

Roman roads in Croatia

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Romans were the most efficient and systematic road constructors in ancient times. They built about 100.000 km of roads from which only 14.000 km on the territory of modern state of Italy.

Romans road constructors particularly improved the pavement construction. They paid special attention to the road foundation (base course) and probably because of that we still have so many remains of their roads all over ancient Roman Empire.

Pavement construction of roman roads, speaking in the modern technical terms, was a type of rigid pavement construction. They also used in pavement construction their great invention, the cement mixture from the site near ancient town of Puzzoli in Italy. Pavement construction had maximum of four different layers called statumen, rudus, nucleus and summum dorsum. Depending on the road placement and importance in the road network, roads had very different geometrical characteristics (pavement construction, width etc.)

The territory of the present state of Croatia was a part of the Roman Empire, thus the Roman legions and domestic people built the roads in this region as well. The Roman road network on the Croatian territory was very dense and was connecting the main settlements of that period in the coastal part and in the continental part of today's Croatia, like: Parenzium-Poreè, Pola-Pula, Iadera-Zadar, Salona_Solin, Naronas-Vid, Epidaurum-Cavtat, Siscia-Sisak, Cibalia-Vinkovci etc.

The main aim of this work is to, along with the concise presentation of the main constructing principles of the Roman roads, give review of presumable and confirmed Roman roads in Croatia and their importance in the entire road network of the Roman Empire.

The Romans were the first people to understand that the road counts less than the places it connects. The road between two towns bears the meaning only for these two places. What is important for the whole territory of the empire is the dense network of roads, the endless ribbon running everywhere. In the Roman empire the traffic played such an important role as the blood circulation plays in a human body. All the ways should have been passable and should not have closed down due to repairs. Nobody knows who invented the road. The Roman censors, consuls, emperors, generals and soldiers were the people who developed the road network. Hermann Schreiber, *The Symphony of the Road* [1].

ROMAN ROADS

The organized construction of roads has been known for 5000 years. The first roads with arranged stone paving for the needs of religious processions dates back into 2000 B.C. in Babylonia. The Assyrians and Etruscans were known as skillful road constructors. The Minoans and Carthaginians paid attention to pavement

construction, and the Phoenicians and Egyptians showed remarkable precision in measurements and surveying.

The most successful and well-organized road constructors of systematic paving of the Antiquity were undoubtedly the Romans. They realized early that well road connections in the Empire would facilitate military operations and enhance the quality of everyday life, so they connected all conquered areas. An organized road construction started around 334 B.C. According to one source the Romans built about 90.000 km, and according to the other about 150.000 km of roads by the time of the height of the power. 14.000 km of roads were built on the territory of today's Italy [2].

The Romans took over the knowledge of road-making from the Etruscans. The Romans improved the pavement construction with emphasis on the foundation construction and drainage system. If one takes a look at the roads built in different periods of the Roman Empire it can be concluded that they had been gradually developing their building methods over the centuries. Due to different building materials, available «tools», landscape and climatic characteristics the road construction varied in different areas. The «tools» e.g. in distant provinces were more primitive.

The Senate created the road legal system. It approved the financing of the roads and passed the laws. As early as 123 B.C. the folk tribune Caius Cracchus passed a law on roads —lex viaria [3]. The roads were built not only by the Emperor but, more or less voluntarily, also by the powerful Romans after whom they were named— Via Flaminia, Via Appia. The roads were built by soldiers in the rests between wars and, to a large extent by the locals of the relevant area. All the builders in the ancient Rome were named architects and they designed the roads. In the beginning, the engineers were of the Greek origin transmitting their knowledge to the young Romans. The roads were maintained by edili who took care of traffic and public safety.

The mile —stones were laid along the road. They were 3 m high stone piles with marked distances to the closest town, and to the province border or there was the name of the ruling censor, consul or Emperor. The distances were measured in Roman miles; 1 mile stands for 1,480 meters.

Classification-geometrical characteristics

The main characteristic of Etruscan and early Roman roads in the terms of road stretching was the «straight line». Such a road stretching prevented constructors from building the roads in a hilly, undulating terrain in the Alps and mountains. The longitudinal slope on the roads was on average 5–7% and on the route sections of the extremely inconvenient terrain the segments were embedded with grading 14–15%, even to 20%, which was acceptable for pedestrians and two-wheel chariots.

The type and the width of the road were interconnected within the road network as all the Roman roads were classified.

- *Via* with widths of 2,37 m and 4,14 m was a road for heavy traffic. As a rule it was 2,96 and 3,56 m wide and thus adjusted to the distance of 86 cm wheels for two-lane and three-lane roads. There were extensions on the serpentine for the width of 4,74 m. The small radii of horizontal curves and a number of hauling animals determined the width.
- *Actus* was a 1,19 m wide one-lane path for hauling animals. The same term was applied to footpaths in the towns. All mountain roads with little traffic were 1,19 m wide.
- *Iter* (the half of actus) was a 60 cm path for pedestrians and riders.
- *Semita* was a half an iter wide (30 cm) boundary path, on the border of meadows, pastures and ways in the hills.

If provided with pedestrian ways urban roads were 7,0 m wide. Without them they were 4,15 m wide. The sidewalks were 1,5 m wide, which is still present-day standard considering two pedestrians passing each other.

The above classifications did not include roads of special importance such as those in Rome, or those intended for religious or imperial processions. Those roads like via Appia were even up to 12 meters wide.

Pavement construction

The pavement construction should have been durable. The engineering progress enabled systematic

approach to construction and the adjustment to traffic requirements, soil contents and climatic conditions.

The road construction started with legionaries —war prisoners or slaves digging a furrow in the direction and width of the proposed road. Then the excavations started in the form of the canal waterbed with canal borders topped with stones.

According to modern terminology the Roman road constructors built a rigid pavement construction that comprised 3 to 4 layers laid on the prepared foundation. The number of the strata depended on the road significance.

The «statumen» is the bottom layer made of stone aggregate. The aggregates were of the size of at least 5 cm and the total thickness of 25 cm to 60 cm;

The «rudus» is laid upon the basic layer «statumen» that was cemented with granulated material (aggregates under 5 cm) with the total thickness of 25 cm;

The «nucleus» is a layer embedded only on the important roads, made up of cemented tiny granulation with total thickness of 30 cm;

The «Summum dorsum» or «summa crusta» is a surfacing made up of large rectangular or polygonal two inch stone slabs stabilized with cement.

The layers were horizontal in the transversal cross section, aside from the paving «summum dorsum» or «summa crusta» that had a lateral grade 1:60 in the transversal direction.

The Romans had used the lime mortar —known already by the Greeks since the third century B.C.— and experimented with it in the road construction. By mixing lime with different gravel types they got so called caementum. Next to the discovery of puzollana, a natural volcanic tufa

called after the site Puteoli near Naples, those materials enabled the construction of a rigid pavement of a high quality.

In this way the pavement construction was circa 1,00 m thick, and as all the layers were stabilized in the above-depicted manner the pavement was built as a «lying wall». The load of heavy wagons with a harness often caused cracks in the rigid pavement construction.

The pavement of inaccessible and rarely used ways in the Alps and in rugged terrain was shaped mostly as a piece of a ground carved out in the rocks with widths usually narrower than the standard ones.

A typical cross section of the Roman road is seen in Figure 1.

ROMAN ROADS IN CROATIA

Roman empire in Croatia

As far as it is known the oldest people of present-day Croatia were Illyrians. Approximately in the third century B.C. the Romans under the Emperor Octavius and Augustus started fighting against Illyrians. The Emperor's stepson Tiberius finally conquered Illyrian and Celtic tribes in A.D. 8 (or A.D.9) in the battle north from today's Vinkovci (called then Cibalae).

United by then, the province of Illyria was divided into the provinces Dalmatia —Dalmatia (from the Adriatic sea to the river Drina and Savus (Sava)) and the province Pannonia (a part of Croatia, of northern Bosnia and a part of Slovenia) in A. D.10. A today's peninsula Histria (Istria-a part of Croatia) was joined to the province Venetia.

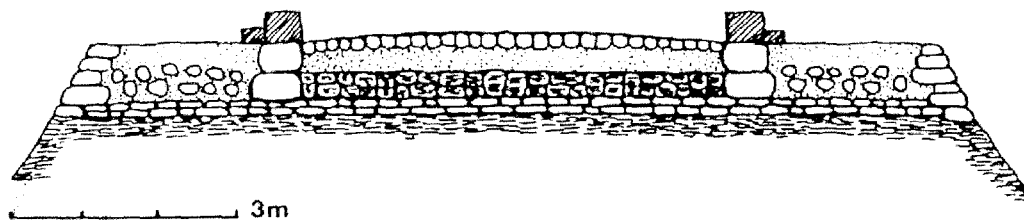


Figure 1
The cross section of the main Roman road [4]



Figure 2
Roman provinces in today's Croatia [5]

In the third century the Emperor Diocletian, following his reforms, divided the Empire into smaller administrative units, so there were six to seven provinces in Croatia. The capitals were the cities Salona (Solin) and Siscia (Sisak).

After the final division of the Roman Empire into the Western and Eastern Empire in the year 395 the whole territory of Croatia belonged to the Western Roman Empire.

In all possessed areas, so in Pannonia and Dalmatia, the Romans built first fortified camps and military roads. They developed trade and crafts in the towns, and in the neighbouring areas like Bosnia they stipulated farming and mining. Over the five centuries of their rule the Romans created a dense network of roads and connected it across Aquileia—the center of the province of Venetia—with the road Via Flaminia that led to Rome.

Many Croatian cities are built on the foundations of Roman settlements: Siscia (Sisak), Mursa (Osijek), Epidaurum (Cavtat), Cibalae (Vinkovci), Tarsatica (Trsat/Rijeka). Several cities are still archeological sites such as the city of Salona (near Solin), and Andautonia (Ščitarjevo near Zagreb). The most recent and quite a rich site that has been intensively excavated in 1994–1995 is Naron near Metković [5]. The same history is shared by the roads built in Roman times that connected the mentioned towns with the remaining part of the Empire. Several Roman roads were used in the succeeding centuries

for the construction of modern roads. Some of them can still be studied on some sections in their original form.

One of the finest and most comprehensive sources on the network of the Roman roads is Tabula Peutingeriana. Tabula Peutingeriana is a copy of Castorius' map. It was found in a Benedictine monastery in Bavaria. Tabula Peutingeriana contained originally 12 pieces of parchment of the total length of 6,8 m. Eleven parchments have been preserved. Today they are to be found in the Austrian National Library in Vienna [6]. The Castorius map is supposed to have been created around 273 during the land surveying. The map serves as a basic source of the geography of earth, as comprehensive and precise as it could have been with the measuring methods of that time. The Castorius map comprises the roads, distances between province stations, camp types, coastal characteristics of the Adriatic Sea, flows and river basins of Croatian largest rivers and mountains.

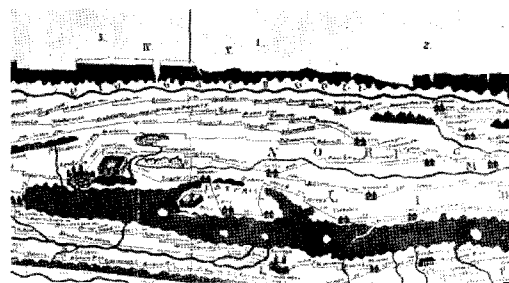


Figure 3
Tabula Peutingeriana [7]

Coastal area-provinces *Dalmatia* and *Histria*

Many towns in the coastal part of Croatia, both on the mainland and on all large islands developed from the Roman settlements. Next to seaways, the Romans also used the roads as the safest ways for military movements on both sides of the Adriatic.

Roman settlements of special importance that possessed all Roman civil rights had the status of colonies. There were more colonies on the coastal side than in the mainland. Connected by roads with the center of the Empire the colonies were the porters of the Roman power and progress.

There was one major road along the coast with the evidenced route mentioned in all the sources as an important traffic direction [4], [8].

The road connected:

— Aquilea-Tergeste (Trieste/Italy) and Tarsatica (Trsat-Rijeka) over the continental part of Istria. The road was called *Via Gemina*.

From Tarsatica the route led to settlements-travel stations:

- Senia (Senj) over the Velebit mountain to Arupium (Otočec) - Epidotio (Kvarte) - Ancus (Kula) - Ausancalione (Lovinac) - Clambetis (Obrovac) - Hadre ab Madre (Medvida) - Burnomilia (Ivoševci near Široka stijena close to Kistanje) and diverged farther into two directions, first Iadera (Zadar) - Scarda (Skradin) - Tragurium (Trogir) - Salona (Solin-Split) and second direction Promona (Drniš) - Andretio (Muæ Gornji) - Salona (Solin).

There are indications that there was another one direction which led from the Senia (Senj) to the south but direction was not confirmed [2].

Tabula Peutingeriana mentions the route from Tarsatica (Trsat-Rijeka) to Salona (Solin) via Promona (Drniš). The distance between Tarsatica

(Trsat-Rijeka) and Salona (Solin) was 182 miles (circa 273 km). Outside Salona (Solin) the road ran further across Dalmatia (Dalmacija) connecting Narona (Nin) and Epidaur (Cavtat).

Roman sites are very well explored and preserved on the Istrian peninsula. Noteworthy is *Via Flavia*, a consular road connecting Tergeste (Trieste) and Pola (Pula). The construction of the road started in 130 B.C. The route began in Aquilea and went on via Tergeste (Trieste-Italy), via Quoev (Istarske toplice) and via Parenzium (Poreč) to Pola (Pula).

According to Tabula Peutingeriana the total length of the road between Tergestica (Trieste) and Parenzium (Poreč) [9] was 48 Roman miles (circa 72 km), and from Parenzium (Poreč) to Pola (Pula) 30 miles (circa 45 km).

This road passed near Parenzium (Poreč), an important settlement developed from the fortified camp (castrum) into the colony (colonia Iulia). The remains of the road considered as *via publica* are to be found in the settlements Pizuga and near Linski kanal [10]. It is interesting that the part of the modern highway passing the western part of the Istrian peninsula is constructed on the old Roman route. Figure 5 shows a stretch of Vižinada to Parenzium (Poreč) road with a typical Roman straight way of laying the route



Figure 4
An ancient Roman Road cut into the mountain Snježnik near Tarsatica (Trsat-Rijeka)



Figure 5
Stretch of Vižinada to Parenzium (Poreč) road with a typical Roman straight way of laying the route

laying the route. As the road connects the tourist resorts it has great significance for this area.

Via Flavia ran from Pola (Pula) colony along the eastern coast of today's Istria connecting:

Nesactium (Nezakcij) - Mausio Arsia (Rakalj) - Alvona (Labin), Lovriana (Lovran) - Tarsatica (Trsat - Rijeka). The road might have crossed the one reaching Tarsatica (Trsat - Rijeka) from the direction of Tergestica (Trieste) on today's area of Kastav, but so far this road has not been dug out.

The total length of Pola (Pula) - Tarsatica (Trsat - Rijeka) road was 48 Roman miles (circa 82 km).

In Dalmatia a dense network of Roman roads was laid in the regions of Iadera (Zadar), Salona (Solin), Narona (Vid) and Epidaurum (Cavtat).

From Iadera (Zadar) the road diverged into three directions [11]. A road, which can be seen today from the air, led to Aenona (Nin) that was otherwise separated from the main coastal road and primarily directed to sea traffic. The other road led to Nedinum (Benkovac) westward and was linked to the mainland way towards Salona (Solin). The main route from Iadera (Zadar) led southward, along the coast via Scardona (Skradin) and Tragurium (Trogir) to the colonies Salona (Solin) and farther Narona (Vid).

Not less than five roads connected the colony of Salona (Solin) with the harbour and the sea. As most Roman settlements Salona (Solin) was located on the hill above the sea and the later built Diocletian's summer residence in Spaletum (Split). Salona (Solin) was among the largest and most developed settlements in the Croatian part of the Adriatic. At the height of its prosperity Salona (Solin) had around 20.000 inhabitants, but some historians claim to have them even 60.000 (the fact based on the number of seats in the amphetheater). The town had an infrastructure of roads which has not been fully explored so far as the financial means are lacking. As evidenced in many documents the urban roads were built here by the army. Most roads were built in the early first century A. D. A part of the main town road can be seen on the archaeological site under magnificent town gates called Porta Caesarea (Figure 6). The road heading under above mentioned Porta Caesarea from Salona eastward next to the ancient city runs over the arm of the River Salon (today Jadro). In this section the road is laid on the masonry stone arches—a specific masonry bridge the part of which still exists as a testimony of Roman skilfulness

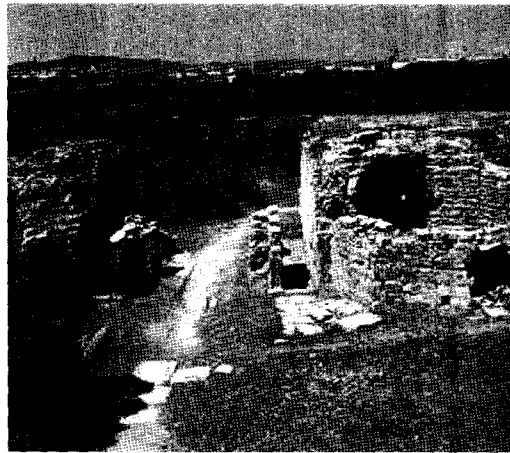


Figure 6
Porta Caesarea [12]

(Figure 7). This find is called by the locals «Five Bridges».

The road that ran from Salona (Solin) northeast to the continental part and to the mainland of the Biokovo mountain by the Roman settlement of Tilurio (Trilj), Ad Nova (Runović-Imotski) to Narona (Vid) was 65 miles long (circa 98 km). Narona (Vid) is another important colony where the excavations have started only recently. Along the river Naro (Neretva) Narona (Vid) was connected with Bosnia and mines of silver and gold which were of particular interest for the Romans.



Figure 7
«Five Bridges»[12]

This road as a combination of a route in the mainland ran from Narona (Vid) to Ad Hihia (Trebinje in Montenegro) and farther to the sea, along the coast to the settlement Asamo (Slano) it continued to Epidaurum (Cavtat) the farthest colony in the southern part of Croatia. This segment of the road was 182 miles long (circa 273 km). The road connected Epidaurum (Cavtat) with the mountainous hinterland (which is today the territory of the state of Montenegro). At Ad Hihio (today Mosko) the road diverged into three directions: already mentioned road to the valley of Drina and Salona (Solin), towards Anderba (Nikšić) and to the west to Scodra (Skadar).

Despite the same principles of construction, the quality of roads varied depending on supplies and quality of masonry material of relevant areas. The craft of masonry was highly developed for the construction of harbours, settlements and roads in the coastal part of Croatia. The supplies of limestone in the open quarries (cava) facilitated the construction of durable and quality Roman roads in this area. Figures 8 (a and b) show the roads close to Iadera (Zadar) and in Salona (Solin) paved with limestone. The construction of surfacing depended also on the location of the road, so the pavement of urban roads (b) differs from that in the country (a).

Continental region-province Pannonia

As in other provinces the centralized Roman power «deeply dug» the stretches of ancient roads in these

regions. They were used for centuries after the fall of Roman Empire. There is an evidence that as early as in the first century B.C. one of two major roads crossed the continental part of today's Croatia. It was only at the beginning of a new era that Pannonia joined the network of Roman roads and became of interest for the Roman state. The major route that is mentioned already in the first century B.C. Via Pannonia got its name after the province it crossed in the west-east direction. The stations that are mentioned as well are Aquilea-Nevoidunum (Drnovo in Slovenia near Novo Mesto), Servitium (Stara Gradiška), Marsonia (Slavonski Brod), Sirmium (Sremska Mitrovica in Serbia) and further across Serbia and Bulgaria to Byzantium (Bizant)[3].

As Balkan Peninsula dominated over the central area of the Roman Empire a dense network of good roads was constructed in the third century A. D. The starting point of all roads was Aquilea with three stretches: northern, central and southern one. A part of the northern route that ran along the Drava in our area connected military, rural and urban centers like Poetovia (Ptuj) and Mursa (Osijek). According to Tabula Peutingeriana the route was 156 miles long (234 km)[3]. Aqua Viva (Petrijanec) and farther to the east Iovia (Ludbreg), Sunsitia (Kunovec breg), Piretis (Draganovac near Koprivnica), Letulis (probably Virje), and Serota (Virovitica) were located on this route [13]. The central route, *Via Pannonia* ran along already known line, Emona (Ljubljana in Slovenia), Siscia (Sisak) and Sirmium (Sremska Mitrovica in Serbia) with several already



Figure 8

A typical pavement of masonry and limestone slabs on the Roman roads

a) in the coastal area of Croatia outside the town near Iadera (Zadar)

b) in the town Salona (Solin)

then mentioned stations. According to Tabula Peutingeriana a part of this road running across the territory of today's Croatia was 110 miles long (167 km)[3]. A southern, already mentioned route ran along the coast of the Republic of Croatia. Five roads are mentioned in this period connecting the southern road with the central one, of which Senia (Senj) to Siscia (Sisak) was on the territory of Croatia.

On the territory of Croatian Zagorje there were two major north-south roads. One followed the flow of Krapinica and Krapina and joined over Bednja and Dravsko polje the poetovian region in the north and across the southern part Siscia (Sisak) and Andauntionija (Ščitarjevo). The other route reached the

southern slopes of Ivančica across the plain of the river Reka. This road joined the road Poetovio (Ptuj) and Mursa (Osijek) across the mountain in the north, and across Medvednica continued to the south in the direction of Andauntionia (Ščitarjevo). This system of roads included secondary roads as well. There is much evidence of it, for instance the remains of the Roman road that ran across the town Sv. Ivan Zelina. The archaeological finds confirmed the existence of the Roman settlement Pyrrí (Sv. Ivan Zelina) near Komin, and a lively traffic along Poetovia (Ptuj) to Siscia (Sisak) road, [14]. It is also known that from Aqua Viva (Petrijanec) the road led over Andauntionia (Ščitarjevo) and Pyrrí (Sv. Ivan Zelina) to Siscia (Sisak).



Figure 9

Part of the main Roman urban road through Andauntionia with the stone edge, paved with stone slabs and porches by the both side

- a) reconstruction according to the ancient writers;
- b) road with preserved bases of the columns-colunades;
- c) groove for the forced guiding vehicle

In the road network between the rivers Mura and Drava the north bound route direction from Poetovia (Ptuj) to the military camp in Carnuntum (Petronell) was of special importance. The road connected here the banks of Drava with the crossing over the Mura where the ancient settlement Halicanum (Martin on Mura) was built. On the territory of Međimurje, beside the mentioned road there is another one that led from Poetovian region eastbound, crossing Mura, and continuing to the northeast in the direction of Aquincum (Budapest).

On the territory of today's eastern Croatia there was Cibalae (Vinkovci), a city that due to its very convenient location at the crossroads of important land routes gained the status of a colony with full municipal rights as early as the first century. From Cibalae (Vinkovci) the road diverged to the east from Sirmium (Sremska Mitrovica in Serbia) to the west over Siscia (Sisak) to Emona (Ljubljana in

Slovenia) along the Drava to Poetovio (Ptuj), farther, over Marsonia (Slavonski Brod), across Bosnia to Salona (Split), and in the north across Mursa (Osijek) to Aquineum (Budim) and farther to the west [15]. From Cibalae (Vinkovci) another road led in the direction of Marsonia (Slavonski Brod) across Certis (Đakovo) and joined the already mentioned Siscia (Sisak) to Sirmium (Sremska Mitrovica) road running along the right coast of the Sava river.

Through Slavonia ran less important roads like Picientium (between Pleternica and Podgorača), Stranianae (between Našice and Orahovica), Aqua Balissa (close to Pakrac), Varianae (close to Kutina) and Siscia (Sisak) led from Certis (Đakovo).

Aside from those most significant roads connecting Roman provinces, there was also a thick network of less important roads linking municipia and colonies of the Pannonia region.

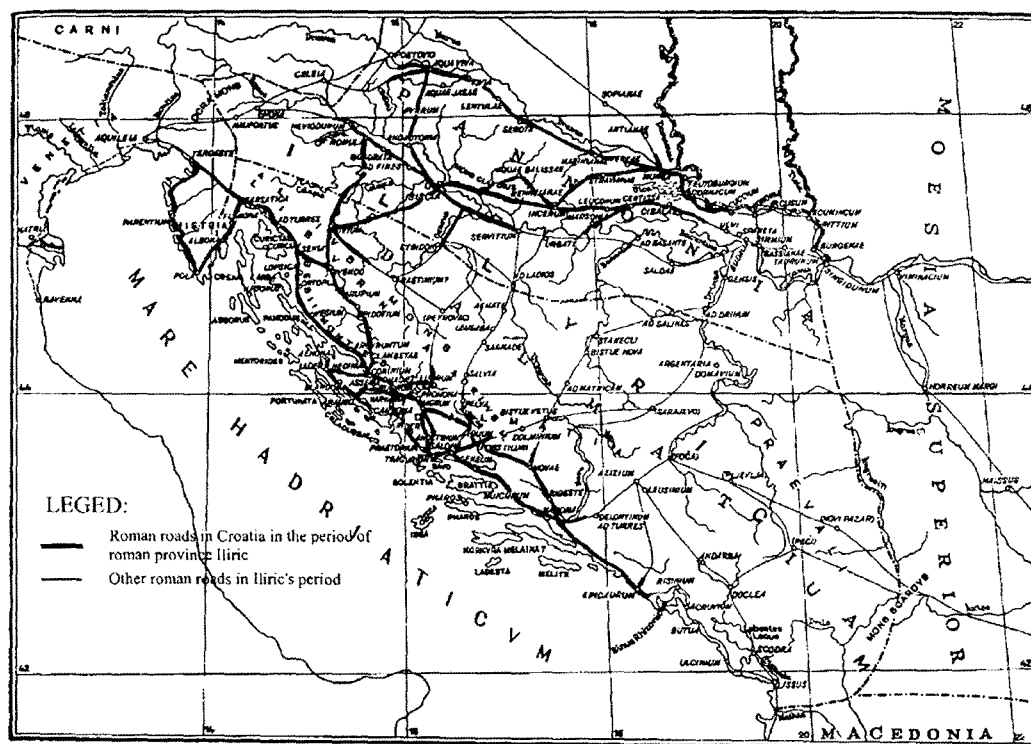


Figure 10
Roman roads during the Roman Empire in the province Iliric [16]

CONCLUSION

From our point of view the Roman achievements created without any help of present-day technology 2000 years ago are really stupendous. Many of them, especially Roman roads and the dense network throughout the whole of Europe still exist today.

What is exceptional about these roads is a precise design of a pavement construction. The technological advancements of the Romans can be seen even in the most modern types of rigid (concrete) pavements. Lower bearing layers made of unbound masonry material, and upper strata and the paving bound with cement (or other material) are a consistent part of the then and the present-day pavements. Due to carefully constructed foundation and well performed drainage the depicted Roman roads can still be explored and studied today.

There are many remains from the Roman age on the territory of Croatia. This paper strives to give a review of major Roman roads in Croatia with the stress on the remains that can be still excavated today. The major roads that led from Rome to the territory of Croatia started in the centre of the Province Venetia, from Aquilea and diverged into three directions:

- northbound to Poetovio (Ptuj in Slovenia) and Mursa (Osijek),
- in the central part to Emona (Ljubljana in Slovenia) and Siscia (Sisak), and further to the east and
- southbound in the direction Tergestica (Trieste), and farther on to Dalmatian metropolises Salona (Solín), Narona (Vid) and Epidaurum (Cavtat).

In this way all specific characteristics of the terrain were respected locating the roads along the rivers or along the coast, using the mountain passes (e.g. over Velebit). The linking of the provinces Dalmatia and Pannonia over the central mountainous region of the present-day Croatia was avoided in this way. There is only one road in this region, the Senia (Senj) to Siscia (Sisak) road running along the longer and the milder route through the river valley of today's Lika, and avoiding the hilly area of Gorski Kotar where the rugged terrain still presents problems in the modern road-making.

Because of lacking finances, not all known sites have been explored. Salona (Solín), one of the principal cities of the Roman age and the seat of Dalmatia has been only partially excavated. Only a few remains can be studied, and there is no possibility of studying the structure of the pavement on the major roads of this settlement. The same case is the site of Narona (Vid) and Andautonia (Ščitarjevo).

There is also another problem in exploring the Roman roads, as many of them are located outside the organized museological space and thus stay unmarked and neglected. Every and even the smallest remain of the road, path or way should be marked even if they make up the basis of the modern roads or an archeological park.

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