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# VEHIICLE IMPACT TESTS ON A HEDGE OF ROSA MULTIFLORA JAPONICA

by

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# VEHICLE IMPACT TESTS ON A HEDGE OF ROSA MULTIFLORA JAPONICA

## ABSTRACT

Tests are described in which a vehicle was driven into a six-year-old hedge, 20 ft thick, of rosa multiflora Japonica, a thornless shrub rose. Three tests were made at entry angles of 90˚, 20˚ and 10˚ to the line of the hedge, at speeds of 19, 32 and 29 mile/h respectively.

The test car, which weighed 2475 lb, sustained only scratches to the bodywork. It passed completely through the hedge at the entry angles of 90˚ and 20˚. In the third test at 10˚ to the hedge the car came to a standstill after traveling 54 ft within the hedge, the average measured deceleration being 0.45 g. The average retardation obtained from the three tests was 0.42 g, which is similar to that obtained by fairly firm braking.

The results show that for motorways, where the maximum width of hedge that could be planted on the central reserve would be about 10ft, a rosa multiflora Japonica hedge would not provide a certain means of preventing vehicles crossing into the opposite carriageway. However, an appreciable reduction in speed could be achieved and for slower impacts at glancing angles cars could be held within the central reserve.

## 1. INTRODUCTION

On the motorways M.1, M.10 and M.45 during 1960 and 1961 at sites other than terminals, junctions and interchanges, out of a total of 741 accidents, 91, or 12 per cent of the total, were due to vehicles crossing the central reserve into the opposite carriageway.[1] The proportion of these accidents which prove fatal, 9 out of 91, was three times that in all other accidents between interchanges, demonstrating that the ‘median-crossing’ accident is the most dangerous. A suitable barrier erected along the central reserve would reduce crossing accidents, and it has often been suggested that shrubs would perform this function satisfactorily.

A selection of shrubs which appeared suitable for such use was planted in 1957 in the grounds of the Road Research Laboratory at Langley, Bucks. After six years a hedge grown from rose bushes known as rosa mulitiflora Japonica had developed more successfully than the rest, and impact tests carried out to assess its energy-absorbing properties are described in this Report.

## 2. CHARACTERISTICS OF HEDGE

Rosa multiflora (the blackberry rose) has a shallow tuberous root system producing many shoots that develop into long tendinous branches which intertwine to form a dense resilient hedge with good anti-dazzle properties; it is thornless and produces small white flowers in June. The rose shrubs of the hedge tested were planted in rows 5ft apart staggered to form a diagonal pattern, the shrubs in each row being spaced at 4 ft intervals. The hedge (Plates 1 and 2), which was planted in 1957, was allowed to develop for six years, and in that time the bushes reached a height of 12 ft.

The initial cost of supplying and planting was about £35 per 100 yards for a hedge four shrubs wide, which on maturing had an effective width of 15 to 20 ft. The shrub does not produce runners so that maintenance of the hedge consists of occasional pruning.

## 3. TESTS

### 3.1 Method

Three tests runs were made at approach angles of 90˚, 20˚ and 10˚ to the line of the hedge at speeds of 19, 32 and 29 mile/h respectively. The hedge width at the impact point of each test was about 20ft. The driver was instructed to drive at a steady approach speed and not to brake, accelerate, or attempt to steer the vehicle while in the hedge. Each run was filmed as described under ‘Instrumentation’.

### 3.2 Test car

A 1955 saloon car weighing 2475 lb was used for the tests. The exterior was painted white so that it would be conspicuous against the hedge during filming of the impact. To guard against possible loss of driver vision due to windscreen breakage the toughened glass windscreen was replaced by wire mesh of sufficient strength to resist impact from branches of the hedge. The driver wore safety harness and crash helmet.

3.3 Instrumentation

Potentiometric accelerometers were mounted on the floor of the car behind the passenger sear to record longitudinal, vertical and lateral accelerations. The floor under the accelerometers was stiffened by a ¼ in steel plate to minimize spurious accelerations generated by vibration of the floor panels. The outputs from the accelerometers were recorded by a 10-channel photographic galvanometer recorder mounted in the boot of the test vehicle.

High-speed cine photographs were taken of each test run. Camera positions included shots at right-angles to the path of the car, from which its entry speed could be derived, and also overhead shots following the path of the vehicle while it was in the hedge. A 16mm camera filming at 64 frames per second was mounted inside the cab on the centre line of the car at driver-eye height.

The vehicle was electronically timed between two light beams 2 ft apart just before it contacted the hedge.

## 4. RESULTS

The test data are summarized in Table 1 and discussed below.

4.1 Deceleration

In tests A and B the car passed completely through the hedge; in test C the car was stopped within the hedge. Films from the overhead cameras recorded the path of the vehicle within the hedge, but did not yield accurate speed data because of perspective distortion. The accelerometer records provided more reliable measurements of the motion of the car.

Figures 1 and 2 show the longitudinal decelerations obtained in the three test runs, and Fig. 3 the corresponding derived velocity-time relations.

TABLE 1

Results of three test runs

| | Test A | Test B | Test C |
|---|---|---|---|
| Approach angle to line of hedge | 90˚ | 20˚ | 10˚ |
| Impact velocity (ft/s) | 27.5 | 47.2 | 43.1 |
| Path length through hedge (ft) | 22.5 | 36.0 | 54.0 |
| Peak longitudinal deceleration (g) | 0.8 | 0.83 | 0.82 |
| Average longitudinal deceleration (g) | 0.37 | 0.44 | 0.45 |
| Loss in velocity while in hedge (ft/s) | 13.4 | 18.6 | 43.1 (stopped) |
| Impact energy (ft ton) | 13.8 | 40.5 | 33.8 |
| Energy absorbed by hedge (ft ton) | 10.1 | 25.7 | 33.8 |

NOTES: g is the acceleration due to gravity and equals 32.2 ft/$s^2$ Decelerations and velocity changes were derived from accelerometer records

A peak longitudinal deceleration of 0.8 g was recorded in all three test runs, but the average deceleration of 0.37 g in test A was somewhat lower than that recorded in tests B and C (0.45 g). In these two tests the car traveled sufficiently far in the hedge to accumulate a mass of foliage at the front; there was no such build-up of foliage in test A.

In test C, where the car came to a standstill within the hedge, the uniform deceleration rate calculated from the entry speed and path length was 0.52 g, which is in reasonable agreement with the measured deceleration rate of 0.45 g.

## 4.2 Energy absorption

In test A the rate of energy absorption of the hedge was 0.45 ft ton per foot length of travel within the hedge. In tests B and C the rate of energy absorption was 0.71 and 0.63 ft ton per foot respectively. Using the mean value of 0.6 ft ton per foot, the length of hedge necessary to stop the test vehicle from higher entry speeds can be estimates. Thus at 50 mile/h the vehicle has a kinetic energy of 98 ft ton, and would need $\frac{98}{0.6}$ or 163 ft of hedge to bring it to rest. This is more than twice the distance measured in American tests on a hedge of rosa multiflora Japonica where a car weighing 4000 lb entering at 50 mile/h was stopped in 75 ft, corresponding to an energy absorption rate of 2 ft ton per foot. However, the American hedge was 14 years old, and the bushes were planted at intervals of 3 ft both along and between rows.

### 4.3 Vehicle and passenger effects

There was no damage to the test car apart from scratches to the body finish. In test B the car tended to follow a curving path in the hedge. The tests were not designed to reveal whether it was possible to steer the vehicle in the hedge.

The driver of the vehicle assessed the impacts as similar to those one would expect from normal braking.

## 5. CONCLUSION

The earth strip of the central reserve on British motorways is 13 ft wide, so that the maximum width of hedge that could be planted would be about 10ft. It is evident that a hedge of rosa multiflora Japonica would not be a positive barrier for vehicles traveling at full motorway speeds, since it would stop those fast-moving vehicles only if they entered the central reserve at very small angles to the line of the hedge. It would, however, produce an appreciable reduction in speed, and for slower impacts at small angles the car could be retained within the central reserve. Braking or speed reduction due to skidding before crossing the central reserve would often lower the impact speed with the hedge or present a greater surface area to the hedge. Such a hedge would also cut out glare from approaching headlights at night.

## 6. REFERENCES

1. MOORE, R.L., and V.J JEHU. Road safety and the central reservation. Theme 2, Seventy International Study Week in Traffic Engineering. International Road Safety Congress. London 21st-26th September, 1964. London, 1964 (World Touring and Automobile Organisation).
2. SKELTON, R.R. Crash barrier tests on multiflora rose hedges. Bull. Highw. Res. Bd. Wash., 1958, (185), 1-18.

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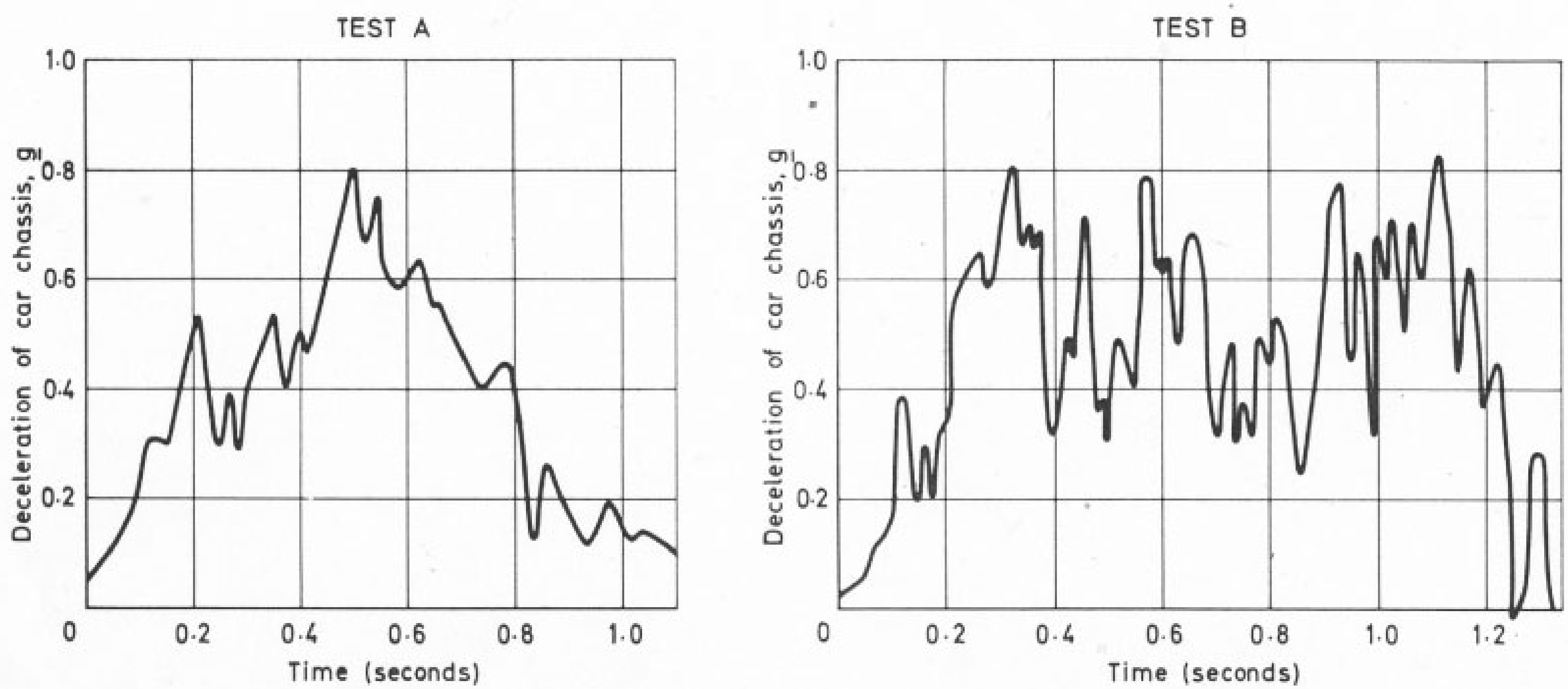
Test car at start of impact with hedge
of rosa multiflora Japonica

PLATE 1

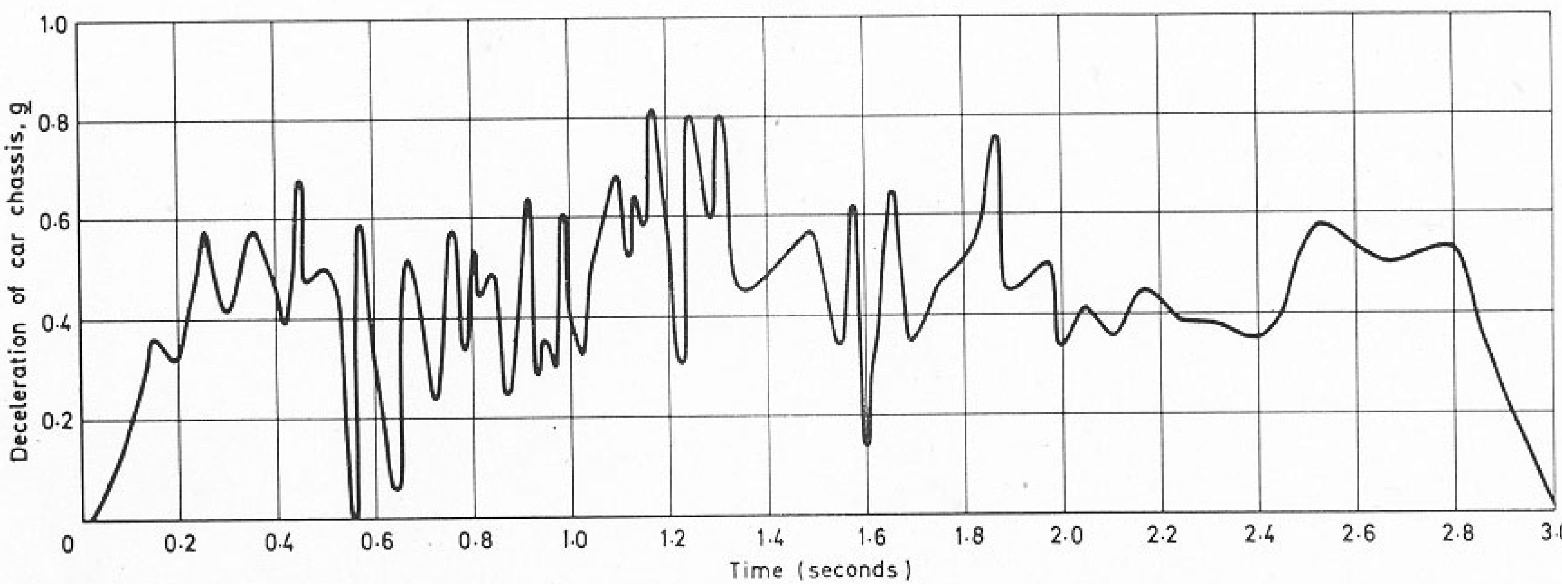
Overhead view showing final position of test car
in hedge of rosa multiflora Japonica

PLATE 2



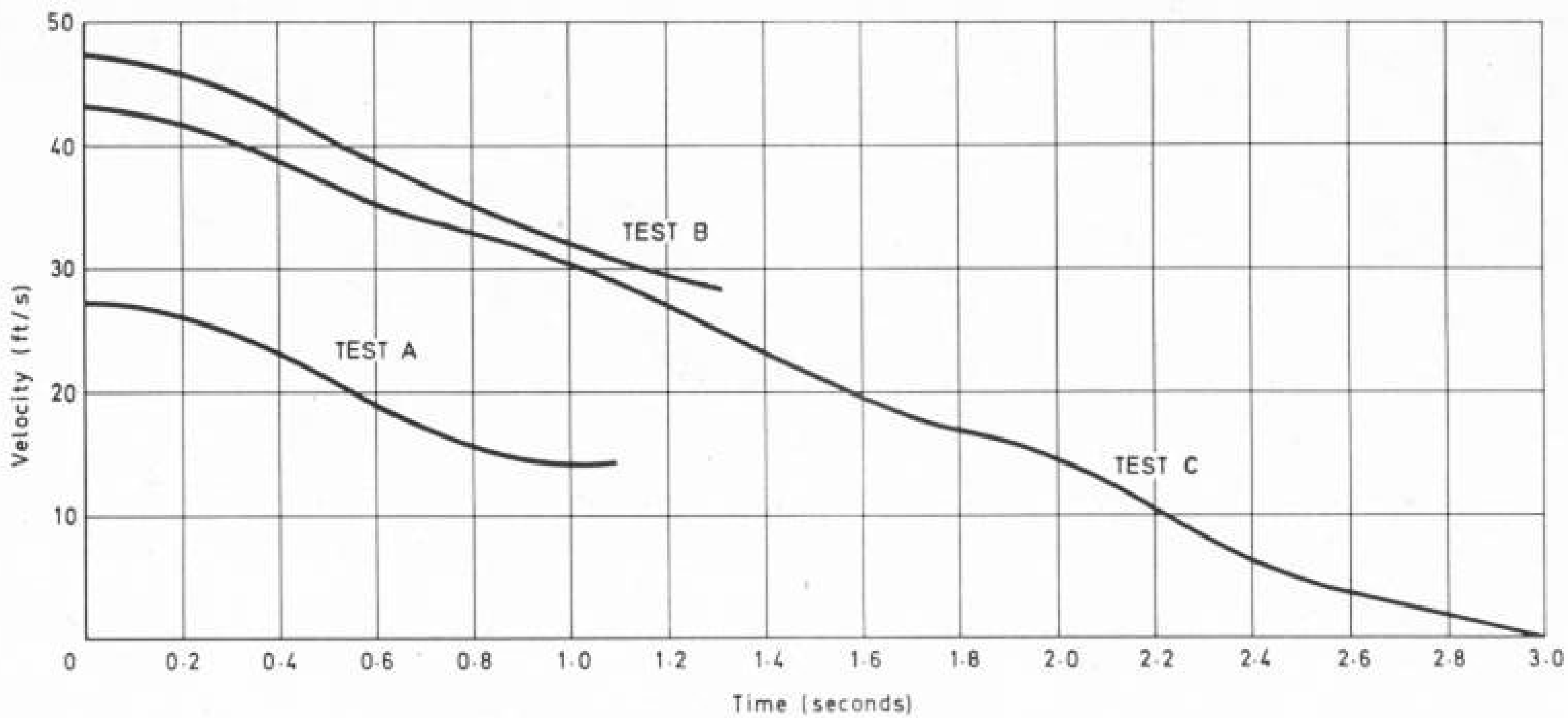

Note: Zero time is the estimated instant at which the car made contact with the hedge
g represents the deceleration due to gravity (32.2 ft/s$^2$)

**Fig. 1. LONGITUDINAL ACCELEROMETER RECORDS (TESTS A AND B)**




Note: Zero time is the estimated instant at which the car made contact with the hedge
g represents the deceleration due to gravity ( $32{\cdot}2\ ft/s^2$ )

Fig. 2. LONGITUDINAL ACCELEROMETER RECORD (TEST C)




Note: Zero time is the estimated instant at which the car made contact with the hedge

Fig.3. VELOCITY OF TEST VEHICLE WHILE IN HEDGE