# Fire Research Note No. 841

## FIRE AND CAR PARK BUILDINGS

by

E. G. BUTCHER

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FIRE RESEARCH STATION

Fire Research Station,
Borehamwood,
Herts.
Tel. 01-953-6177

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SUMMARY

Brief details are given of the experimental work which lead to the suggestion that an open sided car park building need have little fire resistance.

Supporting information is derived from an analysis of the fire incidents which have occurred in such buildings and from a survey of current practice in their use.

KEY WORKS: Car park, Fire.



MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
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Building Regulations, owing to their broad classification of occupancies, can require up to 4 hours fire resistance in Car Park Buildings but it is recognized that a car park building might well fall into a special category of occupancy and that it might not be completely appropriate to grade it as a storage building.

During a very large investigation into the behaviour of structural steel in fires[1] which was carried out a few years ago at the Fire Research Station it was found that at low fire loads 3.0 - 4.0 $lb/ft^2$ and under conditions of high ventilation the temperature reached by unprotected structural steel was considerably below the failure temperature.

At this stage it was suggested that the fire load appropriate to a car park building would fall into this range and in order to confirm this a study of the combustible material which goes to make up a car was made for two typical and popular types of family saloon. This showed that the fire load (wood equivalent) was of the order 500 - 700 lbs (or 4 - 5 x $10^6$ Btu). To obtain this figure it was assumed that the car had a full tank of petrol, and in both cases the petrol represented $^1/_3$ of the total fire load.

In a car park building the floor area allocated to each car must contain a proportion of the manoeuvring space allowed. In their design the floor space allocated per car varies from 200 $ft^2$ to 290 $ft^2$ per car, and using these figures and the fire load for the larger car examined the fire load density falls in the range 2.4 - 3.5 $lb/ft^2$, which figure places it within the range shown by the research to be safe for unprotected steel provided the ventilation is high.

An examination of the reports of fire incidents for recent years shows that the number of fires in parked cars is very small and that for cars parked in a building still smaller. Moreover it was noted that in the reports of such fires there was no fire spread to adjacent vehicles.

In the Fire Statistics for 1966 (which examined a 1 in 2 sample of the reports) only two fires in car park buildings were noted, only one of which involved a vehicle and in that case there was no fire spread beyond the vehicle. A similar

study for 1967 (which embraced all the reports) showed 6 fires in cars in car park buildings (4 of which were in basement car parks) and in none was there spread beyond the car first ignited. The figures for 1968 (which are taken from a 1 in 4 sample of the reports) were 4 fires in cars in car park buildings, (two of which were above ground and two basement) and again no spread to adjacent cars occurred.

However in order to test the likelihood of fire in a parked car spreading to other vehicles the Fire Research Station with the co-operation of the Greater London Council carried out three experimental fires. These are fully described in Fire Note 10[2] and many people will be familiar with the details. Briefly these were that we erected a special building 60 ft x 30 ft x 9 ft high of scaffolding and corrugated sheeting. A thermally insulating ceiling of wood wool cement slabs 2 in. thick was suspended 7 ft from the ground and the ventilation was restricted by closing in the two long sides to half the height of the building; for one of the tests each short end was also closed in completely. Nine saloon cars were assembled and placed in 3 rows of 3 cars in positions to simulate the spacing which would apply in a 'drive in' car park building, the spacings used ranged from 2 ft to 4 ft 6 inches. Inside each car a considerable quantity of combustible material was placed (cardboard boxes, pieces of wood, paper, old tyres, etc) to represent the personal 'clutter' which can often be found in parked cars. Six gallons of petrol was put into each car tank so that in aggregate 54 gallons of petrol was present.

The centre car was ignited inside the passenger compartment (using a tray with about 2 pints of petrol in it) and the fire allowed to develop so that the whole vehicle was involved. There was no fire spread beyond the ignited car. This experiment was carried out three times in all - a different car being used in the centre position for each fire and in none was there any fire spread to adjacent cars.

Another feature of the tests was that in no case was there any rupture of the petrol tank but the petrol vapour burnt away with a lazy flame at the filler tube of the tank. Photographs of one of the tests at its maximum development show clearly that considerable flaming was present, flames reaching the ceiling and spreading sideways under it.

The results of these three experiments therefore confirmed the suggestion made as a result of the study of fire incidents in parked cars namely that the risk of fire spread from one vehicle to another in a car park building was small.

There are however three possible points on which the validity of this assumption could be questioned. They are:-

(1) That the spacing of the cars used in the tests was too great

(2) That the tests used only private cars and the presence of loaded commercial vehicles would give a much higher fire load

(3) That only metal bodied cars were used and the presence of an appreciable number of plastic bodied cars would represent a different condition.

In order to investigate these points the Fire Research Station has carried out a survey of the conditions which are commonly found in multi-storey car park buildings.

Visits have been made to 20 multi-storey car park buildings in various parts of England, covering as wide an area as was practicable. Visits were made as far west as Brixham, as far east as Dover and as far north as Billingham and others were scattered as widely as possible throughout the Home Counties.

The first important point which was noted was that in every one of the buildings visited the parking bays were indicated by painted lines on the floor. In 12 of the buildings visited the bays were 8 ft or more wide and in the other nine they were 7 ft 6 inches. This fact automatically controls the spacing to a very great extent.

If the width of an average car is taken to be 5 ft 6 in (many cars are less than this in width) then with 8 ft bays the spacing must average out at 2 ft 6 in and with 7 ft 6 in bays at 2 ft.

In all, the spacing of some 7500 cars was looked at and only 5 cases were noted where the spacing was 1 ft and nowhere was a less spacing than this found. However because of the prescribed parking bays close spacing such as this automatically means that on the other side of the car there will be a very wide gap.

Hence even when close spacing does occur the worst that can happen is that fire will spread to two cars and two only.

In 1968 the record of fire incidents show some twenty fires in parked cars. With 11 million cars on the road and the prospect of close spacing being 5 in 7500 it would appear that the chance of one of those close spaced cars being involved in fire is of the order of 1 in 800 million.

Measurements were actually made of a sample of car spacings in 10 of the buildings visited, a complete row of cars in each case was measured. In this way some 300 measured spacings were obtained.

When these spacings are plotted out (Fig.1) it is immediately obvious that the most frequent spacing is 2 ft 6 inches. Only 10 per cent of the spacings were below 2 ft, with only one space at 1 ft 6 inches.

It would therefore seem clear that the spacings used in the experiments were not unrepresentative of those which obtain in practice.

The second point concerns the additional danger which might be introduced by the presence of commercial vehicles.

It was noted that without exception the car parks visited either had restricted head room or a height limit was deliberately imposed at the entrance and for this reason only very small commercial vehicles were able to enter, i.e. mini-vans or 10 cwt vans.

In the 7000 vehicles in car park buildings which were inspected 33 small van type vehicles were found and more than 50 per cent of these were in use as private cars with seats in the van part. Thus it would seem that less than 1 in 200 of the vehicles was a van type of which only 1 in 400 carried goods and again it should be emphasised only small vans could enter.

The last point concerns the plastic bodied car. As we know it at present there is no doubt that this type of car body will burn readily - much more so than the conventional metal bodied car. At the time when Fire Note 10 was published enquiries were made from the trade as to the likely development of the use of plastic material for the car body. Enquiries weremade from several sources and all said that the 'plastic car body' for use on production line models was unlikely for a good many years to come and that when it did come it would not be the resin bonded fibre glass at present in use in a few small cars. The section of the trade responsible for the development of plastic bodies was emphatic in saying that they were aware of the fire hazard associated with the material at present in use and the fire retardant properties of alternative materials was very much in their mind.

It is quite clear that at present the plastic bodied car presents little danger; of the 7000 cars inspected in the 20 car parks visited not one car was plastic bodied.

## CONCLUSIONS

The conclusion given in Fire Note No.10 that an outbreak of fire within a single parked vehicle is unlikely to result in uncontrollable fire spread within a car park building (open sided and above ground) is supported by a study of the reports of fire incidents for such buildings.

A survey of the conditions which currently obtain in such buildings has confirmed that the experimental arrangements used were representative of normal practice.

## REFERENCES

(1) BUTCHER, E.G., CHITTY, T.B., and ASHTON, L.A. The temperature attained by steel in building fires. Fire Research Technical Paper No.15. HMSO. 1966

(2) BUTCHER, E.G., LANGDON-THOMAS, G.J., and BEDFORD, G.K. Fire and Car Park Buildings. Fire Note No.10. HMSO. 1968.

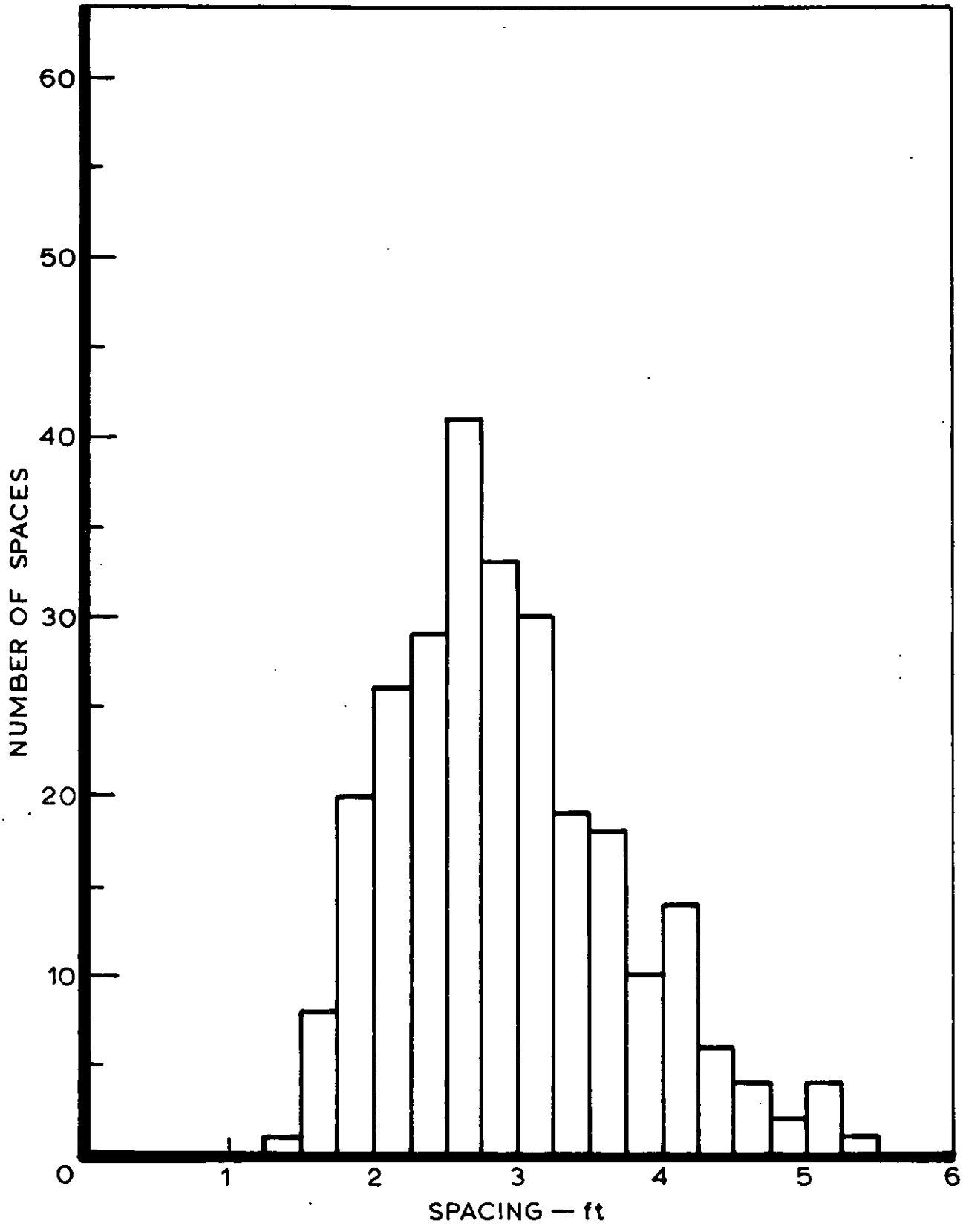


FIG. 1 FREQUENCY OF SPACING DISTANCES IN A SAMPLE OF PARKED CARS TAKEN IN 10 MULTI-STOREY CAR PARK BUILDINGS

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