# Fire Research Note No. 834

MULTI-STOREY CAR PARKS
A COST COMPARISON : STEEL VERSUS CONCRETE

by

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SUMMARY

This report seeks to show that where unprotected steelwork can be used in multi-storey car park construction, it is a better economic proposition than the conventional reinforced concrete structure.

The figures are based on the overall costs of existing car parks, both concrete and steel, and even though the sample of steel car parks is rather small, the trend is noticeable and the possible savings quite large.

KEY WORDS: Car park, comparison, concrete, cost-benefit, economics, steel.



DEPARTMENT OF TRADE AND INDUSTRY AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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## INTRODUCTION

There are only a few structural steel multi-storey car parks for which there has been sought and obtained, relaxation of Part E Building Regulations requirements. Therefore the figures stated, and in particular, the conclusions drawn, must be considered in this light. Even so, there does seem to be more than enough information to state that there are definite cost-benefits to be obtained by using unprotected steel in preference to concrete. However, as more figures become available, and trends in rising prices more obvious, so it might be necessary to review the situation.

### Details of car parks

Up to the time of writing this report, information has been obtained concerning ten concrete car parks and five steel car parks. The larger number of concrete structures indicates only the greater number available to choose from.

### Concrete:

| Site | Date | Overall cost (£1,000's) | No. of places | Cost per place £ | 1970 figures £ |
|---|---|---|---|---|---|
| Barking (Outer London) | '65 | 102 | 206 | 495 | 569 |
| | '66 | 86 | 181 | 475 | 532 |
| | '67 | 81 | 181 | 448 | 488 |
| Watford | '64 | 206* | 705 (575) | 292 (359) | 424 |
| | '65 | 286 | 650 | 440 | 506 |
| | '69 | 290+ (265) | 550 | 525 (482) | 497 |
| Birmingham | '65 | 137 | 365 | 375 | 431 |
| Glasgow | '67 | 118 | 270 | 437 | 476 |
| Swansea | '68 | 108 | 350 | 309 | 328 |
| London | '70 | 251 | 460 | 546 | 546 |
| | | | Average | | 480 |

*This figure does not include the cost of ground works whereas the number of places 705 does include ground floor parking. To obtain a more realistic cost per place, the ground floor parking of say 130 places, should be deducted from the overall number.

+This figure seems to include very high land costs and to obtain a more realistic cost per place, a suggested £25,000 is deducted from the overall figure to represent these excessive costs.

**Steel:**

| Place | Date | Overall cost £ | No. of places | Cost per place £ | 1970 figures £ |
|---|---|---|---|---|---|
| Billingham | '66 | 149,000 | 514 | 290 | 325 |
| Torbay | '68 | 85,000 | 333 | 255 | 270 |
| Worcester | '67 | 128,700 | *228 (370) | 564 (347) | 378 |
| Boreham Wood | '68 | †33,500 (32,500) | 92 | 365 (353) | 374 |
| Northampton | '67 | 90,000 | *212 (270) | 425 (333) | 363 |
| | | | Average | | 342 |

*These figures do not include for ground floor parking and again in order to arrive at more meaningful figures an allowance has been added for ground floor parking. (It might be noted that in the case of Worcester car park, a garage and a supermarket occupy the ground floor area, and in the case of the car park at Northampton, the local cinema has a private car park on the ground floor).

†This figure includes the ground costs and seems to be the reverse situation to the previous note. It is suggested that £1000 be deducted from the overall cost.

Two points concerning these figures should be noted:-

(i) The cost per car parking place may vary depending on the circulation area and the bay size. The more generous the circulation and bay sizes, the fewer the number of cars that can be allocated in a car park and hence a more expensive cost per place.

(ii) The overall costs do not include the cost of land, but do include all other costs normally included in a final account. Although these figures are adequate for the purposes of this report it might be recorded for future reference, that a more selective form of comparison (omitting the more variable items) could be more useful.

In both sets of details there is a final column which updates all the cost per place figures to that approximating to 1970 costs. This has been achieved by adding 3 per cent for each year. (For the latter years, this could be considered somewhat conservative).

Taking the average of steel, using 1970 figures, as £342 per place and of concrete as £480 per place there would appear to be a saving of £138. However, this figure is not very realistic since it does not reflect the difference in land, labour and material costs in different regions, i.e. that which costs £100,000 in Devon, would cost considerably more in London - perhaps £150,000. It also does not take into account that the steel car parks so far constructed, are barely 'multi-storey' in the conventional sense of the word. They seem to be limited to two or three storeys with some only one or one and a half storeys above ground level. It is obviously going to be more expensive to build these steel car parks more 'Multi-storey' than they are at the present moment. Thus to provide a reasonable comparison for the future an allowance needs to be added to the cost per place of steel car parks to 'convert' them, as it were, to genuine 'Multi-storey' car parks. The following table seeks to illustrate the need for these adjustments, and tries to show that the more realistic cost difference is considerably less than that obtained by simply deducting these two "average" figures.

Considering this supposed saving of £138

| | | |
|---|---|---|
| Cost per place using concrete | | £480 |
| Cost per place using steel | £342 | |
| Add 12½% (average 'regional' effect) | 43 | |
| Add 12½% (average 'multi-storey' effect) | 43 | £428 |
| A more realistic saving | | £ 52 |

The true extent of this saving can be ascertained by comparing the car parks on a regional basis. An allowance might be added to the figure to reduce them to a common year i.e. adjustment of 3 per cent per year difference. For example, to compare a 1965 car park with one built in 1967 it would be reasonable to add 6 per cent to the 1965 figures. An adjustment might also be made for the 'Multi-storey' effect mentioned in previous paragraphs, and suggested as being about 12½ per cent.

(1) Swansea and Torbay: The car parks are of similar height and were built at the same time.

| | | | | |
|---|---|---|---|---|
| Swansea (concrete) | 1968 | £107,823 | 350 places | £308 per place |
| Torbay (steel) | " | 85,000 | 333 " | 255 " " |
| | | | Saving | £ 53 |

(2) **Birmingham and Worcester:** Again the car parks are of similar height but an adjustment is necessary for the difference in date.

| | | | | | |
|---|---|---|---|---|---|
| Birmingham (concrete) | 1965 | £136,839 | 365 places | £398 | (+ 6%) |
| Worcester (steel) | 1967 | 128,700 | 370 " | 348 | |
| | | | Saving | £ 50 | |

(3) **Glasgow and Boreham Wood:** Because the car park at Boreham Wood has only one storey above ground level the 'multi-storey' allowance needs to be added. Also required is a slight adjustment for date.

| | | | | | |
|---|---|---|---|---|---|
| Glasgow (concrete) | 1967 | £117,924 | 270 places | £450 | (+ 3%) |
| Boreham Wood (steel) | 1968 | 32,500 | 92 " | 398 | (+ 12½%) |
| | | | Saving | £ 52 | |

(4) **Birmingham and Billingham:** Despite the apparently large number of car parking places at Billingham the car park is barely multi-storey and the 12½% adjustment is reasonable. Again a slight adjustment for difference in date is also necessary.

| | | | | | |
|---|---|---|---|---|---|
| Birmingham (concrete) | 1965 | £136,839 | 365 places | £386 | (+ 3%) |
| Billingham (steel) | 1966 | 149,000 | 514 " | 330 | (+ 12½%) |
| | | | Saving | £ 56 | |

(5) **Watford and Boreham Wood:** Since details of three car parks have been provided for Watford an average has been taken to compare with Boreham Wood. Again date differences (3% per year) and the 'Multi-storey' effect have been allowed for.

| | | | | | | |
|---|---|---|---|---|---|---|
| Watford (concrete) | 1964 | £206,136 | + 12% | 575 places | | |
| | 1965 | 285,000 | + 9% | 650 " | | |
| | 1969 | 265,000 | + 3% | 550 " | | |
| | | £799,536 | | 1,755 places | £450 | |
| Boreham Wood (steel) | 1968 | 32,500 | | 92 places | 398 | (+ 12½%) |
| | | | | Saving | £ 52 | |

Even though the number of structural steel car parks at present is quite small, there does appear to be a fairly consistent saving of between £50 to £55 per car parking place.

Relating this to the Ministry of Transport figures of 50 new car parks per year (each with about 500 car parking places) then the overall saving that could be obtained using unprotected steel would be in the region of £1¼ M - £1½ M per year.

## Steel requiring fire protection

It might be worthwhile to consider briefly the effect on the economics of using steel, if fire resistance is deemed necessary.

To provide a fire resistance of say 2 hours, the cost of protecting the steel using concrete for the columns and sprayed asbestos for the beams would add about 40 to 60 per cent to the cost of the steel work itself. From details supplied on three of the steel car parks, the steel frame work forms about 20 to 30 per cent of the overall building cost.

Thus in providing this degree of fire resistance up to 20 per cent is added to the cost of the structure: this in terms of cost per car parking place amounts to an addition of about £75 per place over the use of unprotected steel.

## Conclusions

The use of unprotected steelwork for multi-storey car parks results in a saving of about £50 per car parking place, over the use of reinforced concrete. When considering protected steelwork concrete is cheaper, showing a saving of about £20 to £25 per place.

There would seem to be, therefore, distinct cost-benefits to be obtained in the use of unprotected steel, although, when fire resistance requirements enters the picture, the situation is somewhat reversed.