Goods Lifts. Who Needs Them?

Len Halsey

Canary Wharf Contractors Ltd, One Canada Square, Canary Wharf, London, E14 5AB, UK

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Abstract. Much has been written about the importance of passenger lifts, their performance and passenger traffic analysis in office and residential buildings over many years. The same cannot be said of goods lifts, even though they play a vital role in the efficient running of buildings. The movement of goods, plant, furniture, and the needs of the emergency services, all need to be considered when assessing the services necessary to ensure the smooth back of house operations that contribute to well managed buildings and satisfied tenants.

The move to higher population densities in office buildings combined with introduction of magnet attractions such as roof top restaurants and retail outlets brings to light the need to reassess both the role of the goods lift and how goods lift provision is assessed. Goods lifts are a key part of building logistics and failure to meet the needs of tenants and owners can be both expensive and frustrating. The humble goods lift provides a wide range of services from everyday deliveries and the movement of back of house personnel to enabling fit out and refurbishment works to be undertaken whilst minimising the impact on passenger lift usage.

Recent years has seen the growth in public access to major landmark buildings with restaurants, retail outlets and viewing areas being located within and at the tops of tall buildings. This together with higher office density levels brings new meaning to planning building logistics and the need for correlation between loading bay and delivery capacities and the ability to distribute goods and materials efficiently and quickly up the building. In addition, the removal of waste is a key use of goods lift time and the ability to manage this aspect of building operations should form a key part of the design associated with goods lift use and building logistics.

The management and operation of goods lifts is something largely overlooked in building design and yet the poor provision of such services has a significant impact on both building operations and tenant satisfaction.

This paper looks at the changing operational needs of office buildings. The current guidance provided, and the key points of reference are examined and assessed against todays demanding requirements for efficient management of modern buildings.

1 INTRODUCTION

This paper seeks to examine how the provision of dedicated goods lifts in office buildings is currently determined and whether this approach is still appropriate to today's buildings operational requirements.

The paper does not seek to examine the costs associated with the various types of goods lifts or their compliance to the various EN suite of standards such as EN81-70. The prime purpose of the paper is to look at the changes that have, and are taking place, and to compare current guidance to today's demands.

The use of goods lifts is reviewed both during the building construction phase (beneficial use) and afterwards in normal operation. It is suggested the design criteria should come from analysing the possible uses of the lifts and what they are required to accommodate, both in terms of load (weight) and volume. In addition, the operational use of the lifts and their ability to provide an efficient and

flexible means of goods and material distribution, as part of a coordinated approach to building operational logistics, is also considered.

Dedicated goods lifts provide an essential service and are the 'life blood' of office buildings. Although mainly back of house and unseen by most tenants their ability to service the building is a major part of the building's operation. The need for a wider assessed provision of sufficient lifts of suitable capacity, speed and flexibility fundamentally changes the way in which goods lifts provision is perceived and established.

The examples covered in the paper focus on larger office buildings but are equally applicable to smaller offices where facilities such as loading bays and dedicated goods receiving areas provide a means of managing the flow of inward goods and outgoing waste.

In this paper the term 'goods lift' refers to 'goods passenger lifts' in all instances and does not refer to goods only lifts that are none people carrying.

2 AREAS OF FOCUS

The key areas of focus move us away from looking at goods lifts in isolation to looking at the wider aspects of building operations and logistics upstream of the lifts themselves.

For example, loading bay design, capacity and management, storage areas, vehicle delivery schedules and means of moving goods within the building all impact on the design of goods lifts and are major considerations within a coordinated approach to the management of building logistics.

The changes to waste management, in consideration of environmental impact, have led to the 'steaming' of waste. This now means waste is separated at source and each stream has its own containment and storage requirements both on office floors and at the consolidation point, generally the building loading bay.

Changes in the use of buildings and public access to 'magnet attractions' such as roof top restaurants, viewing galleries, retail outlets and tenant amenity spaces all impact on the ability of the goods lifts to service the building. The trend by developers to look to provide roof top amenity spaces is a more recent phenomenon. These are all important areas that need to be serviced and should form part of the thinking when considering goods lift provision.

3 WHAT HAS CHANGED?

Within office building design probably the single biggest change is a move to greater occupational density. The change from cellular to open plan offices combined with a need for offices to 'earn their keep' has led directly to higher occupational densities as organisations seek to minimise their costs and consolidate their operations. As a result, developer's now design for higher density levels in a bid to attract tenants

The change in planning requirements and the desire for the buildings to encompass the public realm, the rise of 'magnet attractions', together with developers seeking to provide better facilities, such as roof top amenity spaces, has introduced the need to services these areas both for people and goods.

The result is higher levels of services for such facilities needing to be provided while maintaining good service to the remainder of the building.

Also significant is the change in delivery methods and systems. The introduction of manual handing regulations has led to the greater use of lifting aides, palletised goods and wheeled caged trollies as opposed to manhandling heavy loose packaged items or the use of sack barrows.

The reduction in postal deliveries is countered by the rise in deliveries by courier. These have progressed from motor cycle deliveries of small packages to large items delivered by vans and small lorries. The rise of ad hoc, same or next day deliveries and the 'long hour' culture of modern delivery services bring new challenges in building operations and management. The ability to track deliveries raises expectations that goods will be received on time and distributed quickly. This shift in dynamics requires a more flexible response from that of the past. The ability to meet the changing needs, expectations and demands of tenants makes the management of building logistics far more important, requiring a coordinated approach.

Another significant change has been in environmental standards on issues such as the separation and recycling of waste. This has led directly to differences in the way waste is managed. The need for different containers for different waste streams adds to the storage requirements on floors and in loading bays, and while not perhaps significant in terms of weight the number of containers to be moved puts added pressure on the goods lifts in terms of the number of journeys needed to service the demand.

The use of goods lifts during the construction of the building has always been a major consideration in the planning of construction logistics. However, there are now wider considerations in this approach as the goods lift become an integral part of planning how buildings get built. The greater use of 'jump lifts' is testament to the changes in building techniques which are only set to put greater emphasis on seeing the goods lift as a 'tool' in the building process.

4 WHAT ARE GOODS LIFTS USED FOR?

Initially it is probable the goods lifts will be used to aid the construction of the building. While passenger lifts may also be used in this fashion these are generally dedicated to the movement of people and smaller items such as tools.

The early use of lifts, particularly the goods lifts, brings major benefits to the construction process allowing for the removal of builder's hoists, the closing of the building façade and with that the ability to make the building water tight. The goods lifts have in many instances a greater capacity and speed than the builder's hoists, meaning people, equipment and materials can be moved faster. Thus, they can be significant factor in the construction logistic plan as the building works progress. However, should the goods lift provided be insufficient to service the construction phase of the works then significant costs can be incurred together with prolonged programmes brought about by the inefficiencies of retaining the external hoists and late closing of the building.

The capacity, size and number of goods lifts are factored into the logistics planning of both the construction completion and the following fitout works. The need to accommodate large pieces of plant and equipment together with fit out materials and furniture, as tenants take occupation, forms a key part of the logistics planning. Together with the material sizes, consideration needs be given to the size and weight of the protective packaging and the means of moving the materials. All of these are major consideration in the goods lift design.

While having been in existence for well over 30 years the use of the 'jump lift' is increasingly applied to high rise buildings as a means of bringing the benefits of the permanent capacity, with perhaps slightly lower speeds, to the building process and serves to emphasise the importance of early beneficial use lifts in the building process.

It is important to remember that every lift that enters beneficial use must be fully compliant with the Lift Regulations and CE marked. Following the beneficial use period, the lifts are generally fully refurbished and retested before being finally handed over for client and public use.

Once the building is completed and operational the goods lifts fulfil several roles, mainly divided into the daily inward and outward movement of goods and materials. The inward movement of consumable office materials, electrical items, maintenance equipment, chemicals, postal/courier deliveries, food and building fit out materials, etc. are required. As is the outward movement of general office waste and equipment, food waste, redundant fit out material, empty delivery trollies and bins.

The use of the goods lifts by 'back of house' staff to move around the building is a key part of the functioning of the building and needs to be facilitated. This can include the distribution and collection of post as well as courier deliveries or collections.

In addition, plant replacement strategy is a key part, albeit not a very regular one, in which the goods lift plays a vital role. The ability to carry both the heaviest and largest items of plant form part of the usage required. In some instances, a 'special' service is required, where the load to be carried exceeds the capacity of the lift. The additional load requirement will depend on the circumstances but an increased capacity of between 15-25% of the rated load is not uncommon.

Increasingly there is a tendency to use good lifts to move exterior glass panels, which due to the design of the façade or limited capacity of the Building Maintenance Unit (BMU), cannot be taken up the outside of the building. In these circumstances the goods lifts form part of the façade maintenance strategy and need to accommodate the building exterior glazing panels.

Use by the emergency services is also a consideration. While not recommended in British Standard (BS) 9999:2017 [1] it is highly likely that the goods lift will be the only lift of sufficient size in the building to fulfil such a function. The ability to accommodate stretchers to move injured people is a necessity that is largely overlooked in design and only becomes apparent when the service is needed, but not available. Stretcher sizes are increasing as the amount of medical aids attached increases. The ability to accommodate this important requirement is essential and needs to be factored into the sizing of door widths and car depth if the goods lift is the only means of moving injured people in such a way.

The transportation of dangerous or hazardous materials is mostly associated with toxic or contaminated substances. However, other materials can fall into these categories such as general cleaning materials, water conditioning salts, glass, materials with high dust content, anti-corrosion liquids for water systems and food waste. Although these are not necessarily heavy the need to transport such materials may require special arrangements involving goods lifts.

5 HOW DO GOODS COME INTO AN OFFICE BUILDING?

Most modern office buildings have loading bays either at ground or basement levels. Access to the loading bays for commercial vehicles can be via a ramp or, where space is limited, by vehicle lifts.

Loading bays by design can accommodate anything from cars and small vans to articulated lorries. Most day to day deliveries, especially in inner city locations, are by smaller vehicles up to 7 tons but can be up to 'large truck' size (circa 20 tons). The use of vehicle lifts will pose a restriction on the size and weight of vehicles, but, generally accommodating dedicated waste removal vehicles is a criterion in the design of the lifts. The use of vehicle lifts also requires a more stringent management of the loading bay logistics. With finite loading bay capacity additional vehicles must be held at street level if there is any turn-around time delay or the vehicle lifts are out of service. This is a major problem in congested city centres and effectively means the operation of the loading

bay, and the operational logistic of the building are contingent on both the reliability of the lifts and the efficiency of the loading bay operation itself.

Goods are generally transported either loosely packed or preloaded onto wheeled cages, pallets or small trollies. The trend to palletised packing brings considerable benefits in terms of consolidation and material/manual handling as they are generally moved by fork lift or 'pump up' truck. Examples are shown in Appendix A.

To effectively manage the loading bay logistics deliveries are 'booked' in advance and sometimes held at a marshalling location a little way from the building before being called forward to be unloaded. Verification of the delivery is generally sought with the tenant/customer before being distributed to the relative floor. This distribution can either be by the delivery company or the customer collecting the goods at the loading bay. In both instances it is the goods lift that will provide access to and from the loading bay.

As part of the loading bay design, short periods of storage for both inwards and outward movement of goods or waste is required. It must accommodate wheeled cages, pallets and separated waste containers all of which adds to the logistics of the loading bay operation.

Most large office buildings also have a 'courier' and mail room where smaller deliveries, that arrive on an ad hoc basis are received, and from which they are distributed via the goods lifts to their destination

6 GOODS MANAGEMENT STRATEGIES WITHIN OFFICE BUILDINGS

Many large buildings operate 24 hours a day 7 days a week. Some businesses operate 24/7 and if not, cleaning, maintenance and refurbishment works are often undertaken out of business hours, at nights and at weekends.

General office deliveries of are mostly between 6.00am and 10.00pm while office cleaning and waste removal are between 7.00pm and midnight. If the building has a public restaurant, then goods lifts will need to be available until the early hours to restock, remove food waste, clean and provide access for staff.

To effectively manage the loading bay and maximise the use of the goods lifts it may be necessary to coordinate the vehicle delivery booking system with a goods lifts booking system. This ensures unloading of the vehicles is aligned with the quick distribution of the goods to their destination. Lifts are taken out of service and switched to independent/priority control and driven from within the car to move the goods from the loading bay to their destination floor providing the most effective and efficient use of the loading bay and goods lift resources. Set time 'slots' are allocated during the day for this type of delivery and distribution arrangement. The timing of these slots is dependent on the approach taken by the loading bay manager, but it does provide knowledge to goods lifts users as to when lifts are 'free running' and available and when service may be restricted/limited.

By example, a 1m sq. ft (circa 93,000m²) office building [2] has an average of 536 deliveries/collection recorded per week based on a 6-day week, some 89 each day. Over a 16-hour day this equates to an average of one delivery every 10/11 minutes during the day, but with greater frequency during working hours this can reach see vehicles arriving every 6/7 minutes.

For buildings that only operate during business hours the need for tight logistics management is potentially greater. Depending on the location, function and use of the building there may be less flexibility to deal with all the building's needs. If this is the case, it is possible the provision of goods lifts should be greater.

Regardless of building opening hours it is almost certain that the need to operate goods lifts will exceed office hours. The recognition and provision of this forms part of the overall successful strategic approach to logistics management.

7 BUILDINGS WITH PUBLIC ACCESS FACILITIES

Other facilities the building may offer also need careful consideration. Public access spaces that have restaurants, retail outlets and viewing areas all need to be serviced to varying degrees.

Public restaurants in the upper parts of buildings, especially at roof level, require a dedicated goods lift service. Generally, these types of facilities have long opening hours. In a few cases the restaurants can be open 24 hours a day.

The levels of services required in such circumstances are considerable and it is not always fully appreciated that while separate provision is made for public access to these areas the same is not the case for the movement of goods.

Restaurants, in particular, have significant servicing needs, not simply food in and waste out. Other service provision includes the movement of:

- Restaurant staff
- Cleaners and cleaning materials
- Drinks and beverages.
- Disposal of separated waste
- Laundry
- Cooking oils and condiments
- Furniture
- Special function requirements.

Spillages from fresh food containers are common. Smells are a significant problem, especially related to the carrying of fresh meats and fish and the removal of food waste. In many instances these issues are not appreciated or considered, either in the operation of the building, or the design of the lift car interiors.

When considering the recent issues experienced at several tall buildings with roof top restaurants the lack of a dedicated goods lift is a significant problem. This has resulted in one of the goods lifts provided for general use being effectively taken over to service the restaurants, to the detriment of goods service to the remainder of the building.

Retails outlets and small coffee shops at high level in the building also merit special consideration. The service need of these types of outlets may not be as intense as restaurants but the ability to provide a satisfactory service is just as important.

8 BUILDING DESIGN FOR GOODS LIFTS

While the design of the goods lift itself is important the environment in which it operates, and the building interfaces are of equal importance. Sufficient space in front of the lifts and in the goods lift lobbies is essential. The ability to accommodate the storage of trollies, bins and stacked boxes/bags is necessary if these are not to be left in tenant spaces. This is especially important where

restaurants and food outlets are concerned. Spillages or leakage from food/beverage containers and smells are things to be considered and are obviously things to be avoided in public or office areas.

The configuration of two or more goods lifts is also an important factor. Ideally, they should be arranged to be next to each other facing into a common lobby. The 'L' shaped arrangement should be avoided unless the lobby is of sufficient size to accommodate the required off floor storage.

Where more than one goods lift is provided they should operate as a group and not be distributed within separate cores. This arrangement leads to inefficiencies in both the service and use of the lifts.

Where lifts do not have lobbies on the floors it has to be accepted that temporary storage of goods and possibly food will be in view of the tenants and that office space will need to be sacrificed to accommodate stored items. This could also mean potentially flammable waste is stored on floors adding to the fire risk and will need consideration as part of the fire strategy. It is also important that stored materials do not obstruct fire exits.

Where goods lifts do open directly into tenant space the need for robust finishes is a consideration. The walls and floors areas, around the front of the lifts, are prone to damage from trollies, pallet trucks and bins. Floors are susceptible to damage from high point loadings of wheels and it is essential that the design of the floor in front of the goods lifts is suitable for the loads likely to be imposed. Raised flooring and carpet are not as robust as concrete floor finishes found in many goods lift lobbies.

At the loading bay level, and possibly other floors where dedicated goods lift lobbies are provided, the cleaning regime may include the areas being hosed down and scrubbed. In these situations, consideration should be given to raising the landing entrance sill 25mm (similar to firefighting lifts) to prevent water ingress into the shaft.

Where the lift entrance is fitted with a full depth architrave the inside landing edge of the architrave should be reinforced to a height of between 1.0 and 1.2m from floor level and robust architrave fixings provided. This area is subject to damage as goods are move into and out of the lifts and will soon show the effects of a poorly designed architrave arrangement.

Finally, from a maintenance perspective the finishes to the landing doors and architraves needs careful consideration. The use of stainless steel is attractive but once damaged is unforgiving in terms of repair, it generally means the door or architrave needs to be replaced. This is expensive and in the case of architraves is not always practical. This leaves few options but 'skinning' the architrave is one, albeit not necessarily an easy solution.

Painted doors and architraves provide a practical solution and can be filled and sprayed easily if damaged.

9 ESTABLISHING THE CAPACITY OF GOODS LIFTS

Goods lifts come in an array of capacities and configurations and both ISO 4190 [3] and BS-EN-81-20 [4] provide guidance. However, some types of goods lifts have limitations. Machine room less (MRL) goods lifts for example generally have a maximum capacity of 3000kg and are limited to speeds of circa 1.6m/s. 'Traditional' goods lifts, those with a machine room, however are capable of both higher capacities and speeds. Guidance provided in the British Council of Offices (BCO) 2015 [5] edition recommends that goods lift should be capable of travelling from the loading bay to the top floor served in 60 seconds.

While recognising any limitations the starting point should be in determining if the lift is to be used for plant replacement. The need to accommodate heavy or large items of plant is vital to the plant

replacement strategy and this requirement is key in establishing both the load capacity and size of the lifts. It generally transpires that the heaviest piece of plant is not necessarily the biggest, so while the heaviest is to be accommodated, the need to cater for large, but lighter, items will inform the height and depth of the car. As we know floor area determines the capacity of lifts and it may be that the need to carry large but light items increased the platform area and hence the capacity.

One area that has not been considered greatly in the past is the ability to replace trees and large plants. These are becoming more popular in office atriums, terraces and roof gardens and are often overlooked, especially if the original installation was accomplished using the site crane during construction.

The next criterion is the ability to move building fit out materials. One consideration here is the building floor to floor height. This is likely to determine the length of fit out materials such as dry lining boards (standard lengths of up to 3.3m), glass partitioning, door and door frame heights. While lighter than anything required for plant replacement they are generally longer. Packaging and the means of transportation also needs to be considered as part of the assessment.

The next consideration is the use of the goods lift during construction. This is usually required, and items such as scaffold equipment, piping, valve units, electrical switch gear, large cable reels, temporary protective screening, and other construction materials needs to be considered.

The use of pallets during construct and fit out together with the extensive use of Eurobins for waste removal, should also form part of the assessment. The ability to fit both the large standard 1200m x 1000mm pallets and the 1240mm x 1070mm 1100 litre Eurobins efficiently into the car makes for a far more efficient use of the goods lifts both during construction and in the general long-term operation of the building.

While car length and width are a major factor, the car height is equally important. The ability to stand and stack materials vertically allows for a more efficient means of transporting goods. Car heights of up to 3.5m allows better service during construction and for the subsequent fit out works during the life of the building.

The provision of ‘top hats’ on the car roof is also something to be considered. This is very much dependent type of lift, the depth of the car and the roping arrangement. While many MRL lifts have underslung cars, traditional goods lifts may have sheaves mounted on the car top. With some traditional 2:1 roping arrangements the position of the car top sheaves and supporting steelwork may limit both the possibility of fitting a top hat and its size. In addition, the safety issues related to accessing a higher level at the rear of the car top for maintenance personnel may mean it does not provide the solution intended.

Along with the car size and height comes the need for wide, tall lift entrances. Doors 1400-1600mm wide x 2400 - 2700mm high will accommodate items such as pallets, Eurobins, and wheeled trollies. Stillages, wheeled high sided trollies, used for the movement of glass, plasterboard and large flat items will also be accommodated within these entrance sizes. Providing large entrances also gives flexibility and is an efficient means of loading lifts quickly.

The assessment of service needs during construction and the on-going operation of the building should form the basis of the goods lifts size and capacity. Without this the risk is the goods lift provided will be inadequate for the building’s needs leading to an ‘operationally sick’ development that will never be right. This detracts from the ability to let/sell the building and hence reduces its attractiveness to potential tenants/buyers.

10 ESTABLISHING THE NUMBER OF GOODS LIFTS REQUIRED.

To establish the number of goods lifts required the starting point is to look at existing guidance.

The 2015 edition of Chartered Institute of Building Services Engineers (CIBSE) Guide D [6] provides a means of establishing the number of goods lifts in office buildings and is based on a calculation of the floor area.

For usable floor areas up to 10,000 m² one lift

For each additional 20,000 m² one additional lift.

The load capacity of lifts is detailed as a minimum of 1600kg with consideration of lifts up to 2500kg.

It is understood this criterion is mainly based on experience and has been in existence for some considerable time.

From the authors research there is no other formally published criterion that is used to formulate the number of lifts required although reference to goods lifts, their operation and use are covered in many books and articles published over a number of years.

BS5655 Pt 6 [7] covers the design and use of goods lifts but does not consider the wider management of logistics in buildings or the means of establishing the number of lifts required

11 POINTS OF REFERENCE RELATED TO WASTE MANAGEMENT.

In terms of waste management BS 5906 (2005) [8], provides guidance on waste management from a wide variety of different buildings and covers a comprehensive spectrum of waste types, many of which are not particularly associated with offices.

Interestingly the guidance details waste in terms of volume as opposed to weight.

Table 1 of the standard [8] provides information on the volumes of waste created in various types of buildings including offices. For offices the stated waste generated is 50 litres per person per week. Some quick calculations will soon establish the volume for a large office building and we will see an example of this below.

12 BUILDING WASTE GENERATION

12.1 Establishing the building population

To arrive at the levels of waste generated in office buildings, using BS5906 [8] guidance, it is first necessary to establish the building population. The population is derived from a density factor, whereby each person is allocating an area measured in square metres. This is expressed as a ratio such as 1:14 or 1:10, meaning one person to every 14 or 10 square metres of occupiable space.

The space available for occupation is generally referred to as the ‘net internal area’ (NIA). The term ‘utilisation’ is used in association with the NIA and is derived from the total floor area (NIA) less the floor space used for circulation, storage and office facilities (meeting spaces, kitchens, photocopiers, etc.). For most offices the utilisation factor is 80% meaning 20% of the floor area is not occupied.

Population densities in offices have increased sharply over recent years from 1:14 some 15-20 years ago to 1:10 or commonly 1:8 today. Some high-density areas such as trading floors are occupied at 1:6.

12.2 Waste generation

If the criterion in CIBSE Guide D [6] is used as a starting point then the provision of a single goods lift is in theory suitable for a building of between 10,000m² and 29,999m².

Given the published guidance has been in existence for some considerable time it is reasonable to assume that building population densities were either 1 person to 12m² or 14m² (1:12 or 1:14) at the time of writing.

Based on a density of 1:14 this would give the following range of population:

Minimum 10000 x 0.8 (utilisation) = 8000m²

8000/14 = 571 people

Maximum 29999 x 0.8 = 24,000

24000/14 = 1417

Range 571 – 1417 people; a spread of 846 people.

If we were to take the same criteria but at a population of 1:8 we have the following:

Minimum 10000 x 0.8 = 8000m²

8000/8 = 1000 people

Maximum 29999 x 0.8 = 24,000

24000/8 = 3000

Range 1000 – 3000 people; a spread of 2000 people.

Both the minimum and maximum points increase:

Minimum: 1000/571 x 100 = 175%

Maximum: 3000/1417 x 100 = 211%

Both show significant differences based purely on using the floor areas and relating it to population. At the extremes the population can vary from 571 to 3000 people, served by a single goods lift.

Using the waste criteria detailed in BS5906 [8] these figures translate into the following volumes:

Per week:

571 x 50 = 28,550 litres/week

3000 x 50 = 150,000 litres/week.

A spread of 121,450 litres a week, a difference of some 425%

Taking a more realistic approach, for example a 46,500m² building (circa 500,000² ft) at a density of 1:8 @ 80% utilisation we have:

46,500 x 0.8 = 37,200

37,200/8 = 4650 people.

Based on BS5906 [8] criteria this would generate a waste volume of 232,500 litres per week or 46,500 litres per day over 5 days.

The use of Eurobins, which come in various sizes measured in litres, is a major means of transporting waste. This can be seen for both domestic and commercial waste where collection vehicles are designed to accommodate various bin sizes as part of an automated process.

If the waste is disposed of in 1100ltr Eurobins this equals 43 bins per day that need to be transported to and from the loading bay. If separation into waste streams is also considered it is quite possible the number of bins could double, albeit they may well be of a smaller capacity.

Waste bin movements monitored each evening in a 1sq ft building [2] with a population density of approximately 1:10 (7435 people assuming full attendance) shows the following:

	Out	Returned	Bin Capacity
Assorted waste	50	50	1100ltr
Residual waste	50	50	1100ltr
Food waste	18	18	240ltr
Bin cleaning	6	6	Various
Totals	124	124	**248** bin movements per night

Bearing in mind that this only considers waste removal then the number of journeys required to cycle the bins is considerable.

While it is necessary to consider the goods in, waste out, approach there are other calls on the services of goods lifts. Interfloor traffic where there is a consolidated tenancy, or one tenant occupies several floors within a multi let building, the use of the lifts by back of house staff, the distribution of post and courier deliveries together with tenant fitout works requiring the movement of both materials and personnel all needs to be accommodated.

13 CONCLUSION

The key conclusion reached to date is that goods lifts should not be viewed in isolation but form part of an integrated approach to the management of building logistics. This approach encompasses a much wider range of considerations than the lifts as standalone entities within the building design.

The size and capacity of the goods lifts can be determined in the first instance by establishing:

- The use of the lifts for plant or glass replacement. The sizes and volumes of items to be moved.
- The sizes and weights of building materials that will be used as part of the building construction and fit out works. Floor to floor heights could be a key factor in determining the lengths of materials to be carried. It should be remembered that packaging and means of moving the items are also a consideration.
- The means of moving the materials; on pallets, in wheeled caged trollies, Eurobins or stillages. Establishing the likely sizes of each and the means of moving goods should inform the car configuration in terms of accommodating the maximum number of pallets, trollies and bins within the car.

The volume of goods, materials and waste to be carried leads to the conclusion that the capacity of the lifts is determined by what needs to be accommodated, both during construction and the operation of the occupied building.

From the above there are multiple factors to be considered when trying to establish the number of lifts required. The current CIBSE guidance [6], based on a calculation of usable floor area covers a wide range of both population levels and waste generation. Other factors such as loading bay capacities and management, delivery patterns, the means of moving goods and the wider understanding of building logistics are all things that need consideration and will form the basis of further research by the author.

From the authors works to date it appears there are two potential methods of establishing the number of goods lifts required:

1. To undertake a complete assessment of the variable factors discussed above and seek to model lift usage using simulation. Establishing round trip times, interfloor traffic demand, delivery patterns etc, is complex given these will vary greatly depending on a number of variables, however, it does merit serious consideration when looking at the wider part goods lift play in managing building logistics. This approach is worthy of further research given the final conclusions may well provide a means of using a simulation programme to establish the number of goods lift required in a meaningful way.
2. To utilise the existing CIBSE Guide D [6] method of equating usable floor space, and resultant population, to the number of lifts required, albeit taking consideration of guidance such as BS5906 [7] and the increased levels of office densities, together with changing delivery and operational patterns of modern office.

The provision of public assessible spaces needs special consideration. A roof top restaurant will certainly require dedicated goods lift provision. Any attempt to make the building goods lift serve the restaurant will have a severely detrimental effect on the operation of the goods service to the remainder of the building if not calculated in from the concept design stage.

REFERENCES

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[5] British Council of Offices (BCO) 2015, Guide to Specification

[6] Chartered Institute of Building Services Engineers (CIBSE) Guide D 2015. Chapter 3 3.13.3

[7] BS 5655-6:2011, Lifts and service lifts. Code of practice for the selection, installation and location of new lifts

[8] BS 5906 (2005) ‘Waste management in buildings- Code of practice’

BIOGRAPHICAL DETAILS

Len Halsey spent a major part of his career with Otis before joining Canary Wharf Contractors in 1998. He is the Project Executive for Vertical Transportation Systems and is responsible for directing Architects, Consultants and Engineers on VT related design matters to meet Canary Wharf and client’s standards. He is a member of CIBSE and is the current chair of the CIBSE Lifts Group.

Appendix A

Typical means of moving goods within buildings.

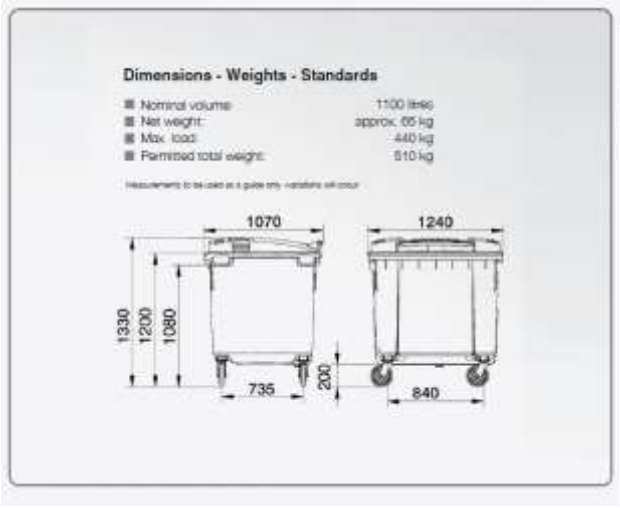
Pallets

The most common size for pallets is 1200mm x 1000mm. Typical loading capacity is 1000kg to 1250kg, but they can be capable of carrying 2500kg. Transported by using hand pulled or electrically operated truck or fork lift. The lift door opening needs to be wide enough to accommodate the full width of the pallet (1200mm) with space to spare to allow for 'operator error' in aligning the pallet with the doors.

Eurobins

These are used extensively in the removal of waste both during construction and the ongoing life of the building. The largest and perhaps most widely used on construction sites and in waste management is the 1100 litre capacity bin

1240mm wide x 1070mm deep and 1330mm high they have a load capacity of up to 440kg.



Caged trollies

Caged trollies are also used extensively in deliveries and distribution of goods. The trollies come in a variety of sizes but can have high capacities of up to 600kg. With 4 wheels and swivel steering they offer a flexible means of managing and manoeuvring goods from the point of delivery to their destination.

Overall dimensions: 735D x 850W x 1690Hmm