Engineering Statics: paper car activity

by

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Statics made memorable

This activity, building and testing paper cars, is a companion document to *Engineering statics in story and verse*.

Version 1.1 – name change

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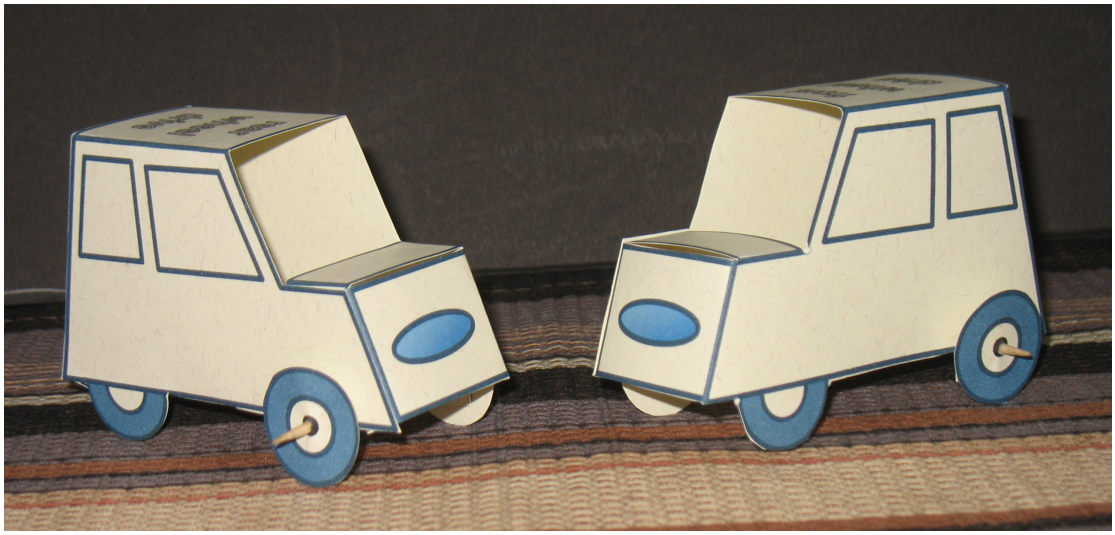
Model cars on a hill

By Robin Ford

"Theory's ok, but I want to see for myself how weight transfer works when cars climb hills?" says Jamie. "All right," the engineering twins reply, "We can make some models and you can check it out."

You can demonstrate the behaviour too with these paper models.



What's the idea?

You can demonstrate the effects of weight transfer on a car climbing a hill by building model cars out of paper (or thin cardboard) and testing them. Templates for the cars are given below.

The model cars come in two forms:

1. Simulated rear wheel drive
2. Simulated front wheel drive

Rear wheel drive car

This has a fixed rear wheel and a freely rolling front wheel. It represents a rear wheel drive car going up hill or, with hand brake on, facing either way.

Front wheel drive car

This has a fixed front wheel and a freely rolling rear wheel. It represents a front wheel drive car going up hill or, in gear with the hand brake off (an odd combination), facing either way.

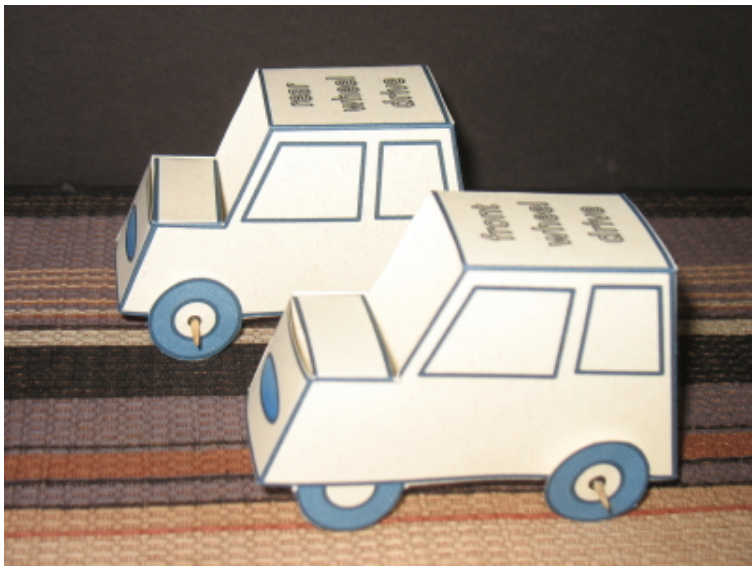
To build the cars

Supplies

You will need the sheets below (best printed on thin card) and, for each car, a freely rolling axle, eg a cocktail stick.

Instructions

1. Cut out the car.
2. Cut out the two rolling wheels – it is important that these are reasonably true.
3. Fold the cross-pieces.
4. Fold the glue tabs (shown dotted).
5. Make clearance holes for the axle (eg cocktail stick) – it important the there is enough clearance to give low-friction at the "bearing".
6. Glue the cross members using the tabs (glue stick is good).
7. Fix one rolling wheel to the axle – it is important to get the axle in the middle of the wheel.
8. Poke the axle through the bearing holes, checking that it rotates freely.
9. Fix the other rolling wheel to the axle.



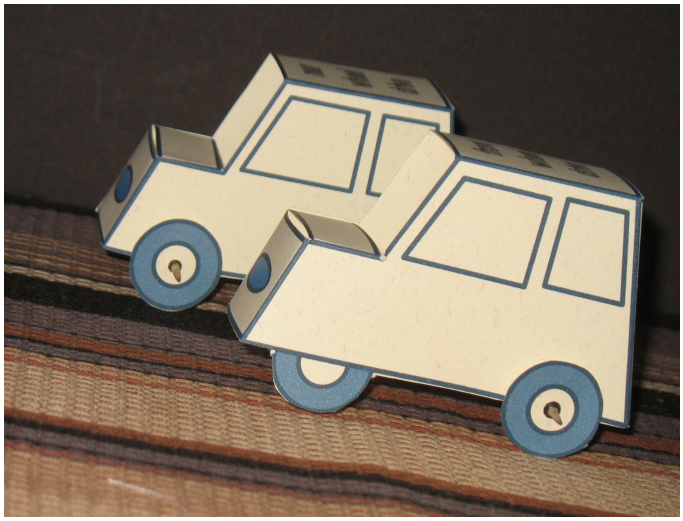
Expected behaviour

With both cars facing up an incline side by side, the front wheel drive car will slide downwards on a lower inclination than the rear wheel drive car. But is it weight transfer or the location of the centre of gravity?

To check this out, you can try reversing the cars on the incline.

With the locked wheel facing up the incline, either model car will generally slide down an incline on which it will stay put with the locked wheel facing down the incline. But for one car it depends on the applicable friction.

The experiments



Equipment

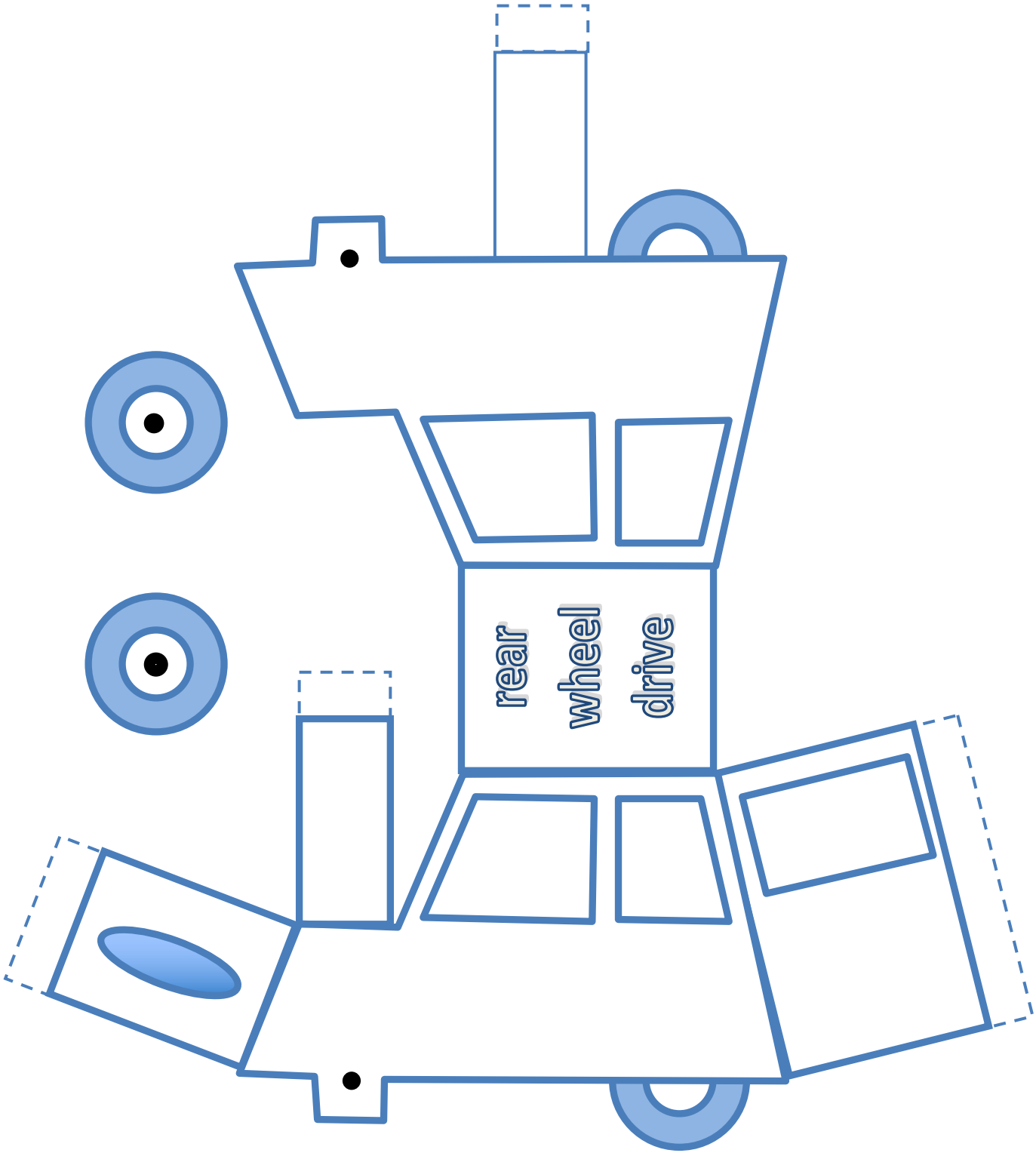
1. Model cars
2. Fabric-covered incline, to generate the required friction (a kitchen board covered with a cloth table mat worked well)

Procedure

1. With the cars facing up hill, increase the angle of inclination of the board until one slides back or topples over.
2. Note which slides first.
3. Taking each car at a time, try it facing uphill and downhill.
4. Note for each car whether uphill or downhill goes with the larger inclination.
5. Think about it.

Templates

Rear wheel drive



Front wheel drive