Elevators for the Commerzbank Building in Frankfurt

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ABSTRACT

This paper describes the chronology of the elevator planing and the effect of the elevatoring system on the design of the high-rise buildings layout. Elevator system and its adaptation to the architectonic building design and the modifications of buildings design during the planning phase will be explained at the example of the New Commerzbank High Rise Building.

Fig.1: The New Commerzbank Headquarter in Frankfurt/Main Germany

Basic Information
Architect is Sir Norman Foster & Partners, London.

Involved elevator consulting engineers:
J. Roger Preston & Partner, Berkshire Great Britain.
(competition and first phase till April 1992)
Lerch, Bates & Associates Ltd. (LBA)
(April 1992 till September 1992)
Jappsen+Stangier Oberwesel GmbH
(December 1991 till Summer 1998)

Autumn 1991
The elevator system in the competition concept is a low rise and a high rise group with 7 elevators in each group. But not all levels are served.

In the normal office areas the elevators serve every third level. In the board office areas the elevators serve each level. The low rise group serves the levels: G (ground level), 5, 8, 11, 14, 17, 20, 23, 26, 29, and 32. Five elevators of the high rise group serve the levels: G, 32, 35, 38, 41, 44, and 47. Two elevators of the high rise group serve the levels: G, 32, 47, 50, 51,52, 53, 54, and 55. Two freight and fire fighter elevators serve all floors.

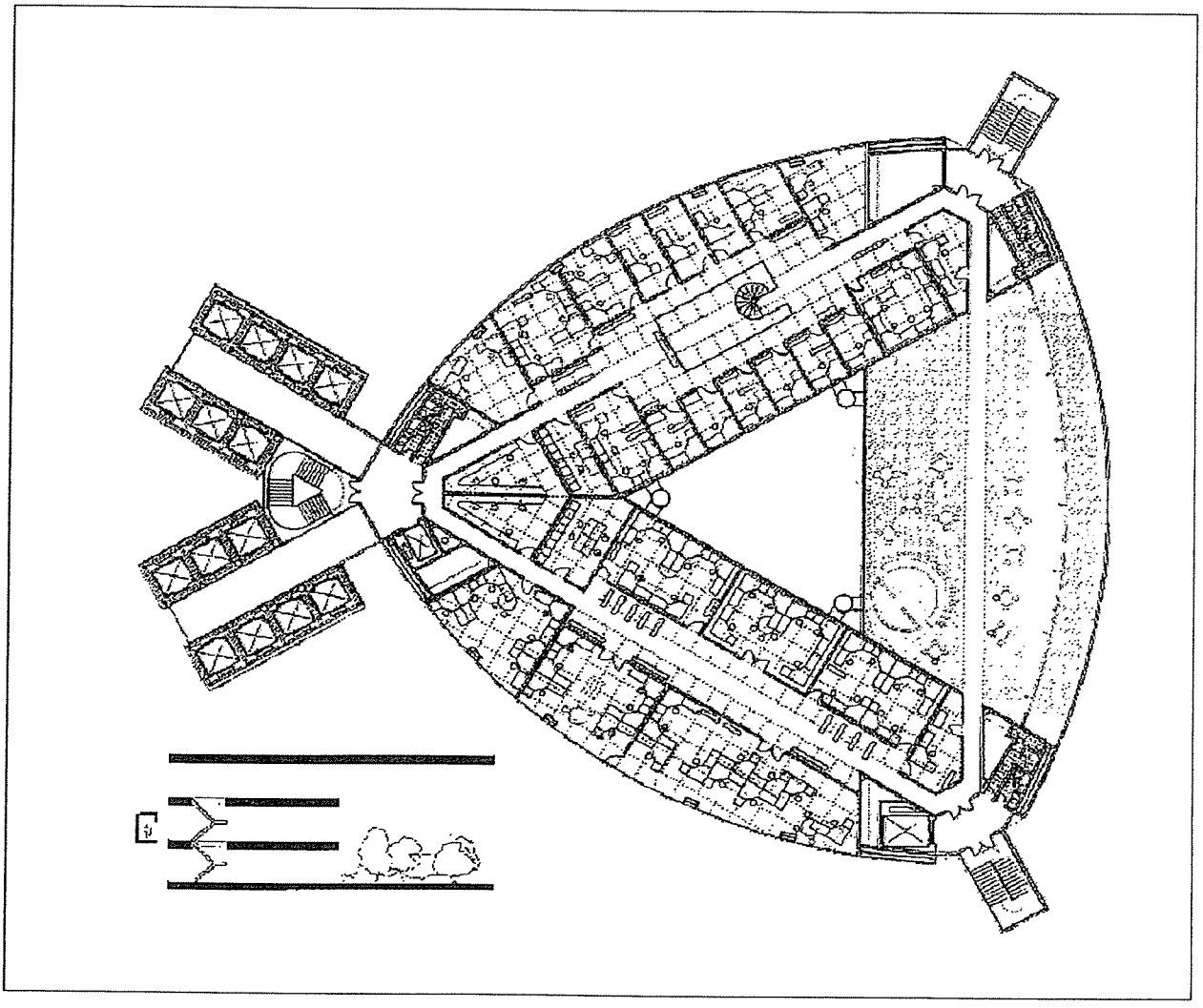


Fig. 2: November 1991 Competition Draft; Typical Floor with Elevator Core in Front of the Garden

Passengers have to use the low rise and the high rise group, to reach their offices. If an office is not on a served level, passengers have to use one stair up or down.
A peculiarity of the building design are the "Skygardens", located in every third floor. The skygardens are three floors high and the next higher skygarden is always 120 degree staggered.
The skygardens bring light to the rooms at the inner facade, and are on the other hand communication areas for the three levels adjacent to a skygarden. Each garden level and both upper levels constitute a village. The architectural draft is contradictionary regarding the served levels in the village. It is not clear, if the elevators have to serve the garden levels or the floors above, in the middle of each village.

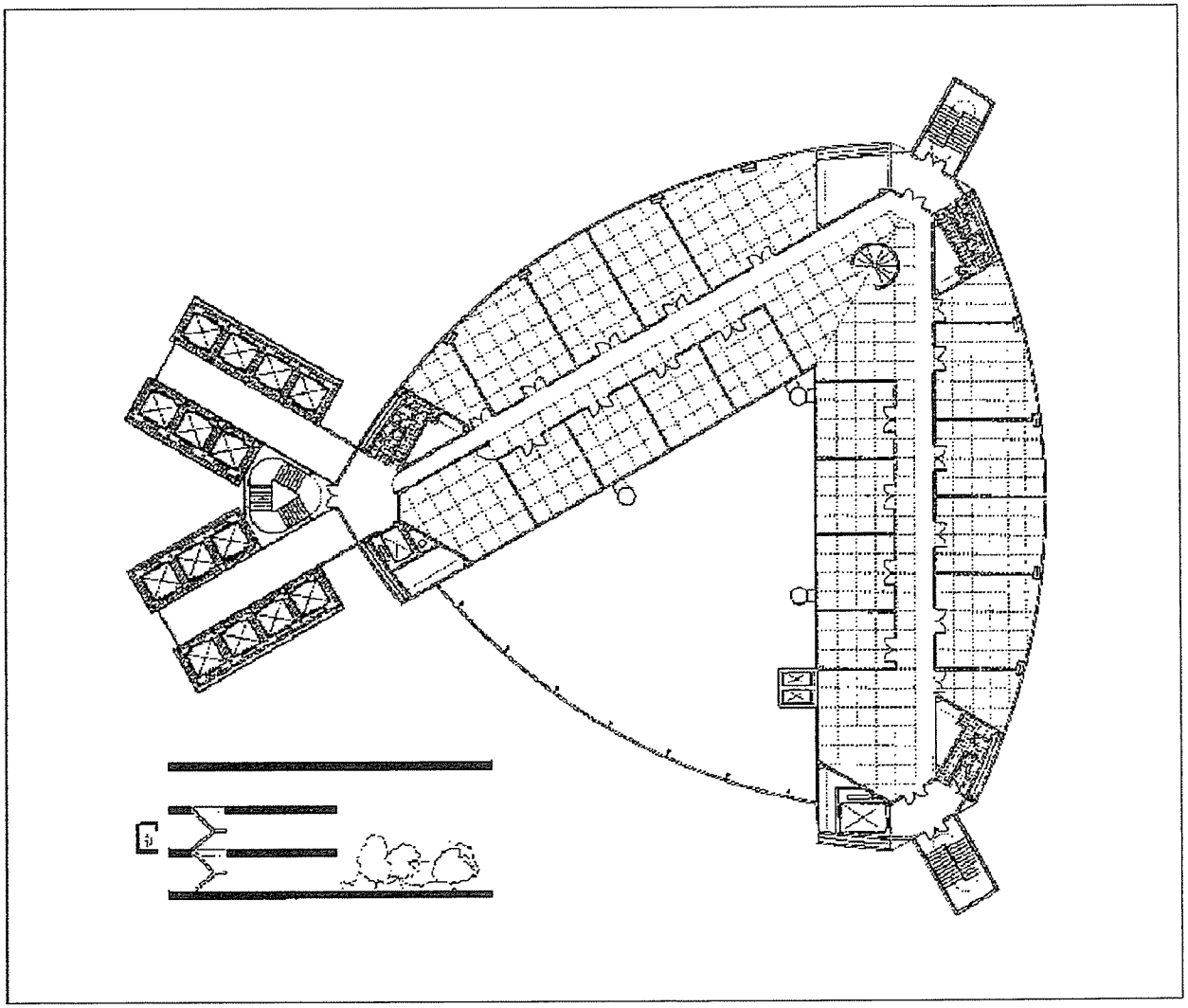


Fig. 3: November 1991 Competition Draft; Typical Floor with Elevator Core beside the Garden

December 1991
The Commerzbank AG asks us to check and to survey the elevator design.

On 16th Dec. 1991 we have a first meeting with representatives of the bank, the architects, and the engineers of J. Roger Preston & Partners.

During this meeting we receive the competition documents and the architects explain the concept.

January 1992
On 21st Jan. 1992 we formulate our Statement for the competition layout:

1. Elevator accessibility from outside the building
   The elevators are well arranged.

2. Elevator accessibility inside the building
   The accessibility of the elevators inside the building should make it possible to have direct connections with short ways between the different departments and between all members of the staff. This is the purpose of concentration of administration within one building only. The distances to reach the elevator cores are too long.

3. Valuation of the internal and external traffic
   For the function of the new buildings a good internal accessibility of the elevators is very important.

4. Implementation of the stairs into the vertical traffic
   We think, it makes sense to implement the stairs into the vertical traffic concept. But at high rise buildings the requirement of fire resistant doors and the lobby in the way make the use of stairs difficult.
   For handicapped people, load carrying people, people carrying bags, suitcases, brief cases etc., it is a not possible or it makes unwelcome strain to move heavy fire resistant doors to get access to the stairwells and to use the stairs

   Result: The traffic design in the building must allow to use the building in an optimal way. Extensions and reductions of departments within the building with a minimum of removals must be possible.
   It is not acceptable that the organisation structure of the bank has to be adapted to the buildings traffic concept. It has to be achieved that the internal structure of the building gives all possibilities of use and does not limit the organisation and not seclude certain persons.

Beginning February 1992
Architects and engineers look for alternative elevator solutions to have the possibility to serve all floors. The result of this evaluation is, that the outside located core, the so called "fishtail", is to small.

Mid February 1992
The architects present a new building ground plan with three elevator cores in the three corners of the building. The fishtail core is eliminated.

Mid February until mid of April 1992
Many alternatives are worked out and discussed with a tremendous number of elevator core alternatives. The target of this is, that all office levels can be reached in the core opposite to the gardens, with the result to have the shortest possible ways to the office areas. Solutions can be seen in Fig. 4 and 5. The problem of this solutions is the correspondence of every floor to the special elevator core. The orientation for the user at the ground floor becomes difficult.

The solution with low rise, mid rise and high rise group has the following assignment:

Core 1 low rise group with stops in level: 5 - 18.
Core 2 mid rise group with stops in level: 19 - 33.
Core 3 high rise group with stops in level: 34 - 54.

A solution with stops on every level opposite to the gardens, the assignment looks as follows:

Core 1: stops in level: 5 - 6, 13 - 15, 22 - 24, 31 - 33, 40 - 42.
Core 2: stops in level: 7 - 9, 16 - 18, 25 - 27, 34 - 36, 43 - 45, 48 - 54.
Core 3: stops in level: 10 - 12, 19 - 21, 28 - 30, 37 - 39, 46 - 47.

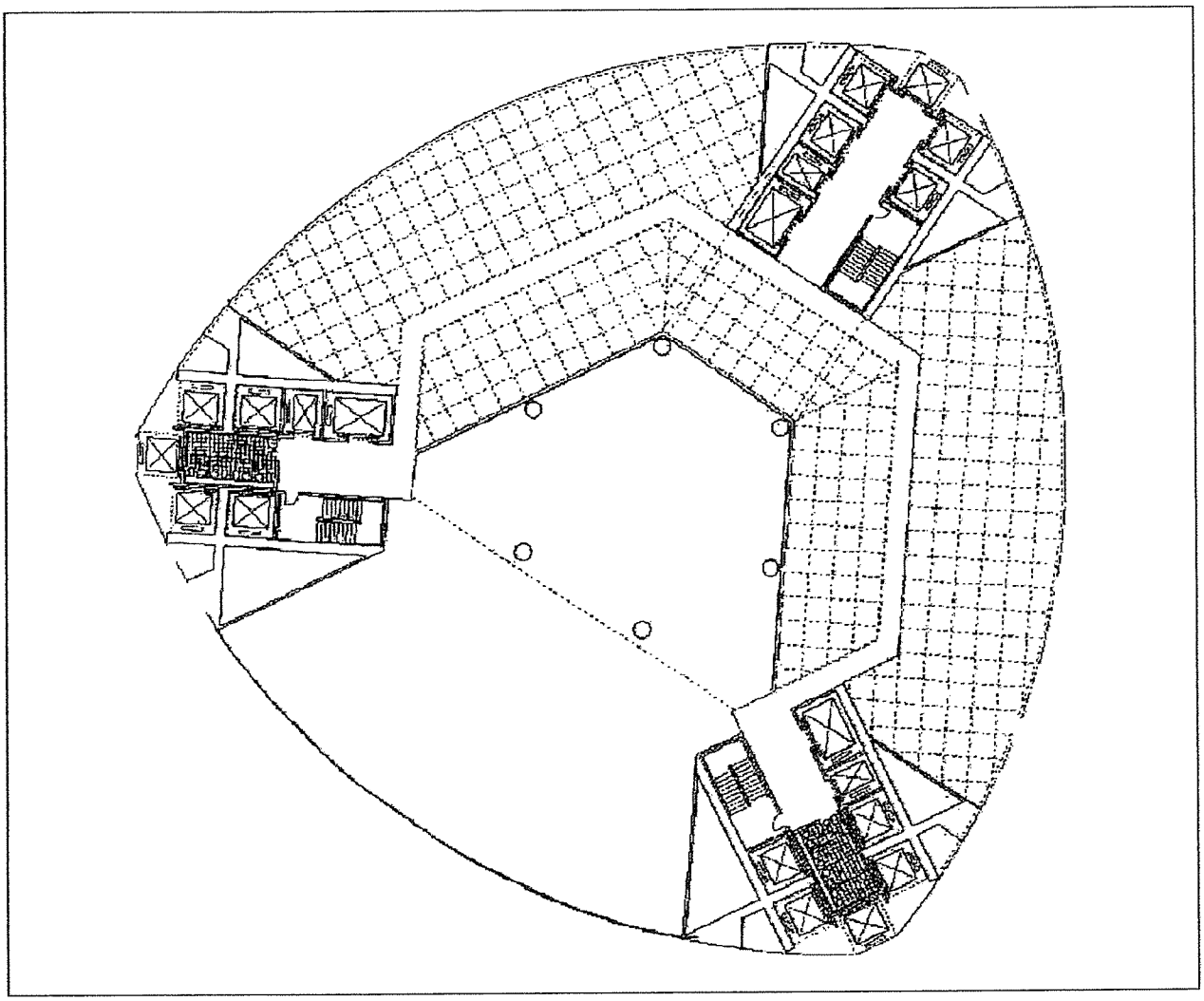


Fig. 4: March 1992; Options with 3 Elevator Cores

The orientation for the people when entering the building seems possible by use of colours for the several cores. People have to learn, in which core the elevators are running to their level.
More confusing is the orientation during interfloortraffic. To reach the next three levels it is necessary to change elevators. We propose the ground level as transfer level between the three elevator groups, alternative a transfer level in one of the other levels. The architects do not agree, to change the elevators. The project managing architect demands, that it must be possible to reach every level of destination from every level of departure without changing elevators. We can not agree, because it cannot be done in a economic way with a satisfactory result. At this time an engineering contract is not yet signed.

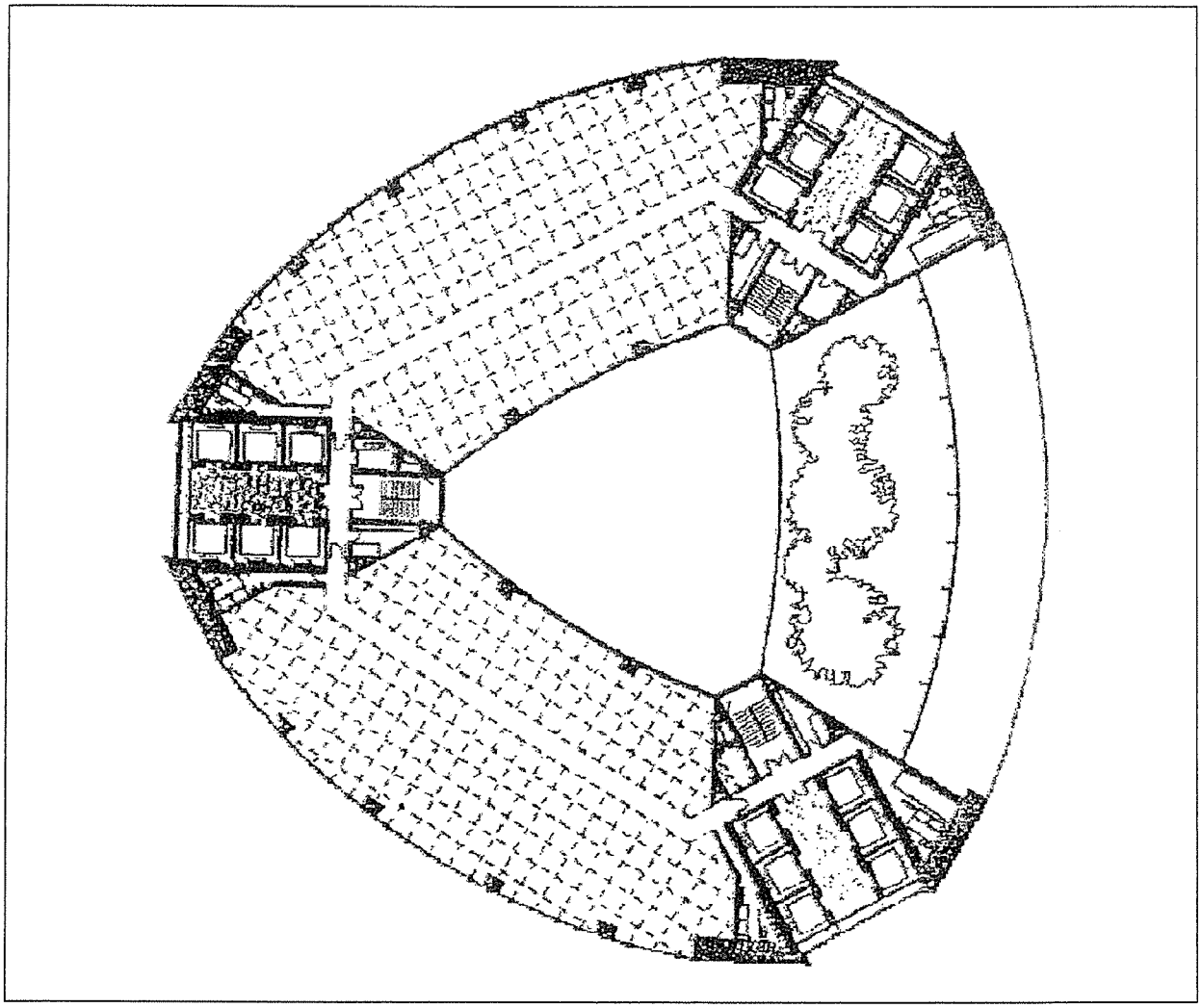


Fig. 5: March 1992; Options with 3 Elevator Cores

27th April 1992

During a meeting with owner and architects we get the information, that the architect and Lerch, Bates & Associates Ltd. (LBA) consulting engineers, have created a solution to reach every level of destination from every level of depart without changing elevators.

This solution is shown in Fig. 6 - 10. Every office level in the building has three elevator lobbies: one primary lobby, where all cars of this elevator group stop and two secondary lobbies, where only three cars of each elevator groups response for hall calls only. Each primary lobby is situated in the core opposite of the gardens and all secondary lobbies in the core beside the gardens. To reach a certain level, people have to know where the primary lobby of the level of destination is located. On his own level he has to go to this elevator core and now it is possible to use one elevator directly to the destination level.

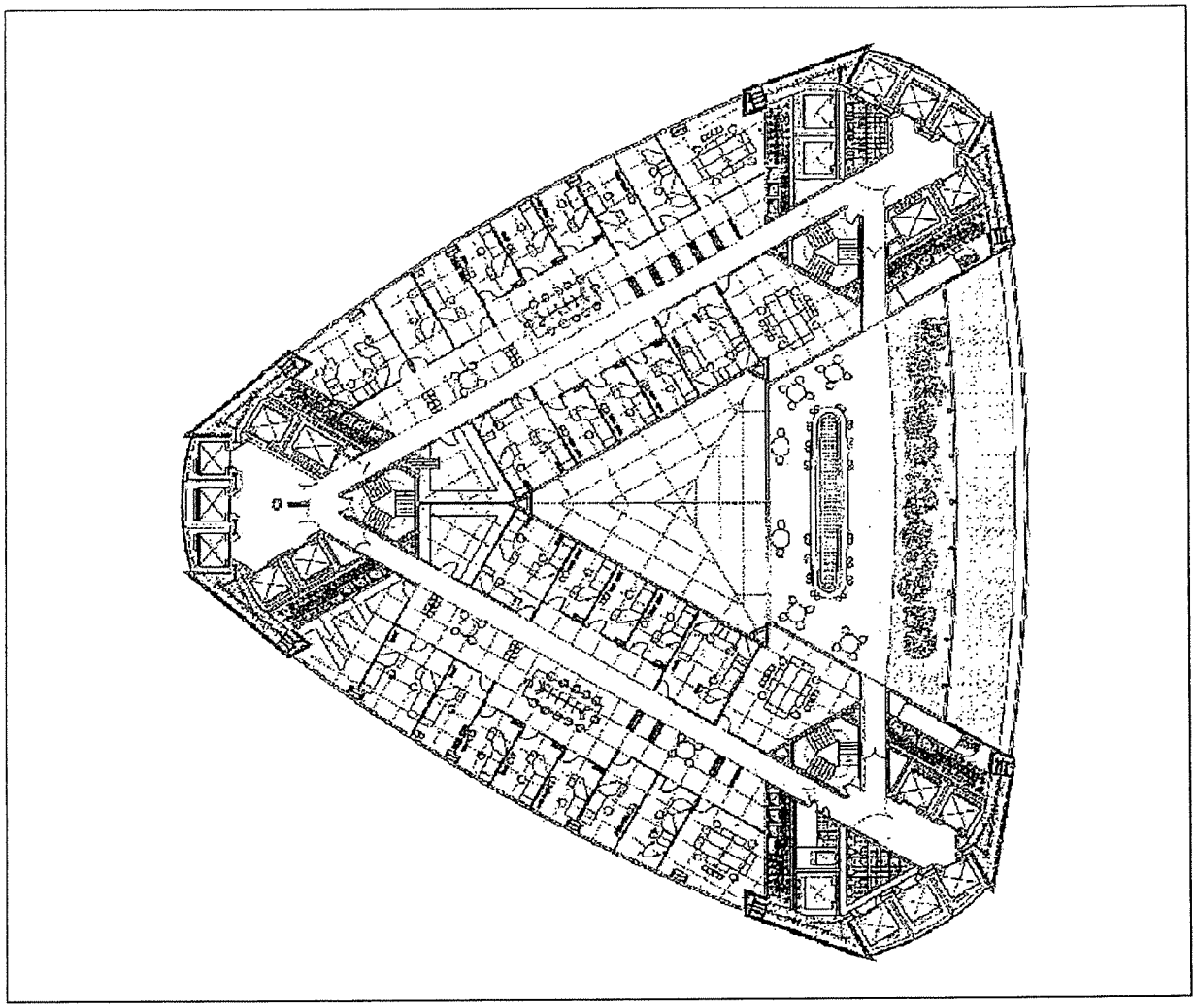


Fig. 6: June 1992; Typical Floor with Primary and two Secondary Elevator Lobbies

This solution has been presented by Mr. Adrian M. Godwin (LBA) at the ELEVCON meeting in Vienna 1993 and has been made public in ELEVATOR TECHNOLOGY 5.

After presentation of architects- and LBA's-concept we have been asked to co-operate with LBA or to leave the project.

From our point of view this concept has following disadvantages: All hoistways of all three elevator groups have to be build nearly over the whole building height. The number of elevators increase from 18 to 20, the number of lobbies is three time more and the number of elevator doors increase from 300 to 550. The concept costs much more space and much more money. Regarding handling capacity and waiting time we have a bad feeling of the new concept. It is known to all specialist of traffic analysis that by concentration of traffic the number of stops will be reduced, the round trip time will be shorter, the waiting time will be reduced and the handling capacity will be higher. Dividing the traffic effects the opposite results.

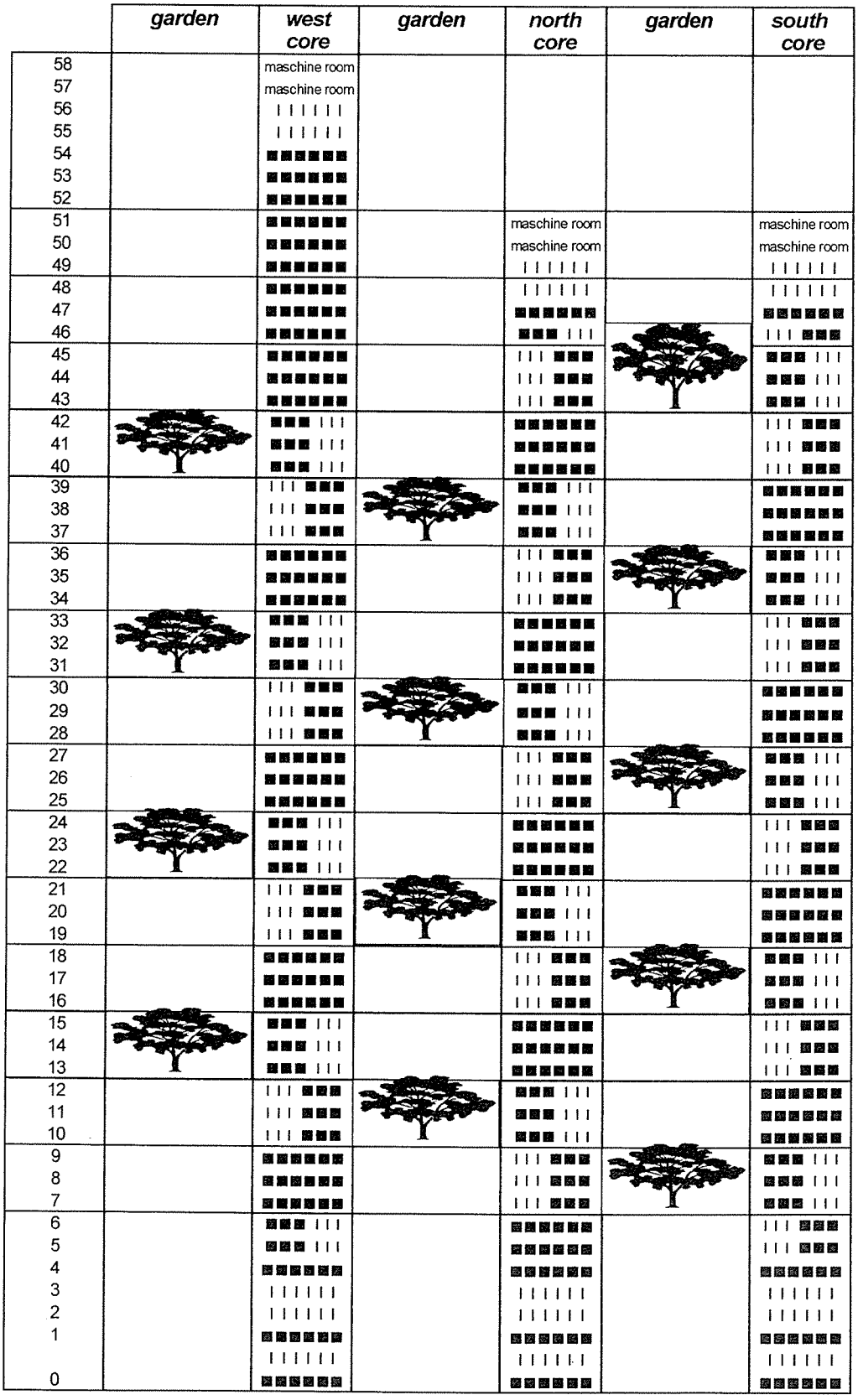


Fig. 7: June 1992; Elevator Strategy with Primary and Secondary Elevator Lobbies

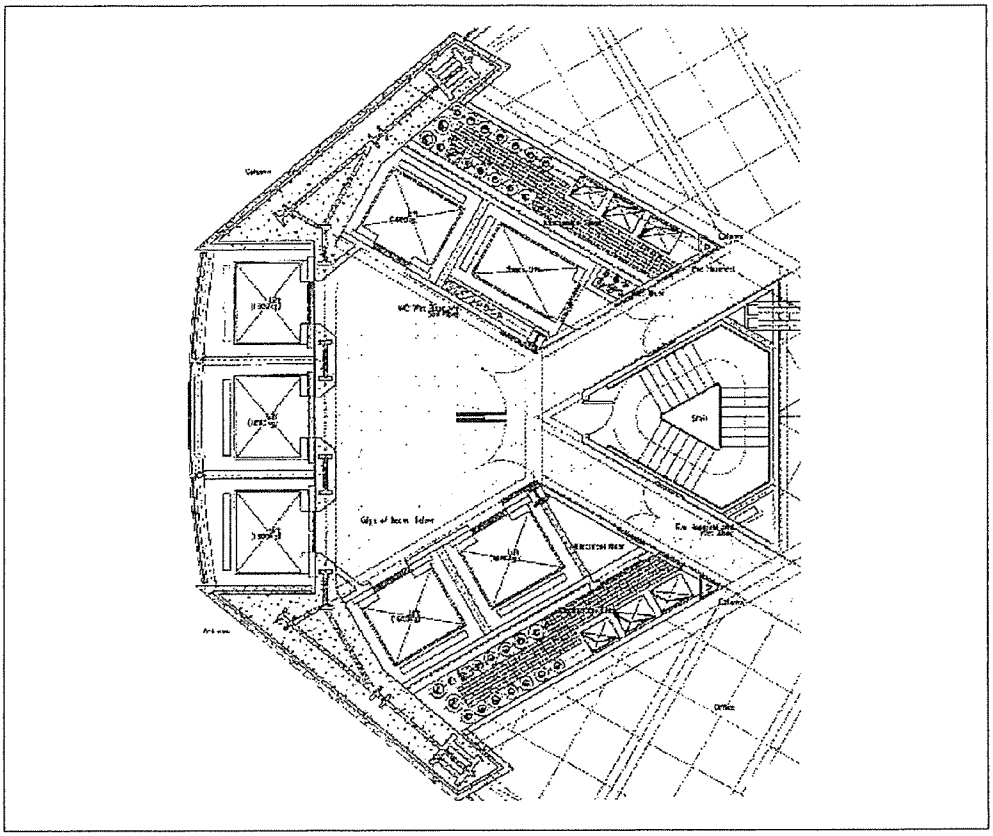


Fig. 8: June 1992; West Core - Primary Lobby

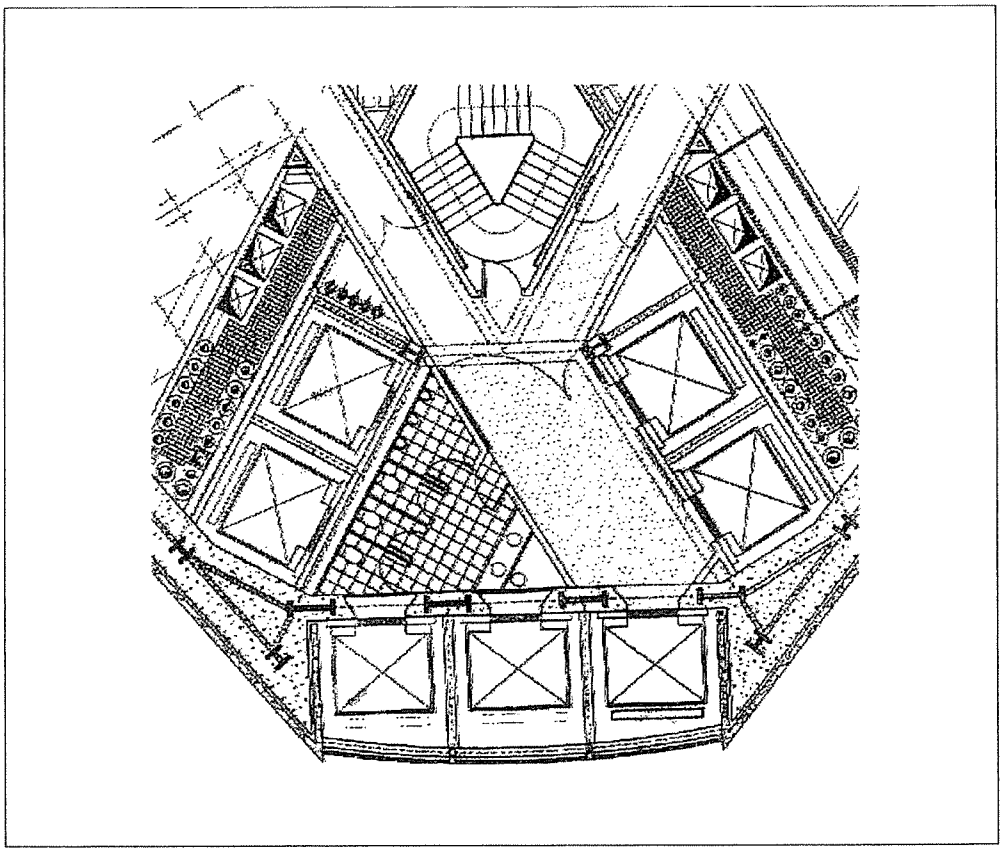


Fig. 9: June 1992; South Core - Secondary Lobby

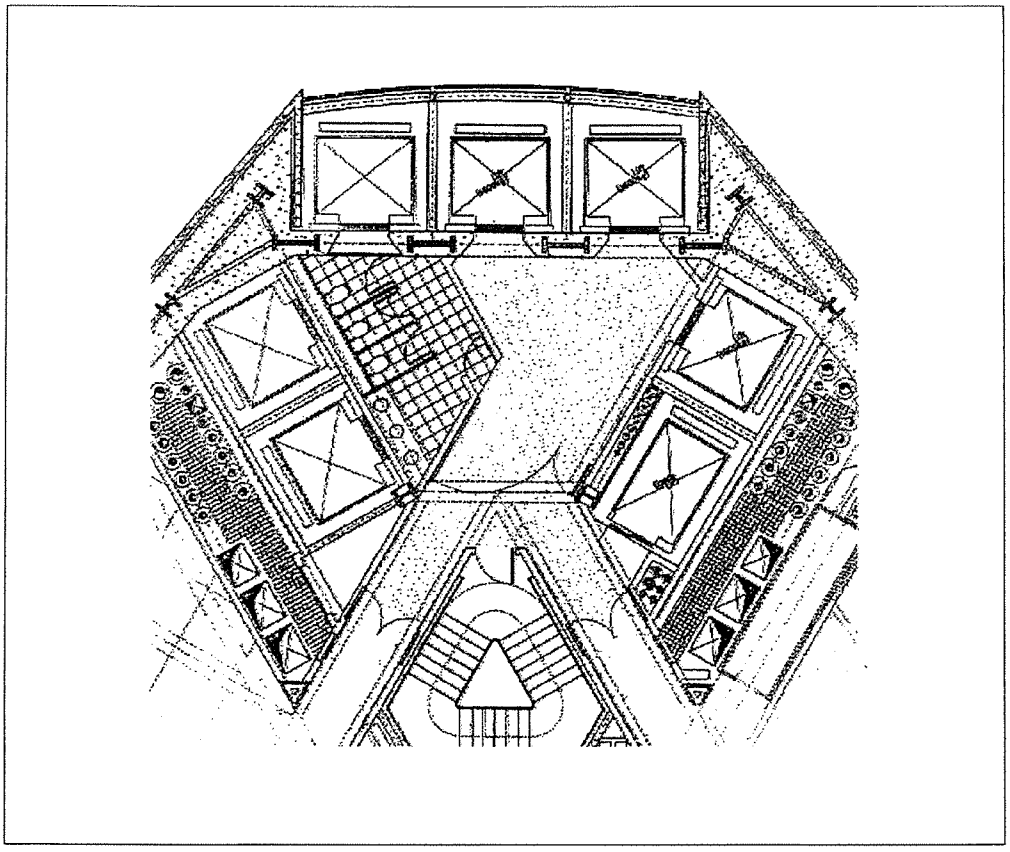
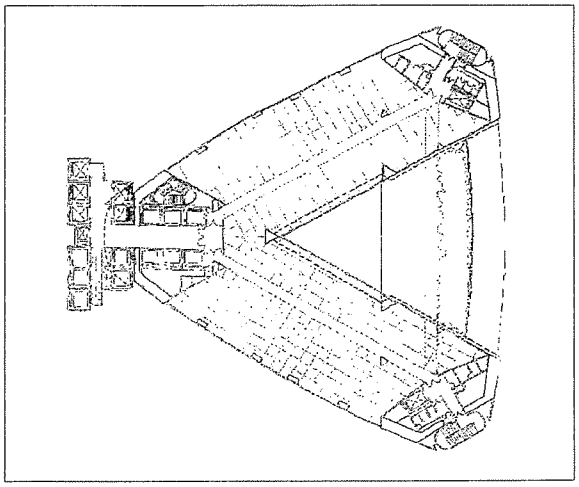


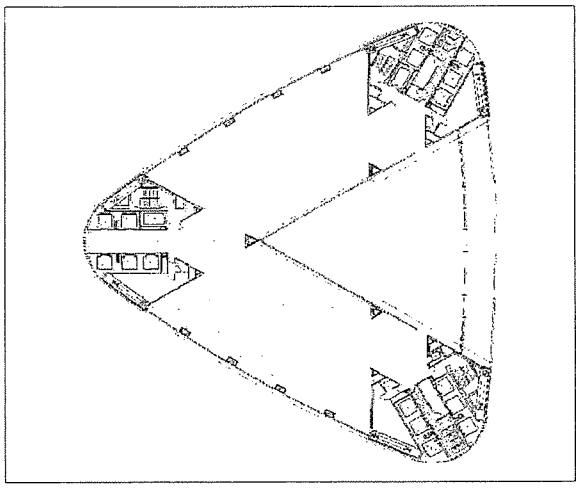
Fig. 10: June 1992; North Core - Secondary Lobby

This concept has one advantage. It gives the possibility in every phase, to eliminate all secondary lobbies with the effect to get the solution like we had in March 1992 with a good handling capacity and short waiting times.
We agree to co-operate with LBA. We think, that the additional costs of nearly 10 Million DM (5 Million $) and in special the bad relation between costs and useful area will cause the owner to modify the planning to get a more economic and space saving solution.

May until September 1992
The planning draft based on LBA concept is worked out together by LBA and J+S. We speak with the owner about the engineering contract.
In June the planning draft of the high rise building is nearly completed.
In September, the building application to ask for a building permit is ready. The board members of the Commerzbank AG stops the procedure and asks the architects to present a cost optimised alternative with better utilisation rate.

1. October 1992
The architects display eight new building alternatives. Typical ground sketches of this alternatives are see in Fig. 11 – 13.





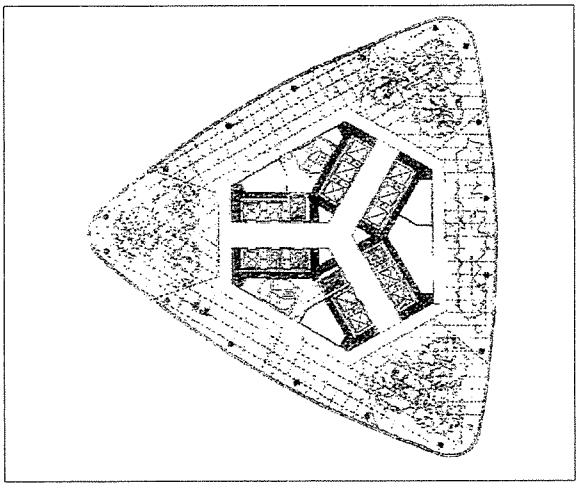


Fig. 11 - 13: October 1992;
Three of the Eight New Options

October 1992 until February 1993
Following the evaluation of alternatives by all planners, the alternative "C" is (Fig. 12) selected to be the best solution of the further planning.

The elevator system of this alternative is a low rise, a mid rise and a high rise group. During the planning the gardens will be extended from 3 floors to 4 floors. The building now get his final design.

As it can be seen by Fig. 17, most of the office areas (67 %) are arranged close to the elevators. 33 % of the office areas are located opposite to the elevator core. 3 % of this office areas are close to the gardens and the people of this office areas are able to use the gardens as a passage to reduce the distance between elevators and offices. 30 % of all people inside the building have to cross a further office area to reach the elevators.

The target, formulated in springtime 1992, to arrange all offices near the adjacent elevators, is not fully realised, but with the low rise, mid rise, and high rise group is realised a simple and clear allocation of every floor to the corresponding elevator core.

The draft phase is finalised with a draft documentation in February 1993 and the documentation is accepted by the owner.

March 1994
In March the specification is ready. The following elevators are specified at the tower:

High rise group:	6 elevators	1600 kg, 6 m/s, 185,85 m travel height	
Mid rise group:	5 elevators	1600 kg, 5 m/s, 126,00 m travel height	
Low rise group	5 elevators	1600 kg, 4 m/s, 73,50 m travel height	
	cars	width:	2,00 m
		depth:	1,70 m
		height:	2,75 m
	doors	width:	1,10 m
		height:	2,20 m
Fire fighting elevator TW6		3100 kg, 3,0 m/s, 215,55 m travel height	
	car:	width:	1,50 m
		depth:	2,50 m
		height:	3,00 m
	doors	width:	1,10 m
		height:	2,30 m
Fire fighting elevator TN6		2000 kg, 3,0 m/s, 192,30 m travel height	
	car:	width:	1,35 m
		depth:	2,95 m
		height:	3,00 m
	doors	width:	1,10 m
		Height:	2,30 m

All drives with frequency controlled AC-motors, gearless.

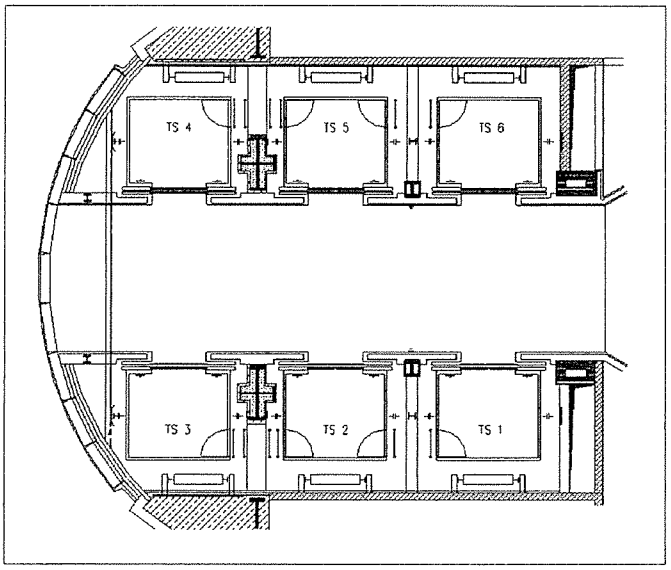


Fig. 14: March 1994; High Rise Group in South Core

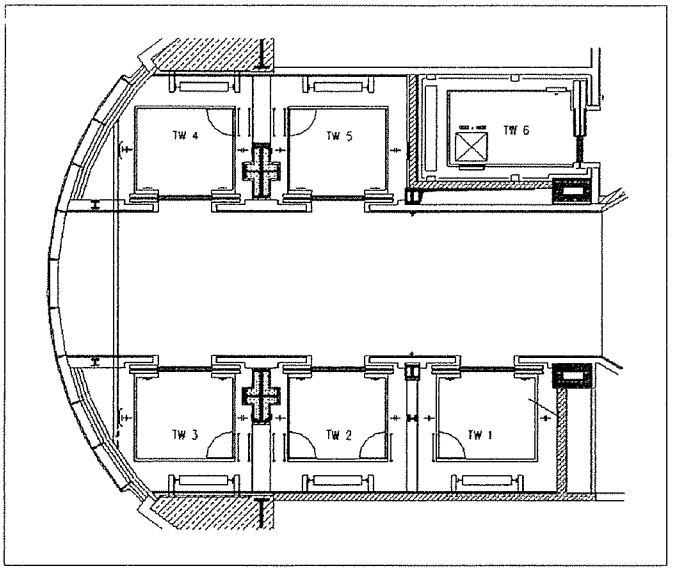


Fig. 15: March 1994; Middle Rise Group in West Core

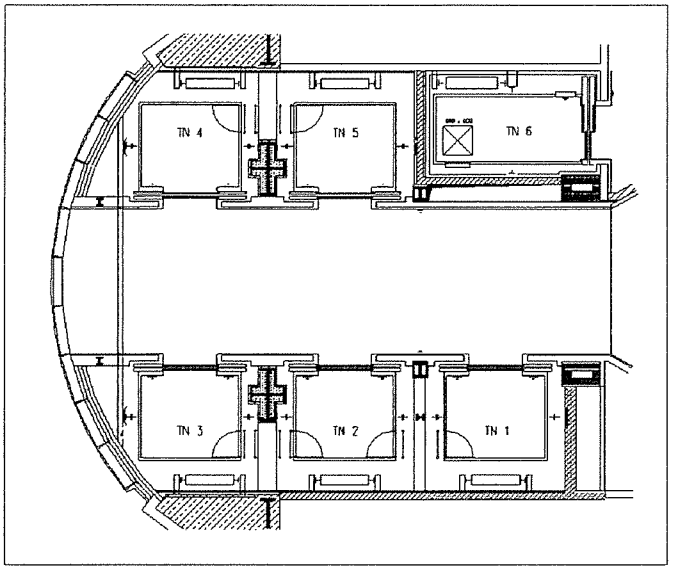


Fig. 16: March 1994; Low Rise Group in North Core

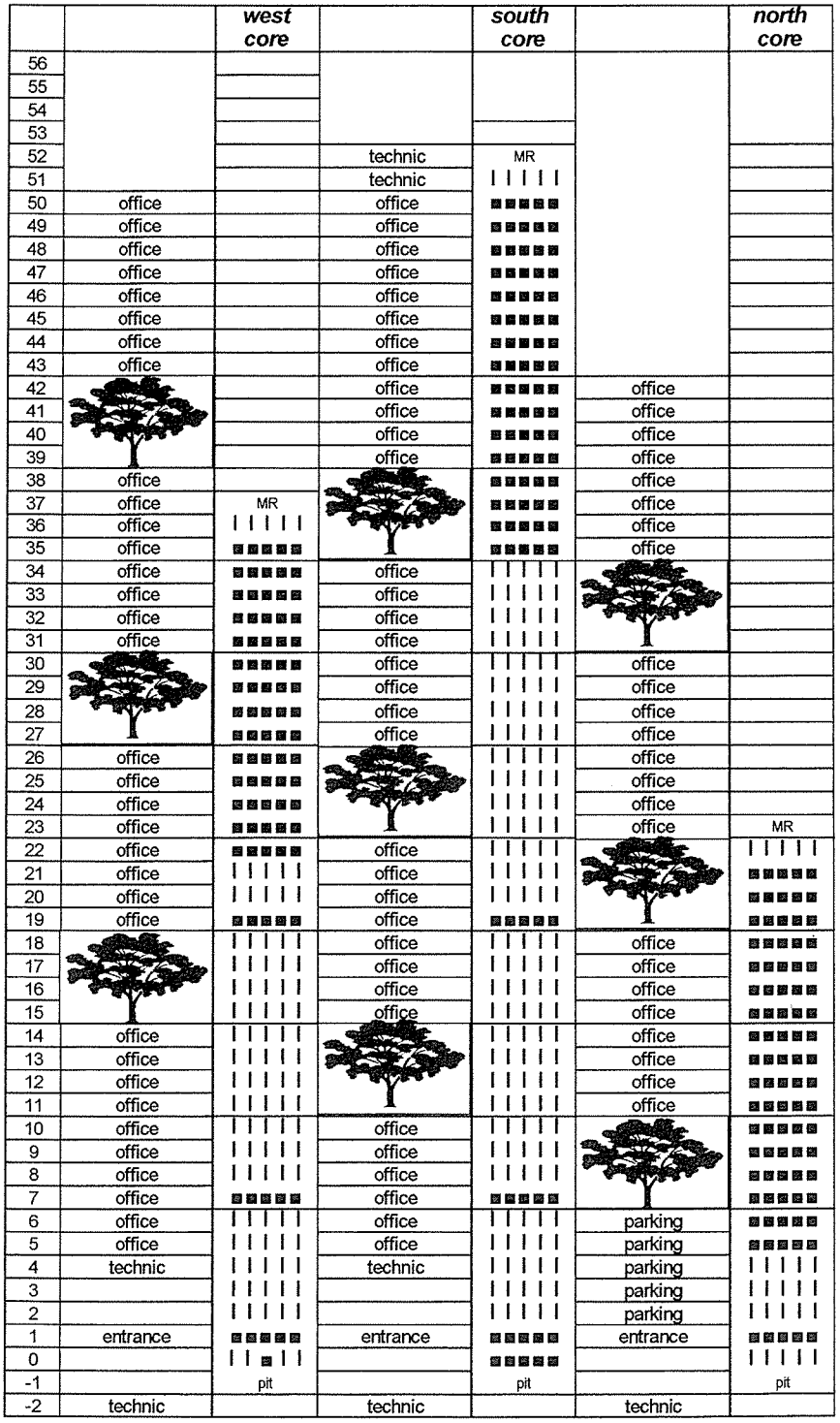


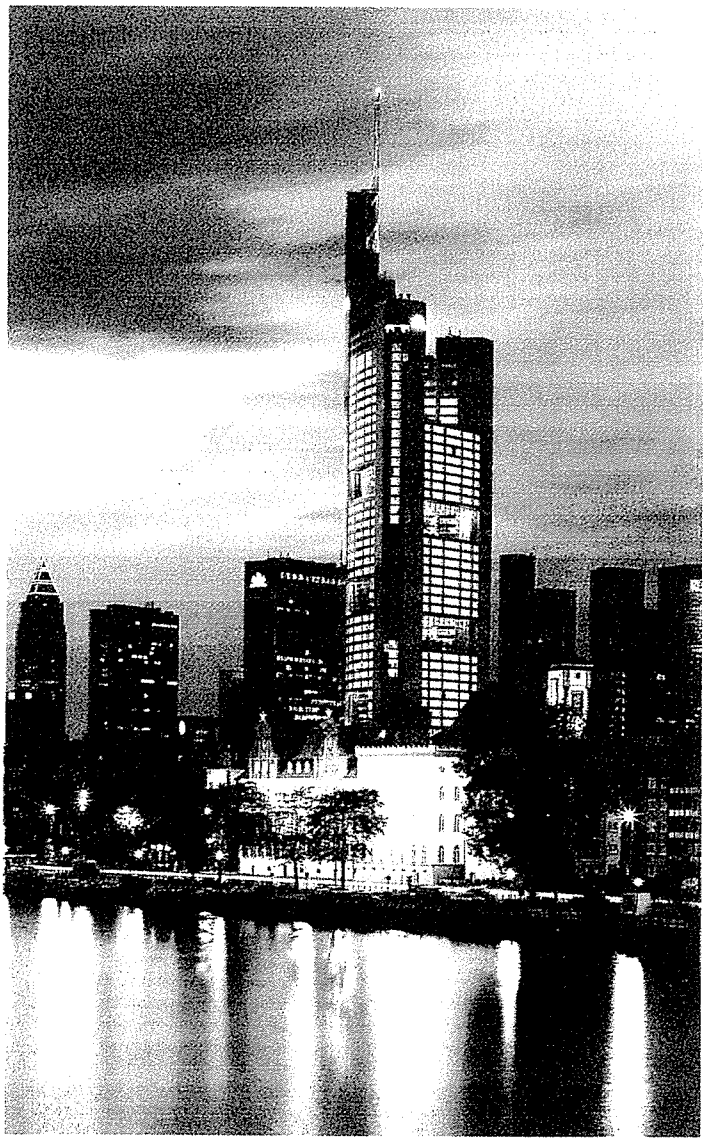
Fig. 17: March 1994; Lift strategy

September 1994

The Thyssen Elevator Company gets the order to build the elevators, according to our specification.

September 1994 until Middle 1998
We supervise the execution of the elevators and we check the elevators on behalf of the owner.

Summer 1998
In summer 1998 the elevators are completed and the owner moves into the new building. Up to now the Commerzbank is very satisfied with the elevators. With the monitoring system we are able to state, that the passenger waiting times keep within the promised limits.



The New Commerzbank Headquarter

Biography
Since 1972 Hans M. Jappsen is working as an Independent Consulting Engineer for elevators and building logistics. He and Günther Stangier founded in 1974 the Independent Engineering Company Jappsen+Stangier.
For a lot of protruding buildings and nearly 80 % of the German high rise buildings, the Jappsen+Stangier Companies have planned elevators, escalators, facade lifts, and the supply and waste disposal areas, and have supervised their realisation. He is under public law ordered and sworn expert for elevators and escalators.