Boosting Traffic Handling Capacity in the A♦DAM Tower

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Keywords: lift capacity, multifunctional high-rise, refurbishment, traffic profiles, creative problem solving, simulation, bespoke traffic handling solutions

Abstract. This paper discusses the technical design and traffic handling simulations for the lift system in the transformation of the multifunctional A♦DAM tower in Amsterdam. This former Shell office for 500 employees was refurbished in 2014-2017 for potentially 3,000-5,000 daily users in a dense mix of different (public) functions. It has become an international hotspot for the music & dance industry since. The lift configuration in the tower has been radically redesigned to accommodate this huge increase of traffic (6-10x) through a combination of drastic technical, architectural and organisational measures.

This paper presents these initial measures, as well as the traffic simulations that were performed to analyse their effect. It gives an overview of several practical modifications that were made after commissioning in 2017 to optimise traffic handling even further, based on the size and characteristics of the actual traffic and the waiting times that were experienced in practice. The paper includes the results of a recent traffic measurement and the unique origin-destination matrix that was measured from the actual destination control system.

1 INTRODUCTION

"A♦DAM tower" is a refurbishment project in the North of Amsterdam. This tower was formerly known as "Overhoeks" and is a former Shell office tower. This monumental icon has been transformed in 2014-2017 by replacing the façade, adding a new podium and adding a completely new crown that increased the height to 94 meters. Through this transformation the tower has been given back to the public as a 24/7 leisure hotspot. It has become a tourist attraction and the epicentre of the Dutch Music and Dance industry, which is especially booming in house music and festivals. An impression of the stripped carcass during the transformation and the finished new crown can be found in figure 1.

Figure 1 A♦DAM's stripped carcass (2015) and new crown (2017)

The name "A♦DAM" is an acronym for **A**msterdam **D**ance **A**nd **M**usic and also reflects a common abbreviation of the word Amsterdam. The tower offers a wide variety of functions, such as:

- "Lookout" (indoor and outdoor observation deck on the 20th and 21st floor respectively);
- "Loft" (event spaces, wedding chapel, meeting rooms, members club);
- Boutique hotel;
- Multi-tenant offices (strictly related to the music and dance industry);
- Studio's (recording and short-stay residential);
- Revolving restaurant and other top food & beverage facilities;
- Several clubs and bars.

A vertical section of the multi-functional stacked tower can be found in figure 2.

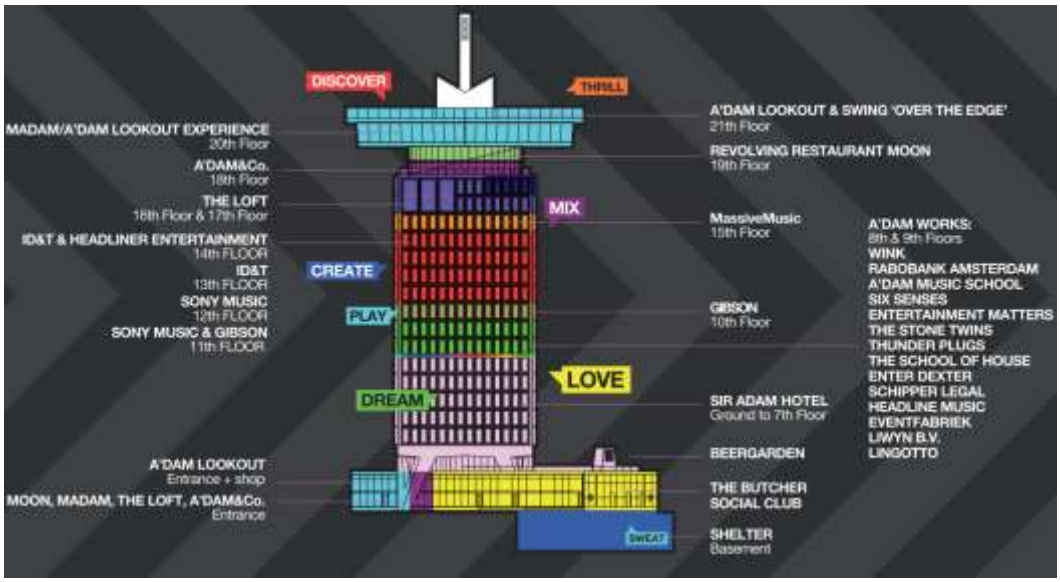


Figure 2 Vertical section of A♦DAM's multifunctional stacked lay-out

2 EXISTING BUILDING AND LIFTS

The tower was originally designed by architect Arthur Staal and opened in 1971. It had an original height of approximately 80 meters and offered four traction lifts with a nominal load of 1,275 kg and a nominal speed of 1.75 m/s. It had conventional group controls and serviced approximately 500 office employees. The tower was sold by Shell to the Amsterdam Municipality in 2009 and offered for sale in a public competition in 2012. A group of investors from Amsterdam (Duncan Stutterheim, Sander Groet, Hans Brouwer and Lingotto) won the competition and transformed the tower into A♦DAM. Figure 3 shows the former silhouette of the building with the modest original crown, figure 4 shows the original lift diagram with stops till the 18th floor.

3 MODIFICATIONS (DESIGN PHASE)

3.1. General

For the new A♦DAM tower the daily number of visitors was anticipated to potentially be 3,000-5,000. This range is due to potential growth in the tourist functions and due to seasonal variations. The tower itself can accommodate approximately 900 people simultaneously, the enlarged 45° rotated crown can hold an additional 600 people. To transport these flows a rigorous change in the lift lay-out and their functional use was required, as well as an unconventional mixing of flows to accommodate the dense, diverse and non-traditional traffic patterns in this building. Fortunately, the client and main

users embraced the idea of mixing different user groups in the lifts, because it enforced the sharing character and the 24/7 attitude of the building. This vital measure and several other initial modifications are described in the sections below. The potential gains of multifunctional lift sharing can be found in [1]. A more extensive description of some of the other measures is included in [2].

Figure 3 Overhoeks Shell Tower in 1971, "Tower for sale" in 2012

3.2. Technical modifications

To serve all the new functions in the tower and specifically in the increased public crown the lift lay-out was modified dramatically. The old and new vertical lay-out can be found in figure 4. The horizontal lay-out is shown in figure 5. The following technical modifications were applied to the lift lay-out for capacity reasons:

- The existing lifts 1 through 4 (1,275 kg) were replaced by new lifts A through D with higher nominal speeds of 3.5 m/s (lift A) and 3.0 m/s (lifts B through D);
- The nominal load of lift A was increased to 2,500 kg to serve as the main shuttle lift to the Lookout (observation decks). For these shuttle rides an "Experience mode" on car controlled operation was introduced. This mode provides an enhanced thrill ride, including lighting and sound effects and a higher acceleration/deceleration rate of 1.2 m/s^2. This rate was initially intended to be even higher but appeared limited by the available room for the lift machine;
- The lift group in the existing core was expanded with an extra lift (lift E - 1,275 kg - 1.6 m/s) that serves the hotel levels in the bottom half of the tower;
- The service range of lifts A and D was expanded beyond the existing highest floor (18^{th} floor) to the new crown levels (19^{th} through 21^{st} floor);
- The new 5-group was equipped with destination controls for capacity reasons, due to the diverse range of serviced levels per lift and for easy integration with access control systems;
- To optimise the available capacity in the new 5-group even further, six local lifts (6 through 11) were added in the podium and the crown for wheelchair access, parking and goods storage. These lifts support the handling of local traffic, concentrate the traffic flows and limit the number of stops per cycle in lifts A through E. They also provide the possibility to reduce the number of main entrance floors in the central core to only one (ground floor) and switch off several other levels from normal operation. Only 13 out of 21 upper floors are served in normal operation (including the manually operated Experience mode), the rest is accessible by key-card authorisation (for mobility impaired users and goods), stairs or local lifts only.

Finally, to emphasize the exuberant and welcoming character of the tower and maximise the traveling experience all the lifts have different and in some cases rather extravagant finishing.

3.3. Organisational and architectural requirements

To support the traffic handling even further, the following organisational and architectural arrangements were required:

- The mixing of different types of users in the main 5-group in the tower's core. The flows were merged into combined lobbies and share lifts together. Study had shown that offering dedicated lifts in the tower for all major user groups would require at least 7-8 lifts in the main core. The required space and budget for this solution was not available. Mixing flows increased the handling capacity significantly and was required in this tower. See [1];
- The uncoupling of external delivery times and internal distribution times for hotel, Lookout and Loft, by generally disallowing simultaneous external and internal goods deliveries. For this purpose, access to additional storage area in the basement was introduced by providing goods lifts 7 and 8. This enabled the internal distribution in lifts A through E to be organised within slow hours, mitigating potential capacity shortage in these lifts during peak hours;
- The use of dedicated lifts during specific time windows, for instance for dedicated Lookout service, special events (such as conferences, launch parties and weddings) in the Loft and goods distribution;

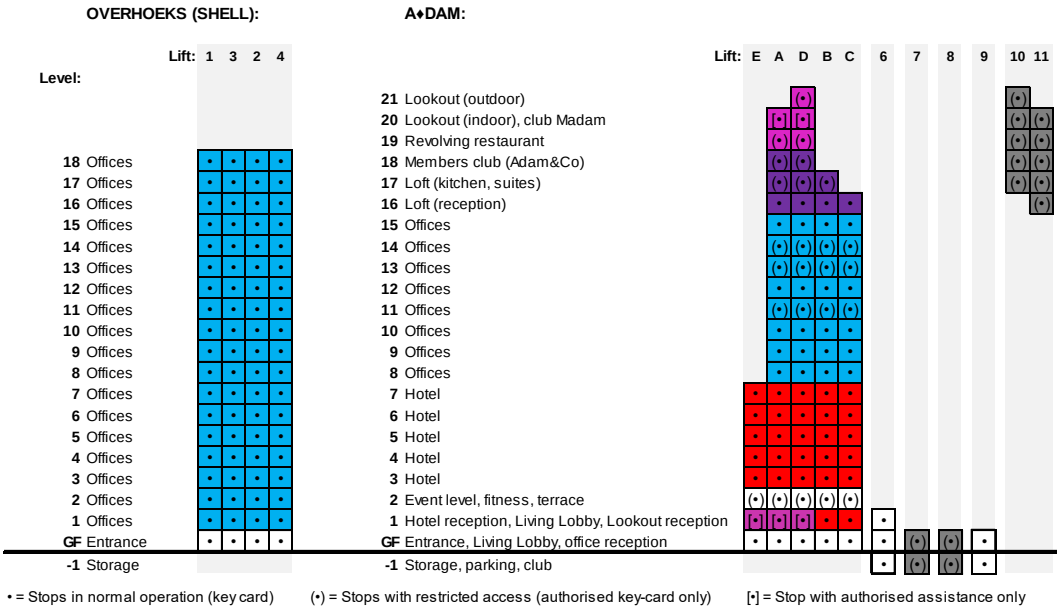


Figure 4 Vertical lift diagram of A♦DAM Tower - before (left) and after (right)

Figure 5 Horizontal lift plan (ground floor, after)

- The positioning of the reception desks for the hotel and the Lookout on the 1st floor, separated from the office reception on the ground floor. This was done to optimise people flow, to concentrate shuttle traffic and for security and commercial reasons. The Lookout received its own reception, lobby and ticketing services on the 1st floor. For this purpose, the lift lobby on this floor was physically split. Figure 6 shows an illustration of this flow separation. These split reception areas and lift home floors for the office/hotel section and the public Lookout section also enable the functional split of A♦DAM into a tower zone and a crown zone. This can be seen in figure 7. No intensive traffic between these zones was originally intended, only authorised VIP and goods traffic.

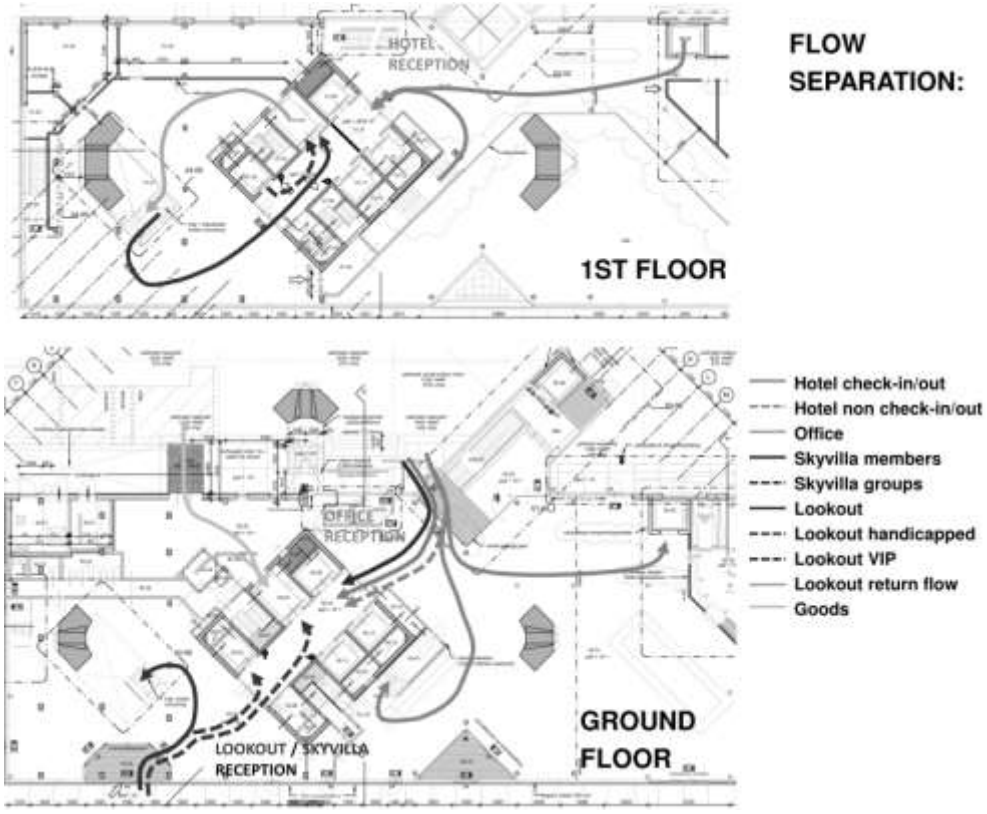


Figure 6 Flow separation: multiple entrances and vertically split main lobbies

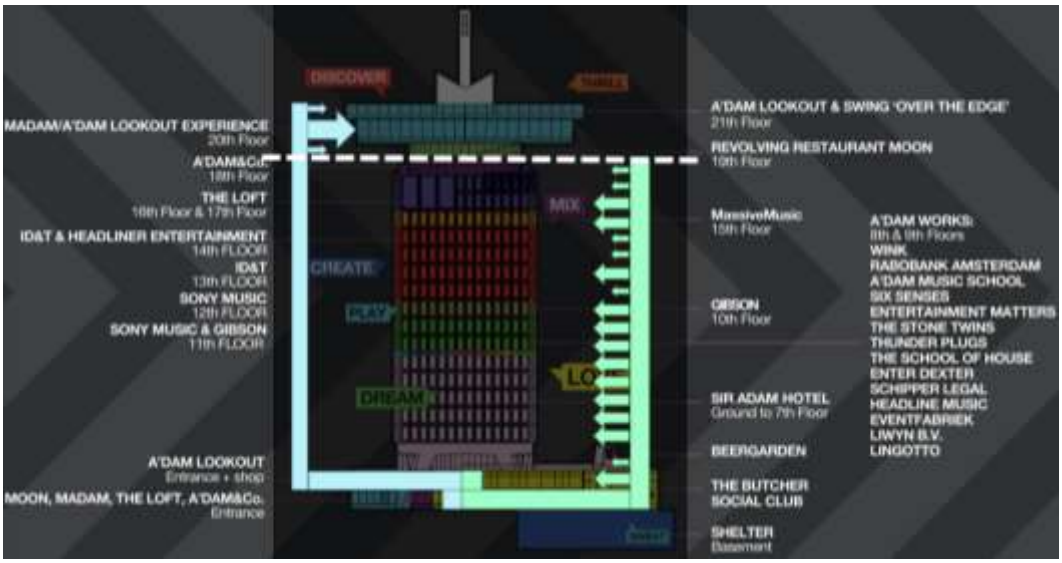


Figure 7 Split main lobbies and zones in A♦DAM: tower and crown

4 TRAFFIC PROFILES (DESIGN PHASE)

The complexity of the originally anticipated traffic profiles in the A♦DAM tower is illustrated in the daily profiles in figure 8. These profiles were estimated with the clients in the design phase, based on the potential traffic density after completion, with a maximum population several years after commissioning. They show the combined anticipated traffic demand for people and goods transportation in the central 5-group.

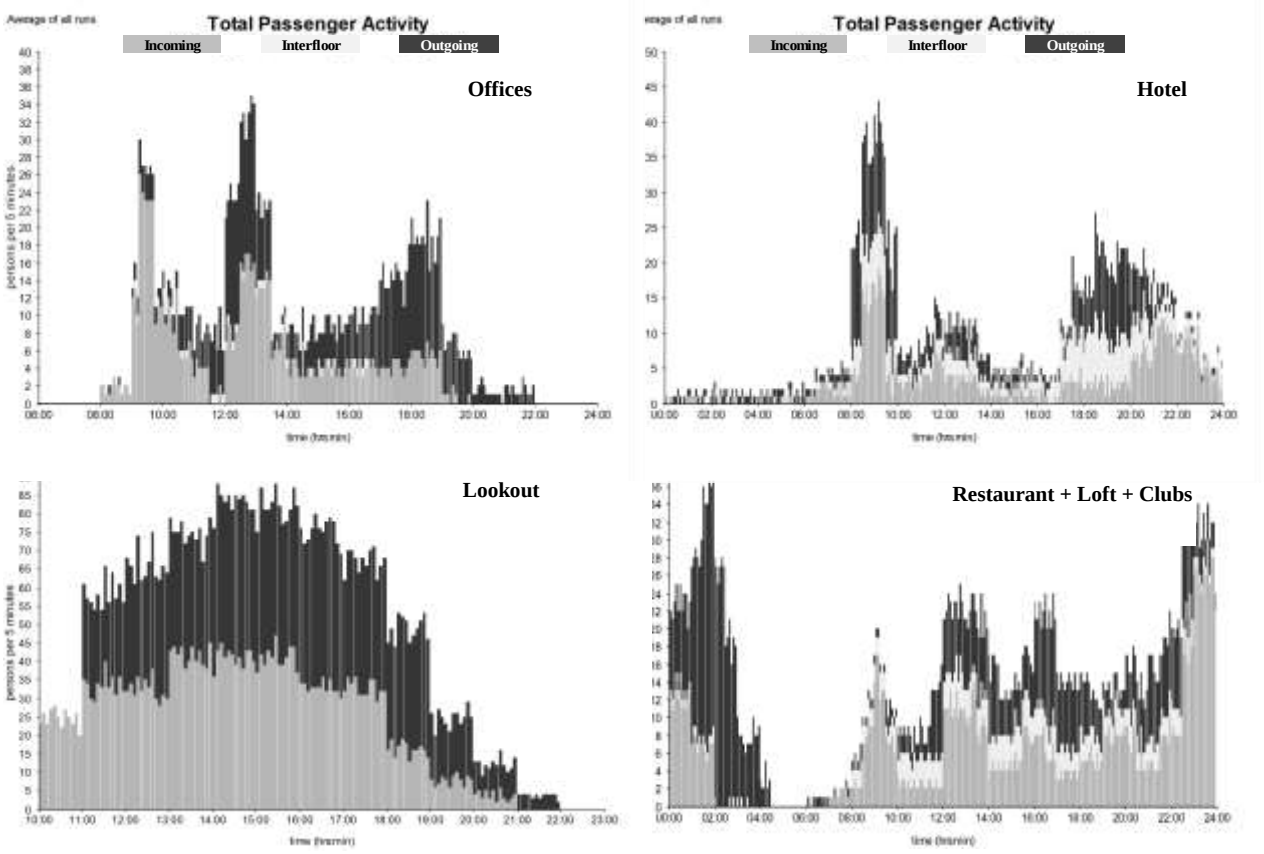


Figure 8 Isolated design traffic profiles per user group

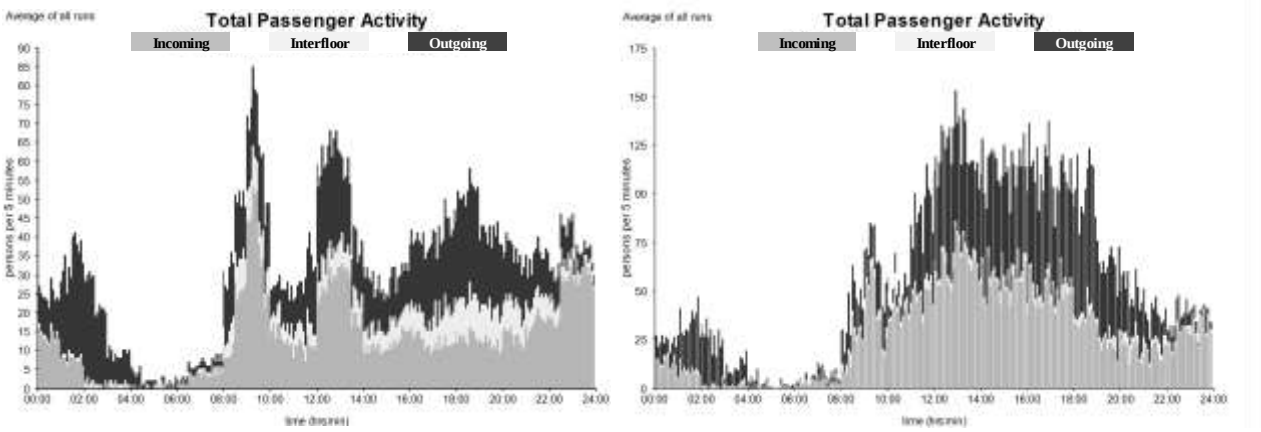


Figure 9 Daily total traffic for A♦DAM: Excluding (left) and including (right) Lookout traffic

The profiles for the office and hotel resemble typical daily patterns for these common functions. The combined profile of the restaurants including the clubs and the Loft is rather unique. The forecast of the maximum Lookout traffic pattern is quite evenly spread during tourism hours, but is dominant in absolute numbers. An average Lookout dwell time of 45 minutes was assumed. These graphs do not yet include any special events, such as conferences, weddings and/or (musical) launch parties. The general idea is that these movements will take place in the Lookout shuttle additionally.

The anticipated maximum number of daily transports studied was approximately 9,000 excluding the Lookout visitor movements and over 16,000 including these movements. The numbers reflect the potential maximum traffic density several years after commissioning. The combined traffic flows in this final phase can be found in figure 9. It shows the daily traffic rhythm prognosis with and without the Lookout traffic.

5 TRAFFIC SIMULATIONS (DESIGN PHASE)

To analyse the effectiveness of the initial design modifications from section 3 and the anticipated traffic profiles from section 4 numerous simulations were performed to identify the potential waiting time development during the day for the final phase traffic [3]. In figure 10 the resulting waiting times predictions are shown with and without the Lookout traffic, but without a dedicated Lookout shuttle. The service without the Lookout traffic will be "excellent", the combined service including this traffic will be only "moderate" – "poor" in the afternoon.

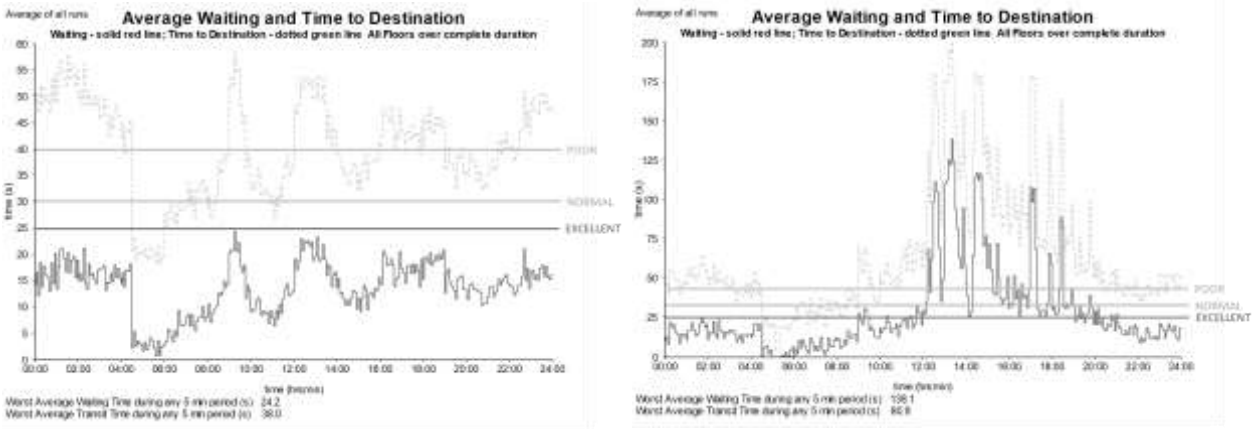


Figure 10 Waiting times without (left) and with (right) Lookout traffic, all lifts A-E available (no dedicated Lookout shuttle)

In figure 11 the intense Lookout traffic has been isolated in a dedicated shuttle lift. This shows to be advantageous in the afternoon for all users involved, especially during the Lookout peak hours.

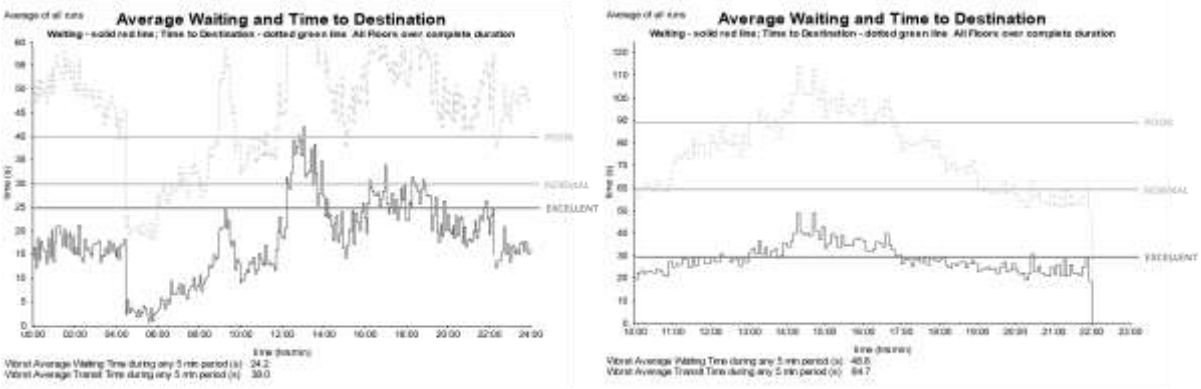


Figure 11 Waiting times in lifts B-E without Lookout traffic (left) and dedicated Lookout traffic in shuttle lift A (right).

6 CONCLUSIONS AND RECOMMENDATIONS (DESIGN PHASE)

From the design phase traffic analysis and lift simulations with the maximum future population the following conclusions were drawn for serving the full population on a busy day:

- The transportation capacity will be sufficient for normal busy day operation. The set of technical modifications, organizational restrictions and broader opening hours (compared to standard office use) provide a potential capacity boost of over 800% compared to the initial traffic handling of the original Overhoeks lift system;
- To serve the potential Lookout traffic in A♦DAM a dedicated shuttle will be required;
- Even with the maximum population present the average waiting time over the whole day will be approximately 30-40 seconds, which should be considered adequate for this multifunctional (existing) tower;
- In the morning peak waiting times will be “excellent” (20-25 seconds), but only if the Lookout shuttle is available to assist in the busiest combined peak hour between 8:00 and 10:00 h (office and hotel peak). During lunch hours and the afternoon/evening peak the waiting times will be “normal” (30-40 seconds). Lookout visitors will have an average waiting time of 30-50 seconds, which can be considered “excellent” for such a feature. Some users will however experience 2-3 times higher waiting times on levels with a reduced number of lifts in service (mainly on the 1st, 17th, 18th, 19th and 21st floor);
- The highest waiting times will potentially be encountered during the lunch peak, while the office has its dominant peak, several restaurants are open (including hotel services) and the Lookout shuttle is in dedicated operation for the observation deck guests.

From the provisional traffic analysis, the following organisational recommendations were made:

- The Lookout shuttle is required to assist lifts B-E for handling the combined hotel and office morning peak between 8:00 and 10:00 h. These functions have their breakfast peak (two-way traffic) and incoming peak more or less simultaneously, even though the office peak will take place significantly later than in regular office towers, due to the nature of the business involved (music and dance scene);
- The above mentioned morning peak restricts the Lookout opening hours to start no earlier than 10 h. After the morning peak a dedicated shuttle can then be made available during Lookout and club opening hours from 10:00 h till 6:00 h the next morning. During

weekends and holidays lift D can join the shuttle service for more capacity. On these days, this lift can be removed from regular service because the offices will be scarcely populated;
- A dedicated time window for goods transportation for all functions is required. Goods can be distributed in lift A in a restricted early morning window between 6:00 and 8:00 h. The transport capacity in this two hour time window is sufficient for all anticipated 150-175 daily goods movements. For incidental hotel back-of house flows outside of this window lift E can be used to a limited extent;
- It is crucial to introduce a reliable means of access control in the main lift core, to prevent unauthorized users from misusing the system by selecting direct travels to stops that have been restricted for capacity reasons. Also, the potential "lift tourism" due to the anticipated attraction of the tower and interest in other lifts (all lifts have unique finishing) than the Lookout shuttle has to be prevented;
- Peak traffic for special events will preferably have to be handled in the Lookout shuttle (lift A). During the day there will be sufficient capacity in this lift to allow momentary shuttle rides to the primary event areas on the 2nd and 16th floor. The waiting times for Lookout guests will obviously increase momentarily, but this is acceptable for such an attraction. Special events should not start before 10:00 h to prevent waiting time interference with the hotel and office morning peak;
- The issuing of key-card authorisations after commissioning should start strictly and conservatively to allow for optimal traffic handling conditions for all parties involved. Only if the (initial) traffic handling volume and/or waiting times are lower than anticipated these authorisations can be issued more freely.

All above recommendations were integrated into the design. Special attention was given to the intelligent integration of the lift destination control system and the building overall access control system through key card authorisation. A wide range of different authorisation levels on personal cards was negotiated with all user groups. Cards are issued with individual and adjustable authorisations to provide customised clearance to otherwise closed-off levels in the tower. Authorisation is granted through the destination control consoles with integrated card readers.

7 TRAFFIC HANDLING (REALITY)

After the phased commissioning of the tower in 2016-2017 traffic measurements and visual observations were performed in May 2017 to analyse the actual use of the lifts and traffic handling quality. The following observations were made:

- The Lookout traffic was initially less intense than anticipated, while traffic handling for all other functions was close to saturation at times. This was not caused by a higher than expected traffic density, but mainly by the following deviations from the original setup:
  - There appeared to be an improper degree of authorised travelling to/from limited access levels, resulting in suboptimal traffic conditions. Partially this was caused by the insufficient restriction in the issuing of cards. Also, the anticipated integration with the required access control systems was not delivered on time and not tuned correctly. This caused leaks in the system;
  - For special events lifts B, C and D were often used instead of Lookout lift A;
  - The strict separation between the tower and the crown section was not maintained stringently: over 8% of the traffic appeared to be interfloor traffic between these zones. Office and hotel guests were offered direct trips to/from the crown instead of using the dedicated shuttle from the podium lobbies;
  - There was a lot of interfloor traffic between the crown floors and the 8th floor, where the back-of-house and office for the Lookout and Loft had apparently been located without

consultation. This conflicted with the intended zonal separation between tower and crown (see figure 7);
  - There was a lot of interfloor traffic between the kitchen on the 17th floor and food & beverage functions in the crown. These flows were supposed to use stairs and goods lifts 10 and 11 only;
  - There was a lot of interfloor traffic between the 11th - 14th floor, which was intended to be a 4-floor segment for one dedicated tenant. These floors were supposed to be connected by stairs only from a local reception on the 12th floor;
  - The revolving restaurant on the 19th floor was being served from the ground floor directly through lift D, instead of indirectly by the Lookout shuttle lift A from the 20th floor by stairs;
  - Lift D could be called from the 21st floor directly. This stop was intended for authorised transportation of mobility impaired guests and goods only;
- Doors were often held open by users and even physically blocked for goods and remaining construction/modification transportation, resulting in a decreased availability for all users and a higher failure rate;
- Lifts were cleaned and serviced/modified during peak hours;
- A substantial amount of ghost passengers (people boarding a car without having put in their destination call first) was observed: approximately 10-20% depending on the time of day;
- The volume of transported goods to/from the food & beverage functions in the crown turned out to be three times higher than indicated in the design phase.

Based on the observations the following immediate modifications were advised:

- Extend the goods transportation window to 8:30 h (implemented);
- Introduce nudging of the doors to activate forced closing (implemented);
- Include the 21st floor as an authorised floor and/or deploy permanent personnel for guidance here (implemented);
- Instruct kitchen personnel once again to use the stairs and the goods lifts 10 and 11 only (implemented);
- Shift cleaning and servicing of the lifts to moments outside of peak hours (implemented);
- Apply a stricter policy in issuing key-card authorisations and revoke incorrectly issued cards if possible to prevent suboptimal lift use (implemented);
- Relocate the Lookout & Loft offices in the crown area (preferably to the 16th or 18th floor) instead of on the 8th floor (not implemented);
- Enforce a higher use of stairs in the office zone between the 11th and 14th floor (not implemented).

Based on the potential traffic capacity that should become available when incorporating the optimisations above correctly the following modifications were allowed on client request:

- Allow limited authorised hotel traffic between the ground floor and the 1st floor (reception), although the use of lift 6 is still preferable for this flow (implemented);
- Allow limited traffic directly to the 19th floor restaurant by lift A, although access through stairs from the main Lookout level on the 20th floor is still preferable (implemented);
- Allow groups travelling to/from events in the Loft to use the Lookout shuttle lift A (implemented);
- Allow limited and guided traffic flows for direct access between the Loft and Lookout floors (including restaurant guests) by selling combi tickets with VIP access cards for certain high-profile events (implemented).

8 RECENT MEASUREMENTS

In 2018 the tower can be considered a commercial success in terms of media attention, events and visitor numbers. The restaurants and hotel are usually sold out, offices are fully rented out and event facilities are crowded almost every week. These events tend to dominate the weekly and daily fluctuation in traffic flows. To evaluate the current traffic handling quality the earlier traffic measurements were repeated in May 2018. Data from a 12-day period was extracted from the destination control system [4]. The graphs in the figures 12-16 below were built up from the retrieved data over this period [1)]. Some interesting numbers and observations from the DCS controller data for lifts A through E are:

- The number of registered calls was approximately 45,000 in 12 days and over 4,800 on a peak day (Friday);
- The number of motor starts was approximately 68,000 for 5 lifts in 12 days. For lifts B through D it was between 1,500 and 1,900 per lift on a peak day (Friday);
- The total number of people and goods moved on peak days was 9,000-9,500 in the 5 DCS lifts combined;
- The number of Experience mode trips for Lookout shuttle A was approximately 7,350 in 12 days. On peak days over 5,200 extra visitor movements were handled on car control mode;
- The average waiting time over 24 hours was approximately 23 seconds and the average destination time was approximately 64 seconds (excluding Lookout shuttle service in lift A). In peak hours these numbers increase to approximately 30-35 seconds and 75-85 seconds respectively. On peak days the average waiting time increases further by approximately 20-30% and the average destination time by approximately 15-20%;
- The peak hours appear to be the morning peak (9:00 – 10:00 h) and the late afternoon peak (17:00 – 19:00 h) instead of the originally assumed critical lunch peak. Waiting and destination times in the afternoon peak are the highest, because lift A is in Experience mode handling Lookout traffic at that moment;
- The waiting and destination times to/from the 18th – 21st floor are indeed substantially higher since only a limited number of lifts serve these floors;
- There is still a substantial amount of traffic to/from the floors that are supposed to have a limited accessibility only through key-card authorisation (approximately 17%). This offers room for improvement.

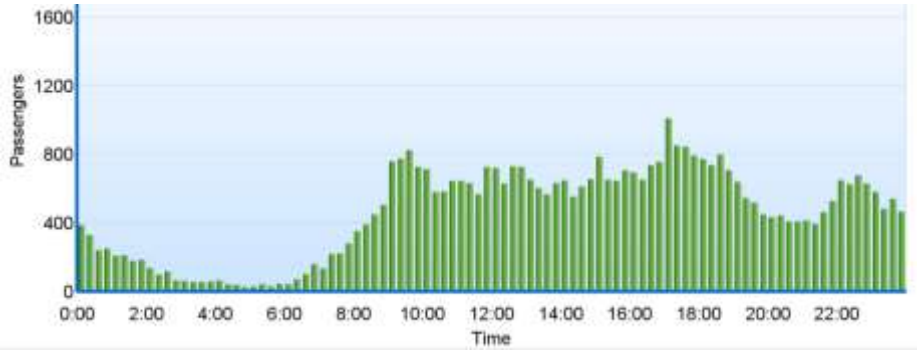


Figure 12 Daily profile of DCS registered movements (© Kone)

[1)] Please be aware that a substantial amount of ghost passengers and most Lookout visitors (handled during activated Experience mode of lift A on manual car controls) are not /included in these graphs. Also these graphs include all traffic over 12 days, without focussing on peak days which appeared to be 20-30% more dense than average days.

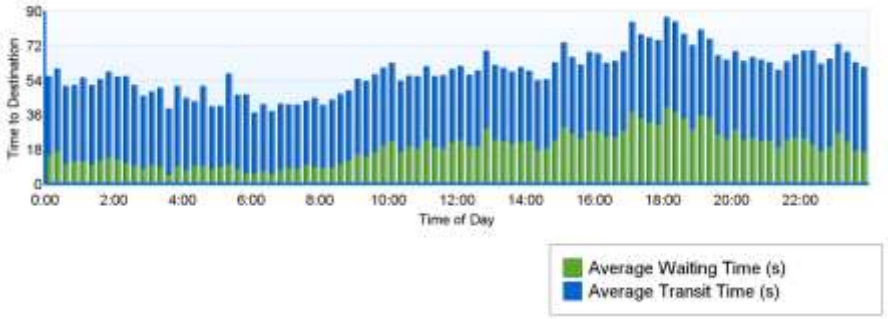


Figure 13 Daily profile of waiting and destination times (© Kone)

Figure 14 Distribution of motor starts over the day (© Kone)

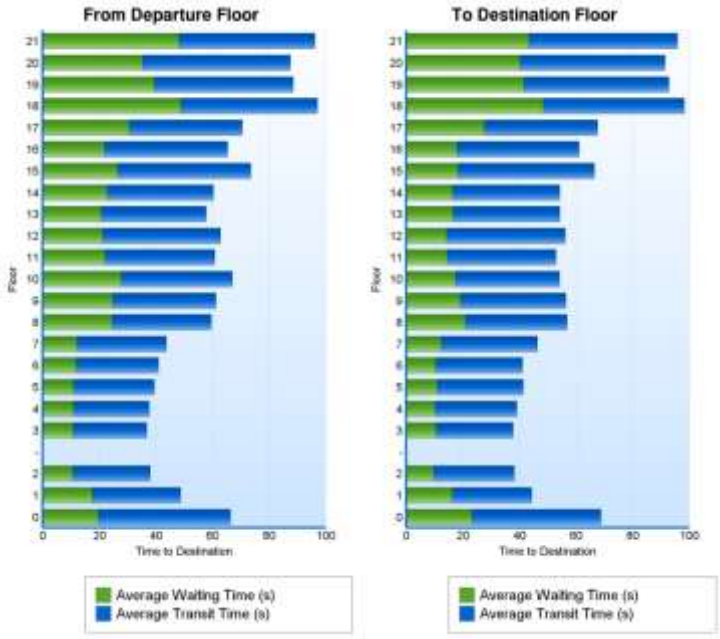
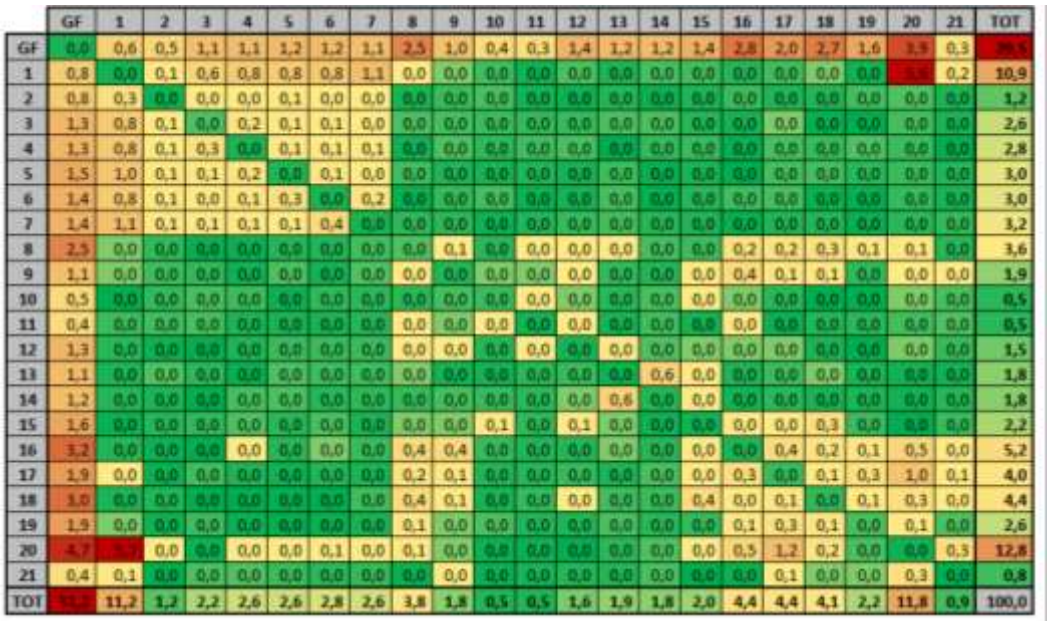


Figure 15 Distribution of waiting and destination times over the height of the tower (© Kone)



	GF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	TOT
GF	0,0	0,6	0,5	1,1	1,1	1,2	1,2	1,1	2,5	1,0	0,4	0,3	1,4	1,2	1,2	1,4	2,8	2,0	2,7	1,6	3,9	0,3	30,5
1	0,8	0,0	0,1	0,6	0,8	0,8	0,8	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	10,9
2	0,8	0,3	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2
3	1,3	0,8	0,1	0,0	0,2	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,6
4	1,3	0,8	0,1	0,3	0,0	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,8
5	1,5	1,0	0,1	0,1	0,2	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,0
6	1,4	0,8	0,1	0,0	0,1	0,3	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,0
7	1,4	1,1	0,1	0,1	0,1	0,1	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,2
8	2,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,2	0,3	0,1	0,1	0,0	3,6
9	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,1	0,1	0,0	0,0	0,0	1,9
10	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5
11	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5
12	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,5
13	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,8
14	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,8
15	1,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,0	2,2
16	3,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,2	0,1	0,5	0,0	5,2
17	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,1	0,3	1,0	0,1	4,0
18	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,1	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,1	0,0	0,1	0,3	0,0	4,4
19	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,3	0,1	0,0	0,1	0,0	2,6
20	4,7	3,1	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	1,2	0,2	0,0	0,0	0,3	12,8
21	0,4	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,3	0,0	0,8
TOT	31,3	11,2	1,2	2,2	2,6	2,6	2,8	2,6	3,8	1,8	0,5	0,5	1,6	1,9	1,8	2,0	4,4	4,4	4,1	2,2	11,8	0,9	100,0

Figure 16 Origin-destination matrix for all traffic (© Kone, [5])

9 FUTURE PROSPECTS

The tower's traffic volume is now at approximately 60% of the anticipated maximum design potential. This is already more than 4x than the original traffic volume handled in the former Overhoeks office configuration. The current quality of traffic handling is excellent and there is room for anticipated further growth in the coming years. That will be necessary, because especially the Lookout attendance will presumably grow due to the following recent developments:

- The opening of the North-South metro line in July of 2018, connecting A♦DAM's location to the city centre conveniently;
- The opening of the THIS IS HOLLAND (3D theme ride) pavilion right next to A♦DAM and the Eye Film Museum, establishing the location as a growing touristic hotspot in the North of Amsterdam in the coming years. Combi-tickets are already available;
- The inclusion of A♦DAM as a recommended must-see in a growing number of (international) tourist sites and brochures.

Should traffic handling become problematic in the future after all the following optimisations are still available (based on the traffic distribution presented in figure 16):

- Eliminate interfloor traffic between the 8th floor (Lookout & Loft office) and the Loft/Lookout floors by relocating these offices to the crown zone mandatorily;
- Add attractive internal stairs between the 13th and 14th floor;
- Block the lift stops on the 2nd through 15th floor in lift D, to free up more of its capacity for the crown area traffic;
- Restrict the amount of authorised member traffic to/from the 18th floor directly by falling back on the original concept (stairs from the Loft reception on the 16th floor);
- Fall back on some of the other original game rules by revoking the allowed deviations regarding for instance the mixing of flows between the crown and the tower and direct access to Loft and Lookout levels other than the 16th and 19th floor;
- Recall a significant fraction of the issued key-card authorisations to eliminate suboptimal traffic handling to/from closed off floors.

Since this tower appears to be functioning like a living organism - it evolves with changing use and the internal flows evolve accordingly – future changes in the traffic handling concept will be almost inevitable. There is and there should be sufficient traffic handling capacity to accommodate this.

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BIOGRAPHICAL DETAILS

Jochem Wit received his MSc degree in Mechanical Engineering with honours from the Technical University of Delft in 1995. He is a transportation and lift logistics consultant at Deerns. He specialises in lift capacity analyses, simulations and logistical studies for the optimal dimensioning of lift groups in high-rise buildings, complex stacked buildings and hospitals. In recent years he has focussed on evacuation using lifts and solving saturation problems in under lifted / over populated buildings. He works at the Transportation & Logistics department of Deerns, an expert group in the field of building related transportation equipment. Jochem Wit was a member of the Technical Committee of the Dutch High-rise Covenant and chairman of the Technical Subcommittee for Vertical Transportation. He was consultant for the lifts and façade maintenance equipment for A♦DAM Tower in Amsterdam.