



# STEP INTO LINE

STRAIGHT-TALKING FROM JOHN WICKERSHAM AS HE LOOKS INTO RECENT IMPORTANT CARAVAN STABILITY RESEARCH

**W**HAT GOES around, comes around. After being invited to participate in a trial for the National Trampoline team, I studied how somersaults are affected by moments of inertia, conservation of momentum and gobbledygook in general. Who would have guessed that nearly 50 years later I'd again be reminded of Newton's Laws of Motion in a room at Bailey of Bristol? An audience of caravanners even watched 'movies' of high-board diving and an ice skater rotating at speed.

Fortunately, caravans seldom rotate like somersaulting gymnasts, but they can get unstable when towed. Factors affecting a trailer's stability are legion, but an understanding of mechanical principles helps to explain some commonplace problems. That's why The Caravan Club and Bailey commission the Department of Mechanical Engineering at the University of Bath to conduct important research.

After all, it is not a lot of good telling caravanners to do 'this' or 'that' if the recommendations cannot be supported by theoretical and practical knowledge. Caravan manufacturers also need to know why some caravans are surprisingly unstable, when others 'tow like a dream'.

Of course, lateral instability which sometimes leads to snaking can be provoked by external forces like a sudden gust of wind, a rutted road surface or vortex effects from high-sided vehicles. As a rule, unsettling deflections like these can't be avoided but whereas some caravans recover with felicitous ease, others are slower to come back in line. That characteristic is one of the issues which came under scrutiny.

## ASPECTS OF TOWING DYNAMICS

The fact that caravan stability varies so much is mainly attributable to: a) differing design and construction; b) the thoughtless

location of heavy accessories; c) the way owners distribute their gear.

Of course, poor towing performance can also be caused by elements such as badly inflated tyres, aerodynamics, length and weight of the caravan, towing speeds, inclement weather or a chassis that's somehow distorted. However, in the latest project, Jos Darling and Richard Burke from Bath University focussed on something they call 'Yaw inertia'. This is defined as: 'A measure of an object's resistance to change in rotational rate'. Its magnitude depends on both the mass (or weight) and how this is spread around the centre of gravity.

So if your caravan is slow to straighten-up after it has been deflected laterally by external forces, it probably has high yaw inertia. That's not good. What caravanners want is low yaw inertia which is influenced by a caravan's design and where heavy possessions are located. Incidentally,

1. Experimentation on test tracks helps confirm what hinders trailer stability

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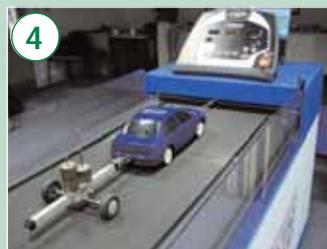
## EXPERIMENTAL TRAILER



2. This trailer has weight-stacking points which can be positioned anywhere along the main central beam



3. Steel weight plates can be mounted on the stacking points to create the loading mass required



4. To provide owners with an insight into towing dynamics, a model is now taken to major exhibitions



5. The rolling road is as authentic as possible and weights on the miniature trailer can also be adjusted

**YAW INERTIA MEASUREMENT PLATFORM**



1. A carefully-balanced cross-beam has a central pivot; springs keep it centrally aligned at rest



2. A caravan requiring evaluation is pushed along the ramps and chocked directly over the cross-beam



3. A dummy towball attached to an overhead cable is inserted into the caravan's coupling head



4. With the dummy towball in place and the cable tightened, its jockey wheel is held clear of the ground



5. The caravan is now turned manually to a start position then left to swing back and forth

stability is also improved by increasing caravan noseweight, but never exceed the limits quoted by car and towbar manufacturers.

**EXPERIMENTAL TRAILER AND MINIATURE ROLLING ROAD**

The research findings demonstrate unequivocally that good weight distribution is essential in the quest for low yaw inertia. Both the amount of carried weight and its positioning are crucial contributors to a stable outfit. Naturally there are mathematical formulae that predict the expected results but to gain experience 'for real', Bailey constructed the trailer shown on the previous page. On one of its many outings it was driven on Millbrook Test Track, carrying contrasting loads when tackling the challenging hill route.

The Bailey trailer has adjustable locations where steel cargo plates can be stacked and it soon becomes apparent why heavy weights should never be placed at the extremities of a caravan – even if optimum noseweight is being achieved. This configuration creates far higher yaw inertia than you get when weights are placed over or close to the axle – even if you still manage to achieve the 'ideal' noseweight.

Some caravanners call this the 'dumb-bell effect'. The description is based on the fact that when a weight-training bar with heavy discs on either end is turned in a horizontal plane, it takes more effort to bring to a halt than one whose discs are slid to the middle; or a bar with no discs at all.

To demonstrate trailer instability, a miniature rolling road is now being taken to caravan exhibitions. This recreation might not replicate real-life towing exactly, but it brings home to observers the wisdom behind that 'sensible loading' drawing towards the back of your *Sites Directory*.

**YAW INERTIA CALCULATING PLATFORM**

Verifying motion theories using Bailey's experimental trailer in a road-going context is important, but how can the stability behaviour of a caravan be measured? Working closely with the University of Bath, Bailey has now built an elaborate electronic calculation platform. It has been

**INFORMATION GENERAL**

- For in-depth information on trailer stability research visit [towingstabilitystudies.co.uk](http://towingstabilitystudies.co.uk)
- Acknowledgements – thank you to Bailey of Bristol and the Department of Mechanical Engineering at the University of Bath for reporting the findings of recent research

constructed adjacent to the factory and the accompanying photographs show how it measures the time taken for a caravan to straighten-up after lateral instability has been initiated. This can also be rechecked after loads are repositioned inside.

**DESIGN IMPLICATIONS**

Since a caravan realigns with its towing vehicle much more quickly when heavy elements are close to its axle, a model with a central kitchen is preferred from the viewpoint of towing performance. Caravans with a rear kitchen are normally far slower to straighten-up after lateral deflections occur.

For the same reason, you should never fit a bicycle rack on the back of a caravan. Equally an ill-chosen design feature made by Bessacarr several years ago was to mount a spare wheel and cover on the rear wall.

Gas cylinders are heavy items, too, and Avondale had the best solution by installing these in a central locker built close to the axle. Why the company put a gas locker right at the back on one of its 2009 prototypes was hard to understand.

**LOADING PERSONAL ITEMS**

Even with good distribution of fixed equipment, thoughtful decisions by a caravan designer are often compromised when heavy items like an awning are placed at one end by the owner. Equally, if you return from abroad with a box or two of wine, these again should be secured on the floor in a central location if you don't have room in your car.

Loading gear correctly really is important as experiments have recently shown. Fortunately, caravan towing incidents are not very common but complacency may lead to problems – somersaults are better when performed in a gym! ■



6. Each time the rotating caravan passes the mid-point, a switch keeps count and each cycle is timed



7. Jos Darling (left) checks the findings which permit a caravan to be given a quantifiable stability rating