Chapter 2: Population- and traffic density patterns

Summary: The monitoring and recording of traffic and performance data is a permanent activity of "Intelligent destination" group controls and the basis of their learning abilities. This chapter shows a method to visualize population- and traffic density patterns in a format that allows the statistical analysis of traffic patterns. The data from analysis will facilitate reasonably accurate traffic predictions. Population- and traffic density patterns are also of great interest for building managers and owners. Know-how of populations and traffic flows in existing buildings is essential for planning new buildings.

Population- and traffic density patterns

The prime task of a group of local elevators serving a building or building zone is to satisfy the demand for UP and DOWN transport capacities with **best-possible waiting- and travel times** under all traffic conditions. The demands for transportation are the ever changing INPUT of a group of elevators. Its OUTPUT is traffic. Traffic density patterns disclose the demand for elevator services because in a **well designed building the demand for elevator services and elevator traffic are identical**. Traffic happens shortly after demand.

Data from traffic monitoring disclose the populations of individual floors and the entire building or zone. These population patterns disclose how the populations of each floor and the entire building vary during each day.

This chapter describes a method to visualize "population- and traffic density patterns" because an understanding of the fluctuating demand for elevator services and traffic conditions is essential for appreciation of the elements that together define elevator service quality. Chapter 9: “Population- and traffic monitoring” describes in detail the methods for traffic density monitoring and conversion of relevant data into population- and traffic density patterns.

The monitoring and recording of traffic data is the basis of the **learning abilities** of "intelligent elevators". It provides the artificial intelligence system of "Intelligent destination" group controls with a data source for accumulating **artificial experience**.

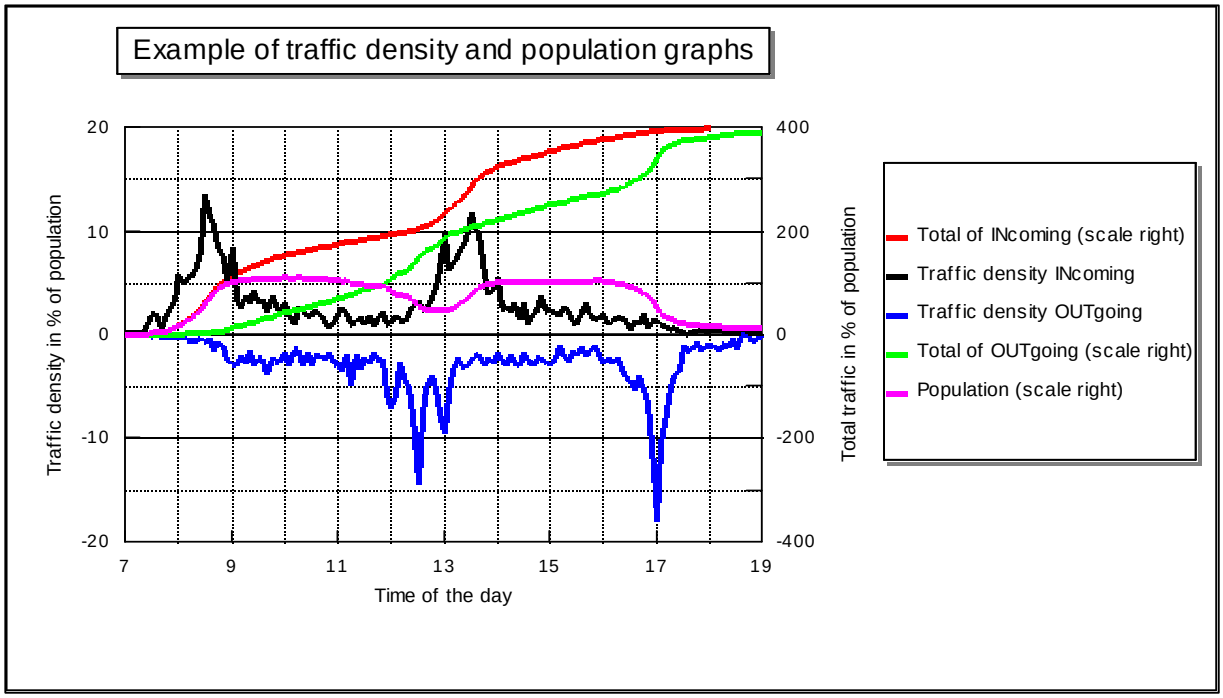
To visualize population- and traffic density patterns we divide elevator traffic in three types:

- UP traffic from floor zero to upper floors
- DOWN traffic to floor zero from upper floors
- Interfloor traffic UP and DOWN between upper floors

By dividing each hour in twelve 5-minute periods for measuring traffic densities it is possible to make **population- and traffic density patterns** for any time period in any building.

The diagram below shows a typical population- and traffic density pattern for a full working day from 07.00h to 19.00h, i.e. it shows the traffic during 144 periods of 5 minutes each in an **imaginary** office building. For each period the **UP and DOWN**

traffic has been set as a <u>percentage of the building population</u>. The black line represents the UP traffic percentages for each 5 minute period. The blue line represents the DOWN traffic percentages. The left-hand scale applies for these two graphs.



The red line represents the total of all UP traffic densities in percent of the population from floor zero for any period from 07.00h onwards. The green line represents the total of all DOWN traffic densities arriving at floor zero for any period from 07.00h onwards. The purple line is the difference between totals for UP and DOWN and shows the momentary building population at any time of the day. The right-hand scale applies for all 3 graphs. Total traffic IN and OUT during the day is assumed to be about 400 % of the population.

In multi-tenant office buildings interfloor traffic is usually rather small and to keep the picture simple interfloor traffic is not included in the diagram.

“Population- and traffic density patterns” will vary from building to building, depending on the size and activities of their populations. The total traffic during a day may well exceed the 400 % assumed for the above graph.

Groups of "intelligent elevators" will automatically produce these patterns for each and every floor, the entire group and for all groups of a building.

Use of traffic patterns

The traffic patterns produced by "intelligent elevators" support three important functions:

- Provide data for the **artificial experience** data structures of the **traffic prediction module**

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- Provides graphs and statistics for the **building management information system**
- Provides essential know-how for the **planning of new buildings**

Traffic monitoring also produces several other patterns or lists of data, for example, service call data, round trip data of cars with car loads, number of stops etc.

Artificial experience

Analysis of traffic patterns for all working days of a week or specific days of the week over longer periods will yield average **patterns of the behavior of the population** that enable an intelligent control system to predict traffic conditions.

The ability to make reasonably accurate predictions of traffic conditions, i.e. the ability to anticipate changes in traffic conditions is essential for intelligent controls. It will enable intelligent controls to be pro-active in respect of setting conditions for control of the cars that will assure best-possible service qualities for anticipated traffic conditions. The control will make the appropriate settings before traffic changes occur. Intelligent controls will check predicted conditions by comparison with momentary traffic data. Control conditions can be adjusted immediately if necessary. Intelligent group controls are highly dynamic pro-active systems. Early last century this task was done by elevator attendants and their supervisor. We could say that existing re-active, i.e. non-intelligent groups, are “flying blind”.

The comparison of anticipated traffic conditions - in terms of predictions for car load, numbers of service calls, number of stops - with momentary data implies that "intelligent elevators" possess **sensory capabilities**, i.e. the control can “feel” whether traffic conditions and trends are in line with anticipated conditions.

Building management information system

When building managers can see the population of each floor and how it fluctuates during the day it enables them to influence population behavior, for example, to reduce traffic peaks in consultation with their tenants. Various aspects of building management information systems are reviewed in Chapter 9.

Elevator planning

The most important input for the planning of a tall building are estimates of future building populations and the traffic density patterns these populations are likely to generate. Populations tend to increase when a building gets older. During the writing of this book it was not possible to obtain meaningful population- and traffic density graphs for existing buildings. For this reason the sample graph of this chapter depicts an imaginary building. This is a remarkable situation because for modern elevators it is relatively simple to generate these graphs.

Groups of "intelligent elevators" will routinely deliver population- and traffic density patterns in combination with service quality data. These data will be of great help for the planning of new buildings.