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ZAGREB AIRPORT FOR THE 21ST CENTURY

ABSTRACT

Zagreb Airport covers an area of 300 ha. The space is almost completely covered by various airport facilities, buildings and areas. The new role of the Zagreb Airport, the main airport of the independent Croatia is also the domicile of the air-carrier Croatia Airlines. It is also the main air base of the Croatian Air Force.

Therefore, the capacities need to be expanded and modernised, especially regarding handling of passengers, luggage, cargo, mail and aircraft.

The physical plan of the city of Zagreb includes airport development at the extended current location. The first phase of the Master Plan includes the construction of a new passenger terminal and accompanying buildings and areas (taxiways, aprons, parking lots, access roads...) and a long-term construction of the second runway.

The paper presents the expected traffic, necessary capacities and the physical plan regarding the Zagreb Airport development. The implementation of sophisticated technical and technological solutions is planned in the process of handling the passengers, luggage, cargo, mail and aircraft.

KEY WORDS

airport planning, airport development, airport master planning, airport extention, airport urban planning

1. INTRODUCTION

Zagreb Airport was built at its current location Pleso during World War II, as the air base, i.e. a military airport. In 1959, the city of Zagreb bought a part of the airport with the runway and a part of taxiways covering an area of 300 ha from JNA (the Yugoslav People's Army), for civil needs, that is for the airport.

The opening of the former state to the foreigners, especially tourists, around the 60s, meant high annual growth rate of the passenger traffic volume at the Zagreb Airport, up to 70%. The traffic grew rapidly until 1975, and then stagnated until 1979 and then showed a tendency of decrease or a light increase, but not reaching the level of 1979. During the intensive growth of traffic, the capacities for passenger and luggage handling were being expanded, but never satisfying completely the level of the greater volume of traffic. Thus, the capacities for passenger and luggage handling were always lacking.

During the second half of 1991, the former state closed the Croatian airspace and her airports. Already on March 1, 1992, Croatia opened her free airspace to air traffic, and on April 1 of the same year, the first aircraft landed at the Zagreb Airport. A traffic of about 300 thousand passengers was realised in that year, and then it grew annually to reach the number of 1.1 million passengers in 1998. The expected growth in passenger traffic will reach in 2002 the capacity of the current passenger building estimated at about 1.4 million passengers annually. Certain technical, technological and organisational measures may provide the increase in capacities to about 1.6 million passengers annually, which is expected in 2003.

The existing passenger terminal in the technical and technological sense, is a one-floor centralised passenger building, reconstructed three times by adding new facilities onto the initial building, with an unfavourable depth (about 60 m which cannot be expanded much), and an unfavourable length in relation to the depth (about 200 m). These facts, as well as the lack of air-bridges, the highest quality connection between the passenger terminal and the aircraft at the apron, indicate a significant lagging behind of the Zagreb Airport in implementing the modern technology in the passenger and aircraft handling.

2. TRAFFIC AND AREA PLANNING

At the beginning of the 80s, the Development department of the Zagreb Airport completed a development concept which was accepted by the airport administration and the city of Zagreb. The concept was included in the 1986 Physical plan of the city of Zagreb.

The aggression against Croatia discontinued all the activities, however modest, in making detailed plans and their realisation [1].

Modifications and supplements to the Plan foresee the development of the Zagreb Airport to additional 700 ha, that is, together with the current area, to about 1,000 ha [2].

In order to prepare the Master Plan, the airport administration formed in 1995 a professional team of four members, two from the airport personnel and two from outside. The team made a Tender for preparing the Zagreb Airport Master Plan [3]. They defined the period which has to be spanned by the Master Plan, until 2030, and, of course, the final capacity, that is the physical arrangement of buildings and areas at full (maximum) physical and capacity utilisation of the location.

The Master Plan is a concept of the final development of an airport. The term "development" includes the whole area of the airport used both for aircraft and non-aircraft activities, as well as the land usage next to the airport. Concretely, the basic purpose of the space immediately surrounding the area reserved for the future development of the Zagreb Airport, is determined by the city of Zagreb Physical Plan. Furthermore, according to the International Civil Aviation Organisation (ICAO), the Master Plan determines the impact of the construction and exploitation on the environment and defines the Airport access requirements.

The Tender included the following requirements:

- analyses of the current situation,
- defining traffic expectations,
- determining the general necessary capacities and their physical values, as well as stepwise realisation,
- proposal of the possible solution or solutions, allowing the selection of the most acceptable one,
- determining of the basic space organisation, measures of utilisation, arrangement and protection of that area with priority activities, and measures for improvement and protection of the environment using all the available mechanisms for planning of efficient land usage, finding the balance in planning and realisation of natural and artificial spaces, and unbuilt ("green belt") and built-up areas, thus achieving ecological balance,
- taking into consideration the specific characteristics of the area planned for the development of the Zagreb Airport, such as: special values - water supply area providing top quality underground water (with the main water pumping site of the city of Zagreb), nature objects (forest parks - oak-grove next to the airport passenger building, important landscapes - the area along the Sava river, numerous monuments of park architecture), cultural monuments, i.e. architectural heritage (ethnographic and archaeological), and the restrictions of the special purpose zone (Croatian Air Force), as well as the additional burdening of space - division of agricultural land into small size allotments (because of the low market price), and illegal construction.

At the international competition by invitation, the Netherlands Airport Consultants B.V. (NACO) from the Netherlands was chosen out of 8 well-known consultant companies.

NACO analysed first the current situation and came to a conclusion that the current location does not satisfy long-term development and that the Zagreb Airport has to be extended to the planned, additional 700 ha.

2.1. Traffic forecasts

The basis for planning the capacities, and then the necessary space for buildings and areas and their interrelations represent the traffic forecast. This has been done for the movement of aircraft, passengers and cargo, as well as motor vehicles in annual and peak hour values.

The annual traffic forecasts are presented in Table 1, and the peak hour loads in passenger traffic in Table 2.

Table 1 - Annual aircraft, passenger and cargo forecasts for the period between 2000 and 2030, mean values

Year	Movement of aircraft	Passengers	Cargo, t
2000	22,400	1,205,000	10,700
2005	31,200	1,955,000	17,500
2010	40,800	2,890,000	26,300
2020	56,900	4,670,000	43,000
2030	70,400	6,275,000	57,500

Table 2 - Forecasts for the passenger traffic, peak hour, for the period between 2000 and 2030, mean values

Year	International	National
2000	770	435
2005	1,305	650
2010	1,980	910
2020	3,260	1,410
2030	4,385	1,890

The traffic forecasts resulted in the development phases, first of all of the new passenger terminal, in the following manner:

1st phase	1997 - 2002
2nd phase	2003 - 2010
3rd phase	2011 - 2020
4th phase	2021 - 2030

The first phase would include the building of the new passenger terminal (NPT) with the capacity of about 3 million passengers annually, for the traffic volume expected around 2010.

2.2. The calculation of necessary capacities

The calculation of necessary capacities is presented according to traffic buildings and areas.

2.2.1. Manoeuvring area

One runway is planned by the year 2030. NACO concluded that one runway can satisfy a traffic volume of 10 million passengers annually, which is expected far beyond the final Master Plan year, and that is later than 2030 (in 2030 a volume of about 6.3 million passengers annually is expected).

The system of taxiways will be extended in accordance with the traffic volume increase (a parallel taxiway, rapid exit taxiways, taxiways leading to the apron, taxiways at the apron...).

2.2.2. Apron

The number of positions for aircraft handling is given for the characteristic years in Table 3.

Table 3 - Number of positions at the apron for the period between 2005 and 2030

Year	Passengers, in millions	Number of positions
2005	2.0	17
2010	2.9	21
2020	4.7	25
2030	6.3	30

2.2.3. Passenger terminal

The floor area of the passenger terminal and the foot-print are given in Table 4.

Table 4 - The floor area and foot-print of the passenger terminal involved in traffic, for the period between 2005 and 2030

Year	Floor area (m^2)	Foot-print (m^2)
2005	33,000	16,500
2010	46,700	23,350
2020	68,275	34,137
2030	80,875	40,437

2.2.4. Cargo terminal

The floor area of cargo terminal, foot-print and the plot size, extended area at the access side and the apron side, are given in Table 5.

2.2.5. Roads and parking lots

The system of public and internal roads and parking lots will be developed in accordance with the development of traffic needs and the needs of the employees. The basic principle is the development of a one-way, two-lane road system with at-grade merging and diverging, without intersections. Special attention will have to be paid to the section of the road passing by the NPT.

Table 5 - The floor area of cargo terminal, foot-print and plot size, extended foot print for the period between 2005 and 2030

Year	Floor area (m^2)	Foot-print (m^2)	Plot size (m^2)
2005	4,375	3,938	9,450
2010	6,575	5,918	14,200
2020	7,170	6,453	15,490
2030	9,580	8,620	20,690

2.2.6. Other

Apart from the basic traffic infrastructure, the Master Plan includes also the development of other facilities of the Zagreb Airport (technical base, heating plant, administration buildings, equipment objects...) and other institutions and organisations (Flight Control Administration, Ministry of the Interior, Customs Administration, Croatia Airlines, INA ...).

3. GRAPHICAL PRESENTATION OF THE MASTER PLAN

As a result, the Master Plan [4], contains, apart from 4 books that textually present the traffic forecasts, facilities capacities of the Master Plan for the whole complex, a detailed plan for the current situation, abstract and graphical supplements: buildings and areas and their physical interrelations in the final years of the single phases and the final phase. The current situation first and the fourth phase have been chosen, as well as the final phase. The graphical supplements are presented in Figures 1, 2, 3 and 4.

4. PROFESSIONAL ANALYSIS OF THE MASTER PLAN

The professional team accepted the Master Plan prepared by NACO with certain restrictions, the major one being the planned capacity of the manoeuvring area with one runway.

The Zagreb Airport is a combined civil-military airport, and the manoeuvring area of the Zagreb Airport is also used by the Croatian Air Force. Therefore,

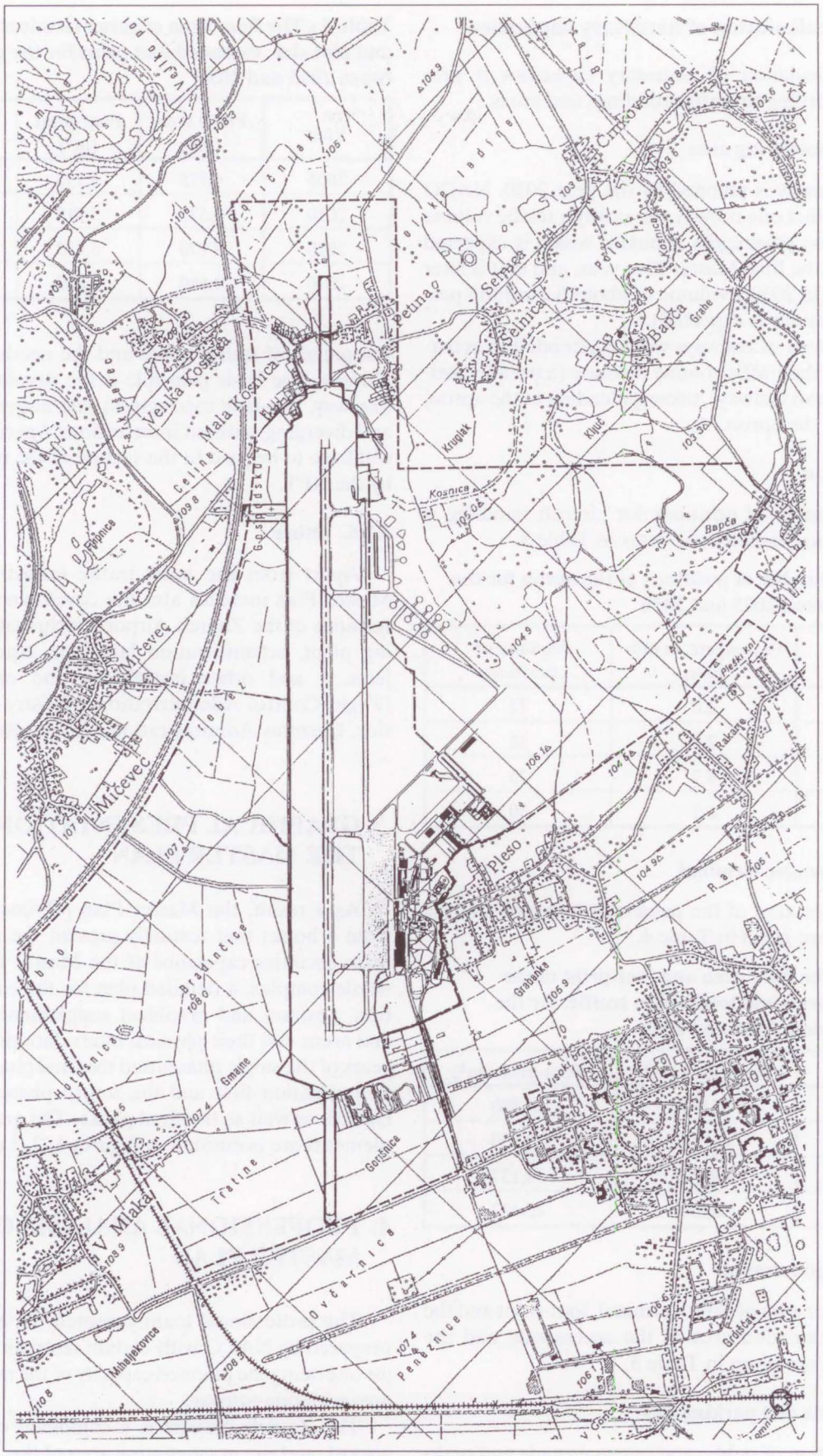

Figure 1 - Current situation

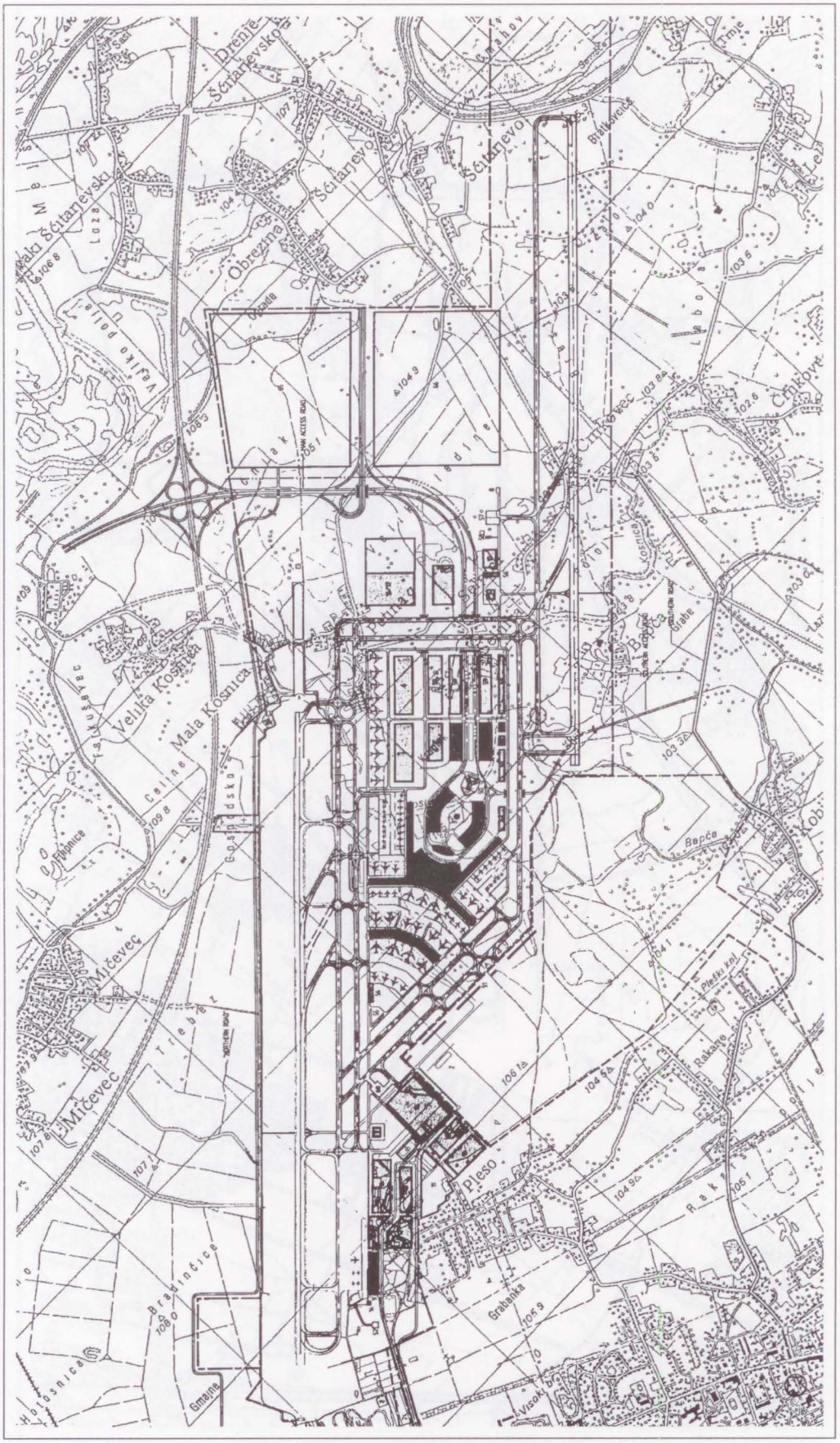

Figure 2 - Phase 1 (1997 do 2002)

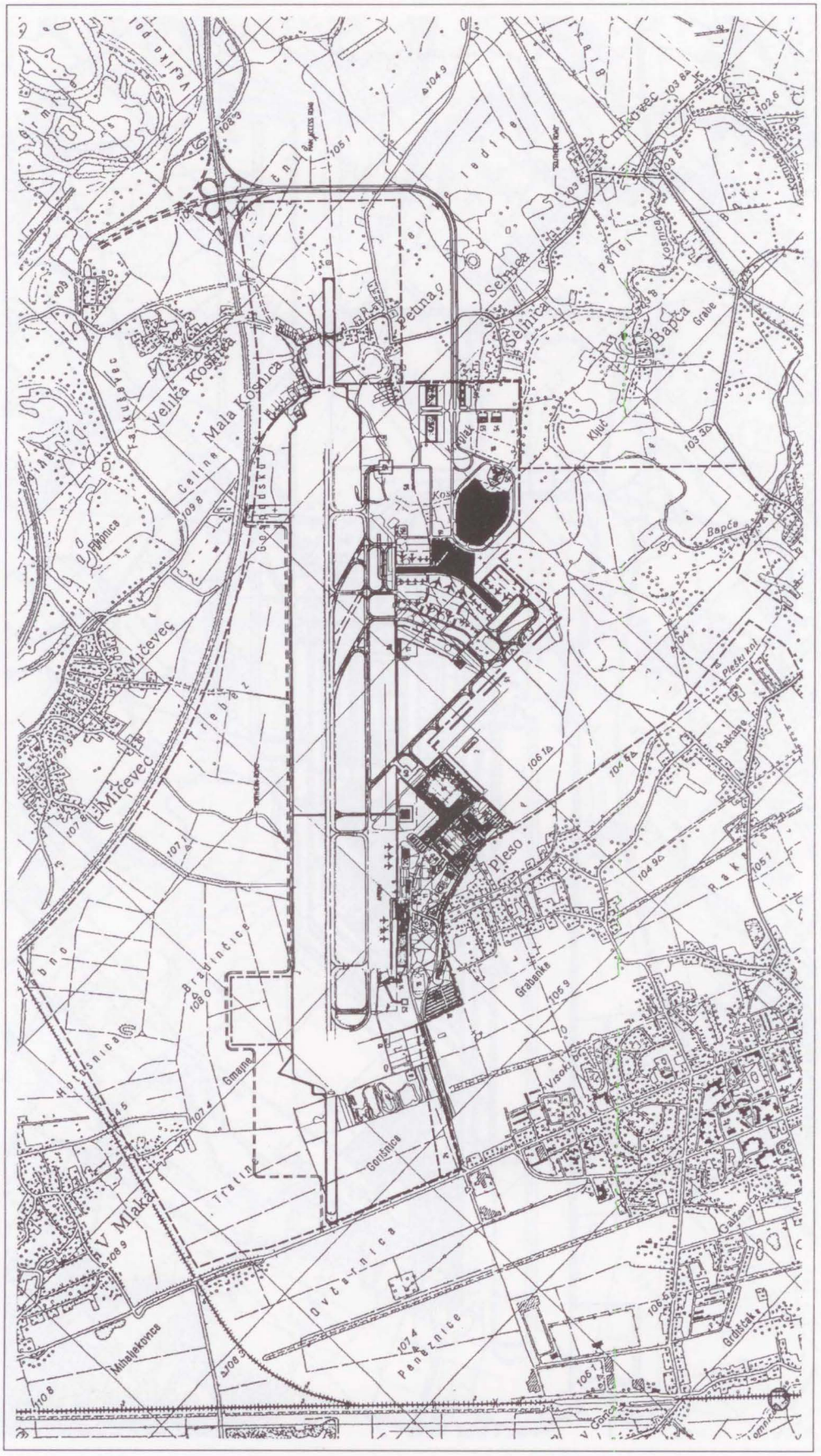

Figure 3 - Phase 4 (2021 do 2030)

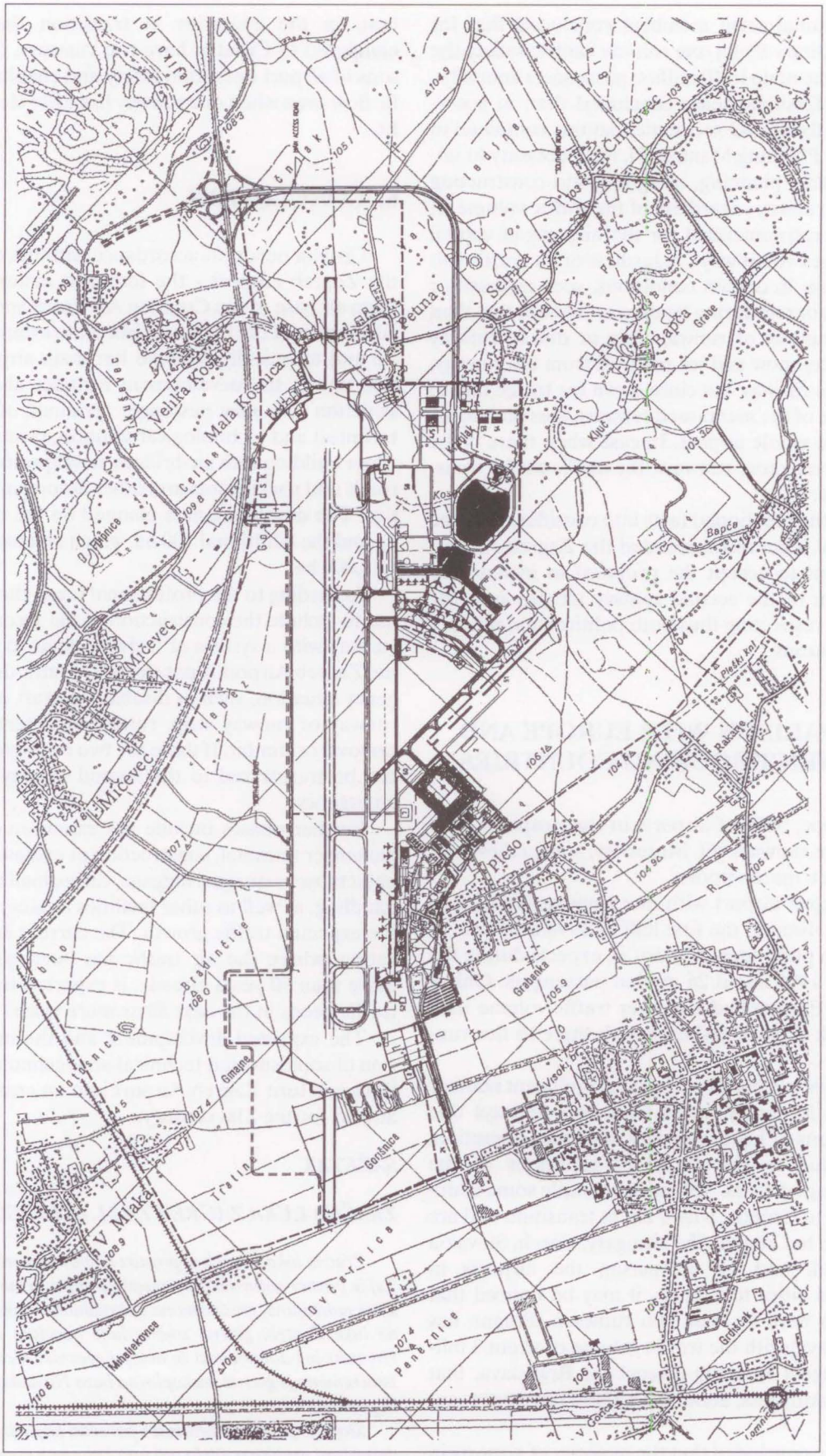

Figure 4 - Final development phase (maximum location capacity)

the professional team members concluded that for civil and military flying one runway cannot satisfy the traffic volume of up to 10 million passengers annually.

The professional team concluded that, in accordance with the ICAO recommendations contained in the Airport Planning Manual [5], it is necessary to immediately start planning, designing and constructing the second runway regardless of the traffic volume. It is, namely, recommended for the airports of capital cities to have two runways, regardless of the traffic volume, because in certain conditions, such as crash or damage of aircraft during landing or takeoff, that then block the runway or runway strip or due to runway maintenance, snow and ice removal from the runway, etc., a single runway can close down for traffic due to one or more of the mentioned reasons, thus practically blocking the whole airport. In case when there is the second or even more runways, the traffic can be transferred there.

Taking the mentioned facts into consideration, the professional team recommended the Zagreb Airport Management to accept the proposal to include the construction of the second runway already into the first phase, respecting thus both political and military strategic reasons.

5. COMPARISON WITH EUROPE AND THE NEIGHBOURING COUNTRIES

In Europe, 56% of airports in state capitals have two or more runways [6]. Moreover, some cities have two and even more airports.

The biggest airport with one runway, Gatwick in London, realised in the first half of 1998 a volume of 13.1 million passengers [7], that is, expects during the whole year 1998 about 26 million passengers. Only 4 airports in Europe had a greater traffic volume than the Gatwick airport, and each with three to five runways.

This leads to a conclusion that a significant number of airports in capital cities have two runways due to the reasons of high reliability of airport operation, and not due to the necessary capacities of the manoeuvring surfaces. Taking as example some countries closer to Croatia, which are in transition and are comparable to Croatia, like Hungary, Czech, Slovakia and Poland, and by comparing the airports in their capital cities to Zagreb, it may be noticed that all of them have at least two runways (Prague has three runways) with the traffic volume of about 3 million passengers annually (except for Bratislava, that has significantly less, about 0.2 million passengers annually).

It may be concluded that the majority of airports in the European capitals, and what is even more important, in the countries in transition that may be compared to Croatia, have two runways, for the reasons of airport operation safety and enabling the traffic flow even when one runway has to be closed to traffic.

6. CONCLUSION

Croatia needs, in accordance with the new role of the Zagreb Airport - the foremost national airport, main air base of the Croatian Air Force and the domicile airport of the Croatia Airlines, to extend, modernise and technically improve her main airport. In the first phase, the development includes also the construction of a new passenger terminal, of a modern technical and technological solution, centralised two-floor building with air-bridges, new aprons and access roads and parking lots and other accompanying facilities. The development is planned on the existing 300 ha and the additional 700 ha, which amounts to a total of 1,000 ha.

According to the professional team, the first phase has to include the construction of the second, parallel runway with a system of taxiways so as to insure that the Zagreb Airport is not closed to traffic due to emergency situation, such as disabled aircraft on the main runway or runway strip, runway maintenance, snow removal or similar. If there are two runways, the traffic can be transferred to the second runway in case of emergency.

Further phases include the extension of the new passenger terminal, construction or extension of other objects for passenger, luggage, cargo, mail and aircraft handling, as well as other facilities in accordance with the expected traffic growth. The current extended location, where the air traffic has been going on for more than 50 years already, is expected to satisfy the traffic needs in the next 50 or more years.

The expected development and the implementation of sophisticated technical and technological solutions will turn Zagreb Airport into an example of the airport for the 21st century.

SAŽETAK

ZRAČNA LUKA ZAGREB ZA 21. STOLJEĆE

Zračna luka Zagreb se prostire na površini veličine 300 ha. Taj je prostor gotovo u potpunosti ispunjen raznim aerodromskim sadržajima, građevinama i površinama. Nova uloga zračne luke Zagreb, glavne zračne luke neovisne i samostalne Hrvatske je i domicilnost za avioprijevoznika Croatia airlines. Istovremeno je glavna zrakoplovna baza Hrvatskog ratnog zrakoplovstva.

Stoga je potrebno proširiti i povećati kapacitete, te je modernizirati osobito u dijelu prijama i otpreme putnika, prtljage, robe, pošte i zrakoplova.

Prostorni plan grada Zagreba predviđa razvitak zračne luke na proširenoj postojećoj lokaciji. Master plan predviđa u prvoj fazi gradnju novog putničkog terminala i pratećih građevina i površina (rulne staze, platforme, parkirališta, prilazne prometnice ...) a dugoročnu gradnju druge uzletno-slijetne staze.

Rad prikazuje očekivani promet, potrebne kapacitete i prostorni plan razvoja zračne luke Zagreb. Planovima se predviđa primjena suvremenih tehničko-tehnoloških rješenja u procesu prijama i otpreme putnika, prtljage, robe, pošte i zrakoplova.

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