COVID-19

A Guideline for Elevators during the Pandemic

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June 2020

1. Introduction

In this guideline we will explain the technical aspects and considerations on the use of elevators in the time of the COVID-19 pandemic. We will provide several options to allow for the social distancing in elevators, and what impact these measures will have on the building usage, the traffic and waiting time.

This guideline concentrates mainly on elevators in commercial buildings, but most of the measures and recommendations can be applied in elevators in other building types as well.

Keeping a safe social distance during the COVID-19 Pandemic is one of the fundamental measures to prevent the spread of the severe acute respiratory syndrome Sars-CoV-2 virus. Depending on country, the recommended social distance is set between 1.5m and 2m.

However, keeping a social distance in an elevator is not easy. “Taking an elevator” is very common for most people, and most of us are accustomed to standing much closer to each other in an elevator than we would normally do in a larger space, or when being outdoors. Standing close to each other in an elevator is an ingrained habit.

In addition, due to our fixation on time management and obsession with instant everything, people are not very tolerant about waiting – indeed, waiting too long is often perceived as a violation of our right to manage and control our time[1)].

Lastly, the psychology of lockdown, and the psychology of the social distancing measures post-lockdown, suggests that sticking to the rules gets harder, the longer it continues.

Hence, if we want to ensure that the social distancing practices are applied in elevators in a sustainable manner, we must apply some special measures.

NOTE: Please note that this guide is a general advisory on the use of elevator during the pandemic with some examples of best practices globally to minimize the risks for infections. In many countries, local government organizations or public health organizations have issued specific instructions, measures or health guidelines, to minimize the spread of COVID-19. Any public guideline or local / national government recommendations must always take precedence over this guideline, where applicable. Elevating Studio is not liable for any direct or indirect damages, in any shape or form, resulting from the use of the information provided in this article, in any country or court of law. It is recommended to discuss and consult with your local elevator consultant and/or elevator contractor, and your local Health Specialist, to discuss the best course of action.

2. Elevator cabin Usage and Fill-Rate

Consider a commonly used office elevator designed with a 1600 kg / 21-person car (or cabin), applying ISO 4190-1[2)] dimension (2100 mm wide x 1600 mm deep). During the typical morning Up-Peak and Lunch Peak, the car will be filled up to about 65% of the rated load, in a well-designed elevator system. This would mean that in this space of 2100 mm x1600 mm there will be up to 13-14 people inside the car, during these peaks. This is a considerably higher car density than the density required for safe social distancing.

Figure 1. Shows an example with a 26-person/2000 kg elevator car, with 16 persons inside the car (16/26 = 62% of the rated load). It is clear that not many more people will enter this elevator, and that social distancing is simply not possible.

Figure 1. A 2000kg / 26-persen elevator car, filled with 16 persons (=62%)
Picture: Courtesy of the British Counsel of Offices

2.1. Complying with Social Distancing in an elevator car

To comply with social distancing, we will need very low occupancy levels (3 – 5 persons) in a 21-person elevator. The shape of the lift car will impact how many people can safely be allowed in the car for social distancing. Applying social distancing in a 21-passenger elevator car would be like changing the elevator capacity into that of a much smaller "telephone booth" cabin, which is used in some European countries.

It may be recommended to apply warning stickers on the elevator car floor, to indicate where passengers should stand and in what direction they should face. This is very useful in both elevators with Conventional Control and Destination Control, and passengers are more likely to follow the behavioral rules. See figures 2 and 3 below.

Figure 2. Clear warning signs and instructions how and where to stand in the elevator, and where not to stand – However, the 1-2 m distancing is not achieved. Picture: Courtesy of Jakarta Post

Figure 3. Car divided into 4 sections to allow for safe distancing, in a residential building. Picture: by Elevating Studio. There is no clear guidance how to stand.

Reducing the maximum number of passengers in the cabin will significantly reduce the handling capacity of the elevators (= the maximum number of people the elevator system can transport during the peak, in 5-minutes period). The reduced handling capacity will lead to major problems in buildings which are fully populated. Passengers will no longer fit into the elevators, and queuing in the elevator lobby will start to increase while waits also increase exponentially. Queuing in the lobby will also mean that the social distancing in the lobby will be exceeded.

As part of the lock-down measures imposed in many countries globally, office populations have recently reduced dramatically, through remote working or tele-working. In many countries, office staff are currently working from home.

2.2. Calculating building population levels during pandemic

For the elevators to function correctly with "in-car social distancing", the population of the building (or zone) should be reduced below the amount found by the following formula:

$$PBP = \frac{NBP \times N}{0.65 \times CL}$$

Where:
PBP = Pandemic Building(*) Population → Maximum Building Population during the Pandemic (persons)
NBP = Normal Building Population → Population before the pandemic (persons)
N = Number of persons allowed in car for social distancing (e.g. 5 persons)
CL = Car Rated Load (persons)
(*) Note: If the building/office is divided in multiple zones, the formula should be applied for each zone

It must be noted that the above formula is based on correctly dimensioned elevator systems, whereby the elevator system is operating with a maximum carload of 65% with the normal building population present.

If the normal building population or zone population is higher than the design population of the elevator system (or the building is 'under-elevated', i.e. not enough lifts), the formula cannot be applied, and more analysis is needed to verify the maximum PBP. It will mean that the PBP will need to be further reduced compared to the outcome of the formula, to ensure sufficient social distancing and not excessive queueing. The BPB can be obtained through traffic simulations and analysis.

If the normal building population or zone population is lower than the design population of the elevator system (or the building is 'over-elevated', i.e. more lifts than needed), the PBP can actually be higher than the formula would dictate. The BPB can be obtained through traffic simulations and analysis.

2.3. If the building population during the pandemic exceeds PBP

If the building population during the pandemic exceeds PBP (maximum Building Population during the Pandemic) found in the formula, the elevators will not be able to cope with the traffic. This will be the case in the early stage of the pandemic, when no or limited precautionary measures or quarantine requirements have been applied by the government, or when the restrictions to work remotely from home are being retracted. Under such conditions the elevator capacity should not be reduced as this will cause excessive queuing in the lobby, which will have a negative effect on social distancing in elevator lobbies. The best way to protect the elevator users is to minimize the spread of the virus by using other commonly applied preventive measures (see "Other methods used to minimize the spread of deceases"). Please note that most countries have issued specific measures or health guidelines to minimize the spread of infectious deceases, which must always be followed.

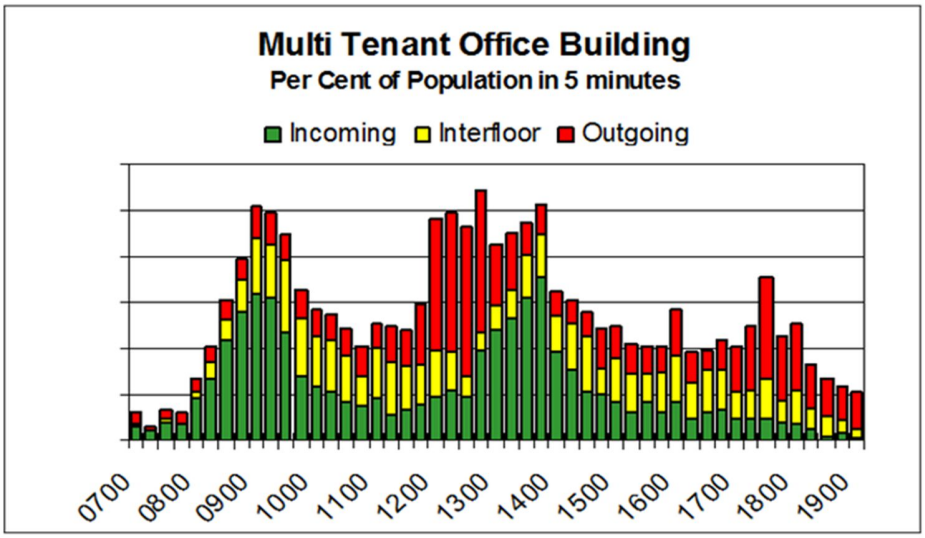

Figure 4. Typical traffic Flow in a Multi-tenanted office building

Figure 4 shows the building traffic over the day in a multi-tenanted office building (Siikonen Profile for office buildings)[3)]. The maximum vertical peaks represent approximately 12% of the population arriving in a 5-minute period, i.e. the arrival rate. At those peaks, the elevator cabins are typically full, with about 65% fill rate – which means that the social distancing measures cannot be achieved. In case the social distancing would be enforced during those peaks, the elevator system will saturate very fast (more people arriving in the lobby than the elevators are able to dispatch), and queuing will increase exponentially. Waiting times can be as high as 30-60 minutes or more – both in the main lobby and on all other floors, too. This is a very dangerous situation – in case of a possible building evacuation, during a medical emergency, and considering the risks for anger, aggression and rage of the users.

2.4. Staggering tenant and passenger arrival times

In office buildings one solution to reduce the peak in traffic is to stagger the arrivals into 3 peaks, for all tenants. This means that different tenants / floors will arrive in the building in different time slots, which will lower the peaks. This must be applied during the Morning Peak, Lunch Peak and Evening Peaks.

A staggered arrival of the building users/tenants, in blocks during the peaks, will reduce the peaks. But even then, one must also prevent off-peak traffic to remain low enough to allow social distancing. As a result, this methodology will only work if the building population can be kept below 50-60% of the normal building population.

A more exact maximum level of occupation can be analyzed for each individual building, based on the population density, passenger arrival rate, and the capacity of the elevator system. The accuracy of such analysis is subject to the data available in the elevator monitoring system and/or turnstiles.

2.5. If the building population during the pandemic is below PBP

If the building population during the pandemic is below the PBP found in the formula, the elevators will be able to cope with the traffic and will automatically adapt to the lower traffic flow (= lower arrival rate). The lower traffic flows will also reduce the average number of people using each car, and typically the number of passengers inside the elevator car will be on or below the desired number, as per the social distancing measures. To guarantee that no more than 5 people will use the elevator at the same time, several technical measures can be considered.

3. Technical measures to ensure social distancing - Elevators with Conventional Control

The following technical measures can be considered in case of conventional control elevators, to ensure that the social distancing measures are enforced.

There are 2 main settings which are relevant in this respect:

1) 'Overload' = A function to keep car doors open when the car is overloaded. A warning voice and or an alarm signal (buzzer) are activated. In some cases, a warning light or signal will flash on the elevator operating panel.
2) 'Bypass' = A function where the elevator will automatically bypass Hall Calls, when the car is loaded to a pre-set limit. The elevator will not stop during the journey to pick up more passengers, when the bypass load is reached.

The measurement of the load inside the elevator car is done by a weighing sensor called Load Weighing Device ("LWD"). The LWD is required by code and is used in every elevator globally. The setting of the overload and bypass loads is typically done on site. The elevator contractor can be requested to adjust these controller settings, to the appropriate level(s).

The maximum population inside the elevator according to the social distancing rules, can be ensured by readjusting the 'overload setting' to 1 person higher than allowed by social distancing. In case social distancing allows maximum 5 persons, the overload is set for 450kg or 6 persons (6 x 75kg = 450kg). The by-pass function should be set to the load as per the social distancing rules, which is 375kg or 5 persons (5 x 75kg = 375kg).

The overload and bypass setting must be re-adjusted using test loads, which is (typically) a relatively easy adjustment to do. However, depending the type of LWD used, some elevators may require that the LWD is changed for another type, to cope with the clearly lower load functions. Please consult your elevator contractor for this.

The newly adjusted overload setting will cause the overload buzzer to activate, when the 6th person is entering the car (=exceeding the maximum allowed number of 5 passengers). The buzzer will indicate to the users, that the last person entering must leave, before the elevator will depart.

The newly adjusted bypass setting will prevent the car from stopping unnecessarily for landing calls when the maximum number of passengers allowed in the car for social distancing has already been reached.

In some countries or regions, the by-pass and overload setting should be adjusted in line with the local situation – for instance in some countries in Asia, Africa and South America, the use of a weight of 65kg or 68kg per person is more appropriate, in Australia, Europe, China and Russia 75kg is typically acceptable, and in US a weight of 85kg or 90kg may be more in line with the reality.

3.1. Social distancing stickers

It is recommended to install social distancing stickers with instruction on the usage of the floor area, on the floor inside the elevator.

Note:
Please be aware that when social distancing restrictions by the government are relaxed, and/or when a vaccine is found, the LWD settings must be readjusted back to the original values to ensure that the elevator system can handle the increased traffic expected after the removal of the restrictions. Adjusting the LWD settings may not be covered by the elevator maintenance contract, and the elevator contractor may charge for the works.

4. Technical measures to ensure social distancing for elevators with Destination Control System

Elevators with Destination Control System ("DCS") will assign passengers with the same destination to the same cars, to minimize the number of stops the elevator will make, during the journey. This way, DCS is able to increase the efficiency of the elevator system significantly. At low arrival rates (during very early morning), some of the smarter and more intelligent DCS systems will understand that extra capacity is not needed and will thus assign the first arriving car to the passengers and let the elevator depart. During this situation, the number of passengers per car will be very low. When the arrival rate increases during the morning up peak and lunch peak, the control system will optimize the elevator usage, and will assign more passengers to each car - usually up to 65% of the nominal load. In this situation, the number of passengers allowed for social distancing will be exceeded.

The best way to prevent the DCS control system from exceeding the number of passengers under the social distancing rules, is to artificially reduce the size of the elevator car in the control system. The earlier used example of a 1600kg/21-persons elevator will thus need to change the car size in the software to a 600kg/8 persons elevator (appr. 350kg at 65% car-fill rate).

In DCS systems of some elevator manufacturers, it is possible to change the "software car size" by changing some software parameters. In some others this can only be done by hardcoding in the DCS software. The most appropriate method and exact value of re-adjustment depends on the capabilities of the elevator manufacturer's software, settings and the algorithms.

In addition to the changes in the DCS software, the overload and by-pass functions must be re-adjusted in the same way as for Conventional Control elevators. This is to prevent that passengers will just follow their colleagues working on the same floor (tail-gating).

4.1. Instructional stickers in the lift car

It is recommended to install stickers with instruction on the usage of the floor area, on the floor inside the elevator.

Note:
If the car size is not parametrized in the software, these software changes may take time to execute, while a copy of the old DCS software must be retained. Adjusting the DCS software setting may not be covered by the elevator maintenance contract, and the elevator contractor may charge for the works.

5. Other methods used to minimize the spread of Sars-CoV-2 virus

There are several measures and methods to minimize the spread of bacteria and viruses, including the Sars-CoV-2 virus. The most common are:

- Clear instructions how to behave or not to behave in elevators and escalators (see appendix)
- The use of face masks and gloves, and possibly glasses
- Use pen or other object to operate elevator buttons (sharp objects should not be used)
- Frequent cleaning of all touched surfaces with disinfectants (especially handrails, landing call buttons/panels, car operating panel and buttons, car door, mirrors, etc), with certain interval per day or per hour, or even per elevator 'ride'.

Special technologies or applications found in the market:

- Air-filtering / Air-sterilizing ventilation units with or without HEPA filter (High-Efficiency Particulate Air). Those filter units can be installed inside elevator cabin or on top of the cabin. Some of these units even use UV light to sterilize the air.
- UV light in the cabin, to sterilize surfaces
- Apply special self-sterilizing or inherent antimicrobial materials (copper, etc.) for buttons, wall surfaces, handrails and elevator doors
- Apply special self-sterilizing or antimicrobial coating on the various surfaces (spray or lacquer)
- Special "no-touch" hologram buttons

Note:
The methods or special technologies should be considered in consultation with the elevator contractor. Some measures or cleaning materials may adversely affect the lifetime of some of the elevator components or parts (especially aggressive cleaning detergent or disinfectants, or paint or spray).

6. About Elevating Studio

This article was produced by Elevating Studio one of the largest Vertical Transportation Consultants in Asia-Pacific, with offices in Australia, Singapore, Thailand, Malaysia and Finland. If you have any questions regarding this article or need further help, please contact us through:

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APPENDIX: BEHAVIOURAL INSTRUCTIONS[4)]