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## THE ROAD NETWORK OF THE CATALAN PYRENEES: DEVELOPMENT AND CURRENT STATE

### ABSTRACT

In this article we analyse the process of development and the functional characteristics of the road network in the Catalan Pyrenees. The study is divided in three main sections: 1) an analysis of the geographical factors that have been determinant in the growth of the network; 2) a description of the process of its regional implementation and 3) its current state, including an evaluation of the plans now in the process of being implemented and recent improvements and an analysis of the significance of two major undertakings - the Llobregat Axis and the tunnel of Cadí. Special emphasis is placed throughout the article on the concept of network integration Labasse, J. 1971), which we define as the degree of connectivity of the comarcas (provincial subdivisions) of the Catalan Pyrenees and their centres of population to a general road network.

This article has drawn on both documentary and bibliographic sources but is based principally on J. Font's doctoral thesis, which analyses the growth of the Catalan road network. Few geographical studies of the transport network of the southern slopes of the Pyrenees have been published, be it in Catalan or Spanish journals. This stands in marked contrast to the attention dedicated to the subject by French academic publications (*Pyrénées, Revue de Geographie des Pyrénées et du Sud-Ouest*). This said, however, we should not overlook the studies undertaken in Spain by A. Escalona (1888), above all those carried out in the Aragon Pyrenees. Any other articles describing the Catalan Pyrenees, though, must be tracked down in individual chapters of regional monographs, both ancient (Solé Sabarís, L. 1951; Llobet, S., 1947) and modern (López Palomeque, F., 1986).

The data sources describing the Pyrenees transport network have improved considerably in recent years. This is due to the growth in number of applied studies sponsored by the various bodies of public administration following the re-establishment of democracy in Spain (1977) and the restoration of the Generalitat, the autonomous Catalan government. Among these studies, at the comarcal level, the most outstanding are the comarcal plans for upland areas (*Plans Comarcals de Muntanya*), carried out at the instigation of the Generalitat and in which the transport network of the comarcas of the Pyrenees are analysed exhaustively; while at the regional level the most outstanding source is the study known as the *Pla de Carreteres de Catalunya* (Generalitat de Catalunya, 1987) - the Road Network Plan for Catalonia. These studies, and others of similar

importance (MAB-6 programme; Gurera, J., 1988), offer an enviable level of information about the transport network of the comarcas of the Pyrenees and their prospects for short-term improvement.

### KEY WORDS

road network, Catalan Pyrenees, Trans-Pyrenean routes

### 1. STUDY AREA: GENERAL CHARACTERISTICS OF THE CATALAN PYRENEES

This paper examines the mountain comarcas of the Catalan Pyrenees (see Figure 1)<sup>1</sup> and adopts the classical division of the Catalan Pyrenees in two distinct sectors: the eastern, comprising the comarcas of the Garrotxa Ripollès, Berguedà y Solsonès; and the western constituting the six remaining comarcas. This division is based on hydrographic criteria and has been followed by most authors who have conducted studies in the Catalan Pyrenees. The western Pyrenees coincides roughly with the area which sheds its waters into the river Ebro, via the Segre and its tributaries, while the eastern sector coincides with the area which sheds its waters directly into the Mediterranean, via its rivers Llobregat, Ter y Fluvià. This criterion of division is geographically significant as both spaces have followed a highly distinctive socio-economic and demographic evolution so that the western comarcas have remained much more isolated than their eastern counterparts (Solé Sabarís, L. 1951; Majoral, R. 1989). In addition to the geomorphologic nature (greater altitude and compactness of the mountain chain in the western sector), this has been due to a number of factors among which the main ones are the proximity of the eastern Pyrenees to the Mediterranean shore and to the most highly populated and developed comarcas of Catalonia, especially to Barcelona.

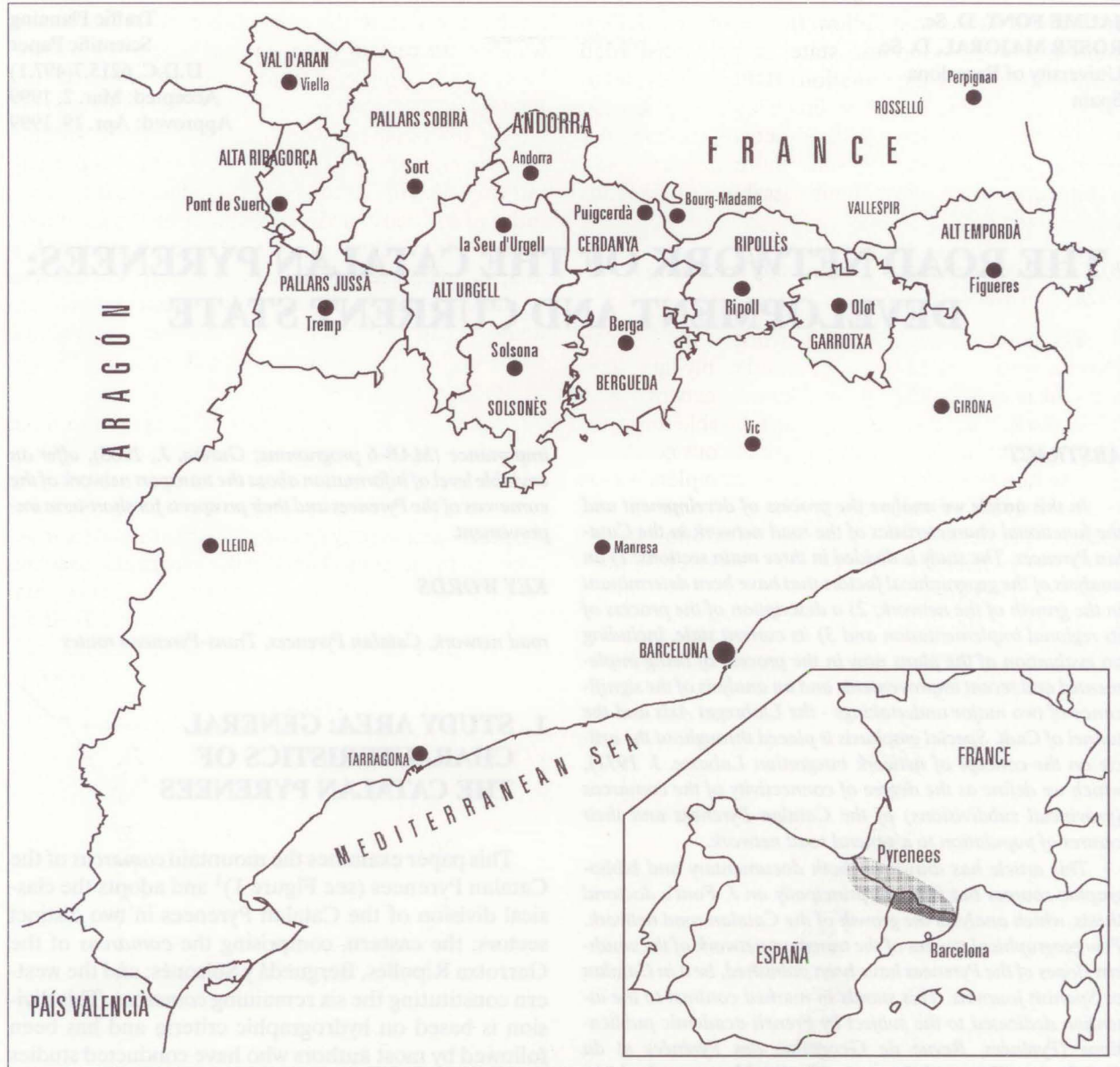


Figure 1 - Localisation Map

*a) Basic typology of the roads in the Pyrenees*

In terms of their function, three types of road can be distinguished in the Pyrenees: those that run through the mountains, those that act as links between the *comarcas* and valleys and those that give access to the settlements located in the secondary valleys and in the interfluvial areas. The first form a part of the basic or general network, the second belong to the *intercomarcal* network and the last to the *comarcal* or local network.

The roads that cut through the mountains follow routes that invariably run parallel to the main river courses (Noguera Pallaresa, Segre and Ter for example) and generally cross the mountain chain via the most accessible passes, becoming, in some cases, trans-Pyrenean roads (Solé Sabarís, 1951). The latter

are the roads that first cut into the mountain and which have progressively undergone improvements. They play a leading role as they constitute authentic axes of communication in the valleys and channel most of the traffic flow.

The intra-Pyrenean roads began to be constructed in the 20<sup>th</sup> century (with a few exceptions) and many of them have not since undergone any improvements; they are usually known as transverse roads and guarantee communication between the various valleys. There are few roads of this type, which have limited the vertebration of the geographical space.

Finally, the local network gives access to the secondary valleys and the small settlements located on the slopes or in upland interfluvial areas. These roads were built at a time when they were long overdue and,

in general, those that follow the secondary valleys were included within the state or provincial road plans. The centres of population off these roads had to build, often with their own financing, the link road connecting them to the general network. Today, the maintenance of these link roads (more often than not, a dirt track, which is just about passable) still depends on the town halls.

**b) Factors conditioning development of road network in the Pyrenees**

The construction of road network in the Catalan Pyrenees was carried out at a considerably later date than the rest of the Catalan and Spanish network. And while the last decade has seen considerable improvements, the roads are in a highly precarious condition and the network is very sketchy and incomplete; this is particularly true of the secondary roads (*comarcal* and local). This delay in the network integration of the Catalan Pyrenees and the poverty and sketchy nature of the network (a description which could be applied to the rest of the Spanish Pyrenees, especially that of

Aragon), is due to the coincidence of various factors which, with certain frequency, appear to be interrelated: the geographical factors, both of a physical (difficulties imposed by the relief) and human nature (low population density and economic marginalisation of the *comarcas* of the Pyrenees) are the most important, but what also needs to be kept in mind are the vicissitudes of the construction process of the Spanish road network, that is the history of public works undertaken in Spain in different periods of its history. The analysis of the importance of each of these factors would demand exhaustive research, which goes beyond the scope of this article. Here, we shall limit ourselves to an analysis of the main factors.

According to Solé Sabaris (1951), there are three main factors that have influenced the establishment and configuration of the road network in the Pyrenees: the powerful moulding effect of the relief, the perpendicular arrangement of the river network in relation to the structural lines of the orographic axes and the compactness of the calcareous Prepyrenees embedded on both sides of the axial nucleus. To these

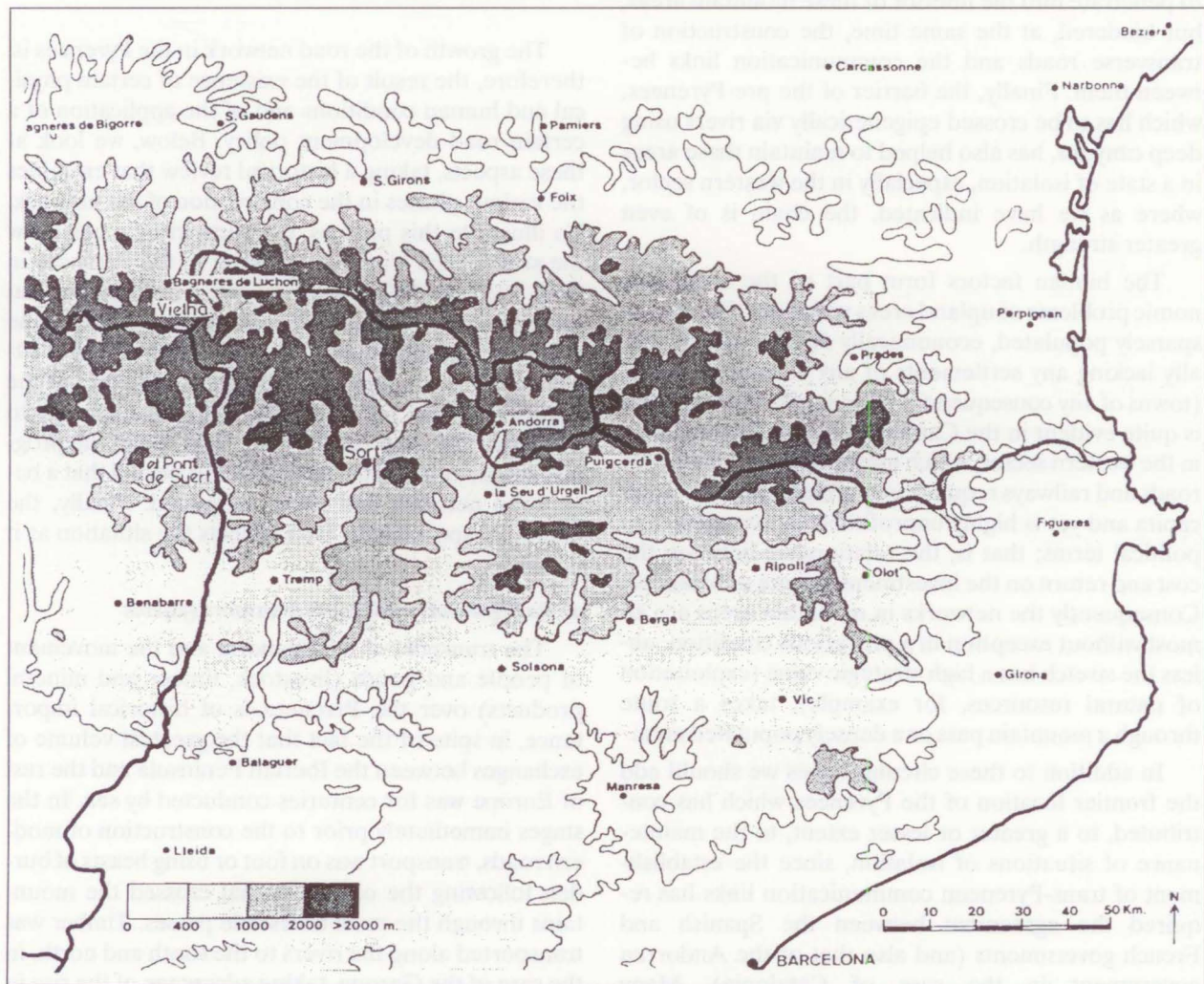


Figure 2 - Sketch of the Relief

orographic factors it is necessary to add those that derive from the difficulties encountered in constructing and maintaining the mountain roads, that is, a demanding environment, with steep slopes and extreme climatic conditions. The freezing conditions and snowfalls in the mountain passes can last up to six months along those roads which follow the high altitude routes.

If we examine the moulding power of the relief it can be seen that in the axial sector of the Catalan Pyrenees (from the Val d'Aran to Ripollès), the summit line is around 3,000 m and the mountain passes are also at a high altitude (in general, above 1,800 m). This has clearly hindered the establishment of communication routes. The river network, moreover, lies perpendicularly to the structural lines (the chain is oriented from east to west, while the river network runs north to south) and has conditioned the formation of a series of long narrow (having been opened out little by glacial erosion) valleys that run parallel to each other, separated by wide, high interfluvial regions. The layout of the valleys and their morphology enabled man to penetrate into the interior of these mountain areas, but hindered, at the same time, the construction of transverse roads and the communication links between them. Finally, the barrier of the pre-Pyrenees, which has to be crossed epigenetically via rivers using deep canyons, has also helped to maintain these areas in a state of isolation, especially in the western sector, where as we have indicated, the chain is of even greater strength.

The human factors form part of the socio-economic problems of upland areas which are, in general, sparsely populated, economically depressed and usually lacking any settlements of any considerable size (towns of any consequence). This set of circumstances is quite evident in the Catalan Pyrenees, in particular in the western sector, which means that the building of roads and railways requires a very high investment per capita and yet is highly unprofitable in economic and political terms; that is, the relationship between the cost and return on the investment is quite unbalanced. Consequently the networks in mountain areas are almost without exception in a precarious condition, unless the stretch has a high strategic value (exploitation of natural resources, for example), takes a route through a mountain pass or a densely populated area.

In addition to these circumstances we should add the frontier location of the Pyrenees which has contributed, to a greater or lesser extent, to the maintenance of situations of isolation, since the establishment of trans-Pyrenean communication links has required the agreement between the Spanish and French governments (and also that of the Andorran government in the case of Catalonia). Many trans-Pyrenean routes, discussed in international ac-

cords on communication networks, were never built (the rail link between Lleida and Saint-Girons, is perhaps the best example of this). Following Spain's entry into the European Union in 1986, the frontier factor has lost influence and the first free pass between Spain and France was opened up in 1992, following the closure of the customs post of Coll d'Ares (between Camprodon and Prats de Molló).

In short, the sluggish way in which the construction of the transport network of the Pyrenees has been undertaken and its current low density and sketchiness are the result of both physical and socio-economic factors which, to a large extent, are to be found in all mountain areas. To these factors we should add, in the case of the Pyrenees, its status as a frontier mountain chain and the history of public works in Spain, factors that have influenced just as significantly, if not more than the physical environment, in maintaining the situation of isolation.

## 2. CONSTRUCTION OF ROAD NETWORK IN THE PYRENEES

The growth of the road network in the Pyrenees is, therefore, the result of the existence of certain physical and human conditions and of the application of a certain road development policy. Below, we look at these aspects, taking a historical review that examines the various phases in the construction of the network. To illustrate this process, the supporting maps show the state of the transport network in the Pyrenees in 1910, 1935 and 1995. This sequence is not arbitrary but rather corresponds to three specific moments in the evolution of the network. The map illustrating the situation in 1910 highlights the precarious nature of the network and the little work that had been done up to this date. The map for the year 1935 shows the progress made, as it was by the end of this period that a basic road network had been completed. Finally, the map corresponding to 1995 reflects the situation as it is today.

### *a) Background: traditional transport systems*

The transport of merchandise and the movement of people and goods (livestock, timber and mineral products) over the Pyrenees is of historical importance, in spite of the fact that the greatest volume of exchanges between the Iberian Peninsula and the rest of Europe was for centuries conducted by sea. In the stages immediately prior to the construction of modern roads, transport was on foot or using beasts of burden following the old paths that crossed the mountains through the most accessible passes. Timber was transported along the rivers to the south and north, in the case of the Garona, taking advantage of the rise in water level during the period of snow melt.

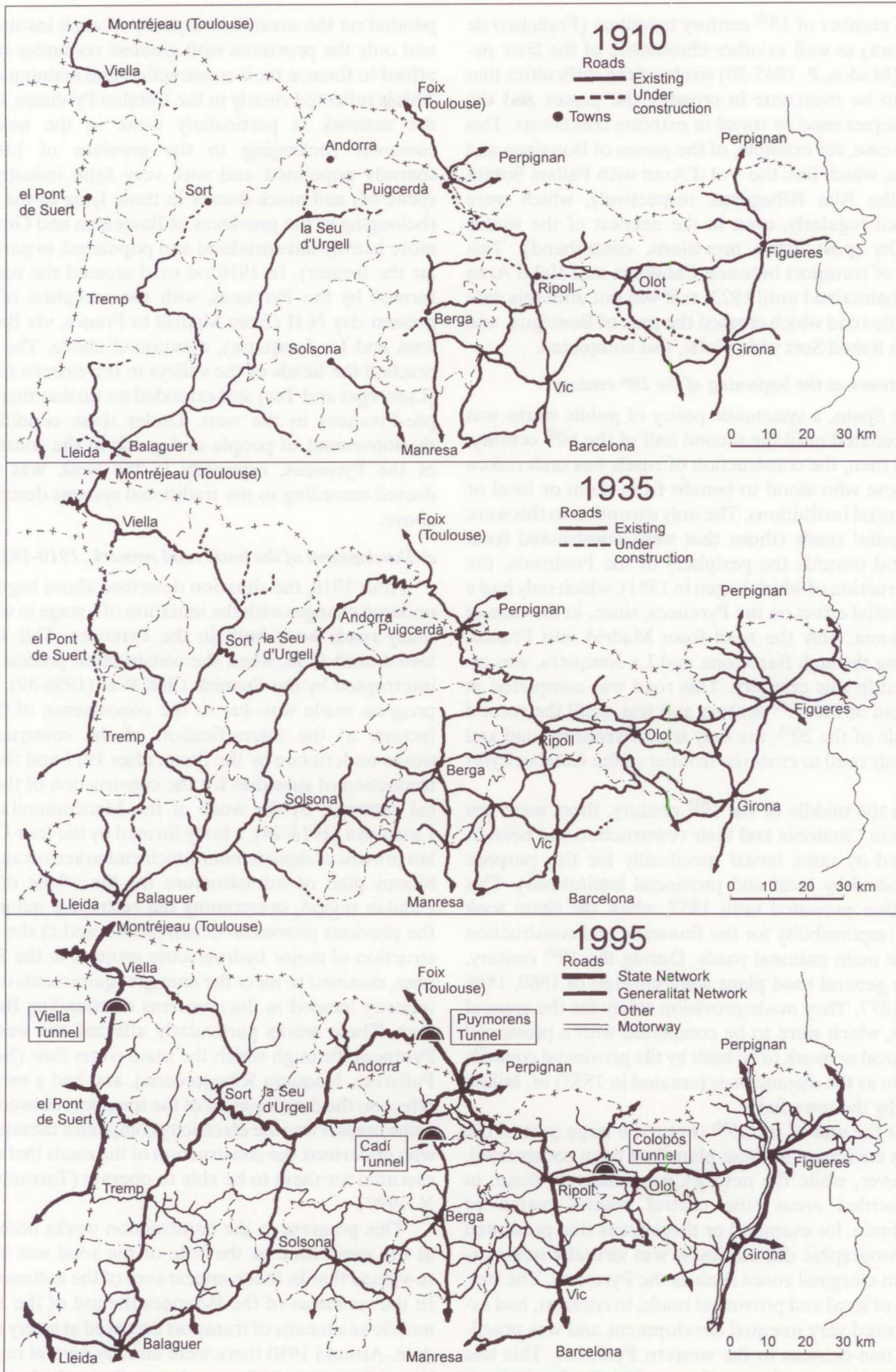


Figure 3 - Growth of the Pyrenean road network

A number of 18<sup>th</sup> century travellers (Francisco de Zamora) as well as other chroniclers of the later period (Madoz, P. 1845-50) wrote of the difficulties that had to be overcome in crossing the passes and the techniques used to travel in extreme conditions. This is the case, for example, of the passes of Bonaigua and Viella, which link the Val d'Aran with Pallars Sobirà and the Alta Ribagorça, respectively, which were crossed regularly, even in the deepest of the winter months (post, basic provisions, contraband). This form of transport between Catalonia and Val d'Aran was maintained until 1923, as it was not until this date that the road which crossed the pass of Bonaigua, and which linked Sort with Viella, was completed.

#### *b) Network at the beginning of the 20<sup>th</sup> century*

In Spain, a systematic policy of public works was not initiated until the second half of the 19<sup>th</sup> century. Until then, the construction of roads was undertaken by those who stood to benefit from them or local or provincial institutions. The only exception to this were the *radial* roads (those that were constructed from Madrid towards the periphery of the Peninsula, the construction of which began in 1761), which only had a tangential effect on the Pyrenees, since, in the case of Catalonia, only the road from Madrid into France, passing through Barcelona and La Jonquera, was included in this category. This road was completed at the end of the 19<sup>th</sup> century and was, until the second decade of the 20<sup>th</sup>, the only trans-Pyrenean road and the only road to cross the frontier of the Catalan Pyrenees.

In the middle of the 19<sup>th</sup> century, there were few roads in Catalonia and their construction had been financed by taxes levied specifically for this purpose (collected by local and provincial institutions). This situation prevailed until 1857, when the State took over responsibility for the financing and construction of the main national roads. During the 19<sup>th</sup> century, three general road plans were enacted in 1860, 1868 and 1877. They made provision solely for the general roads, which were to be completed with a provincial and local network to be built by the provincial councils known as the *diputaciones* (created in 1833) or, failing that, by the town halls.

At the end of the 19<sup>th</sup> century, a large part of the roads envisaged in these plans had been constructed. However, while the network was relatively dense in the settled areas (the central coastal region of Catalonia, for example) or those areas that presented few orographic difficulties, it was virtually non-existent in marginal zones such as the Pyrenees. The network of local and provincial roads, in contrast, had experienced very unequal development and was practically non-existent in the western Pyrenees. This was because these roads were financed by the *diputaciones* and the town halls, which meant that construction de-

pended on the economic capacity of each institution and only the provinces with greatest resources could afford to finance their construction and maintenance. This is reflected clearly in the Catalan Pyrenees, since the network is particularly weak in the western *comarcas* (belonging to the province of Lleida, sparsely populated and with very little industry to speak of) and much denser in those lying to the east (belonging to the provinces of Barcelona and Girona, more heavily industrialised and populated, in particular the former). In 1910 no road crossed the barrier formed by the Pyrenees, with the exception of the present-day N-II (from Madrid to France, via Barcelona and La Jonquera), mentioned above. The rest reached the heads of the valleys in the eastern sector (Llobregat and Ter) and extended no further than the pre-Pyrenees in the west. Under these conditions, the movement of people and goods in the *comarcas* of the Pyrenees, especially in the west, was conducted according to the traditional systems described above.

#### *c) Development of the basic road network, 1910-1935.*

After 1910, the situation described above began to undergo changes with the initiation of a stage in which many roads were built in the Pyrenees. This stage lasted until 1936, when the construction process was interrupted by the Spanish Civil War (1936-39). The progress made was due to the concurrence of three factors: a) the intensification of the construction works undertaken by the State, after 1911 and the introduction of subsidies for the construction of the local network; b) the work of the Mancomunitat de Catalunya (1914-24), a body formed by the four Catalan provincial *diputaciones* which embarked on an ambitious plan of infrastructure for the whole of the Catalan region, overcoming the restrictive nature of the previous provincial demarcations and c) the construction of major hydroelectric projects in the Pyrenees, destined to meet the energy requirements of the industry located in the *comarcas* surrounding Barcelona. These works particularly affected the western Pyrenees, through which the main rivers flow (Segre, Pallaresa, Noquera Ribagorçana), and had a marked effect on the development of the transport network. In some cases it was the electricity companies themselves who undertook the construction of the roads that were essential for them to be able to operate (Tarraubella, X. 1990).

This progress in the construction works occurred at the same time as the role of the road was being re-valued thanks to the appearance of the automobile. In the *comarcas* of the Pyrenees the use of the automobile as a means of transport occurred at a very early date. Around 1910 there were already several regular lines of transport for road travellers which linked some of the *comarcal* capitals with their nearest rail-

way stations (p.e. from Tremp to Tàrrega and La Seu d'Urgell to Calaf).

In short, the differences between 1910 and 1935 reflect the progress undergone by the road network during these years. Major achievements included the completion of the roads from Seu d'Urgell to Puigcerdà and Andorra (1914), following the valleys of the Segre and Valira, respectively, and the road from Ripoll to Puigcerdà, via Collada de Toses. Later in 1923 the Esterri d'Aneu (from Pallars Sobirà to Viella in the Val d'Aran), road was completed (via the pass of Bonaigua), which put an end to the centuries-old lack of communication between the Val d'Aran and the rest of Catalonia and later, in 1935, the road from Bossost (Val d'Aran) to Bagnères de Luchon (France) was finished. In this period, furthermore, two roads were built that improved communications between Catalonia and France, the first of these crossed the pass of Puymorens, which connected Puigcerdà with the French network in 1914, while the second linked Andorra with France via the Pass of Envalira (1933).

In spite of this construction work, the process of network integration of the Pyrenean *comarcas* was far from finished, as the roads only went as far as the main valleys and a large number of villages with more than 50 inhabitants had no access to the road network by 1935. In short, by 1935 there existed a minimal basic road network, organised around the main river courses. Yet, most of the settlements situated in the secondary valleys and on the slopes and in interfluvial areas remained unconnected by roads to the network (see Fig. 4)

#### d) Developments after 1935

After 1935 the developments made can be divided in two stages: the first takes us up to the sixties and was

characterised by the sluggish nature by which the network was extended, a part of which had been destroyed during the civil war. During this stage a few trans-Pyrenean roads were constructed, the network was extended to include the secondary valleys and approach roads were built to the main settlements that had remained isolated up until this time. The second stage coincided with the widespread adoption of private vehicles and with the revaluation of the Pyrenees as a tourist region or leisure resource for the large metropolitan area of Barcelona (López Palomeque, F. 1982). Both stages coincided with a period of massive rural depopulation in the mountain *comarcas* of Catalonia, especially in the west.

In this first stage in which a number of trans-Pyrenean roads were constructed, the tunnel of Viella was eventually opened, work on which had been interrupted by the civil war. The tunnel was opened to transport in 1948 and was 5,320 m long. Its northern mouth was at an altitude of 1,400 m and its southern mouth at an altitude of 1,620 m. It is currently being modernised as it has many defects (López Palomeque, F. & Majoral, R., 1982). In 1962 the road from Camprodon to Prats de Molló (France) was opened. Since this date no further cross-border roads have been opened in the Catalan Pyrenees, with the exception of the A-2 motorway, open to traffic since 1976. The motorway which runs parallel to the N-II road crosses the Pyrenees through the historical pass of Portús (near La Jonquera). The construction of the secondary network was carried out in a very uneven manner in this stage and many secondary valleys did not acquire roads until the fifties (Boí p.e. in the Alta Robagorça). The construction of these roads has to be seen in the light of the second phase of major hydroelectric projects (Majoral, R., 1989). The small settlements had to build, often financing the projects them-

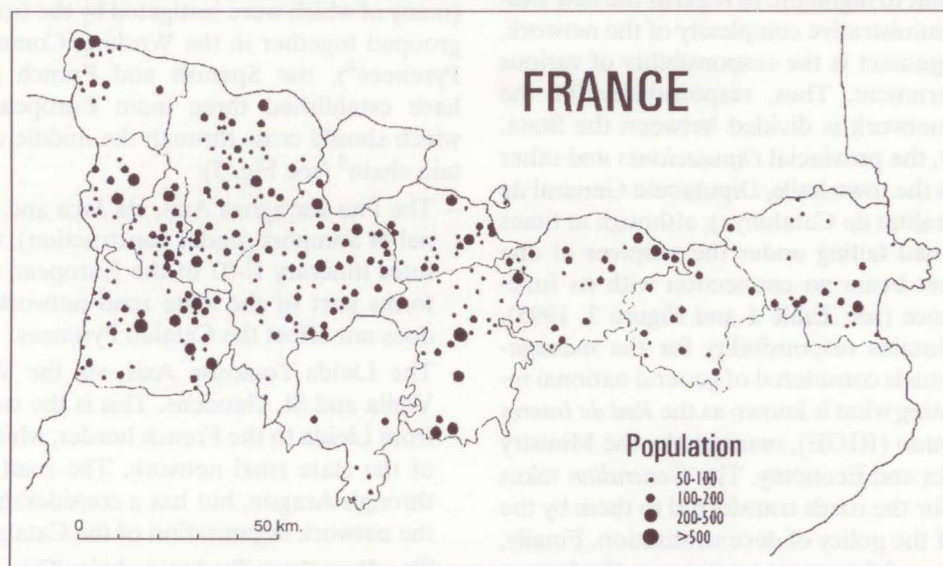


Figure 4 - Settlements not connected to the road network in 1935

selves, links to the main network. At the end of this stage asphaltting was in general use, though this did not mean an improvement in the routes taken by the roads, as in general only a tarmac recovering of the surface was made to replace the former gravel roads.

The second stage of construction and improvements was initiated in the mid-sixties and finished with the arrival of the democratic regime which has lasted to the present day. This coincided with the widespread use of private vehicles and the first flirtations with winter tourism, which led to the improvement of the roads entering the Pyrenees and the opening of access roads to the ski resorts. The rest of the network, especially the local network, improved only very slowly. The most remarkable feature of this stage was the abandonment suffered by the network of secondary roads, since most investments in roads were destined at reducing the growing congestion of traffic along the principal routes (MOPU, 1986).

### 3. THE PRESENT-DAY SITUATION: RECENT PROJECTS AND UNDERTAKINGS

The projects currently being carried out were established in the eighties within the framework of the political decentralisation of Spain and the entry of the country into the European Union (1986). Decentralisation meant that those regions closest to the local problems and those most aware of the marginalisation of the *comarcas* of the Pyrenees took responsibility for the management of a major part of the transport network. Similarly, Spain's entry into the European Union helped revitalise the role of the trans-Pyrenean roads<sup>2</sup> (MOPU, 1986).

The first point to highlight, as regards the new situation, is the administrative complexity of the network, since its management is the responsibility of various levels of government. Thus, responsibility for the Catalan road network is divided between the State, the *Generalitat*, the provincial *Diputaciones* and other bodies (such as the town halls, *Diputación General de Aragón*, *Generalitat de Catalunya*), although at times the fact of a road falling under the auspices of one body or another bears no connection with its functional importance (see Table 1 and Figure 3, 1995). The State maintains responsibility for the management of those roads considered of general national interest, constituting what is known as the *Red de Interés General del Estado* (RIGE), managed by the Ministry of Public Works and Economy. The *Generalitat* takes responsibility for the roads transferred to them by the State as part of the policy of decentralisation. Finally, the *Diputaciones* of the provinces manage the former network of provincial and local roads, and the town

halls and other bodies are responsible for the remaining roads of local importance, which is frequently the case in the Pyrenees (access roads to settlements and ski resorts, forest paths and similar roads).

In addition to the management problems caused by the administrative fragmentation of the network, recent proposals are included in the *Pla de Carreteres de Catalunya 1985-2201* (Road Act) drawn up by the *Generalitat* and passed in 1985, and in the plans drafted by the Spanish central government since 1984<sup>3</sup>. These plans reject former network policies, being particularly critical of the radial pattern of the Spanish network and with construction being undertaken during the sixties and seventies solely as a response to traffic demands. Such policies had marginalised the roads of the Pyrenees (with the exception of the two extreme frontier crossing points of Irún in the west, and La Jonquera in the east). The new plans make provisions for the redress of the imbalances in territorial accessibility. Thus, the *Generalitat's* plan considers all the roads in Catalonia, regardless of the title they might have been given by other bodies, and proposes the construction of a network of basic axes that should cover the whole of Catalonia. This proposal, insofar as it affects the Pyrenees, envisages the strengthening of the traditional roads cutting through the mountain, the opening of tunnels and new frontier passes and the construction of a large Intra-Pyrenean communications axis to bear the name of Pyrenean Axis. The specific projects include the tunnel of Cadí (built in 1984), that of Boniaigua (under study) and the cross-border tunnel of Salau (under study).

Most of the cross-border roads form a part of the State network, with the exception of the road from Camprodon to Prats de Molló (C-151) and are subject to European agreements governing roads. At the end of the eighties and as the result of various proposals (many of which were instigated by the frontier regions grouped together in the Working Community of the Pyrenees<sup>4</sup>), the Spanish and French governments have established three main European itineraries which should cross through the middle of the mountain chain<sup>5</sup> (see Fig. 5):

- The Pau-Zaragoza Axis, via Jaca and the new tunnel of Somport (under construction), which constitutes itinerary E-07 of the European network and forms part of the state road network (RIGE). It does not affect the Catalan Pyrenees.
- The Lleida-Toulouse Axis, via the Viella tunnel, Viella and St. Gaudens. This is the current N-230, from Lleida to the French border, which forms part of the state road network. The road runs largely through Aragón, but has a considerable impact on the network organisation of the Catalan Pyrenees.
- The Barcelona-Toulouse Axis. This is the European itinerary E-09, which runs along the Llobregat



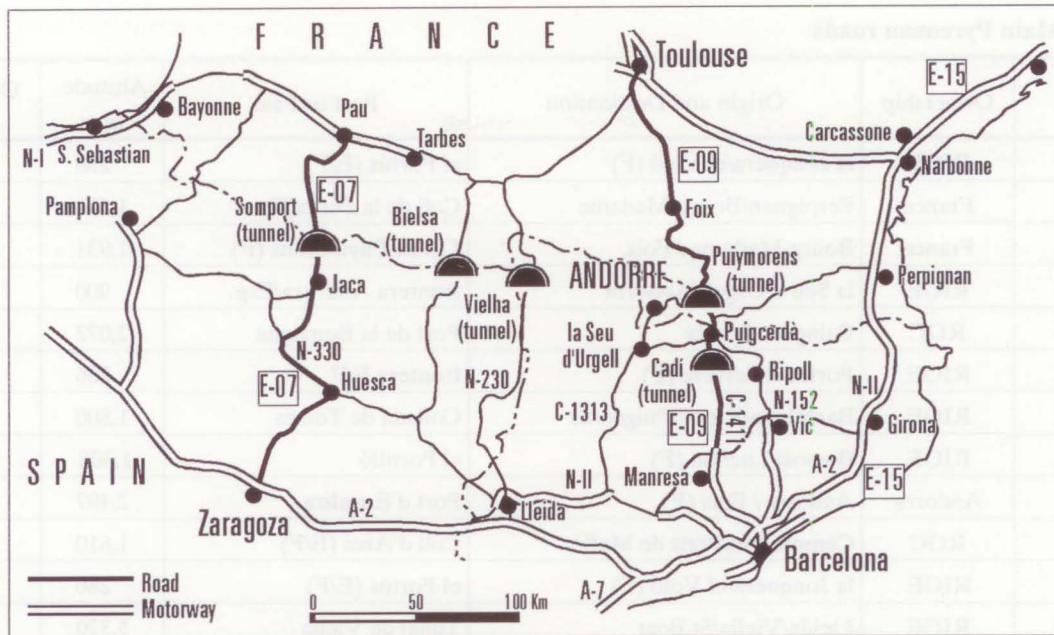


Figure 5 - The main Trans-Pyrenean roads

Axis and through the Cadí tunnel (opened in 1984), Puigcerdà, the Puymorens tunnel (France; opened in 1994) and Foix. The section through Catalonia forms part of the *Generalitat's* road network.

*a) Condition and use of the roads in the Pyrenees*

It is beyond the scope of this paper to offer a detailed appraisal of the conditions of the road network in the Pyrenees. However, in the case of Catalonia, it is possible to highlight the improvements undergone by the main axes throughout the decade (N-230, N-152, C-1313, C-1411), while the transverse routes and the local network have only improved at certain specific points (certain stretches of the Pyrenean Axis, N-260). This means that the network continues to revolve around the main valleys while the roads that act as interconnectors remain few and insufficient in number. To a certain extent the network model which reproduces the pattern of the river network described by Solé Sabaris (1951, p. 410) in the fifties continues to hold true today.

The roads that cut into the mountain, with a few specific exceptions, are the only ones to have been straightened and which allow comfortable transit and which are adapted to the characteristics of modern vehicles. The rest of the network is in a poor condition. In general the roads are narrow (4-5 m.), winding considerably and with an irregular surface (no more than a superficial asphalt cover). The result is roads that permit only very low velocities (less than 50km/h). Similarly, the access roads to the small villages in the highest areas still have to be built, in many cases, access is via forest paths and dirt tracks that have not been integrated into the official road network.

The use of the roads reflects perfectly the condition of the network. Thus, only the A-2 motorway and the road from Seu d'Urgell to Andorra (N-145) have an average traffic intensity (MDI) greater than 10,000 vehicles a day<sup>6</sup>. The rest of the roads only come close to such figures near the towns located at the entrance to the Pyrenees (La Seu d'Urgell, Solsona, Berga, Ripoll and Olot), but after these points the traffic falls and is only greater than 5,000 vehicles a day in Puigcerdà and 3,000 in Viella. To these roads should be added that of the C-1411, which passes through the Cadí Tunnel, the opening of which siphoned off a considerable proportion of the traffic between the Barcelona area and Cerdanya and Andorra, with great repercussions for these areas. The level of transit on the transverse roads is very low (meagre in most cases and always below 2,000 vehicles a day).

Today, there are seven frontier passes in the Catalan Pyrenees (that of la Jonquera, crossed by the A-7 motorway and the N-II road, can be considered as a single pass). In the table attached (Table 2) the number of persons crossing at each point is shown. However, there are only five cross-border passes along the 180 km of the frontier in the highest zone of the Catalan Pyrenees. (Two in the Val d'Aran and one in the Alt Urgell, Cerdanya and Ripollès).

The use of these passes is highly uneven. The border traffic at La Jonquera (A-2 and N-II) and at the point of access into Andorra (N-145), which, as we have seen above have an average traffic density of more than 10,000 vehicles each day, is much heavier than at the other points. Thus, according to the traffic intensity data for 1995 (last published figures), only the frontier point of Les (Val d'Aran) and Puigcerdà

**Table 1. Main Pyrenean roads**

Road	Ownership	Origin and Destination	Port or Pass	Altitude in m	Opening year
N-II	RIGE	la Jonquera/el Voló (F)	el Portús (E/F)	280	1792
N-116	France	Perpignan/Bourg-Madame	Coll de la Perxa(F)	1,574	1850
N-20	France	Bourg-Madame / Foix	Col de Puymorens (F)	1,931	1871
C-145	RIGE	la Seu d'Urgell/Andorra	frontera Andorra/Esp.	900	1910
C-147	RGC	Balaguer /Viella	Port de la Bonaigua	2,072	1923
C-252	RIGE	Portbou/Cervere (F)	frontera E/F	206	1927
N-152	RIGE	Barcelona/Ripoll/Puigcerdà	Collada de Tosses	1,800	1920
C-141	RIGE	Bossost/Luchon (F)	el Portilló	1,308	1932
N-II	Andorra	Andorra / Foix (F)	Port d'Envalira	2,407	1933
C151	RGC	Camprodon/Prats de Molló	Coll d'Ares (E/F)	1,610	1962
A-7	RIGE	la Jonquera/el Voló (F)	el Portús (E/F)	280	1976
N-230	RIGE	Lleida/Viella/St.Beat	Túnel de Viella	5,320	1947
C-1411	RGC	Barcelona-Puigcerdà	Túnel del Cadí		1984
N-20	France	Bourg-Madame / Foix	Tunel de Puymorens	4,820	1994
C-153	RGC	Olot-Camprodon	Túnel de Colobós	1,884	1994

Various Sources

RGC: Red de la Generalitat de Catalunya

(Cerdanya) have daily figures above 3,000. To complete these statistics, in the corresponding table and figure, the number of persons crossing the various frontier points in 1995 are shown. These figures back up what we have outlined above, i.e. the flow of traffic is concentrated in the passes of La Jonquera and Andorra; the others have very low flow of persons both entering and leaving Spain, being a meagre trickle in the pass of Camprodon. These data, in short, clearly reflect the highly impermeable nature of the Pyrenees, a fact stressed by various authors (Serratosa, A., 1986). Thus, 80% of the flow between the Iberian Peninsula and Europe is channelled through the passes at

the two extremes of the Pyrenees, that of La Jonquera, in the Mediterranean and that of Irún in the Atlantic; as for the remaining 20%, most corresponds to the Andorran border, the main focus of the Pyrenean tourist attraction. This emphasises in particular the highly impermeable nature of the central part of the mountain chain.

*b) The case of the Llobregat Axis and the Tunnel of Cadí*

The Llobregat Axis today comprises the main road cutting through the Pyrenees from Barcelona; it comprises a range of network infrastructure, constructed parallel to the river Llobregat, much of which has re-

**Table 2. Traffic MDI Evolution. Access roads to the border passes in Catalonia, 1985 - 1995 .**

		Mean Daily Traffic Intensity (MDI)							
Frontera	Road	1988	1989	1990	1991	1992	1993	1994	1995
Portbou	N-260	858	1,320	1,241	1,132	1,315	1.375	1.327	1.262
la Jonquera	N-II	8,846	7,263	7,124	7,301	7,086	7.455	8.068	8.799
la Jonquera	A-7	14,023	14,980	14,365	14,946	14,473	14.473	15.724	16.521
Camprodon	C-153	-	-	703	650	591	-	-	739
Puigcerdà	N-152	5,271	6,162	6,400	-	-	6.280	7.623	7.523
Seu d'Urgell	N-145	-	10,244	11,693	11,233	12,400	12.201	12.565	13.975
Les	N-230	3,961	2,892	2,744	2,908	3,092	4.165	3.468	3.541
Bossost	N-141	< 500	< 500	< 500	< 500	< 1.000	< 1.000	< 1.000	< 1.000

Sources: Ministerio de Fomento: *Mapa de Tráfico* (various years), and Generalitat de Catalunya:

cently been constructed or modernised, thanks to both public and private investments. The Axis forms part of the European itinerary, E-09, and should eventually link Barcelona with Toulouse. The axis is considered, at the supra-regional scale, as one of the most important roads in the central mountain chain, since it will connect two large metropolitan areas (that of Barcelona, with around four million inhabitants and that of Toulouse, with around a million), which, in the new European context might contribute to the formation of a macro-region in the Pyrenees with axes through Barcelona, Zaragoza and Toulouse (Brunet, R., 1990). However, its greatest impact, in the short term, is envisaged as being at the regional scale of Catalonia since its construction has meant a marked improvement in the accessibility between Barcelona and the *comarcas* of Berguedà, Cerdanya, Alt Urgell and the principality of Andorra. As for its effectiveness as a European route, this will depend on the improvement of the access to the tunnel of Puymorens, from both approaches.

The greatest undertaking along the Llobregat Axis is without doubt the tunnel of Cadí. It was constructed thanks to private initiative and its opening gave rise to heated debate in the *comarcas* of the Pyrenees as it opened a new route between Barcelona, Cerdanya and Andorra which threatened to marginalize the traditional routes (the N-152, from Barcelona to Puigcerdà and the C-1313, through the Segre Valley). The tunnel was opened to traffic in 1984; cutting through the upland area of Moixeró (2 260 m), at the point where the orographic barrier which separates Berguedà and the Cerdanya is the weakest. It is 5,024 long; its southern mouth is at an altitude of 1,170 m and the northern mouth is at 1,230 m. The total invest-

ment was around 14,000 million pesetas and users are required to pay a toll. This new route cutting through the Pyrenees from Barcelona is complemented by the motorway from Terrassa to Manresa (constructed in record-breaking time and with severe environmental impact (Font, J., 1990); and the C-1411, which has been restructured). The motorway was built on private initiative while the improvements made to the former *comarcal* road, the C-1411 were paid for by the *Generalitat* and funds received from the European Regional Development Fund (ERDF). Thanks to these works, the improvement in the accessibility between Barcelona and Puigcerdà can be calculated as a saving of more than one hour. This means, on average, a little over a third of the time needed to make this journey if following the traditional routes.

The impact of these works, especially the tunnel of Cadí, have been considerable, since in addition to establishing a new link between Berguedà and Cerdanya, the tourist numbers in the *comarcas* thus affected, have increased (principally in Cerdanya and Andorra). This increase is clearly reflected in the attached graphs. In short, the improvement in accessibility and the consequent increase in traffic and the numbers of tourists visiting Cerdanya, Alt Urgell and Andorra, have been the positive effects of the improvement and diversification of the links between the Barcelona area and certain *comarcas* in the Pyrenees, diversifying and increasing the link roads between both areas. On the down side, the increased speculation should be mentioned regarding land prices, as a result of increase in tourism. This has been particularly evident in Cerdanya, where the growth in second residence complexes and tourist facilities has been notable in recent years, introducing marked changes in the *comarca*.

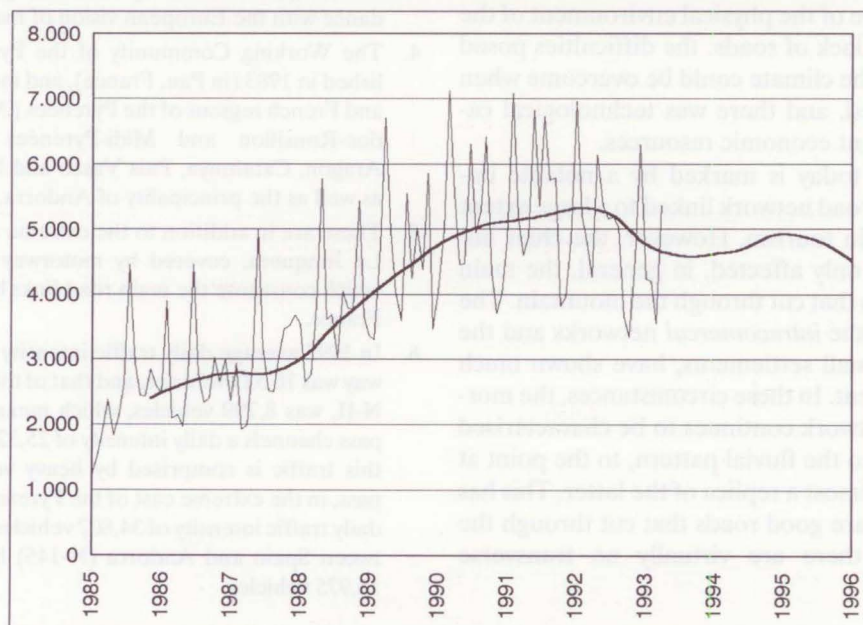


Figure 6 - Evolution of the traffic MDI in the Cadí Tunnel

#### 4. CONCLUSIONS

The main characteristics of the process that has shaped the road network in the Pyrenees were, above all, its sluggish pace - combined with the particular history of the Spanish public work programmes - and the different rates of development recorded by the eastern and western *comarcas*. These distinct rates can be attributed equally to the basic configuration and to several factors of socio-economic nature, in particular the proximity of the eastern *comarcas* to Barcelona and its incorporation into the process of industrialisation of Catalonia. Moreover, the existence of the border between Spain and France has had the effect of exacerbating the barrier effect imposed by the relief.

At the beginning of the present century, only the cross-border road, the N-II, passing through La Jonquera had as yet been constructed in the Catalan Pyrenees. No roads reached the main valleys of the Pyrenean *comarcas* until the 1930s, while the construction of the road network in the secondary valleys and the access roads to the settlements located in the high interfluvial zones was not carried out until much later. Thus, the process of network integration of the small settlements remains incomplete as in many cases the maintenance of their access roads is undertaken by local bodies that do not have the necessary funds for this work.

The successive improvements undergone by the road network in the *comarcas* of the Pyrenees up to the present day, should be seen in the light of distinct phases of natural resource exploitation: minerals, forestry and energy (hydroelectricity) resources up to the fifties and, at a later date, tourism (snow and natural environment). To a certain extent this refutes the link between the nature of the physical environment of the Pyrenees and the lack of roads: the difficulties posed by the relief and the climate could be overcome when the interest existed, and there was technological capacity and sufficient economic resources.

The situation today is marked by a notable improvement in the road network linked to a large extent to developments in tourism. However, the chief improvements have only affected, in general, the main axes and the roads that cut through the mountain. The transverse roads, the *intracomarcal* networks and the access roads to small settlements, have shown much slower improvement. In these circumstances, the morphology of the network continues to be characterised by its adaptation to the fluvial pattern, to the point at which today it is almost a replica of the latter. This has meant that there are good roads that cut through the mountain while there are virtually no transverse roads.

The political decentralisation, the entry of Spain into the EU and the revaluation of the Pyrenees as a tourist area - in connection principally with the metropolitan agglomeration of Barcelona - have combined to revitalise the geographic area of the Pyrenees. However, as far as the road network is concerned, it is necessary that the undertakings should not be restricted solely to the main axes and the cross-border roads, but should also focus their attention on the needs of the intra-Pyrenean roads and the network of access roads to the small villages. Only in this way will the *comarcas* of the Pyrenees ever acquire full integration into the network.

#### NOTE

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1. For a better understanding of the process that led to the configuration of these *comarcas* as territorial units with their own legal personality, see the studies of Jesús Burqueño (1992).
2. In line with the declaration of the Council of Europe "...that the frontiers, yesterday's scars of history, might today become meeting points between peoples".
3. The main plan is known as the *Plan General de Carreteras* 11984/91, drawn up by the State (MOPT) and enacted in 1986 and the *Plan Director de Infraestructuras* 1994-2007. Currently, a new road plan is being drafted, in accordance with the European vision of major road axes.
4. The Working Community of the Pyrenees was established in 1983 (in Pau, France), and includes the Spanish and French regions of the Pyrenees (Aquitaine, Languedoc-Rousillon and Midi-Pyrénées in France and Aragon, Catalunya, País Vasco and Navarra in Spain), as well as the principality of Andorra.
5. These are in addition to the extreme routes of Irún and La Jonquera, covered by motorway and road routes, which constitute the main road links between Spain and France.
6. In 1995 average daily traffic intensity of the A-7 motorway was 16,521 vehicles, and that of the parallel road, the N-II, was 8,799 vehicles, which means that this border pass channels a daily intensity of 25,320 vehicles (25% of this traffic is comprised by heavy vehicles). The Irún pass, in the extreme east of the Pyrenees, has an average daily traffic intensity of 34,807 vehicles). The frontier between Spain and Andorra (N-145) has an intensity of 13,975 vehicles.

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