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DESIGN BULLETIN
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PART 2

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Service cores in high flats

The selection and planning of passenger lifts

CONTENTS

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Introduction

1. This bulletin deals mainly with the selection and planning of passenger lifts for blocks of flats of between 10 and 21 storeys. There is now considerable experience of lift installations in buildings lower than this, and in the lower part of this range; but, outside London at least, not many authorities have yet had experience of blocks of up to 20 storeys.

2. The bulletin has been prepared after consultation with lift engineers and manufacturers, and following a study of recent practice in the United States. The Building Research Station, which has already published a paper analysing tenders for lift installations, is working on user requirements, and it is hoped that, in due course, their findings will supplement this bulletin. The first section of the bulletin deals with the selection of passenger lifts in terms of the number, size and shape of lift cars, the speed of travel and the system of control and floor stops (i.e. whether each lift stops at every floor). Information is given about the number of people who can be served adequately by different types of lift installations in blocks of flats of various heights and sizes, and some comparisons of cost are made. Then follows a section on the planning of lift installations having regard to the positioning of lifts in buildings, the dimensions of lift wells and machine rooms, and other design details. There are two appendices; one dealing with the characteristics of electric lift motors, the other giving relevant extracts from the Standard Code of Practice on Fire Precautions.

3. Much of what is said, especially in the section on the planning of lift installations, is applicable also to blocks of maisonettes, but the figures of optimum populations and costs for various types of lift installations will be different. It is hoped later to publish material on maisonettes, but meanwhile further information may be obtained from lift manufacturers.

Selecting a lift installation

4. In this section the questions which have to be decided in selecting a suitable lift installation for a given building are considered. Briefly, the things that have to be decided are:

(a) the number of lifts required;
(b) the size and shape of the lift cars;
(c) the speed of travel;
(d) the type of control;
(e) the system of floor stops.

5. In deciding these questions, the following factors must be considered:

(a) the requirements of users as they affect the size and shape of the lift cars;
(b) special requirements, such as those of the ambulance and fire services, which affect the size, shape and speed of the lift cars;
(c) the standard of service required: this has a bearing on all the things mentioned in paragraph 4 and is considered in detail in paragraphs 17–23 below;
(d) the comparative costs of alternative installations.

Some of these questions are simply answered, because the lower limits are determined by fixed requirements.

Number of lifts

6. The Report of the Central Housing Advisory Committee's Sub-Committee on Housing Standards, 'Homes for Today and Tomorrow', states that, in any building in which the entrance to any dwelling is on the fourth storey or above, a lift service should be provided. In blocks of more than six storeys the provision of only one lift may lead to acute inconvenience during household removals, breakdowns, servicing, overhauls, re-roping and replacement, and the Sub-Committee recommends that two lifts should normally be provided. This bulletin assumes that the Sub-Committee's advice will be adopted and that a minimum of two lifts will be provided in all blocks within the range of height covered by the bulletin.

Size and shape of lift cars

7. The minimum size is determined by the requirements of the fire services. The British Standard Code requires each block of flats or maisonettes to have a "fire lift" with a platform area of not less than 15½ sq. ft. and capable of carrying a load of 1,200 lbs. (see Appendix 2). This means in practice an 8-person car.

8. In blocks of flats or maisonettes lifts must be large enough to carry prams. A deep lift is needed and the recommended dimensions are 5′ 2″ deep by 3′ 9″ wide. Lifts of this size will also take most large pieces of furniture.

9. If 8-person cars are used, coffins can usually be carried by tilting them slightly.

10. In some areas the authorities have insisted on something larger than 8-person lifts, so that a standard stretcher may be accommodated. Where this is so, the cheapest solution is to add a 'cupboard extension' to the lift, although this entails a large increase in the size of the lift-well. In many cases, however, the provision of either a cupboard extension or a lift large enough for a stretcher will be pointless, since it is normally impossible to manoeuvre a stretcher in a horizontal position within

the individual flats. The great majority of stretcher cases can be carried in collapsible carrying chairs. In the very few instances where this is not possible the stretcher can usually be carried down the stairs.

11. 8-person cars may not give an adequate standard of service in large or very high buildings, and 10- or 13-person, or even larger, cars may have to be used (see Table I).

Speed of travel

12. The minimum speed of lifts in high blocks is determined by fire requirements and the standard of service required. The British Standard Code recommends that a fire lift should be capable of reaching the top floor from ground level non-stop in one minute. On the assumption that the floor-to-floor dimension is 8′ 6″, lifts capable of the following speeds are needed to meet this requirement.

10 – 12 storeys	100 feet per minute
13 – 17 storeys	150 feet per minute
18 – 21 storeys	200 feet per minute

These are the minimum speeds needed for a given height, but higher speeds are sometimes called for to give the standard of service required.

Type of control

13. Where two lifts are serving the same floor they should be close to one another so that the controls can be interconnected; calls registered may thus be answered by the nearest available car. It is also assumed that the controls provide for one lift to return and park at the ground floor after use, and for the other lift to remain at the floor at which it terminated its last journey.

14. In blocks of flats, unlike office blocks, most journeys either start or finish at the ground floor. In other words, calls originating on floors above the ground will generally be for downward journeys. Under these conditions the most effective system of control is the "highest call down collective" system, and standards of performance have been based on the assumption that this system will be adopted. It provides for the registration of all up calls made by passengers entering a car at the ground floor and the answering of these calls in floor sequence. During the journey all calls made by pressing the landing buttons are registered and retained. The lift then answers the highest call first and collects all the other landing calls on the way down.

15. If there is likely to be a large number of journeys which neither start nor finish at the ground floor, e.g. journeys between flats and a roof drying ground, full collective control, although more expensive, should be considered. This will ensure that landing calls are collected on both upward and downward journeys.

System of floor stops

16. Some blocks of flats, mostly 10- or 11-storey tower blocks, have two lifts, each of which stops at alternate floors above the ground floor. This results in a saving in cost of about £150 to £250 per storey, since nearly half the number of landing doors, trims to openings and panels are omitted. The disadvantage of this system is that the waiting interval is greatly increased, since there are in effect two independent installations, each comprising one lift and each serving only half the floors above ground level. Moreover, when one lift is out of normal service, perambulators must be manhandled down the stairs for one storey. It has been assumed in this bulletin that both lifts will stop at all floors in blocks of flats of over 10 storeys. In blocks of maisonettes it is of course necessary for lifts to stop only at the entrance levels to the dwellings; normally at alternate floors. They can be interconnected, and, with fewer stops than in flats, the number of people they can serve satisfactorily is slightly increased.

The standard of service

17. This is a complex question and one that has been too little considered. In the past, a rough yardstick of one lift to fifty flats has been used, but in the following paragraphs an attempt is made to suggest more precise criteria for selecting an adequate and economical lift installation.

18. There are two factors to consider in assessing the adequacy of a lift installation – its traffic capacity and the waiting interval. Each is considered in turn, on the following assumptions:-

(a) that a minimum of two 8-person lifts will be installed (see paragraphs 6 and 7 above);
(b) that the lift speed will be such as will meet fire requirements (see paragraph 12);
(c) that highest call down collective control will be used (see paragraphs 13 and 14).

Traffic capacity

19. In selecting lift installations for commercial buildings, te[illegible] of traffic capacity are usually made in terms of the proportion of the building population that can be carried in a given period. In such buildings, there will be periods of very high demand at the beginning and end of the working day, and perhaps at lunchtime. This may mean that as many as 75% of the building's population above the first floor will have to be transported in 30 minutes.

20. In residential buildings, peak demands are not usually as high. People start and finish work at different times and have different periods of travel, children go to different schools and so on. Thus the morning and evening peaks are flatter and spread over a longer period than in office blocks. Just how high these peaks, expressed as a percentage of the building population, will be in a block of flats or maisonettes it is difficult to determine. It is a subject on which little work has been done in this country, but it is apparent that the peak demand will vary from one building to another, and, perhaps, through the period of a building's life. For example, the figure is likely to be higher in a block of bed-sittingroom or one-bedroom, flats, where almost everyone goes out to work, than in a block of family flats. [illegible] the latter type of block, conditions are likely to vary with the changing proportions of children below school age, attending school, and going out to work.

21. A traffic count was made on a single weekday at a 17-storey block of flats in southeast London. This showed a peak of only 3·75% of the building population above the first floor using the lifts in a period of five minutes. This is very close to the results of a Swedish survey. In the United States, where there are extensive records of traffic counts in high flats, lift requirements are calculated on the basis of the movement in five minutes of 7% of the building population on the 1st floor and above of luxury flats, and of 5% of this population in municipal flats. Until further evidence is available of the pattern of use of lifts in high blocks of flats in this country, it seems desirable to base the standard of service on the movement in five minutes of 6% of the building population above the 1st floor. Experience may show, however, that this figure is on the generous side.

22. This establishes the level of demand. The next question is how to meet this demand. The answer will depend on three variable factors; the number of lifts, the size of cars, and the 'round trip travel time' of the lift. This time, which is calculated by the lift manufacturer, is the period which elapses between the

departure of a lift from the ground floor on a typical journey, and its return to that floor. The factors taken into account in calculating it include the speed of the lift and the distance of travel, the acceleration and deceleration times, the number of passengers likely to use the lift, the probable number of stops on a typical journey, the door opening and closing times, and the type of lift control. Once this travel time has been ascertained, the maximum carrying capacity of one lift in a five minute period may easily be found by dividing the round trip travel time (in seconds) into 5 minutes $\times$ 60 and multiplying the answer by the number of persons likely to be carried on each trip. This is usually reckoned to be about 80% of the maximum capacity of the car. If there is more than one lift stopping at the same floors, the total capacity of the installation may be found by simply multiplying the carrying capacity of one lift by the number of lifts installed.

Waiting interval

23. This is the time which elapses between calling the lift and its arrival. With one lift the waiting interval is unlikely to exceed the round trip travel time and experience shows that with two lifts the waiting interval is unlikely to exceed half the round trip travel time. There is no information on which to base an estimate of what is an acceptable waiting interval, but for the purpose of this bulletin a figure of 90 secs. has been taken as the acceptable period. Although in office buildings the acceptable interval is usually reckoned to be much shorter than this, any improvement on these figures would mean an extravagant over-provision of lifts in blocks of flats.

Utilisation of lift capacity and comparative costs

24. Using the assumptions made earlier about the number of lifts, their size and speed, the system of floor stops, type of control, peak demand and acceptable waiting interval, a table may be constructed showing the maximum population per floor in blocks of various heights which will be served adequately by different types of lift installations. This has been done in Table I. Assuming that full use of the lift capacity provided were possible in each case, the cost per person of the lift installation can be calculated and this is shown in Table II. This table appears to indicate that the cheapest lift costs per person served would derive from using large fast lifts in buildings in the lower part of the range of height covered by this bulletin. But to achieve this result, large blocks with a high population per floor would have to be built. In practice other factors tend to operate to keep the size of blocks smaller than this, and it has rarely been possible to exploit the full potential of the lifts installed.

Table I

Passenger Lifts—Traffic Handling Capacity of Two-car Installations

Maximum number of people per floor who can be served adequately by lift cars of different sizes and speeds. Standard of service based on both lifts serving all floors; inter-connected controls – highest call down collective system; waiting interval of 90 secs.; 6% of population on second floor and above transported in 5 minutes; 8′ 6″ floor to floor.

	Capacity persons/lbs							
	8/1200				10/1500			13/2000
No. of storeys including ground floor.	Speed in F.P.M.							
	100	150	200	300	150	200	300	300
10	46	54						
[illegible]	37	45	49		54			
12	32	39	43	51	46	49		
13		34	37	44	41	43	49	
14		29	33	39	35	38	44	52
15		26	29	35		33	39	47 [91]
16		23	26	31		30	36	42 [94]
17		21	24	28		28	33	38 [97]
18			22	26			30	34 [100]
19			20	24			27	31 [103]
20			19	22			25	29 [106]
21			17	21			24	27 [109]

Note. The figures in brackets in the last column indicate waiting intervals in seconds slightly in excess of the standard of 90 seconds suggested in para 23.

Table II

Passenger Lifts—Estimated Cost in £s per Person of Two-car Installations Based on Population per Floor as Given in Table I

Cost of builders' work, lift shaft, machine room, etc. is included. Cost per person is related to maximum number of people who can be served adequately by each installation (see Table I).

	Capacity persons/lbs.							
No. of storeys including ground floor	8/1200				10/1500			13/2000
	Speed in F.P.M.							
	100	150	200	300	150	200	300	300
10	27	24·7						
11	32	28·3	27·1		24·1			
12	35·7	31·3	29·6	27·5	27·2	26·4		
13		35·7	33·1	30·5	30·3	29		
14		40·5	36·9	34·1	34·3	32·6	30·8	27·6
15		43·8	40·7	36·7		36·4	33·5	29·4
16		48·2	44·1	40·1		38·9	35·2	31·8
17		51·5	46·6	43·2		40·6	37·3	34·1
18			49·6	45·3			39·9	37·1
19			53·4	47·9			43·3	39·7
20			55·1	51·1			45·8	41·4
21			60·5	52·5			46·7	43·6

Note. Figures based on mid-1961 costs.

Table III

Passenger Lifts for Typical Blocks of Flats of Different Floor Sizes and Heights—Estimated Cost in £s per Person and per Flat of Two-car Installations

Cost of builders' work, lift shaft, machine room, etc. is included.

	Storeys	Speed (feet per minute)	Percentage of capacity utilized	Cost £ per person	Cost £ per flat (4 flats per floor)
12 persons per floor	10	100 8-person	26	103·3	310
	11	100 cars	32	98·8	296·5
	12	100	37·5	95·2	285·5
	13	150	35	101·2	303·4
	14	150	43	97·9	293·8
	15	150	46	95	285
	16	150	52	92·4	277·2
	17	150	55	90·2	270·5
	18	200	54	90·9	272·7
	19	200	60	89	267
	20	200	63	87·2	261·7
	21	200	71	85·7	257·2
	Storeys	Speed (feet per minute)	Percentage of capacity utilized	Cost £ per person	Cost £ per flat (6 flats per floor)
20 persons per floor	10	100 8-person	43	62	206·6
	11	100 cars	54	59·3	197·7
	12	100	62·5	57·1	190·3
	13	150	59	60·7	202·3
	14	150	69	58·7	195·7
	15	150	77	57	190
	16	150	87	55·4	184·8
	17	150	96	54·1	180·3
	18	200	91	54·5	181·8
	19	200	100	53·4	178
	20	300	91	56·2	187·5
	21	300	96	55·1	183·7
	Storeys	Speed (feet per minute)	Percentage of capacity utilized	Cost £ per person	Cost £ per flat (8 flats per floor)
24 persons per floor	10	100 8-person	52	51·7	155
	11	100 cars	65	49·4	148·2
	12	100	75	47·5	142·7
	13	150	71	50·6	151·7
	14	150	83	48·9	146·8
	15	150	92	47·4	142·5
	16	200	92	47·7	143·4
	17	200	100	46·6	139·8
	18	300	92	49	147·2
	19	300	100	48	143·4
	20	300 10-person	96	47·6	143
	21	300 cars	100	46·6	140

Note. Figures based on mid-1961 costs.

25. Table III presents a very different picture. This is based on three typical block sizes, accommodating 12, 20, and 24 persons per floor respectively, and shows for each floor size, at heights of from 10- to 21-storeys, the percentage utilization of the installed lift capacity (which is in effect an index of efficiency), and the cost of lifts per person, calculated with reference to the population which each block is designed to house. In each case the lift installation is that which will meet the minimum requirements of size and speed (based on the criteria already mentioned) most economically. In typical ten-storey blocks the capacity utilized ranges from as low as 26% of that available (with a floor population of 12) to only 52% (with a floor population of 24). Even in some 21-storey blocks it may be no higher than 71%. As would be expected, the percentage rises as the floor size increases at any given height. It also rises fairly consistently as the number of floors increases, and 100% utilization is reached with 17-, 19-, and 21-storey blocks with 24 persons per floor. The greater degree of utilization of lifts which comes with higher blocks is more than sufficient to offset the higher cost of faster, and in some cases larger, lifts required for higher and bigger blocks. This can be seen clearly from the column giving the cost per head of population served. Thus the cheapest lift installation per person

in the examples shown is for a block with 24 persons per floor at heights of 13, 17 and 21 storeys, and the dearest is for a 10-storey block with 12 persons per floor. In the larger, higher building the cost per person is £46·6; in the smaller, lower building it is more than twice as high at £103·3.

26. By using the Tables it is also possible to work out the approximate cost per person and per flat of the most economical lift installation, based on the standard of service used in this bulletin, for a block of flats of any given size. The three examples that follow show how this may be done easily and quickly.

Block A

An 11-storey block of flats, with 4 four-person flats per floor, and a floor-to-floor height of 8′ 6″.

Floor population in block A is 4 × 4 = 16 persons

Table I shows that 2 eight-person lifts at 100 f.p.m. will serve 37 persons per floor.

Therefore percentage utilization of lift installation in block A will be $\frac{16 \times 100}{37}$ = 43·2%

Lift costs per person with 100% utilization (Table II) = £32

Therefore lift costs per person in building A (43% utilization) = $£32 \times \frac{100}{43 \cdot 2}$ = £74·1

Therefore lift costs per flat (4 persons per flat) = £74·1 × 4 = £296·4

Block B

A 20-storey block of flats, with 8 flats per floor, comprising 6 four-person flats and 2 two-person flats, with a floor-to-floor height of 8′ 6″.

Floor population in block B is (6 × 4) + (2 × 2) = 28 persons

Table I shows that 2 thirteen-person lifts at 300 f.p.m. will serve 29 persons per floor (note that waiting interval is 106 seconds).

Therefore percentage utilization of lift installation in block B will be $\frac{28 \times 100}{29}$ = 96·5%

Lift costs per person with 100% utilization (Table II) = £41·4

Therefore lift costs per person in building B (96·5% utilization) = $£41 \cdot 4 \times \frac{100}{96 \cdot 5}$ = £42·9

Therefore lift costs per flat (average 3·5 persons per flat) = £42·9 × 3·5 = £150·1

Block C

A 10-storey block of flats, with 12 flats per floor, comprising 8 four-person flats and 4 two-person flats, with a floor-to-floor height of 8′ 6″.

Floor population in block C is (8 × 4) + (4 × 2) = 40 persons

Table I shows that 2 eight-person lifts at 100 f.p.m. will serve 46 persons per floor.

Therefore percentage utilization of lift installation in block C will be $\frac{40 \times 100}{46}$ = 87%

Lift costs per person with 100% utilization (Table II) = £27

Therefore lift costs per person in building C (87% utilization) = $£27 \times \frac{100}{87}$ = £31·1

Therefore lift costs per flat (average 3·33 persons per flat) = £31·1 × 3·33 = £103·7

Planning a lift installation

27. Lifts should be within easy reach of dwelling entrances, and preferably centrally placed on each floor. To comply with the fire code, lifts must be entered from either (i) a separate and enclosed lift hall; (ii) a common access hall or corridor from which flats are entered; or (iii) a staircase enclosure. The space in front of the lifts should be large enough for the movement of passengers and the manoeuvring of prams and furniture in and out of the cars. Access to the lifts at the ground floor must be direct. They should not be too far from the main entrance to the block, and should be easily visible from there. There will be more people waiting for lifts at this level than on the upper floors. Sufficient space is needed also for furniture during delivery and removals. Space for use by passengers waiting for a lift, whether on the ground floor or upper floors, should be free from draughts, for it must be borne in mind that high blocks are sometimes subject to the full force of high winds.

28. The grouping of lifts is advisable, as the combining of shafts and motor rooms will save money on structure and on lift installation costs. Even more important, it will allow the lift controls for the calling of lifts to be inter-connected.

29. The positions of the lift well and motor room, and their insulation, or structural separation, from dwellings should be carefully considered with a view to reducing nuisance from noise. Unless unavoidable, no habitable room should adjoin the lift well or motor room, and this is particularly important in the case of bedrooms. It is especially important for the concrete beds for the machines to be insulated from the machine room floor by noise insulation pads.

30. B.S. 2655: Part 3 gives outline dimensions for lift installations. Figures Nos. 1 and 2 in this bulletin amplify this by giving data for larger sizes of car and for higher lift speeds.

31. Figure No. 1 shows the minimum plumb sizes for lift wells. For 8-person lifts only, recesses may be provided to accommodate the sliding doors on the car and landing. These recesses, which allow the well to be reduced in size, are shown by dotted lines in Figure No. 1. Where 'cupboard' extensions for stretchers or coffins are fitted to the back of a lift, the depth of the well from front to back must be increased. This is shown in Figure No. 1. The increased depth is shown applying to the whole width of the well so as to simplify construction. The car dimensions A and B in Figure No. 1 are those measured over the outside of the platform. The internal dimensions will vary with the design and internal finish and should be obtained from the manufacturers.

32. Single sliding doors are most suitable for flats. They are simple and less likely to give rise to maintenance costs, and they cost less to install. The nett opening size for the doors has been standardised at 2′ 9″ wide by 6′ 8″ high. This has been found sufficient for the largest sizes of perambulator. Vision panels should be provided in the door.

33. Figure No. 2 gives pit depths for lifts of various speeds, minimum dimensions between the floor level of the topmost stop and the floor of the machine room, and the minimum height of the machine room. This room, which should be placed at the top of the lift well, needs to be larger than the area of the lift well, and may extend beyond it on all sides. The relative positions of the machine room and the lift well may vary, but this will not affect the area of machine room. Generally, this will be governed by the type of installation and control, and by planning and structural considerations.

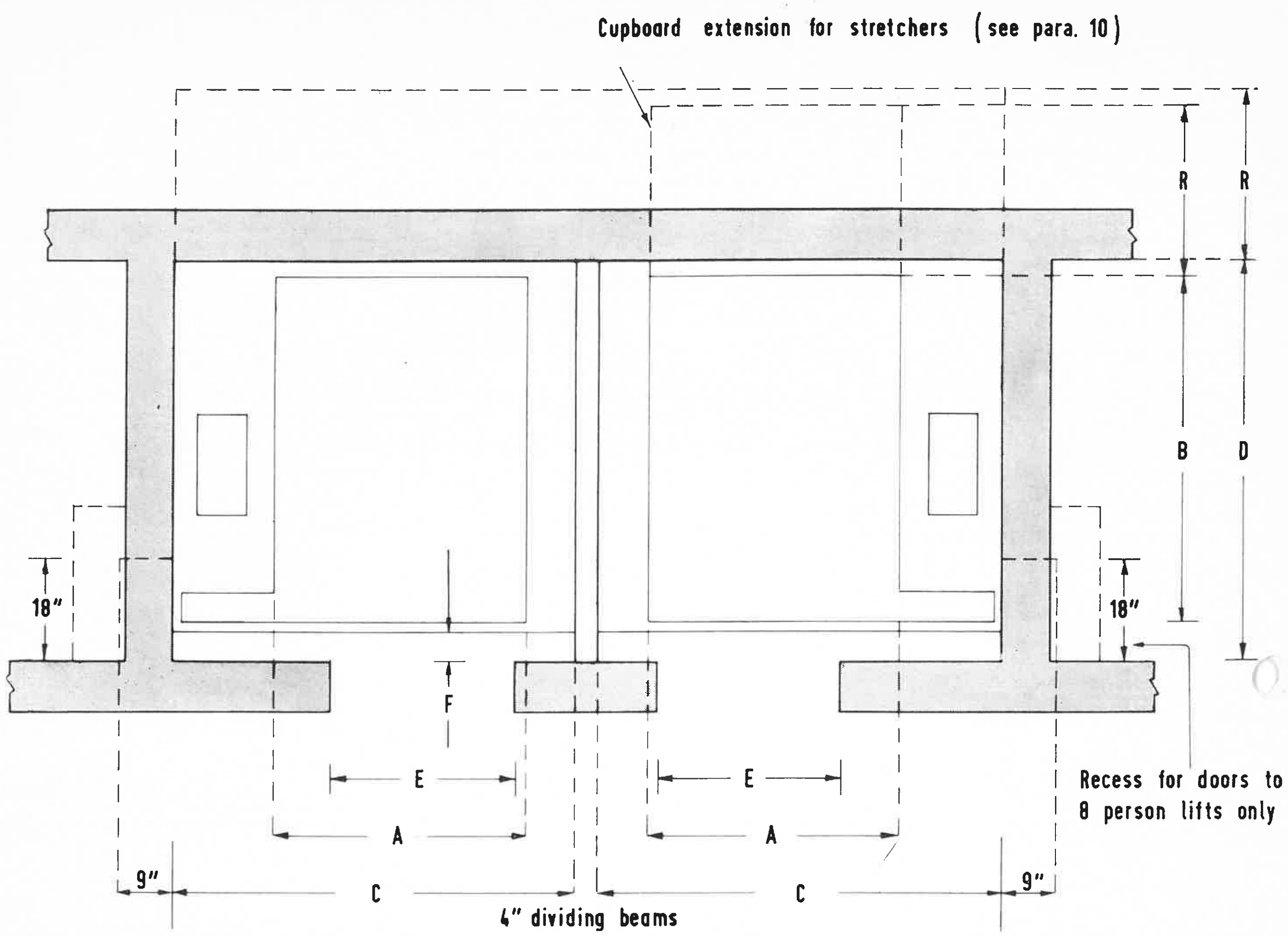

Fig. 1

Passenger Lifts—Outline Dimensions

These dimensions amplify those given in B.S. 2655: Part 3 (page 11) by showing data for higher speed lifts.

Outline dimensions on Plan (minimum clear plumb sizes)

Load			8 persons 1200 lbs.	10 persons 1500 lbs.	13 persons 2000 lbs.
			ft. ins.	ft. ins.	ft. ins.
Platform		A	3 9	4 3	4 3
		B	5 2*	5 8*	6 9*
Liftwell		C	6 0†	6 9	6 9
		D	6 0*	6 6*	7 7*
Entrance		E Doors	2 9 single sliding	2 9 single sliding	2 9 single sliding
Cill	F approx.		– 5	– 5	– 5
R*	Extension		3 0	2 6	1 5

†Dimension "C" should be 6′ 9″ if recess for doors is not provided.
*Add for cupboard extension to provide 7′ 9″ clear space in the car for stretchers.
Dimensions also apply to minimum size of wells for single lifts.

34. For initial design purposes the following approximate machine room areas are suggested for a well with 2 lifts; these should be confirmed with the manufacturers:

	100 f.p.m.	150 f.p.m.	200 f.p.m.	300 f.p.m.
8 person cars	148 sq. ft.	190 sq. ft.	220 sq. ft.	300 sq. ft.
10 person cars	162 sq. ft.	205 sq. ft.	220 sq. ft.	300 sq. ft.
13 person cars	—	—	—	330 sq. ft.

35. Figure No. 2 indicates a dimension of 7′ 0″ in the machine room from the top of the motor base, which must be immediately above the lift well, to the underside of the lifting beam. The depth of the beam adds approximately 10″, giving almost 8′ 0″ from the machine room floor to its ceiling. In order to reduce the height of superstructures at roof level, concessions can sometimes be made by lift manufacturers so as to reduce the required 7′ 0″ height to 6′ 0″ over the whole area of the lift well, provided special lifting eyes and anchorage plates are cast into a concrete roof suitably reinforced for the purpose. But this becomes less practical with increased block height because the higher the building the greater the load that has to be carried by the lifting devices. The part of the machine room required for controls and other gear, and which need not be immediately above the lift well, should be about 8′ 0″ high. Thus in the cases where Dimension J is less than 7′ 0″, the motor bases will stand above the rest of the machine room floor.

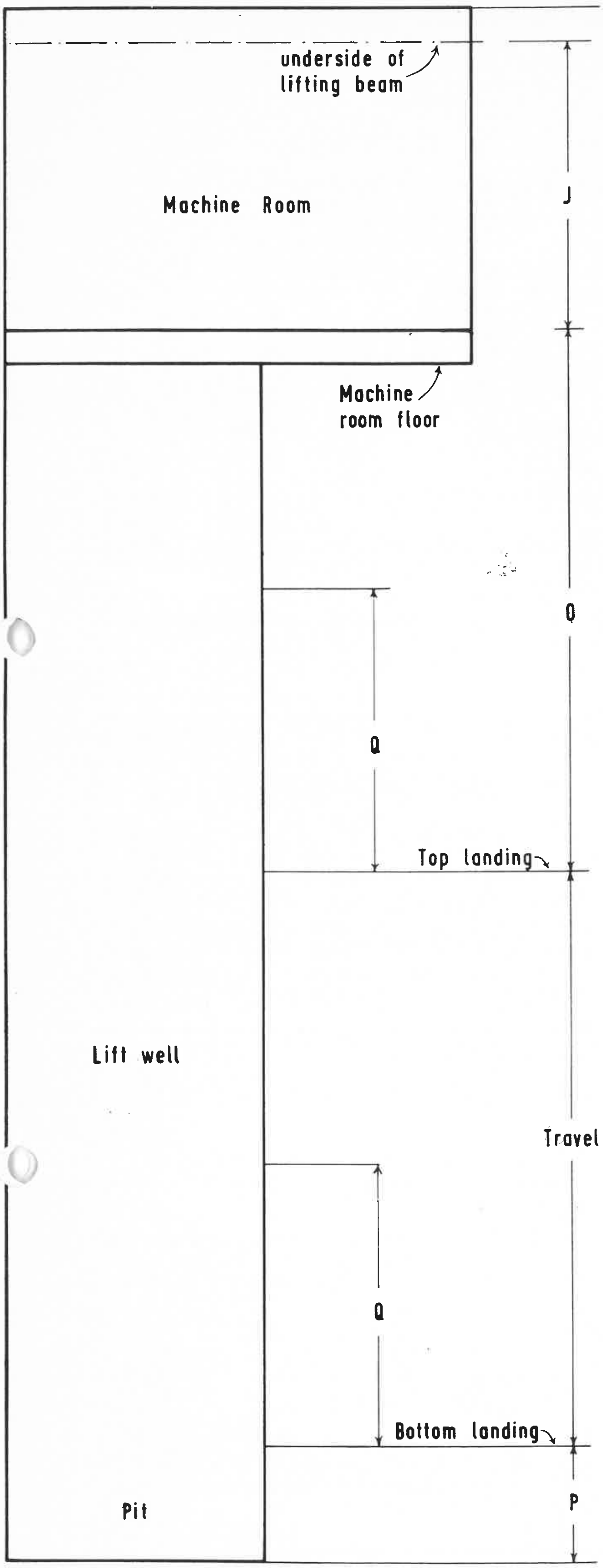

Fig. 2 Passenger Lifts—Outline Dimensions of Pit Depth and Headroom

These dimensions amplify those given in B.S.2655: Part 3 (page 7) by showing data for higher speed lifts.

Dimension J

	ft.	ins.
Height from machine room floor to underside of lifting beam	7	0

Dimension O

Speed	Load					
feet per minute	1200 lbs. 8 persons		1500 lbs. 10 persons		2000 lbs. 13 persons	
	ft.	ins.	ft.	ins.	ft.	ins.
100	13	6	13	6	14	0
150	14	0	14	9	14	9
200	14	9	15	0	15	0
300	15	0	15	3	15	3

Pit Depth P

Speed	Load					
feet per minute	1200 lbs. 8 persons		1500 lbs. 10 persons		2000 lbs. 13 persons	
	ft.	ins.	ft.	ins.	ft.	ins.
100	3	6	3	6	3	9
150	3	9	4	3	4	3
200	5	0	5	0	5	0
300	5	0	5	0	5	3

Dimension Q

Clear height in entrance	6 ft. 8 ins.

Note: Machine room floor may be required to overhang lift well on any side or all sides.
For machine room sizes consult lift makers.

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Appendix 1

Types of lift motors and their characteristics

100 F.P.M. single speed motors

These lifts stop out of full speed by means of mechanical braking and, by using a severe braking action, achieve a levelling accuracy of plus or minus one inch. A figure of $1\frac{1}{2}''$ can be obtained with a less severe braking action. Instantaneous safety gears are used on the cars.

150 F.P.M. polechange motors

For a travelling speed of 150 f.p.m., a two-speed polechange motor is ideal. These motors have a 3:1 speed ratio, giving a levelling speed of 50 f.p.m., thus enabling a comfortable stop to be made with a levelling accuracy of plus or minus one inch. These motors are relatively quiet in operation. The speed of 150 f.p.m. is the maximum at which an instantaneous safety gear can be used, and a lift at this speed with a polechange motor is economic and gives a good performance.

200 F.P.M. polechange motors

For speeds of 200 f.p.m. the 3 : 1 polechange motor is still the best proposition when cost is of paramount importance. The safety gear must be of the friction type which in itself increases the costs. A levelling accuracy of plus or minus one inch can be obtained, but braking is more severe than with a speed of 150 f.p.m.

Speeds above 200 F.P.M.

While polechange motors have sometimes been used for speeds of 250 f.p.m. because they are relatively cheap, factors affecting braking at the expense of motor performance have led manufacturers to avoid using them widely. Traffic handling calculations show that the polechanger lift at 250 f.p.m. has very little more capacity than the 200 f.p.m. polechanger.

Variable voltage system

Above 200 f.p.m. consideration should be given to the variable voltage system. With this system the lift motor is slowed down, as necessary, by a reduction of voltage in the generator. The levelling accuracy can be plus or minus half an inch without any difficulty.

Appendix 2

Fire code requirements

(B.S.C.P.3. Chapter IV, 1962)

The "British Standard Code of Practice on Fire Precautions in Flats and Maisonettes over 80 ft. in Height" contains recommendations regarding lifts. The following are extracts from the code:

"A lift introduces a negligible fire hazard provided landing doors are fire resisting, the motor room is at the top, and permanent ventilation is provided at the top of the shaft. There is, therefore, no objection to arranging lifts within a staircase enclosure on any floor, including the entrance floor".

"Lift enclosures. The walls enclosing lift shafts should have a fire resistance of not less than one hour except where the lifts are in a staircase enclosure. Shafts should have permanent vents at the top not less than 1 sq. ft. in area. Lift motor rooms should be separated from lift shafts by the enclosing wall of the shaft or by a floor of the motor room . . ."

"Doors in lift shaft enclosures. The doors in the enclosing walls of lift shafts should, in conjunction with their frames, have a fire resistance of half an hour. They should be fitted with an automatic closing device which will ensure that the doors are kept closed at all times except when persons are entering or leaving the lift. The doors, when closed, must be effectively smoke tight".

"Doors to lift motor rooms. The doors to lift motor rooms, where located within the building, should in conjunction with their frames, have a fire resistance of half an hour, and be made self-closing".

"Lift motor rooms. Lift motor rooms should preferably be sited at the top of the shaft and should always be so sited if the lifts open out of a common approach route or staircase that provides the only means of escape from a dwelling".

"Fire lifts. A normal passenger lift or lifts should be arranged as to be available for the exclusive use of firemen in any en[illegible]gency by providing at ground level a switch in a glass fronted box marked "FIRE SWITCH" which operates a control whereby firemen can obtain the use of the lift without interference from the landing call points. Alternatively the fire switch may be protected by a metal cover and unlocked by a key which would pass the dry riser box and any other locks which would require to be opened by the fire brigade."

"A sufficient number of lifts should be arranged as fire lifts to ensure that in flats, every floor, (except, under the circumstances described below, the top floor) and in maisonettes every entrance floor, has direct access to at least one such lift. A fire lift should not be more than about 15 feet from a main staircase if that is the only staircase to which there is access, or about 50 feet if there is another staircase on the same floor to which there is access. In addition, if a fire lift is not in a main staircase enclosure or within 15 feet of a door in a main staircase enclosure it should be within 15 feet of a smokestop door that leads to a main staircase".

"In order to ease the difficulty of accommodating the space necessary for over-run at the top of the shaft for a high-sp[illegible] lift it is considered that a fire lift need not serve the top floor o[illegible] building provided the lift is not more than 15 feet from a main staircase on the floor below, the hydrant outlet on the top floor is within the staircase enclosure or in a ventilated lobby adjoining the staircase, and the number of flats on the floor does not exceed eight".

"A fire lift should have a platform area of not less than $15\frac{1}{2}$ sq. ft. and be capable of carrying a load of 1200 lbs. Its speed should be such as will reach the top floor from ground level (non-stop) in one minute. The electric supply to any fire lift should be provided by a sub-main circuit exclusive to the lift except that where the lift is one of a battery of not more than six lifts (whether fire lifts or not) the other lifts may be fed from the same supply. The cables supplying current to the lift motor should pass through routes of negligible fire risk".

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