Annex F (normative) Typical traffic calculation method

COMMENTARY ON Annex F

This is a simplified method. Refer to CIBSE Guide D 2010, Section 3 [37], for more complex calculations and where additional references can be found. Examples of traffic calculations are given in Annex G.

F.1 Formulae

The *RTT* in seconds (s), of a single lift during up-peak traffic can be calculated using Equation F.1:

$$RTT = 2H\frac{d_f}{v} + (s+1)\left[t_c + t_f(1) + t_o - \frac{d_f}{v}\right] + 2Pt_p \qquad \text{(F.1)}$$

where:

H	is the average highest reversal floor;
d_f	is the average interfloor height in metres (m);
v	is the rated speed in metres per seconds (m/s);
S	is the average probable number of stops;
t_c	is the door closing time in seconds (s);
$t_f(1)$	is the single floor flight time in seconds (s);
t_o	is the door opening time in seconds (s);
P	is the average number of passengers in the car;
t_p	is the average passenger transfer time in seconds (s).

*NOTE 1 Average values for H and S can be obtained from Table F.1, which assumes equal floor populations. These tables are calculated for H and S for buildings with 5 to 24 floors (N) served above the main terminal using the rated car capacities (CC) in BS ISO 4190 (all parts). The rated car capacity is given by the formula in BS EN 81-1:1998+A3, **8.2.3**a) or BS EN 81-2:1998+A3, **8.2.3**a), as appropriate. The average value for P shown in parentheses is assumed to be 80% of the rated capacity.*

NOTE 2 The term $t_c + t_f(1) + t_o$ can better be expressed as a performance time (T), which is the time from the instant when the doors start to close to the time when they are open to 800 mm at the next adjacent floor. Typical performance times for a floor height of 3.3 m are 8.0 s for an excellent system, 10.0 s for an average system and 12.0 s for a poor system. The lift contractor can provide these figures.

NOTE 3 The t_p can only be estimated. Typical values are 0.8 s for a very busy office building to 2.0 s for a residential care home. An average passenger transfer time of 1.2 s can be assumed.

Table F.1 **Values of *H* and *S* for rated capacities: 6 people to 33 people**

No. of floors, *N*	Values of *H* and *S*															
	CC = 6 (*P* = 4.8)		*CC* = 8 (*P* = 6.4)		*CC* = 10 (*P* = 8.0)		*CC* = 13 (*P* = 10.4)		*CC* = 16 (*P* = 12.8)		*CC* = 21 (*P* = 16.8)		*CC* = 26 (*P* = 20.8)		*CC* = 33 (*P* = 26.4)	
	H	*S*	*H*	*S*	*H*	*S*	*H*	*S*	*H*	*S*	*H*	*S*	*H*	*S*	*H*	*S*
5	4.6	3.3	4.7	3.8	4.8	4.2	4.9	4.5	4.9	4.7	5.0	4.9	5.0	5.0	5.0	5.0
6	5.4	3.5	5.6	4.1	5.7	4.6	5.8	5.1	5.9	5.4	6.0	5.7	6.0	5.9	6.0	6.0
7	6.2	3.7	6.5	4.4	6.6	5.0	6.8	5.6	6.8	6.0	6.9	6.5	7.0	6.7	7.0	6.9
8	7.1	3.8	7.4	4.6	7.5	5.3	7.7	6.0	7.8	6.6	7.9	7.2	7.9	7.5	8.0	7.8
9	7.9	3.9	8.2	4.8	8.4	5.5	8.6	6.4	8.7	7.0	8.8	7.8	8.9	8.2	9.0	8.6
10	8.7	4.0	9.1	4.9	9.3	5.7	9.5	6.7	9.7	7.4	9.8	8.3	9.9	8.9	9.9	9.4
11	9.6	4.0	10.0	5.0	10.2	5.9	10.5	6.9	10.6	7.8	10.8	8.8	10.8	9.5	10.9	10.1
12	10.4	4.1	10.8	5.1	11.1	6.0	11.4	7.1	11.5	8.1	11.7	9.2	11.8	10.0	11.9	10.8
13	11.2	4.1	11.7	5.2	12.0	6.1	12.3	7.3	12.5	8.3	12.7	9.6	12.8	10.5	12.9	11.4
14	12.1	4.2	12.6	5.3	12.9	6.3	13.2	7.5	13.4	8.6	13.6	10.0	13.7	11.0	13.8	12.0
15	12.9	4.2	13.4	5.4	13.8	6.4	14.1	7.7	14.3	8.8	14.6	10.3	14.7	11.4	14.8	12.6
16	13.7	4.3	14.3	5.4	14.7	6.5	15.0	7.8	15.3	9.0	15.5	10.6	15.7	11.8	15.8	13.1
17	14.5	4.3	15.3	5.5	15.6	6.5	16.0	8.0	16.2	9.2	16.5	10.9	16.6	12.2	16.8	13.6
18	15.4	4.3	16.0	5.5	16.6	6.6	16.9	8.1	17.1	9.3	17.4	11.1	17.6	12.5	17.7	14.0
19	16.2	4.3	16.9	5.6	17.4	6.7	17.8	8.2	18.1	9.5	18.4	11.3	18.5	12.8	18.7	14.4
20	17.0	4.4	17.8	5.6	18.2	6.7	18.7	8.3	19.0	9.6	19.3	11.6	19.5	13.1	19.7	14.8
21	17.9	4.4	18.6	5.6	19.1	6.8	19.6	8.4	19.9	9.8	20.3	11.7	20.5	13.4	20.6	15.2
22	18.7	4.4	19.5	5.7	20.0	6.8	20.5	8.4	20.9	9.9	21.2	11.9	21.4	13.6	21.6	15.6
23	19.5	4.4	20.4	5.7	20.9	6.9	21.4	8.5	21.8	10.0	22.1	12.1	22.4	13.9	22.6	15.9
24	20.3	4.4	21.2	5.7	21.8	6.9	22.4	8.6	22.7	10.1	23.1	12.3	23.3	14.1	23.5	16.2

The up-peak interval (*INT*), in s, of a group of (*L*) lifts can be calculated using Equation F.2:

$$INT = \frac{RTT}{L} \qquad \text{(F.2)}$$

The up-peak handling capacity (*HC*), in persons per 5 min, of a group of *L* cars can be calculated using Equation F.3:

$$HC = \frac{300PL}{RTT} = \frac{300P}{INT} \qquad \text{(F.3)}$$

The percentage (*%POP*) of the total daily population (*POP*) above the main terminal floor that can be served during up-peak traffic can be calculated using equation F.4:

$$\%POP = \frac{HC}{POP} \times 100 \qquad \text{(F.4)}$$

Annex G (informative) Examples of traffic calculations

G.1 Determination of car size

NOTE Definitions of symbols are given in Annex F.

If the *HC* and *INT* of a target system are known, they can be used to estimate the rated CC required. For example, if the required interval is 30 s and the required handling capacity is 100 persons per 5 min, the rated car capacity can be calculated as follows:

Given data:

Required interval:	30 s
Required handling capacity:	100 people per 5 min
Calculation:	
Number of trips in 5 min period:	300/30 = 10
Number of people in the lift per trip:	100/10 = 10
Rated CC is:	10/0.8 = 12.5

The nearest standard car size conforming to BS ISO 4190 (all parts) has a rated car capacity of 13 persons, so *P* is 13 persons × 80%, i.e. 10.4 persons.

NOTE For statistical reasons, when sizing a lift system, each car is assumed to fill to an average of 80% capacity on each trip.

G.2 Calculation of lift performance from known data

The building referred to in **G.1** has 10 floors, at an interfloor distance of 3.3 m. The rated speed is 1.6 m/s (see Table 5) and the performance time is 10.0 s (obtained from the lift contractor).

Given data:

Required interval:	30 s
Required handling capacity:	100 people per 5 min
Number of floors to be served:	10
Rated capacity:	13 persons

Rated speed:	1.6 m/s
Performance time:	10.0 s

Derived data:

P = 10.4 (13 people × 80%, see **G.1**, Note)

H = 9.5 (from Table F.1)

S = 6.7 (from Table F.1)

t_p = 1.2 s (assumed)

Calculation:

The *RTT*, in s, calculated from equation F.1, would be:

$$RTT = 2 \times 95 \times \frac{3.3}{1.6} + (9.5 + 1)\left(10 - \frac{3.3}{1.6}\right) + 2 \times 10.4 \times 1.2$$

$$= 39.1 + 83.4 + 25.9$$

$$= 148.4$$

The required interval is 30 s. As there can only be an integer number of lifts, it is necessary to divide the round trip time of 148.4 s by an integer number to achieve an interval close to 30 s. Select five lifts, then calculate the *INT*, in s, using equation F.2:

INT = 148.4/5 = 29.7

The up-peak *HC*, in persons per 5 min, calculated from equation F.3, would be:

HC = 109

NOTE 1 This is a little larger than required.

The provision of five 13-person lifts would be satisfactory.

NOTE 2 Specialist advice can be taken before any final schemes are established.

G.3 Calculation of lift performance from estimated data

NOTE 1 This is an example of one solution for this particular set of data. There might be other solutions that might require specialist advice.

An office building has eight floors above ground, each with a 3.3 m interfloor distance and 1 526 m^2 gross area.

Given data:

Number of floors to be served:	8
Gross floor area:	1 526 m^2
Interfloor distance:	3.3 m
Assumed data:	
Interval:	30 s (see Table 6)
Floor density:	one person per 12 m^2 (see Table 6)
Gross to usable ratio:	80% (see **6.4.2**)
Attendance ratio:	90% (see **6.4.2**)
Peak arrival rate:	12% (see Table 6)
Rated speed:	1.6 m/s (see Table 5)
Performance time:	8.0 s

Passenger transfer time:	1.2 s

NOTE 2 Total travel distance:= 8 floors × 3.3 m = 26.4 m.

Derived data:

Usable area per floor:	1 526 m^2 × 80% = 1 221 m^2
Total possible population:	1 221 × (8/12) = 814 persons
Total daily population:	814 persons × 90% = 740 persons
Required handling capacity:	740 persons × 12% = 89 persons per 5 min

Calculation:

Number of trips in 5 min:	300/30 = 10
Average car occupancy:	89/10 = 8.9 persons
Rated car capacity:	8.9/0.8 = 11.1 persons

NOTE 3 The nearest standard car size from BS ISO 4190-1 has a rated car capacity of 13 persons, so P is 13 persons × 80%, i.e. 10.4 persons.

P = 10.4

H = 7.7 (from Table F.1)

S = 6.0 (from Table F.1)

The *RTT*, in s, calculated from Equation F.1, would be:

$$RTT = 2\times 7.7\times \frac{3.3}{1.6} + (6.0+1.0)\left(8.0-\frac{3.3}{1.6}\right) + 2\times 10.4\times 1.2$$
$$= 98.3$$

The up-peak *INT*, in s, calculated from Equation F.2 and assuming three lifts, would be:

INT = 98.3/3 = 32.8

The up-peak *HC*, in persons per 5 min, calculated from Equation F.3, would be:

HC = 300 × 10.4/32.8 = 95.1

The percentage (%*POP*) of the total daily population (*POP*) above the main terminal floor that can be served during up-peak, calculated from Equation F.4, would be:

%POP = 95.1 × 100/740 = 12.9

NOTE 4 A handling capacity of 95.1 persons per 5 min can be provided by three 13-person cars. This is more than the required handling capacity of 89 persons per 5 min (see derived data). However, the interval is longer at 32.8 s than the required interval of 30 s (see assumed data). In practice, the cars would fill to less than 10.4 persons per trip, when the round trip time and interval would shorten, until the handling capacity of the lifts equalled the passenger arrival rate.