

For the mathematically minded - (Repeated from issue 26)

Calculating Basement Service

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I wrote in the recently published second edition of CIBSE Guide D:

“The effect of serving floors below the main terminal has an effect on the main traffic patterns. During interfloor traffic there will be no appreciable deterioration in service. But during up peak and down peak, the loss of cars below the main terminal will affect service.”

“The time penalty for the extra stops can be between 10s and 20s and say between 5s to 10s for the increased passenger loading times, i.e. some 15s to 30s to be added to the RTT. In the case of a 16 passenger car serving 16 floors the RTT could be 150s and the extra times would add 10% to 20% to the RTT.”

Can there be a calculation method for basement service? Yes! Nahon suggested it in Elevator World in February 1990.

Just calculate the Round Trip Time (RTT) by your usual method. I would use:

$$RTT = 2Ht_v + (S+1)t_s + 2Pt_p$$

And add

$$2H_M t_{vm} + S_M t_{sm}$$

The term t_{vm} is the basement interfloor distance divided by the rated speed; t_{sm} is the cycle time minus t_{vm} ; and to find H_M and S_M you will need to solve the equations in the box below.

As an example, consider a building with 16 floors above the main terminal, served by lifts with a rated capacity of 16 persons. There are 1, 3 and 5 basements and two levels of demand of 105 and 205 traffic originating in the basement.

Basement Demand	N/CC	RTT(N)	RTT(N,M=1)	RTT(N,M=3)	RTT(N,M=5)
	16/16	159			
10% Demand			166	172	176
20% Demand			166	176	182

The RTT for service above the main terminal only is given as 159s. The extra time incurred to serve the basements will increase the RTT from 6s to 23s, dependent on the number of basement floors (M) served and the level of demand (x). The ratio of the above the main terminal round trip time to the round trip time obtained with basement service varies from 4% to 14%.

The figures obtained are (thankfully) close to the estimates I suggested in Guide D.

$$H = N - \sum_{i=1}^{x-1} \left(\frac{i}{N} \right)^p \quad S = N \left[\left(\frac{N-1}{N} \right)^p \right]$$

Symbols Used

- CC rated capacity (persons)
- H highest reversal floor
- H_M lowest reversal floor
- M number of floors below the main terminal
- N number of floors above the main terminal
- P average number of passengers (persons)
- RTT round trip time(s)
- S average number of stops above the main terminal

- S_M average number of stops below the main terminal
- t_s stopping time above the main terminal(s)
- t_{sm} stopping time below the main terminal(s)
- t_v interfloor transit time above the main terminal(s)
- t_{vm} interfloor transit time below the main terminal(s)
- t_p average passenger transfer time(s)
- x percentage basement demand (percentage persons)