the mistake and who was at fault. This is the standard of court room presentations we will move towards. In this case each individual frame of the entire sequence is under the control of the illustrator, who must be able to justify each and every phase of the animation.

As a potential member of the Jury – would you prefer to see this as a summary of an incident, or hours of verbal advice from witness's?

Rel-Mo animation here.

16. OUR CHALLENGE.

We face the same challenges as the engineer.

Many of our roads are narrow and substandard. Many are carrying traffic flows well beyond their design capacity. Even small incidents can cause congestion costs well beyond the costs of the immediate crash scene. Both professions accept the need to keep traffic flowing safely and efficiently.

Police treat a fatal or potentially fatal traffic crash scene as a crime scene. This means that we make all efforts to collect the forensic evidence quickly, accurately, safely and at the earliest opportunity re-open the road.

We do not have the luxury of closing a crime scene for days until we complete our enquiries. We may have only minutes to gather the information needed to continue our enquiries. Fortunately, we almost always have the drivers available. Hit and run crashes, particularly where a pedestrian is involved are the exception. These scenes require meticulous scene investigation and prolonged road closures may occur.

There will always be a tension between the need to re-open the road and our need to collect the evidence. The public expect that where appropriate, enforcement action will be taken against erring drivers. As professionals working in this area I suspect you support the view of taken enforcement action against drivers who have offended criminally.

Generally we get the balance between rapid scene enquiries and early road re-opening about right.

During February 2005 the police Superintendent in charge of Auckland Traffic services stated; "*we (the crash Investigators) can get in and collect all the immediate evidence we need and have our task finished before the tow trucks arrive*".

Should the Auckland Road Controlling Authorities, jointly decide to purchase their own tow trucks and move to rapid deployment – then once again we will need to re-evaluate our procedures.

By working as a team we can help you and you can help us.

17. CONCLUSIONS

The science of Traffic Crash Investigation within the New Zealand police has undergone rapid change over the last 13 years. Further changes will occur as new equipment and procedures are introduced. Police are moving towards increased professionalism, standardisation and expertise with their qualified staff. Efforts will continue to locate equipment and techniques to gather forensic evidence quicker and to reduce road closure times attributed to traffic crashes.

18. ACKNOWLEDGMENTS

The support of now retired Police Assistant Commissioners Wright and Trendle, who at key times provided encouragement and funding support to introduce professionalism into Police Serious Crash Investigation duty. Canterbury and Central Districts Serious Crash Units who provided the majority of the scene photographs.

19. DISCLAIMER

The views expressed in this paper are those of the author and are not necessarily those of the New Zealand Police.

20. REFERENCES

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