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Study on Environmental Influences
February 1992

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THE STUDY ON ENVIRONMENTAL INFLUENCE

FINAL ESTIMATE

IPZ - INŽENJERSKI PROJEKTNI ZAVOD, ZAGREB

ZAGREB, FEBRUARY 1992
MOTORWAY RIJEKA - ZAGREB
SECTOR VRATA - KUFJAK

STUDY ON ENVIRONMENTAL INFLUENCES
FINAL ESTIMATE

Zagreb, February 1992
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PRELIMINARY NOTES

The Study is elaborated on the basis of the Law on regional planning and environmental arrangement (National gazette of the Republic of Croatia Nos. 54/80 and 6/86). The contents and the process of elaboration, public debate and the final estimate were carried out in compliance with the By-law on elaboration of studies on environmental influences, given by the Ministry for protection of environment, regional planning and building construction of the Republic of Croatia.

Based on numerous factors (meteorological, climatic, hydrological, geological, geomechanical, seismic, pedological, hydrogeological, flora and fauna, inhabitants and settlements etc.) the Study deals with valuation of the state of natural and built-up areas, with surveyed negative influences of the motorway and suggested measures of reducing the adverse influences into acceptable limits. The complete Study comprises 129 pages, 9 graphical representations and according to the By-law is divided into 3 chapters and several paragraphs:

A) Observations and conclusions
B) Chapters:
   1. Description of the position - general and particular (the existing state of natural environment: air, water, sea and soil)
   2. Description of the investment
   3. Survey of possible environmental influences
   4. Survey of possible protective measures for reduction of damages to the environment
   5. Appendix - data used
C) Suggested program for monitoring of the environment during the construction and upon putting the road into operation

Due to the scope of the complete Study, and for practical reasons of easier monitoring of realization of the introduced conclusions, besides the above notes, only this final estimate is given.

Since all the relevant questions of the motorway influence to the environment have been dealt with in the final estimate, as well as protective measures, the following represents the Study summary.

Zagreb July 23, 1992

"HRVATSKE CESTE"
Department for planning, designing and building construction

Mate Jurišić, Head of the Dept.
INTRODUCTION

Position - general and particular description

The motorway Rijeka - Zagreb is a part of the international road route E-65, which is connected to the road routes E-59, E-70 and E-71 near Zagreb and thus became one of the main road connections of the Adriatic coast with the Middle and North Europe and is included into the Project of Trans-European route "North-South". In the Croatian road network this road represents a connection between Zagreb, the capital and economic and traffic center of Croatia, via Karlovac to Rijeka, the main transit port of the Croatian part of the Adriatic sea.

Following this route a part of the motorway has already been constructed from Oreohovica to Kikovica, 10.5 km, from Zagreb to Karlovac, 40.1 km and a semi-motorway Kikovica - Oštrovica, 7.9 km. By construction of the remaining section of this road between Oštrovica and Karlovac, the traffic connection from the Croatian seaside with the Middle Europe would be considerably improved, and the distance between Rijeka and Zagreb reduced to 147.1 km.

This Study comprises the motorway section from km 32+389.51 to km 49+239.28 from Vrata to Kupjak in length of 16.85 km.

The basic characteristics of this section is passage through a distinctly karst area, and waters from this area gravitate to the river Kupa, i.e. the Black-sea river-basin.

This section is a continuation of the section Oštrovica - Vrata. The route follows the railway line Rijeka - Zagreb on the western side till the tunnel "Lučice", where it passes under the railway line, goes by the places Delnice and Dedin and eventually ends next to the main road M-12 nearby the village Kupjak.

TECHNICAL AND TRAFFIC DATA OF THE MOTORWAY

In respect to the configuration of soil the motorway route passes through, the level is very ragged and ranges between + 4 % and - 4 %. The route is in ground plan well extended with minimum radius of horizontal curves $R = 700$ m, except for parts between km 33 and 35 as well as km 43 and 45, where due to configuration of soil, minimal ground plan elements were applied.

In this sector the route passes several mountains and valleys and, consequently, numerous structures shall have to be built.
The expected traffic is analyzed in a feasibility study made by GI Zagreb (Building construction institute) in 1990. Design traffic load at the end of the planning period in the year 2014 is as follows:

<table>
<thead>
<tr>
<th>AADT Average annual daily traffic</th>
<th>TYPE OF VEHICLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domestic passenger cars</td>
</tr>
<tr>
<td>14.996</td>
<td>9.042</td>
</tr>
<tr>
<td>100 %</td>
<td>60.3 %</td>
</tr>
</tbody>
</table>

Traffic requirements till the year 2014 as per traffic analyses, can be satisfied by a dual carriageway road with an additional lane for slow vehicles on slopes. This is the reason why this motorway is planned to be constructed in two phases. In the first phase a semi-motorway shall be constructed with an additional lane for slow vehicles on slopes and with all the interchanges and two level crossings. After the planned period, when required, the second carriageway shall be constructed (second phase). Consequently, in the end this shall be a two lane dual carriageway road in each direction with a stopping lane i.e. an additional lane for slow vehicles.
FINAL ESTIMATE

of

Professional commission for evaluation of studies on environmental influences of motorways and main roads for:

The Study on Environmental influence of Motorway Karlovac - Rijeka Sector Vrata - Kupjak


1. Upon its meeting held on March 22, 1991, the professional commission decided that the subject Study can be put to public debate.

2. The public debate was proclaimed in the "Novi list" (New Gazette) of Rijeka and lasted from April 27 to May 27, 1991. Two public debates were held in the town hall of the county district Delnice, on May 8 and May 23, 1991. During the entire duration of the debate, each party concerned had the opportunity of insight into the necessary documents, made available in the Department for town planning, construction, communal and housing operations of the county Delnice.

3. In the course of the debate the authors of the Study have answered to the raised questions and comments, and some written comments were received as well.

The written comments received in the course of the debate were sorted according to issues and answered by the Study authors.

4. After having considered all the comments and suggestions it has been decided that the Study on environmental influences of the motorway Karlovac - Rijeka, section Kupjak be accepted.
5. Remarks and conclusions:

a) The subject Study has been made in accordance with the Law on regional planning and environment arrangement and with the By-law on elaboration of the Studies on environmental influences.

b) The motorway Rijeka - Zagreb is located in the corridor of the international road E-65, and according to the Decision on main roads (Official Gazette No. 39/84) it has been determined as the road M-12 and comprises the following route: Croatian-Hungarian state border-Goričan-Čakovec-Varaždin-Zagreb-Karlovac-Rijeka-Rupe-Kozina-Slovene-Italian state border.

c) Sector Vrata - Kupjak of the motorway Rijeka - Zagreb in its entire length is located in the region of the county district Delnice. The length of the subject section is 17.46 km.

d) The suggested motorway route Zagreb - Rijeka, sector Vrata - Kupjak is in compliance with the corridor of this route foreseen in the Regional plan of Croatia and county district Delnice.

e) More significant and the most obvious influences are those that cause changes of the purpose of wood land and arable land, as well as physical and aesthetic environmental changes. These influences comprise as follows:

- decrease of the forest area for approx. 35 ha
- decrease of plow-fields and meadows for approx. 30 ha

f) Water management parameters of the region

In its entire length the route passes through a distinctly karst area with numerous dolinas (funnel-shaped depressions in limestone) and underground streams that belong to the Black-Sea river-basin. The route passes through the third zone of sanitary protection of potable water-springs, and only shortly near Delnice encroaches into the second zone of sanitary protection. Due to a possible influence of the road to the qualitative change of underground waters used for drinking, it is necessary to eliminate this influence by protective technical measures applied in the course of construction and exploitation of the road.

g) Meteorological and climatic parameters of the region

This region abounds in precipitation. In the route region 150 l/sq.m of precipitation in one day is possible, and nearby Vrata as much as 200 l/sq.m., and the precipitation in this region is one of the most intensive in
Croatia. For this reason it is important to pay special attention to construction of installations for water drainage from the carriageway. The main problems in this region are caused by snow in winter. Total height of snow near Delnice amounts to approximately 100 cm.

h) Flora and fauna

Throughout its almost entire length the route passes through the woods of reed, hop hornbeam and fir-trees. This region abounds in fauna, specially game. Out of 43 species of mammals and birds that dwell the hunting-grounds in Croatia, 31 species dwell in Gorski kotar. Due to the severe climate in Gorski kotar, the game frequently migrates to climatically more favourable regions.

Besides, mating, constant search for food and water forces animals to pass the road corridor.

i) Regional potentials

The suggested route of the motorway Rijeka - Karlovac is in compliance with the corridor foreseen for this road in previous regional plans. The motorway passes through some parts and sites that are registered as valuable landscapes or are protected as water management resources. They comprise the park forest Golubinjak, river source Ličanka and wildlife refuge Petehovec. No other cultural or historical places subject to protection on any basis are registered in the motorway corridor. Through the subject region, specially nearby the places Vrata and Delnice, many transmission lines pass. The motorway also crosses the Adriatic oil pipeline (JANAF) twice.

j) Air quality

It is known from the past experience that the woods on the road route, as well as other parts of Gorski kotar are much affected by emission of harmful substances from the atmosphere (influence of highly developed industries in the Western Europe, acid rains). Taking into consideration that the traffic load for 1990 amounted only to AADT (Average Annual Daily Traffic) = approx. 5,500 vehicles/day, i.e. the design traffic load for the year 2014 amounts to AADT = approx. 15,000 v/day, and also in view of technical improvements of vehicles and the use of unleaded petrol, the influence of the motorway to people and flora now and in future when the motorway reaches the maximum designed traffic, shall be acceptable, due to the fact that the increase of traffic shall be accompanied by technical improvements on vehicles.
Some former researches show us that the concentration of harmful gases alongside motorways depend upon traffic load and the distance from the carriageway margin. For the above stated traffic load the lead concentration on the distance over 35 m from the carriageway margin shall, at the end of the planned period and according to German technical literature, be less than 0.002 mg/c.m. of air.

6. Protective measures

6.1 Water management parameters

For the purposes of protection of waters and in compliance with the Water management development plan, the water from the carriageway shall be drained through water-tight sewers, via special devices (separators, "lagoons") and finally released to the tested and approved underground places. Separation of oily substances and sedimentation of large particles takes place in separators. The water from separators is drained into the ground or, if required, into special "lagoons" lined with clay where water is kept for approximately 15 days. Here further sedimentation and neutralization of harmful substances takes place and afterwards the water is released through a drainage system underground. The areas above the reception drainage system shall be planted with special plants capable of absorbing the residue harmful substances from the water.

Upon construction and exploitation of the motorway the influences to surface and underground waters shall be regulated in accordance with the decisions of local authorities on water protection, i.e. adequate regulations (Law on waters, By-law on sanitary protection of potable waters).

It is expected that, with the foreseen protective measures and the appropriate maintenance of the drainage system, the quality of underground waters shall not be affected. During the exploitation of the road, it is necessary to monitor functioning of the drainage system and establish regular quality control of the purified waste water from the carriageway, and also establish the system of observation of underground waters in the zones of infiltration of purified waste waters from the carriageway. Due to insufficient
experience with the suggested system of water protection on the motorway, as well as to the fact that the waters from the motorway after having been treated gravitates to the potable water springs, the Investor shall, by agreement with the local authorities in Delnice, in the course of motorway construction, take part in construction of a substitute water supply system based on exploitation of Omladinsko jezero (Youth lake).

In this way, the absolute protection of potable water from further contamination from the motorway and other roads in the region shall be obtained, because the lake is situated on a higher level than the motorway and other roads.

Upon possible incident situations on the motorway (overthrow of a tank truck, etc.), contamination of underground waters may occur and thus cause disturbance in water supply. This calls for a special by-law which would regulate measures of emergency intervention, according to which the maintenance service would sanitise such contaminations.

6.2 Meteorological and climatic parameters

Snow drifts are expected in some parts of this section, specially in shallow cuts from the tunnel "Dedin" till the end of the section. This shall be avoided by construction of snow-guards. The dimensions and positions of snow-guards shall be determined in practice.

In the course of exploitation of the motorway constant monitoring of weather conditions is required, as well as timely maintenance and removal of snowfall from the carriageway.

6.3 Flora and fauna

The wood margins resulted from cutting through the woods for the motorway construction shall be biologically sanitised by planting of adequate plants which shall decrease negative influences of felling, as well as lessen the penetration of exhaust gases into the depths of woods.

Along the parts of the motorway that pass through plow-fields it is necessary to plant such hedges that shall decrease the penetration of harmful substances from exhaust gases into the fertile soil. The kind of the hedge, its density, height, etc., shall be determined by technical documentation for construction of the motorway.

Pursuant to the requirements of organizations responsible for the game in the region, the places for passage of animals have been determined, and it has been decided that undisturbed migrations of the game in search for food and water shall be made possible.

It is necessary to put up safety fences on either side of the entire length of the motorway route. The height and type of safety fence shall be determined in accordance with the kind of the game and with the height
of snowfall (1.80 to 2.40 m). Since the standard safety fence represents no obstacle for brown bear (experience from the motorway Vrhnika - Postojna in Slovenia), it is necessary to place off-standard fence on places of possible passage of bears, which shall prevent their entrance into the fenced motorway area.

6.4 Regional potentials

All the traffic and utility installations which the planned motorway crosses, shall be put into the previous functional condition. During elaboration of working drawings special attention shall be paid to forming of all the parts of the road, choice of materials and aesthetic fitting into the environment.

Alongside the whole section biological improvement of sanitary conditions is obligatory. Consequently, all the cuts, embankments, fills and division surfaces shall be stabilized not only by technical measures but also by adequate planting with autochtonous plants.

It is extremely important that the surplus material be overhauled to waste areas to be defined in cooperation with professional services of social and political community (abandoned mine pits, rocky grounds), and adequately arranged.

6.5 Air quality

The inevitable influence of air pollution alongside the motorway shall be diminished by the previously mentioned measures for protection of flora, i.e. by planting of hedges and special kinds of trees for protection of newly formed wood margins, as well as by introduction of unleaded petrol and other technological improvements on vehicles, which has already been determined as a policy and regulations in the Western European counties.

Upon elaboration of technical documentation for the route sections in tunnels it is necessary to make thorough calculations of possible concentration of harmful substances in the air, and accordingly apply protective measures by natural or artificial ventilation.

6.6 Noise level

In the course of elaboration of technical documentation it is necessary to make detailed calculation of the noise level in the settlements alongside the motorway, based on technical parameters of the route and the traffic load. By application of the most optimal technical solutions, the noise level shall be reduced to a minimum.

Upon putting the motorway into operation, check measurements of noise levels shall be performed, and, if necessary, adequate protection from its harmful influence applied by building of aesthetically shaped barriers against the noise spreading.
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CONSTRUCTED AND PLANNED MOTORWAY NETWORK IN THE REPUBLIC OF CROATIA
POSITION OF THE REPUBLIC OF CROATIA
IN THE EUROPEAN ROAD NETWORK
AUTOCESTA (MOTORWAY) KARLOVAC – RIJEKA

KARAKTERISTIČAN PROFIL NA TERENU
(CROSS-SECTION SHOWING A FREeway)
AUTOCESTA (MOTORWAY) KARLOVAC - RIJEKA

KARAKTERISTIČNI PROFIL U TUNELU

(CROSS-SECTION IN TUNNEL)
ZA RASPONE < 30 m

ZA RASPONE > 30 m

AUTOCESTA (MOTORWAY) KARLOVAC - RIJEKA

KARAKTERISTIČNI PROFIL NA ORJEKTU