An Overview of India, Travelling Tall

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Abstract. This paper offers an insight which should go into the design of tall buildings and the potential factors that may influence it, keeping India and Indians in mind. The paper explains how Indian tall buildings are unique vis-a-vis the tall buildings constructed or under construction worldwide. It also details the cultural / lifestyle impact that the buildings have and highlights the precautions the designers need to take to successfully construct, habitable tall buildings. The author also reviews "Transportation systems in buildings, CIBSE Guide D: 2015" in context of India, the vertical transportation practices followed here and how cultural aspects affect the theories.

1 INTRODUCTION

There are many papers being presented across the world, on the latest trends and technologies for construction of a tall building and that there is not yet a technology to change the core of the building midway or post construction. Hence, this paper tries to cover the essential aspects of constructing a technically right tall building with a focus on vertical transportation, which according to the author is the essence of a tall habitable building.

Every country has its own growth curve, and so does India. India did not see tall residential buildings (around 40 floors and around 120m) with lift speeds 4.0m/s (meter per second) and above until 2002. Hence, we are in a very interesting phase where we, as designers, are debating between what the ideal tall building should be and what the precedents are. The learning curve is a very interesting phase to be in. Hence it all begins with understanding the major design requirements of the tall building and then designing it to be habitable post occupancy. Habitable is the word we all need to concentrate on, because a building's success depends on the building services being designed based on the occupant's needs.

2 KEY DESIGN PARAMETERS

This section identifies the key inputs which need to be looked at while designing a habitable tall building. These inputs are listed below:

1. Type and class of the building
2. Location of the building and nearby places
3. The building's population distribution
4. Other service requirements
5. Emergency evacuation
6. Economic impact
7. Project planning
8. Selection of the right type of equipment (lifts/escalators/moving walks etc.)

The following paragraphs try to detail the above inputs with respect to different types of tall buildings from an Indian context.

2.1 Type and class of the building

As per the author's experience, we, as designers, need to firmly decide what type and class of building we want to construct. For example, a pure residential tower, office, commercial tower, hotel tower or mixed use building, luxury or low-income residential building, class "A" or class "C" office building. Of course the Indian market is fluctuating as this is a developing country but we as designers have to take a call on these aspects before the construction starts and achieve the goal of constructing a habitable building. We need to understand that every type of building has its own VT (vertical transportation) requirements. For example, residential building requirements are totally different to mixed-use buildings, and hotels have different requirements to commercial buildings. Also, we need to keep in mind that a 60 storey building is not equal to three 20 storey buildings. Hence, designing a VT system for a tall building is totally a different ball game. As we go tall the VT requirements get complex and all the more difficult to alter. Clarity on what type and class of building we are designing is therefore required.

Some of the VT requirements followed in India are as follows:

1. For any residential building, a minimum of 7.5% of up-peak handling capacity (as per NBC (National Building Code of India) 2005) is to be designed for.
2. Office buildings could be of many types: single tenant, multi-tenant, 24/7 buildings, call centres, etc. For a single-tenant building a minimum of 15% up-peak handling capacity (as per NBC (National Building Code of India) 2005) is to be designed for, whereas for a multi-tenant building a minimum of 10% handling capacity is to be designed for.

Note: Further details are mentioned in heading 3, page 4.

2.2 Location of the building and nearby places

The geographical location of the building is crucial in designing the VT system, particularly for tall buildings as this influences the type of VT system we need to design. This also includes the cultural impact that the location of the building has on the VT system. Even the population of the building can be influenced by the location of the building. For example, the service staff figures could vary depending on the location of the building. Other factors which influence the VT system are: tier of the city, the target customers, exact location of the building (for example prime locality, near to the airport, near to the metro station etc.), wind loads, seismic zone, developer of the building, etc.

2.3 The building's population distribution

The distribution of a building's population primarily comes into consideration in the case of residential and mixed-use buildings. The VT system is influenced by the lifestyle choices of the building's population. While designing, the building population needs to be systematically bifurcated so that there is no mixing of different constituents and they travel hassle free once the building is constructed. VT system compliments the requirements of bifurcation of different constituents.

1. A residential building's population could be bifurcated into residents and service staff which includes the floating and resident service staff. Further details are mentioned below in the section entitled "design considerations in reference to India".
2. In a mixed-use building, bifurcating the population of different sections of the building is crucial. In a hypothetical mixed-use tower where the lower floors are a shopping mall, the middle section is a hotel and the upper floors are residential floors, we cannot expect the residential population to travel with the hotel guests or the hotel guests with the shopping mall visitors. They have to be physically bifurcated with separate VT systems designed for all these 3 constituents so as to avoid any inconvenience to other passengers. In mixed-use

buildings proper thought even needs to be applied while designing the multi-level car parking. Not many Indian buildings have shuttle lifts for parking floors. The debate is always on whether to provide separate parking shuttle lifts or main lifts serving the parking floors. But with time this scenario is changing.

2.4 Other service requirements

As the buildings get taller, all the services (mechanical, electrical, plumbing, air-conditioning, firefighting etc.) get complex in design and need to be coordinated together. For example, a transformer which needs to be carried to the 60th floor has to have a lift which can accommodate it. Also, an observatory deck, which needs to be serviced from the basement, requires pre-planning. Freight lifts are crucial in tall buildings, since these will be used for renovation, material movement (to transfer upright pianos, modular kitchens, marble/granite pieces, furniture etc.). The author has experienced that if meaningful co-ordination between different service requirements does not happen then it ends up with tall structures rather than habitable tall buildings.

2.5 Emergency evacuation

We usually read “do not use lifts in case of fire”, which means that only the fireman’s lift is to be used by authorised personnel to evacuate the entire building. In many buildings, we only have one dedicated fire lift for the entire building, which could be inadequate. Hence for a tall building more thought needs to be given to designing at least one or two lifts per group (depending on the size of the group) as fire lifts. Also, we need to answer whether the fire lifts are capable of evacuating the entire population of the building. How will the elderly, children, pregnant women or disabled people use stairways or fire chutes in the case of fire lifts being unavailable for immediate rescue? Fire lifts can evacuate people in turns and hence the designers need to address this issue as a priority when designing tall buildings, especially in India. Thought needs to be given to providing protected lobbies which in turn will make the lifts available in case of fire on any floor. This thought is being applied in few buildings in India, after mishaps in fire lifts were noticed. The capacity of these lifts is also an important factor to be looked at. The evacuation plan will have to be designed from the beginning, in tandem, with VT design. To achieve this, all the services (mechanical, electrical, plumbing, air-conditioning, firefighting etc.) need to work together and not in isolation, as is usually the case in India.

Another important parameter to be designed for is that the fireman’s “lift shall work at or above 1m/s so as to reach the top floor from ground level within one minute” (Indian Standard 14665 (Part 2/Sec 1): 2000 Electric Traction Lifts). The local (particular to a state) fire norms also need to be accounted for. This aspect of design has more significance in designing tall buildings, which the designers need to understand. Another important aspect for emergency evacuation is the seismic zone of the location of the building. A VT system that is designed according to the seismic zone will not be helpful if the structure does not support the same. The author has experienced cases where the VT system has been designed according to the seismic zone but the structure is not. Hence it has to be a combined design effort.

2.6 Economic impact

Being a developing country, economic considerations are key factors since a project has to be financially viable for it to see the light of day. We Indians are still concerned about the cost of the equipment vis-a-via the VT technology required for the project. We still do not feel the need to adopt the best of the technologies available if it is high on the cost scale. We keep wondering whether high speed lifts, the cutting-edge of lift technology, are worth spending money on. Having said this, there are projects which demand huge freight lifts (as high as 18tons) and escalators travelling up to 13.0m, which is still new for India. However, in many cases the financial implications are still the factor that ultimately decides the VT system in the building.

2.7 Project planning

Project planning is another aspect where designers in India are in the learning process when related to the construction of tall buildings. The designers may fail to understand the intricacies involved while the construction is underway. They tend to ignore the critical aspects such as construction accuracy, vendor's involvement in the project, installation process etc. for tall buildings. Design changes happen at times even mid-way through the construction, and designers try to manipulate the existing systems to work for the changes. In this process most of the times buildings end up having compromised VT systems. It is beneficial that the designers understand the adverse effects the tall buildings have due to improper project planning.

2.8 Selection of the right type of equipment (lifts/escalators/moving walks etc.):

The type of equipment and their detailed specifications are crucial, and designers need to understand this as the environment for maintaining the equipment could be unique. For example:

1. A lift car provided with a top hatch is dangerous in India, since most of the times the rescue operation is performed by the security personnel who are not completely trained or educated
2. The Indian climatic condition requires blowers/fans inside the car, which is usually located in the false ceiling.
3. Due to the type of attire majority of Indians wear (sarees, dupattas etc.), a saree guard is a must in escalators.

3 DESIGN CONSIDERATIONS FOR INDIAN BUILDINGS AND REMARKS ON CIBSE GUIDE D: 2015

Below is the gist of a study made by the author on a few important categories of buildings.

3.1 Residential Buildings

Most Indians are used to getting their daily milk, newspaper, laundry and other items delivered at their doorstep. The important aspect designers need to note is that VT design requirements are crucial for allowing access by service staff such as maids, drivers, deliveries, garbage disposal et al. when the buildings are tall. Additional service staff movement needs to be accounted for as in a tall building they will definitely use the lifts. This usually happens in the morning, which sometimes overlaps with school children going downstairs and office workers leaving home early, which impacts the overall VT performance if dedicated service lifts are not provided. Hence the most important design period for residential buildings across India is morning peak as against the practice followed in the other parts of the world. In continuation to the peak period in residential buildings, the author remarks as follows:

> CIBSE Guide D 2015, clause 3.15.9 on Residential buildings, states that "the commonly used design period for a residential building is afternoon, 5-minute, two-way traffic condition, which is considered the most demanding traffic period". In India the afternoons mostly witness very light traffic.

The majority of the buildings still have gas cylinders being used for cooking, which are taken up the building by lifts. The lifts are also used for garbage disposal from every floor, since garbage chutes are rarely designed. These are the parameters which need planning from the design stage itself to make a building habitable.

The population figures assumed are in Table 1, below:

Table 1 Indicative population figures for residential buildings

Apartment Type	Residents	Service Staff: resident	Service Staff: floating
1 BHK	2 to 3	NA	0.5
2 BHK	2 to 4	NA (0.5 to 1 if servant's room provided)	1
3 BHK	4 to 5	NA (0.5 to 1 if servant's room provided)	1.5
4 BHK	4 to 6	1 to 2	2
5 BHK	4 to 6	2 to 3	2.5
6 BHK	4 to 6	2 to 3	3
Penthouse (5 to 7 BHK)	4 to 6	3 to 4	5

Notes:

1. The above figures are just indicative (as per the author's experience) and could vary depending on the location of the building.
2. The figures in the table usually hold good for tier 1, 2 and few tier 3 cities.
3. Resident service staff includes full time maids/helpers.
4. Floating service staff includes maids, drivers, cleaners, milkmen, paper men etc. Maids, cleaners, milkmen, paper men could be common for the floor(s) or shared between apartments, hence the decimal figures.
5. BHK is "Bedroom, Hall and Kitchen"

Another parameter to be considered in residential buildings is the stair factor (some percentage of population using the stairs, maybe floor 1 and 2 residents). Below is the author's remark on CIBSE Guide D: 2015 on stair factor (clause 3.14.3: Stairs, Page 3-17).

> What if the floor height is a double height entrance lobby or a floor with height of 6 to 8m? Most of the tall/premium buildings in India are designed with higher heights which unable passengers to go up by stairs. Hence, the stair factor has to be a function of the floor height.

In a luxury/high-end/tall building the ratio considered for self-driven to chauffeur driven cars could sometimes be 50:50. Hence, with multi-level car parks being designed, this factor needs to be given thought while designing the shuttle lifts dedicated to parking floors. Buildings in India rarely have a concierge desk, so an additional count for the drivers, cleaners etc who go up the building to collect keys and then go back to the parking floors for cleaning the car or getting the car at the main lobby, needs to be accounted for. The drivers' and cleaners' movements happen in the morning peak itself, hence morning peak is crucial in a residential building as explained above.

3.2 Office Buildings

The population is usually assumed based on the area per person. The area can vary from $4m^2$ per person (for small offices) to $25m^2$ per person (for single tenant office space) on carpet area. If an office building is near to a metro station, then it goes without saying that this could have a great impact on the arrival rate. This is all the more crucial an aspect in a tall building in order to meet the target VT requirements. Regular working hours are from 10:00hrs to 18:00hrs (excluding multi-National Companies, call centres, airports etc.).

Below mentioned are few target VT requirements:

Table 2 Recommended handling capacity as per NBC 2005

Type of Building	Handling Capacity
Office- Diversified Tenants	10 to 15 percent
Office- Single Tenant	15 to 25 percent

Table 3 Recommended Quality of Service in office buildings as per NBC 2005

20 to 25 seconds	Excellent
30 to 35 seconds	Good
34 to 40 seconds	Fair
45 seconds	Poor
Over 45 seconds	Unsatisfactory

Note: NBC 2005 is silent on the requirements of Average Waiting Times for both residential and office buildings.

The author's another remark on "Clause 4.4.2 Mixed traffic, Page 4-2" of CIBSE Guide D: 2015 is as follows:

1. From an Indian context, there are different patterns observed in office buildings during lunchtime. In Multi-National Companies (MNC), occupants usually travel to the common food court or main lobby (to go out of the building). Few buildings also have common areas on every floor for employees who carry their own lunch. Another pattern observed is that meals are served on every desk, and service staff movement is quite high.
    a. The importance of morning peak and lunchtime peak is still what we are trying to understand, hence even today many of the high end buildings have longer waiting periods at lunchtime – as high as 15-25 minutes.
    A common solution to avoid waiting in the queues is that people pack their lunch and go to their respective floors and have lunch on the desk itself. Alternatively, a few people have longer lunch breaks or a multi-tenant building has staggered lunch breaks. Unfortunately, NBC 2005 does not emphasise on the waiting periods at lunch time.

b. Another source of traffic includes smokers exiting the building during morning and afternoon peak periods, making 2 trips per person. They usually go up the building to keep their belongings, then travel back to have a smoke and then travel up to their respective work stations. As such, 3 trips per person happen during peak periods.

3.3 Hotels

While the international norm of 1 lift per 100 keys does work in India, additional service lifts need to be provided since a few of the items such as masala chai, fresh ginger tea etc. cannot be prepared at the room and so require room service. Also, the usual check in and check out times vary depending on the hotel. If the hotel operator is known at the design stage itself (which rarely happens in India), the VT design could incorporate this. Another aspect includes the fact that Indians do tend to celebrate their weddings / engagement-ceremonies / birthdays in a grand way and the needs of a huge crowd (which prefer to travel together) need to be considered when designing the VT system for banquets, wedding halls etc.

Note: Generally, escalators are provided for banquet / wedding halls if the hall is on the 1st or 2nd floor (with nominal floor heights). Lifts are preferred for travel above 3 floors. However, it is advisable to service these banquet / wedding halls by lifts since the attires could be flowy (sarees, dupattas etc.) which could get stuck in escalators or moving walks and are difficult to manage on escalators in a hurry and huge crowd.

3.4 Mixed-use Buildings

With the rapid urbanization and scarcity of land, mixed-use buildings are the way forward for primarily tier 1 and 2 cities. India still has very few tall buildings in this category as precedents and hence Indian designers are in the learning phase of understanding the art of mixed-use developments. An important aspect in designing VT systems for mixed-use buildings is the bifurcation of all the constituents of the building and utilizing the space available in the best possible way. It is known that the ideal VT system changes as per the type of building, hence the same has to be applied to mixed-use buildings. Physical bifurcation of all the constituents is a must for the success of a mixed-use building and a proper VT system facilitates this. Most of the buildings have poor VT systems catering to the service movement (maids, helpers, drivers etc.). Servicing a small building could be managed without specific VT arrangements, but how to service tall buildings without a proper VT design is the question which needs to be answered at the design stage itself.

3.5 Hospitals

Due to the space constraint and the healthcare sector getting better, India has hospitals with more than 5 to 8 floors in tier 1 and 2 cities. These definitely require proper VT systems to cater to the various activities in a hospital, such as emergencies, health camps, visitor movements, etc. The type and size of the lifts are crucial when designing VT systems for hospitals. The author's remark on CIBSE Guide D: 2015 is as follows:

> Clause 3.15.5: "Hospitals", provides that "In Britain, most hospitals are designed on a 2-3 storey low-rise principle, although many city hospitals have high rise elements. Lifts are provided in UK low rise hospitals mainly as a means of moving bed bound patients and for service activities moving floor to floor as staff and visitors use the stairs."
>
> In hospitals, in the west or far-east very few visitors visit or are allowed; whereas in India we tend to visit the patient or new-born with the entire family. Hence separate visitor lifts (sometimes with specific visiting hours) need to be provided. With the healthcare sector blooming in India, tier 1 and 2 cities have many hospital buildings which are 6 to 7 storeys high as against the info quoted above. In tall buildings visitors cannot be expected to use the

stairs. These are crucial design considerations which can have a major impact on the VT system.

4 SUMMARY

With the world getting smaller day by day, all thanks to the internet and social media, there are still very unique characteristics of the way people live and it is called the culture or lifestyle of the city / country. While one tends to follow the precedents for the latest VT design or technology, designers also need to appreciate the fact that cultural differences cannot be changed / ignored when designing the VT system for any building. Of course, tall buildings have some fixed design criteria which need to be adhered to, but this needs to be addressed keeping in mind the cultural impact the VT system has. Though the aim is to construct world class buildings with respect to the architecture, design, technology etc., the additional services factor (maids, helpers, drivers, etc.) cannot be ignored, which primarily differentiates Indian buildings from buildings across the world. The goal needs to be set at constructing habitable tall building and not a tall structure. In this paper the author has tried to point out a few crucial aspects in designing tall buildings in India.

5 LITERATURE REFERENCES

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BIOGRAPHICAL DETAILS

Anandi Khandekar is the Regional Director-South at TAK Consulting Pvt. Ltd., currently located in Bengaluru, India. She has been involved in E&E design for various prestigious projects including super high rises, including IndiaBulls Sky at Mumbai, Supernova at Noida, Krrish Square at Colombo and Nathani Heights at Mumbai, to name a few. She has published articles in Elevator World and Elevator World India. She is also the committee member for drafting the National Building Code of India 2015 with specific responsibility for drafting the chapter on building design guidelines for elevators and escalators. She holds a bachelor of engineering degree in Electrical and Electronics discipline.