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Analysis of the current situation of the Rodalies R1 railway line and feasibility of the proposed solutions

BACHELOR THESIS

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ABSTRACT

This thesis aims to understand and analyse the current situation of the R1 Rodalies de Catalunya line that runs along the Catalan coast from *Maçanet-Massanes* to the destination town of *Molins de Rey* as it passes through the centre of the Barcelona city.

The line is one of the busiest lines of the Catalan territory due to its location and its historical circumstances, since it contains the first railway line that circulated in the Spanish state for the first time in 1848 and constitutes one of the lines with the highest passenger flow near the Barcelona area. This original railway section going from Mataró city in the Maresme region to Barcelona centre continues now a days circulating in its original layout, fact that aggravates the problems of the R1 line due to the lack of modernized systems and due to a layout of almost 30 years old. Both the characteristics of the line layout and the layout of the lines close to it cause the problems to be more frequent than the users and the Rodalies administration would like. The main problem of the line lies in the non-compliance of the schedules and in the frequency of the incidents in the daily circulations, fact that causes a general discontent in usual users of the line.

The study tries to analyse in depth the indicators that characterize the behaviour of the railway line and therefore the problems present in it. Once the indicators are characterized, a diagnosis of the causes and consequences that these factors bring to the line is made, thus facilitating a better understanding of the state and its behaviour. Then, a list of implementations has been proposed as a measure to solve the above problems. The solutions reside in the improvement of the characteristics of the line and in the implementation of new systems on the railway road. For this, taking advantage of the annual stay in the city of Budapest due to the Erasmus mobility program, the R1 railway line has been compared to the Budapest- Székesfehérvár line in Hungary, because of its similar characteristics with the Catalan railway line and for having suffered a complete modernization project in recent years.

Finally, analysing the viability of these implementations and their effectiveness in the line, a list of measures to carry out and the general consequences that they would cause to it is proposed.

FOREWORD

Motivation

As a daily user of the R1 line of Rodalies de Catalunya for more than 6 years, it is not difficult to understand the motivation that led me to choose this topic for my final thesis.

Since my childhood I have lived in a small coastal town in the Maresme area called Premià de Mar, located 20 km away to the north from Barcelona city. Since completing my basic compulsory studies some years ago, I've always had to move to study outside my town in nearby cities such as Mataró or Barcelona to study both the baccalaureate and the Bachelor in Civil Engineering in the Polytechnic University of Catalonia (UPC). In order to do that, for years, I had to take daily the R1 line that runs along the coast passing through the different towns in the area, and therefore I have also suffered the daily circulation problems that this railroad presents.

It's not unusual that, during the frequent incidences in the line as the restrictions in the circulation due to storm periods or the eternal breaks in the circulation between the stations of El Clot-Aragó and Arc de Triomf, complaints and even some fleeting and usually senseless proposals are heard from the passengers inside the train as a result of the desperation and resignation they feel with the service. This made me think about what I, as a senior civil engineering student, could do about it, and decided to dedicate my final thesis to the study of the line and the possible solutions that it allows.

In addition, as a result of my stay in the city of Budapest, Hungary, within the mobility program Erasmus + during the last year of my Bachelor degree, I had the opportunity to learn about other railway transport management systems, which has allowed me to acquire a new vision of the management of the suburban roads that connect the capital city with the neighbouring towns and apply this new knowledge to the realization of this project.

Goal and Scope

The objective of this study is, therefore, to know in depth the real situation of the R1 line and to interpret the most incidents indicators in the behaviour of the line and the service it provides to the users, understanding the reason for these incidents and being able to propose some solutions to them.

In addition, it is necessary to study the feasibility and the consequences that these solutions would imply on the line to have a greater global vision of the problem, so the scope will be to understand in an exhaustive way the complexity of the line and its implementations taking into account the main factors that involve the feasibility of the solutions proposed.

Another objective is to familiarize myself with a construction project in order to learn to work on them, and having a first contact with a real construction project, as in the case of the Budapest railway line, from which I was able to obtain the construction project and analyse it in depth.

Acknowledgements

Although it is difficult to thank all the people who in one way or another have helped in the preparation of this thesis, I will try to highlight the most important figures that have accompanied me throughout the preparation of the study.

First, I would like to thank my tutor and professor Andrés López Pita for introducing me to the complex world of the railroad during his subject of Railways last year and for guiding me and advising me when I needed it in the course of this work.

I also wanted to thank Professor Nándor Liegner of the BME University of Budapest for providing me with the resources he had available regarding the Hungarian line, and especially Mr. Richard Mólnar, head of office of the NIF company (National Infrastructure Development Corporation of Hungary) who provided me with the project documents of the Budapest railway in English, essential for the preparation of this thesis.

Of course, I would like to thank my parents Daniel and Maria José, and also Javier and Carlos who, although being away from home have helped me and given me unconditional support in moments of weakness.

Finally, to thank my roommates in Budapest, Natalia, Kat, Laura, Sandra, Patricia and Maria, who have accompanied me during my stay in Hungary and have become also part of my family.

TABLE OF CONTENTS

Index of figures

Index of Tables

Index of Charts

1. INTRODUCTION

The railway is one of the most used means of transport since its appearance during the first half of the 19th century, and it was a key element in the Second Industrial Revolution where, taking advantage of the technical advantages it presented, constituted one of the most important transportation systems used in Spain. The implementation of railway lines throughout the Spanish territory led to a transformation in the transport systems by allowing fast and efficient transportation of people and goods at low cost and in a regular and safe manner.

It should be noted that, although the first Spanish railway was built in Cuba, which in 1837 was a Spanish province corresponding to the Havana-Güines line, it was not until 1848 that the first railway line was built in Spanish territory that connected the cities of Barcelona and Mataró in the eastern part of the peninsula. Since then, the expansion of the railway and its effects on the society have grown rapidly and solidly until today, where there is a large railway network that connects the cities of the territory and coexists with other transportation systems that have appeared later as the high-speed lines more and more present nowadays.

If we focus on the history of the railroad in Catalonia, due to the construction of this first railway line along the Catalan coast that connects with the capital, the importance of the railway has been very significant, especially in this area where the industry Textile began to emerge and the rapid transport of goods to factories was a matter of maximum necessity. The R1 line is therefore an important transport centre for almost 30 years and until today, which represents one of the lines with the highest passenger flow in the Catalan territory.

However, other transport methods such as the airplane have caused in recent years that the railroad has lost a lot of users especially in trips that involve long distances by significantly reducing the travel time and the cost with respect to the railway and for the comfort that the air system implies.

Taking into account all these factors and the fact that the rail network, being of greater antiquity, presents some of its own characteristics that do not provide the necessary service to users, the possibility of a renewal in the railway system is considered, with the objective of returning the competitiveness that the railway has lost and makes it more attractive for the user. In order to do that, this thesis aims to understand and analyse the current situation of the R1 Rodalies de Catalunya line and propose feasible implementations to give competitiveness to the railway line.

2. R1. BARCELONA-MATARÓ RAILWAY SECTION

2.1. General description and historical background

The R1 railway line is one of the busiest railway lines in Barcelona area connecting two coastal towns by 95,1 km of railway; *Molins de Rei* and *Maçanet-Massanes.* The line follows the coastline and passes through the main cities in its path such as *Barcelona, L'Hospitalet de Llobregat, Blanes* or *Mataró* in the *Maresme* region as it can be seen in *Figure 1. R1 stations and stops*. Nowadays, this railway line belongs to *Rodalies de Catalunya*, the main commuter and regional rail system in Catalonia and more specifically in the Barcelona area.

Since 2014, Rodalies of Barcelona has been connected with the Girona commuter rail service through the RG1 railway line, connecting L'Hospitalet de Llobregat with *Portbou*, near the French border, and going through Girona city centre. Rodalies is operated by *Renfe Operadora* but administered by the Government of Catalonia.

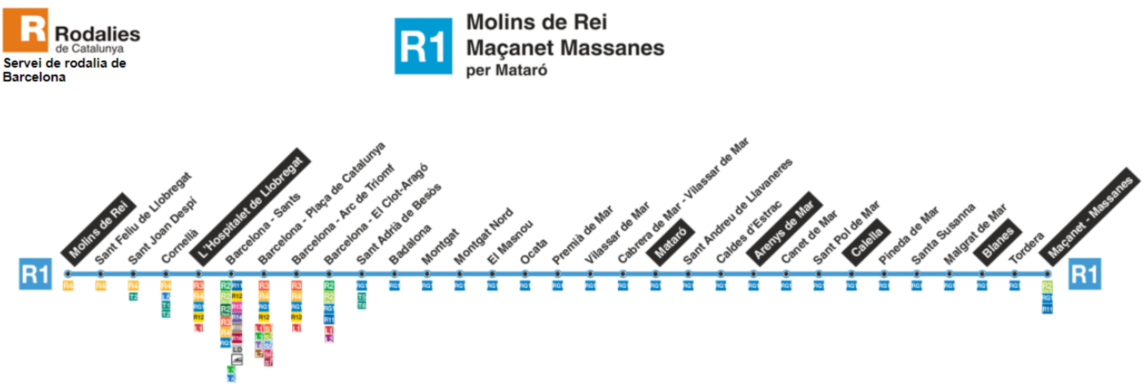

Figure 1. R1 stations and stops

The R1 line was created in 1989 by RENFE company and was originally known as C1 instead of R1 because of its original Spanish name "Cercanías". The RENFE company was founded in January 1941 during the dictatorial regime of Francisco Franco, and constituting the railway network monopoly of the country for more than sixty years. Its name corresponds to the acronym "*Red Nacional de los Ferrocarriles Españoles*" which means National Network of the Spanish Railways in Spanish.

RENFE was the state company responsible for the transport of passengers and goods operating from 1941, after the Spanish Civil War, until December 2004 when the company split into two new companies: *ADIF "Administrador de Infraestructuras Ferroviarias*" in control of the railway infrastructure management, and the previously mentioned *Renfe Operadora* responsible for the exploitation of public railway lines in the Spanish territory.

This separation was motivated by compliance with European regulations on rail transportation after the Second World War, when a nationalization and unification process started among the railways of the main European countries promoted by the European Union. This process led to the separation between the operational activities and the infrastructural management ones and allowed any transnational operational company to use the railways of any European country by just paying for the use of the railway.

This moderation promotes the railway interconnection between countries and their main cities through Europe and makes it easier for passengers to travel around the European territory in addition to the advantages that brings in the field of goods transportation.

The R1 line also contains the oldest railway section in the Iberian Peninsula where the first Spanish locomotive circulated for the first time in 28th October 1848 (see *Figure 2. Mataró locomotive (first locomotive circulating in Spain)).*The original line goes from Barcelona to the city of Mataró and still operating in its layout built in 1848.

In this thesis, the Barcelona-Mataró railway segment will be the main study section due to its important role in the development of this area in the 19th century, when the textile industry in the Maresme zone began to take its place in the Catalan economy. Most of the coastal towns that were connected by the railroad were a very important part of this industry, and the construction of the railway made easier to travel and access into these towns.

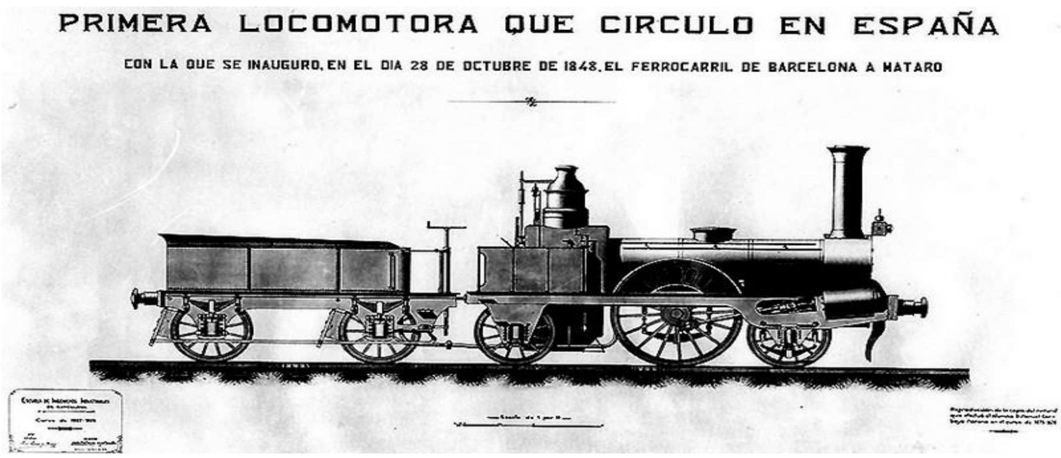

Figure 2. Mataró locomotive (first locomotive circulating in Spain)

Furthermore, nowadays its localization in the Catalan network and its significant value of daily passenger flow (especially during rush hours) make the railway track one of the most important lines within the Barcelona public transport network. The original railway section is 29,1 km long and runs through coastal towns of the *Maresme* and *Barcelonès* areas such as *Badalona*, *Montgat, El Masnou, Premià de Mar, Vilassar de Mar* and *Cabrera de Mar* on its way to Mataró. In its original layout it had seven stations and the total travel time were sixty minutes per trip, almost duplicating the current travel time which is about forty minutes. The approximate cost of one-way ticket was 6 "*Spanish Reales"* which is approximately 5 euro, while in 2016 the price of the same ticket was 2,67 euro. The daily flow in 1848 was six trains in each direction in comparison of one-hundred and six trains in working days and fifty-seven in weekend days running in 2018 (see *Annex A. "R1. Working and weekend days Schedule"*), this is a huge increase taking into account that the land occupation of the railway hasn't been modified along the years and this fact proves the potential of the original railroad layout.

2.2. Current situation of the rail network

The R1 line is part of the Mediterranean corridor, one of the European Rail Traffic Management System (ERTMS) corridors which constitutes one of the most important economic and commercial railway axes of Spain and a powerful connection to Europe through the French border. As *Figure 3. Path of the Passangers Mediterranean corridor* shows, the corridor is 9765km long and passes through six different countries in the European Union; Spain, France, Italy, Slovenia, Croatia and Hungary.

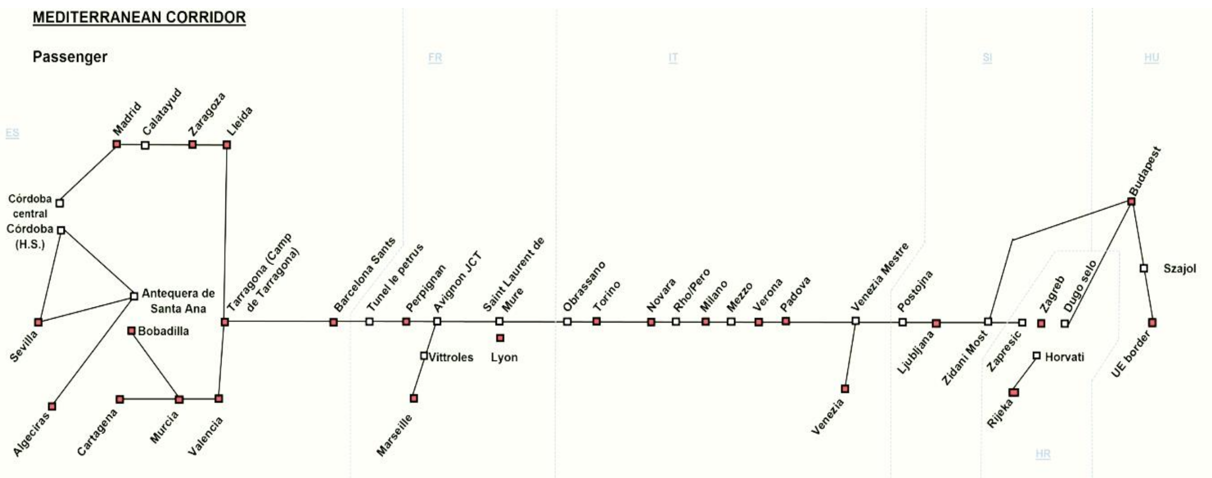

Figure 3. Path of the Passangers Mediterranean corridor

The two main characteristics that gives such importance to this set of railway lines in eastern Spain are the railway access to Spanish Mediterranean ports and the union of the Algeciras-Stockholm axis, two important factors in good transportation and in the international market.

Even though the importance of this corridor and its location in the Catalan network, there are some disadvantages in terms of international connectivity that will be studied below.

First of all, in order to understand the current situation of the R1 railway line is necessary to analyse the connections with other lines in the same area. The study range focuses on the northeast area of the Spanish territory as it can be seen in *Figure 4. Traffic management areas*. According to the division in Traffic management regions made by ADIF the whole territory of the country is divided into six areas (Norwest, North, Northeast, Centre, East and South) in order to facilitate the railway traffic management. Within this Northeast area, the coastal lines are the most relevant ones, such as RG1, R2, R3, R4 lines as they connect with the R1 railway line (see *Figure 5. R1 connection lines*). The line has also connections with regional services, the Barcelona subway and tram line, and with high speed and long distance services.

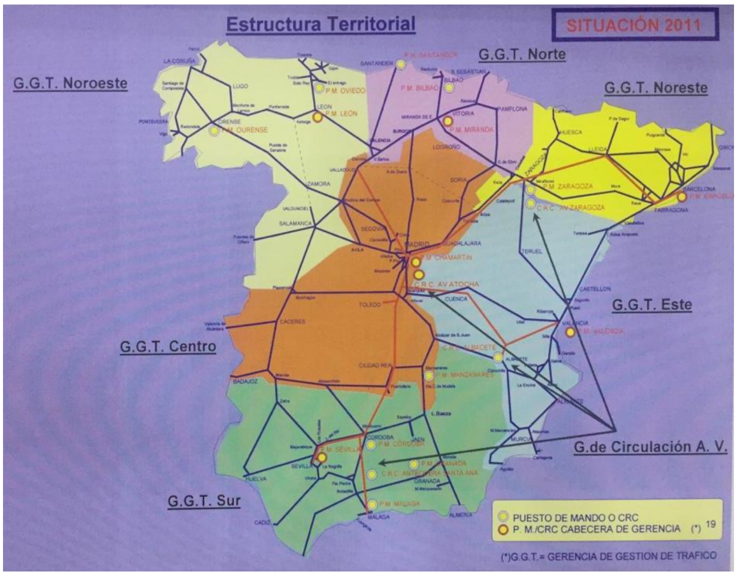

Figure 4. Traffic management areas

Figure 5. R1 connection lines

2.2.1. Connection with the RG1 railway line

The RG1 railway line was built in 2014 and it started to operate in 24th May of that year, but it wasn't until 20th June when the trails began to run the full route to Portbou. The line is 181,2 km long and has 44 stations in its path seen in *Figure 6. RG1 stations and stops.* The construction purpose of the line was to prolong the layout of the R1 from its end in Maçanet-Massanes to Portbou going through Figueres and the city of Girona, so passengers can travel from L'Hospitalet de Llobregat in the southern part of Barcelona to Girona city in about two hours. This is, in fact, the most important connection concerned in the coastal area, because it communicates two province capitals in Catalonia; Barcelona (1,6 million inhabitants) and Girona (98.255 inhabitants).

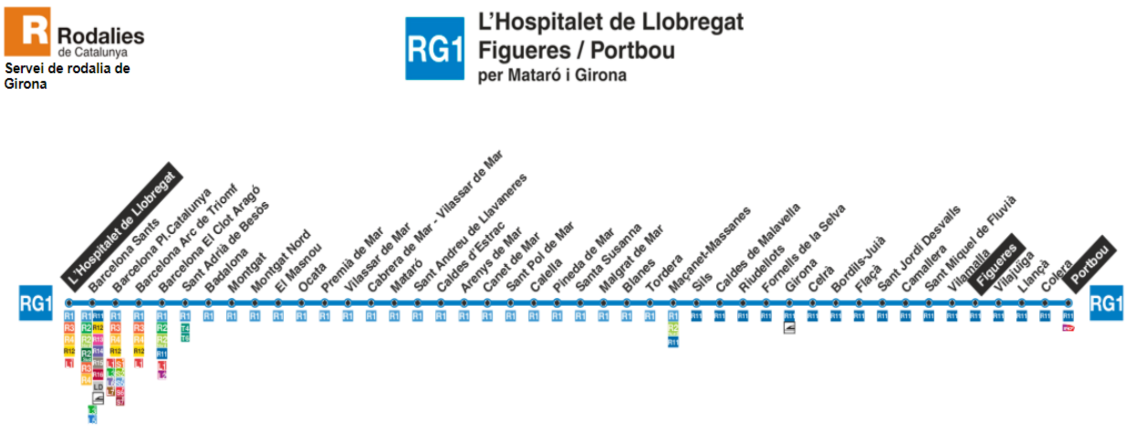

Figure 6. RG1 stations and stops

That's why the main consequence of the construction of the RG1 line, as a prolongation of the existing R1 line, translates in the increasing passengers flow in the Maçanet-Massanes – Barcelona section during morning rush hours and in the opposite direction during afternoon rush hours in weekdays (due to the people living in these locations and going to work to Barcelona city centre). This will be, definitely, an important factor in the study of the current problems in the R1 railway line and in its serviceability level.

2.2.2. Connection with the R2 railway line

The R2 railway line was built in 1989 with the original name “C2” as the second line of the “Cercanias” network, just like in the case of R1 line, and its 133km long. In its first operational period, the line went from *St. Vicenç de Calders* to *Maçanet* in a single railway layout going through six different regions of Catalonia; *el Baix penedès, Garraf, Baix Llobregar, Barcelonès, Vallès Oriental* and *La Selva*. Then, in January 2009, the R2 line was restructured and divided into 3 different railway lines, the R2-south, the R2-north, and the R2 “centre”, as shown in *Figure 7. R2 stations and stops.* This division was made because of the simultaneous construction of the high speed lines in Barcelona with the purpose of maintaining good service in the R2 line and reducing the effects of the high speed line construction in this long line.

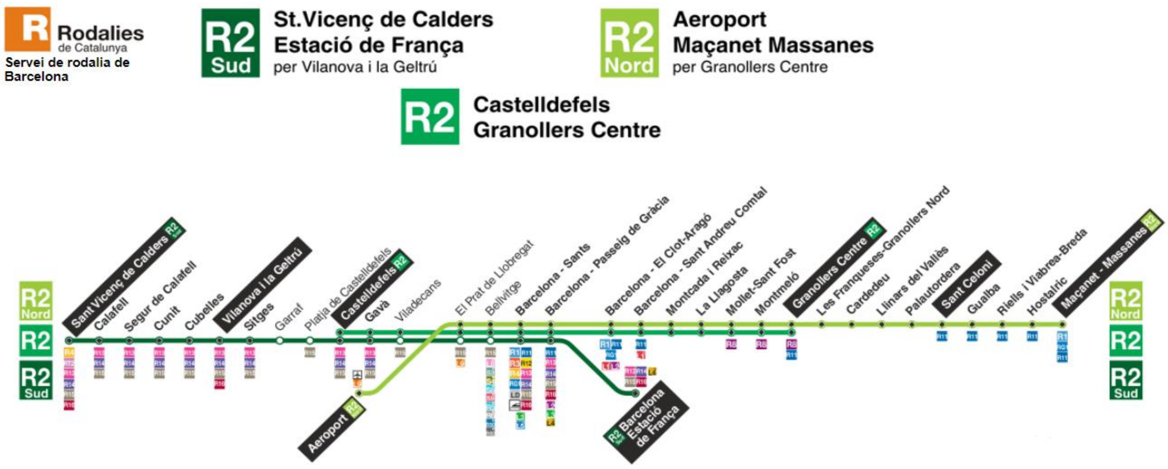

Figure 7. R2 stations and stops

In the line are some sections without the double-track layout, for example in the connection with the Barcelona – El Prat Airport which is also the beginning of the R2-north line, where there is a single-track in the path.

This problem is not particular only for this route, but in the entire Spanish railway system where only 37,3% of the total railway length is provided with two or more railway tracks. These single-track sections involve a reduction of almost 50% in the capacity of the road, since the trains of both directions have to be synchronized to cross these problematic sections and therefore while one train passes, the other must stop the necessary time so its circulation is safe with respect to the previous one.

This involve also an efficient organization and management in daily schedules and rapid reactions in technical problems that may occur along the day, especially during rush hours.

If we look at the path of the line in *Figure 8. Path of R1 and R2 lines*, it has some common stations (connection stations) with the studied R1 railway line like the ones in Barcelona city centre (Sants, El Clot-Aragó). Then it separates from the coast following its journey through the interior of the littoral zone passing through villages like *Granollers* or *Sant Celoni* to finally reach the same final station as the R1 line in Maçanet-Massanes.

Figure 8. Path of R1 and R2 lines

This fact is also important for the study of the Barcelona-Mataró section, because it can be a possible solution by connecting the two lines in more central points to distribute the passengers flow in this section.

2.2.3. Connection with the R3 railway line

The R3 railway line as *Figure 9. R3 stations and stops* shows was created in 1989 and it's 161km long. The line goes from l'Hospitalet to Puigcerdà through the city of Vic, one of the capitals of central Catalonia. Even though it is considered as one only line, the R3 line is clearly separated into two in Vic station, because from this city to Puigcerdà the line behaves as a regional line, and the other section of the line behaves as a Rodalies line.

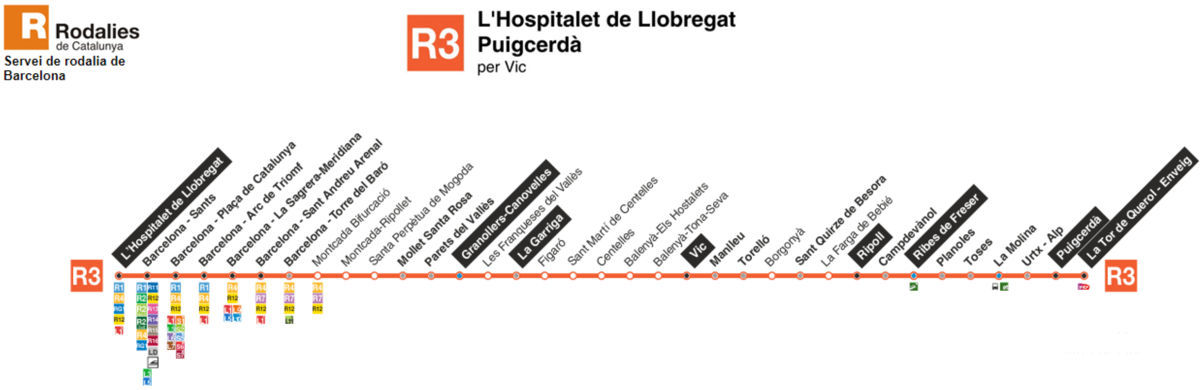

Figure 9. R3 stations and stops

The only connections with R1 railway line are in Barcelona city centre stations, as Sants, Plaça de Catalunya and Arc de Triomf, and at the beginning of the line in L'Hospitalet de Llobregat.

As the lines don't have any common connections beyond the connection in Barcelona, it doesn't seem to have any relevance in the behaviour of the R1 railway line.

2.2.4. Connection with the R4 railway line

The R4 railway line was built in 1989 already with the actual route from *St. Vicenç de Calders* to *Manresa.* The total length of the line is 143 km and has 40 stations, being one of the largest railway lines in the Rodalies system.

The line connects some important cities of the central zone of Catalonia as *Cerdanyola del Vallès*, *Sabadell* or *Terrassa* with Barcelona city centre where are the connections with the R1 railway line (see *Figure 10. R4 stations and stops*).

Figure 10. R4 stations and stops

Due to its journey through the centre of the Catalan territory, the line separates from the coaster zone and therefore from the R1 railway line, that's why it doesn't seem to have much influence on the line analysed in this thesis.

2.3. R1 railway line properties

Nowadays, the R1 railway line is composed by 31 train stations and a total length of 95,1km from *Molins de Rey to Maçanet-Massanes* with the following terminal stations; ***Molins de Rei*** and ***l'Hospitalet de Llobregat*** in the southern area and ***Mataró***, ***Calella***, ***Blanes*** or ***Maçanet*** in the northern zone. In order to evaluate the main properties of the track and the line itself, some parameters have been obtained and analysed from the CIRTRA documents.

Published by *Adif* in January 2011, CIRTRA (acronym for "*Circulaciones por Tramos*" in Spanish that means Circulation by Segments) is an information system designed in 1993 to know in a reliable, systematic and useful way the characteristics of the ADIF network. This system gets to know the evolution of the equipment of the network and its current situation through the years. In this documents, the R1 railway line is part of the called Axis 02 (*EJE 02: M. Chamartín – Zaragoza – Lleida – Barcelona – Portbou/Cerbere*), in the North-eastern zone of the Spainish territory. The line is entirely electrified and its composed by a 37 km long Single-track section, from the northern station Massanet - Maçanes to Arenys de Mar station, and a second part with the rest of the line, 58 km long, in a Double track section from Arenys de Mar to Molins de Rei.

In terms of physical properties, the track width is the distance between the internal faces of the two lanes that compose the track. Is one of the most important characteristics of a railway since it determines the trains and the compatibility with nearby networks. In this case it's used the so called **"1688mm - Iberian Width"** stablished in the entire line in 1955 as in the rest of the Spanish railways. The 1688mm - Iberian Width is the most used width in the peninsula although it coexists with 5 different widths in the same territory (*see Figure 11. Different track widths in the Spanish network*) as the "1672mm - Spanish Width" only used on Line 1 subway in Barcelona, "1435mm - International or Standard Width (UIC)" used in high speed lines, the "1445mm - Madrid's Width" in Madrid's subway, the "1000mm – Metric Width" used by the Adif narrow gauge network, or the "914mm Width" used in Mallorca.

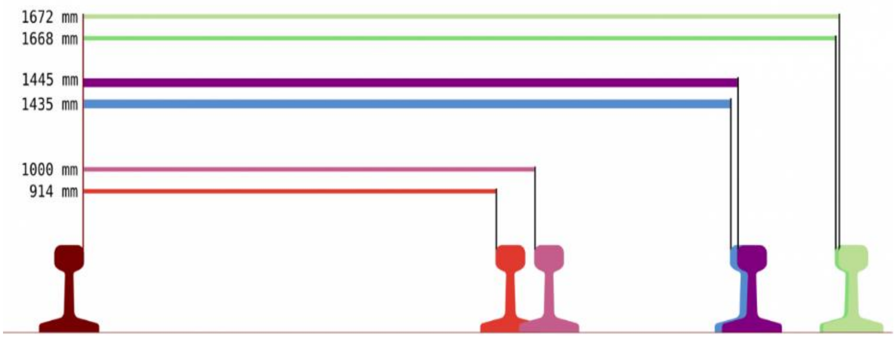

Figure 11. Different track widths in the Spanish network

The fact that the most widely used width is so different from the "International Width (UIC)" used in most European countries has caused many interoperability problems between the Spanish railway and the rest of the European network.

The line is divided into several sections systematically numbered in "***Map 5 05***" of the *Meshes of Sections* chapter in the CITRA document, as it can be seen in *Table 1. R1 sections following CIRTRA system*. In this thesis, the sections have been renamed in order to facilitate reading and the new section numbers have been integrated into the table with the main characteristic values of each segment.

SECTION		*Beginning of the Section*		*End of the section*		*Length*
#	*# CIRTRA*	*Station Code*	*Station Name*	*Station Code*	*Station Name*	
1	022400130	72300	MOLINS DE REI	72305	L'HOSPITALET	9,89
2	022200110	72305	L'HOSPITALET	71801	BARNA-SANTS	3,8
3	022200100	71801	BARNA-SANTS	B8801	BIF. VILANOVA	4,525
4	022660010	B8801	BIF. VILANOVA	B7184	BIF. GLORIAS	0,9
5	022620020	B7184	BIF. GLORIAS	79009	BARNA-CLOT-ARAGO	1,018
6	022620025	79009	BARNA-CLOT-ARAGO	B7900	BIF. SAGRERA	0,636
7	022760005	B7900	BIF. SAGRERA	B7943	B.SAG.AG.KM 0,9	1,853
8	**022760020**	**B7943**	**B.SAG.AG.KM 0,9**	**79500**	**MATARO**	**24,88**
9	022760030	79500	MATARO	79600	ARENYS DE MAR	9,88
10	022760040	79600	ARENYS DE MAR	79603	CALELLA	10,678
11	022760050	79603	CALELLA	79606	BLANES	11,384
12	022760060	79606	BLANES	79200	MAÇANET-MASSANES	15,232

Table 1. R1 sections following CIRTRA system

In the table, some information as the beginning and ending stations in every section and its codes have been expressed as well as the total length of the segments. Also the main studied section of the R1 railway line has been highlighted corresponding to section 8 going from ***BIF. SAG. AG. KM 0,9***, a prominent point of the network located in a fork in the Sagrera area, to ***MATARÓ*** city, which corresponds to the longest stretch (24,88 km).

Besides this general information about the railway line, information about the track of the line is necessary, then the most characteristic parameters that will affect the behaviour of the network are explained below with the corresponding attached plan of each zone.

2.3.1. Signalling: Blocking system

This signalling system guarantees the safety of the trains that occupy a line segment (named "Cantón" in Spanish) preventing others from entering it. There are different types of Blocking systems:

- *"Telephone Lock (TL)"*: in this type, the security is guaranteed through the transmission of telephones between the Circulation Managers, responsible for the coordination in the daily circulations, in the nearby stations.
- "*Manual electric Lock (MEL)*": Electrical devices are used by Circulation Managers.
- "*Radio circulation control (RCC)*": In this system, used in non-busy lines, circulation is ensured through the permanent knowledge by the Circulation Manager of the situation of the trains in the sections.
- "***Automatic Lock (AL)***": This blockade has intermediate segments ("Cantones") between stations protected automatically by signals. One can differentiate between different Automatic locks depending on the line conditions and characteristics, as the "Automatic Locks in Single-tracked lines", the "**Automatic Locks in Double-tracked lines**" and the "**Banalized Automatic Lock (BAL)**".
- "***Automatic release Lock (ARL)***": this system has single segments ("Cantones") between stations automatically protected by signals and axle counter devices.
- "*Side signal Lock*": specifically designed for high speed lines.
- "*Automatic control Lock (ACL)*": the safety distance is maintained by regulating the speed of the train that the machinist receives continuously by means of signalling in the cabin.

In our sections, the previous highlighted systems are applied, as it can be seen in the following Blocking system plan, *Figure 12. Signallizing System plan*.

In sections 1-3, 6-9 there is Banalized Automatic Lock system implemented, then in sections 4-6 the system used is Automatic Lock and finally sections 10-12 there is Automatic Release Lock system.

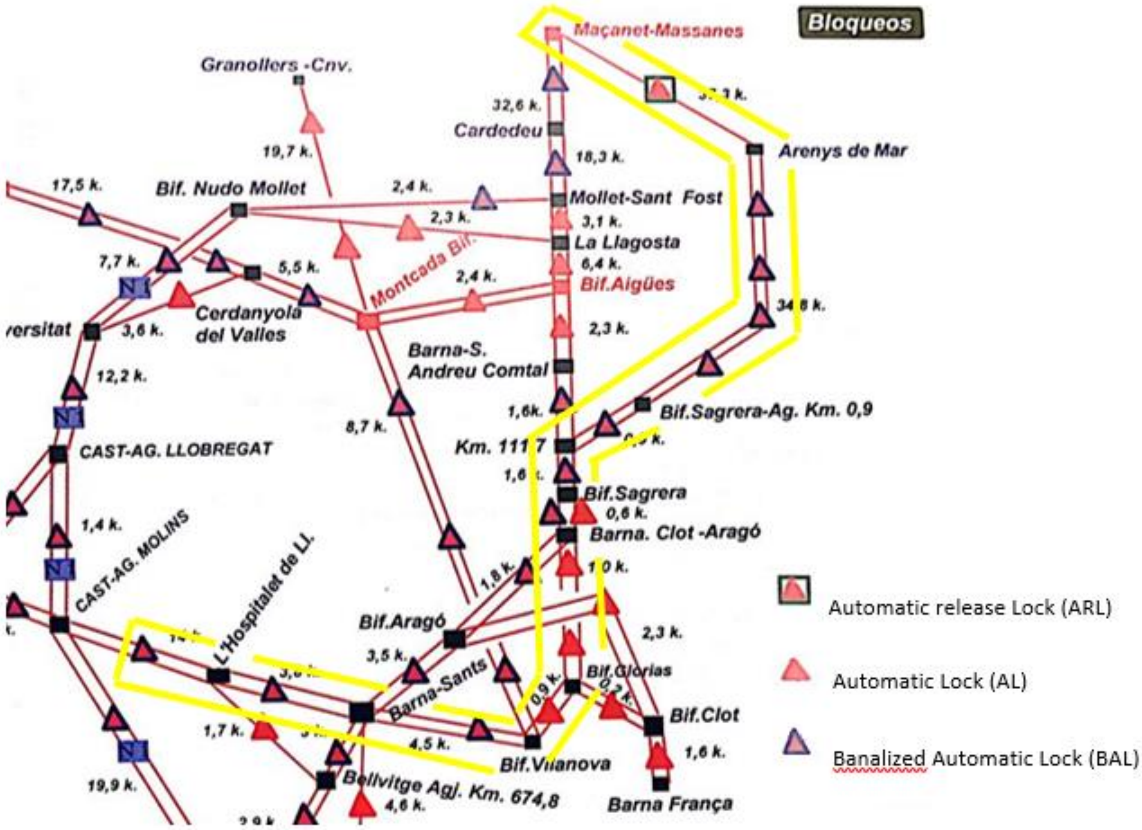

Figure 12. Signallizing System plan

2.3.2. Security Systems

The cab signalling systems provide indications and magnitudes of speeds and distances in the cabins of trains equipped conveniently. The main types of cabin signalling systems are:

- "*LZB (LinienZubBeeinflussung)*": control, signalling and assisted driving system, which continuously monitors the speed of the train and controls its way by means of the cabin signalling.

- "*ERTMS (European Rail Traffic Management System)*": control, signalling and assisted driving system that complies with the European interoperability standards. The ERTMS system coordinates two different subsystems, on one hand the ETCS system manages the signalling and protection of the train, on the other hand the GSM-R provides the communication aspects of the trains. Depending on the way in which these two subsystems are coordinated, different levels of functionality are acquired. In the Spanish network, only LEVEL 1 is reached, based on track and order circuits, by means of Euro-beacons and movement authorizations with their respective speed curve until the next beacon, which provides maximum speeds of up to 300 km / h and frequencies of 5:30 minutes between trains. This level of functionality is usually only acquired in high speed railway lines.

- "***ASFA (Anuncio de señales y frenado automático)***": Signal Announcement and Automatic Braking system. It announces in the cabin the indication of the signals by means of beacons located along the railway line and also stops the train automatically if its conduction doesn't respect the signalling advertisements.
  This system provides frequencies of 8 minutes between trains and a maximum speed of 200 km/h. The last development of the system is called ASFA DIGITAL and it proposes improvements in the equipment inside the train, keeping the original system's beacons. The signal received by the train is digital and therefore allows the use of braking curves and a better representation of the signals in the cabin.

- *"ATP (Automatic Train Protection)*": the security system is based on timely information provided by beacons installed on the rail track in order to perform continuous monitoring of the train's speed and location.

As it can be seen in *Figure 13. Security Signallizing System plan* the whole line has implemented the ASFA system for signal safety and braking, as in most of the Spanish railway network.

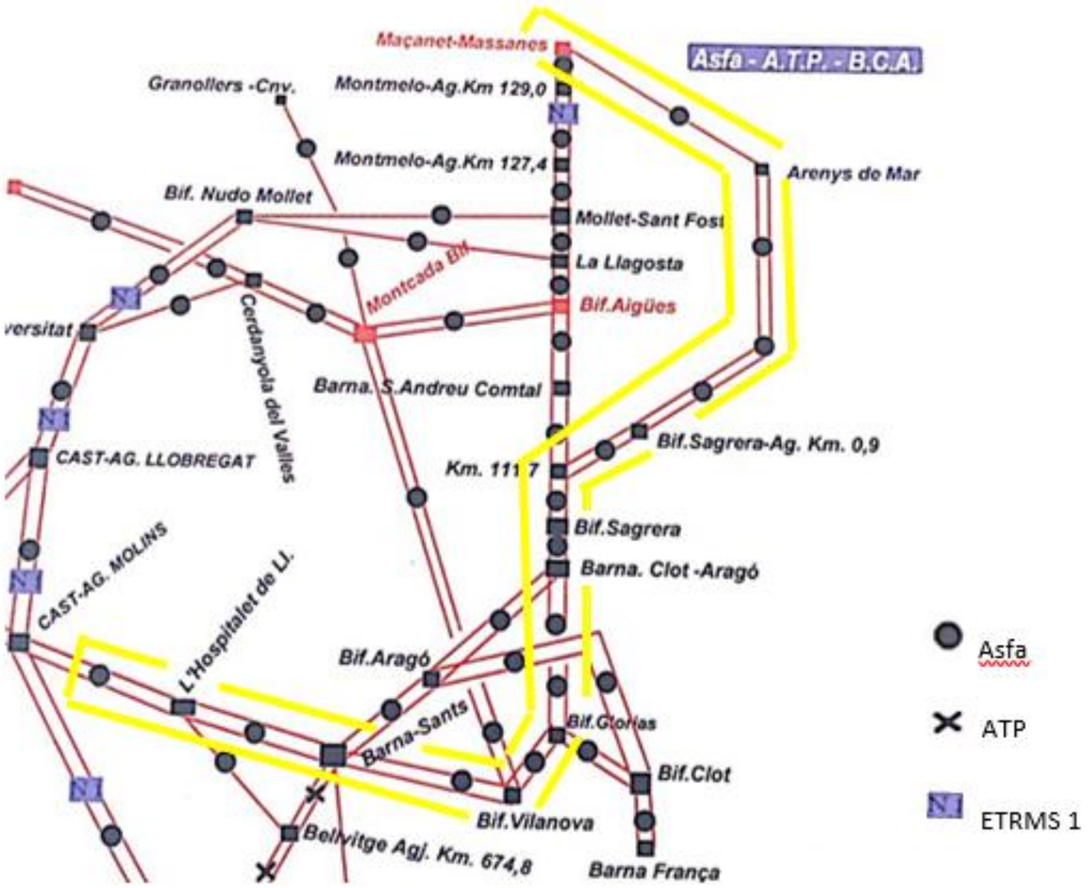

Figure 13. Security Signallizing System plan

The fact of not having the ETRMS system in service reduces the interoperability of international trains to enter the Spanish network. In the case of the lines with ETRS 1, the system could be compared to the ASFA but with technologically more advanced functions. In addition, these two systems could coexist in the same network, which opens the possibility of incorporating the ETRMS system into the line.

2.3.3. Radiotelephone Communication systems

Two types of radiotelephone communication systems can be differentiated depending on the type of signal used as it can be seen in *Figure 14. Radiotelephone Communication System plan*:

- "***Tren-Tierra***": which means Train-Ground in Spanish. In this system an analogue signal is used in order to permit communication between the trains and the Command Post or the Regulation and Control Centre.
  This is the present system in the Spanish railway network mostly with 76.1% of implementation. In the near future, a gradual migration of this system to the GSM-R system is foreseen.

- "*GSM-R*": development of GSM technology (Global System for Mobile Communication) specific for communication and rail application that has exclusive frequency bands to avoid any type of interference. Being part of the ETRMS system allows interoperability at European level. Currently this system is used in high speed lines.

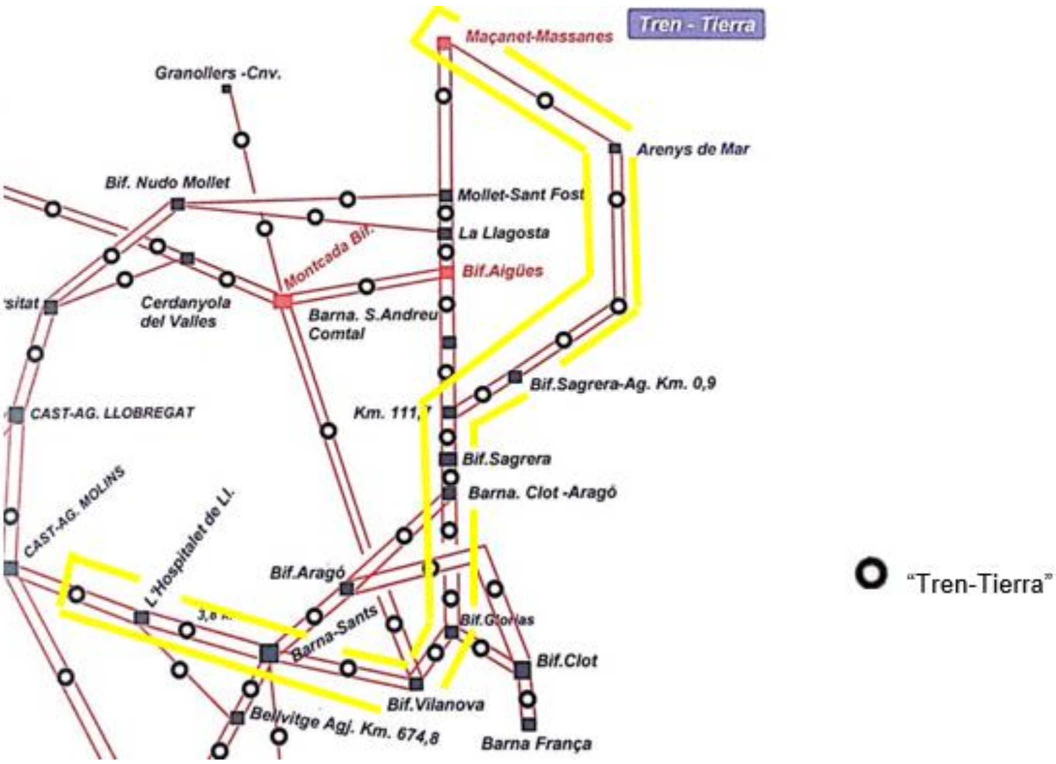

Figure 14. Radiotelephone Communication System plan

2.3.4. Maximum velocities

Another important parameter affecting to the behaviour in a railway line is the maximum velocity permitted in its sections. In the R1 line, due to its early construction, the conditions of the track are not designed to withstand high speeds comparing to other lines far away from the coastal zone.

The *Figure 15. Maximum velocity chart* below shows that the maximum speeds reached in the R1 line are considerably lower than those of the near railways, specifically comparing with the R2 railway line that runs parallel to the coastline along the inland area of the Catalan coastal territory.

For example, the same route between “Maçanet-Massanes” and “Barna. Clot – Aragó” involves a 20-minute difference between lines, if the R1 railway line is chosen it takes 1 hour and 23 minutes to arrive to Barcelona in comparison with 1 hour and 3 minutes duration if the inland line is taken. This fact will condition the behaviour of traffic flows along the line, so it will be studied later.

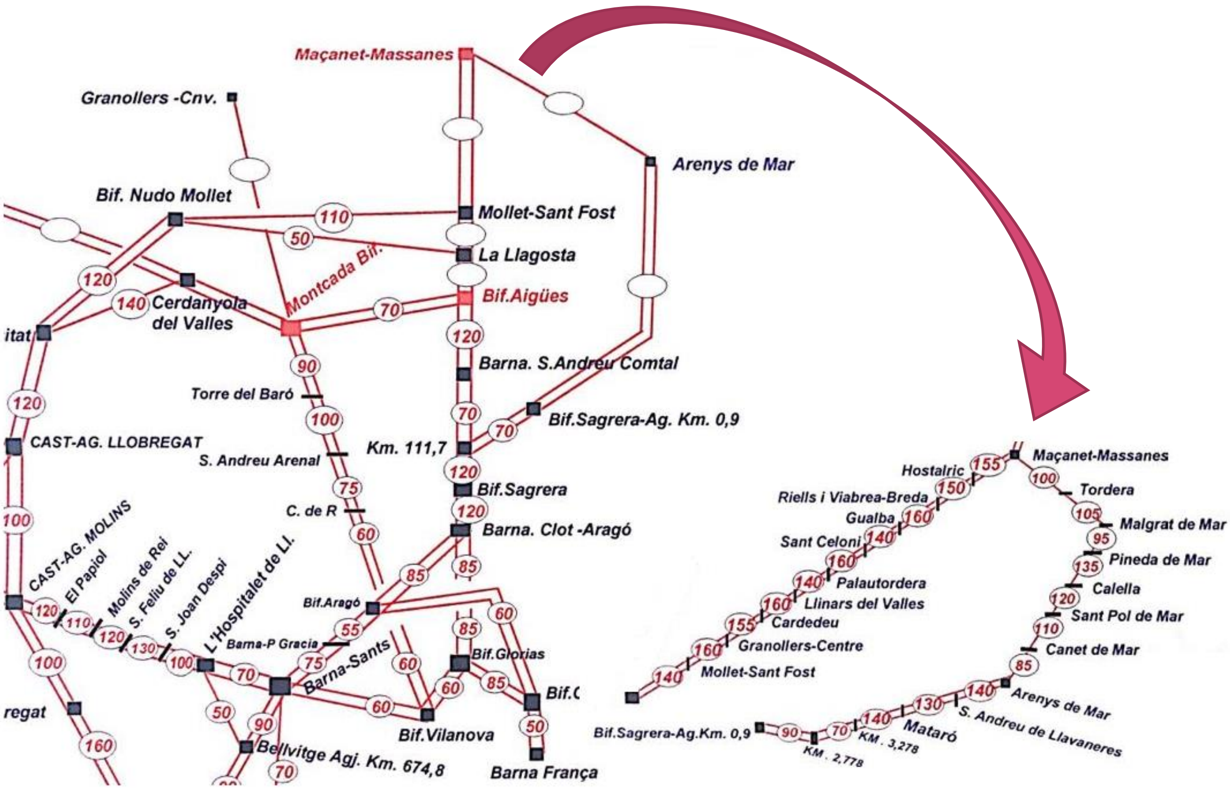

Figure 15. Maximum velocity chart

2.3.5. Interlocking system

This system is composed by Interlocking devices controlling the circulation in a certain railway station. Is capable of handling signals, deviations, shims and semi-enclosures of the rail track and it prevents the changing of the previous elements if the new configuration is incompatible with some other element in the system. There are three basic types of Interlocking:

- "*Mechanical Interlocking*": this system has two variants. One consists in a Locking bed of steel bars forming a grid connected to switches, derails signal or other appliances. The bars are constructed so that if there is a conflict between the two bars the system will move the conflict bar.
  This variant represents only 0,5% of the lines in the North-Eastern part of the Spanish territory meanwhile the other variant represents 5,8% of it. This second variant works with cams, levers and pulleys and is called the Bouré system.

- "***Electro-Mechanical Interlocking***": In this system, power interlocking devices are used to ensure the proper sequence of the levers. The machinery is composed by complex circuits formed by relays in a relay logic arrangement that determines the state or position of each signal device. This type of interlocking system represents 31,1% of the total network in the North-Eastern zone.

- "***Electronic Interlocking***": is the most modern version of the system, governed by microprocessors. The use of this software instead of cable circuits greatly facilitates the ability to make modifications when necessary with a simple reprogramming process. This is the most used type of Interlocking system in this zone with 62,6% of the total network implemented.

The *Figure 16. Interlocking System plan* shows the two systems used in the R1 line, mostly composed by the Electronic Interlocking system (12 devices in the totallity of the line) and by the Electro-Mechanical Interlocking system (9 devices in the line).

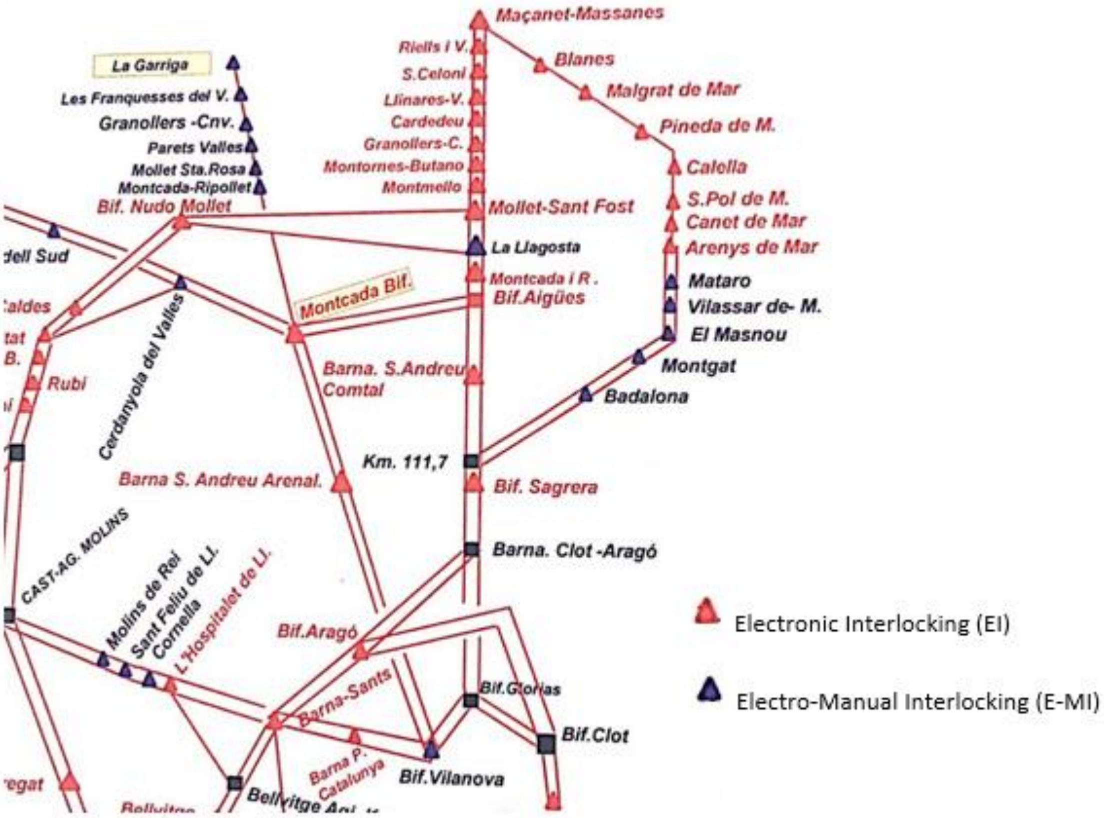

Figure 16. Interlocking System plan

2.3.6. Overhead wire

The Overhead wire, also called Catenary or "Catenaria" in Spanish, is the power line that transmits electrical energy to the locomotives or any motor-material. It's the main object of the electrification system in railways and usually composed by one or more overhead wires. This wires are electrified with high electrical potential through feeder stations which, in turn, are fed by the high voltage electrical network (3000V, DC).

The overhead wire network is mostly compensated, which means that they have a constant mechanical tension, which ensures the horizontality of the contact wire at any temperature. This property is achieved by joining the support and the contact cable to counterweights giving only the possibility of vertical displacements.

As it can be seen in *Figure 17. Electrification System, Overhead Wire plan*, most of the network is compensated except section 3 from *Barna-Sants* to *Bif. Vilanova*.

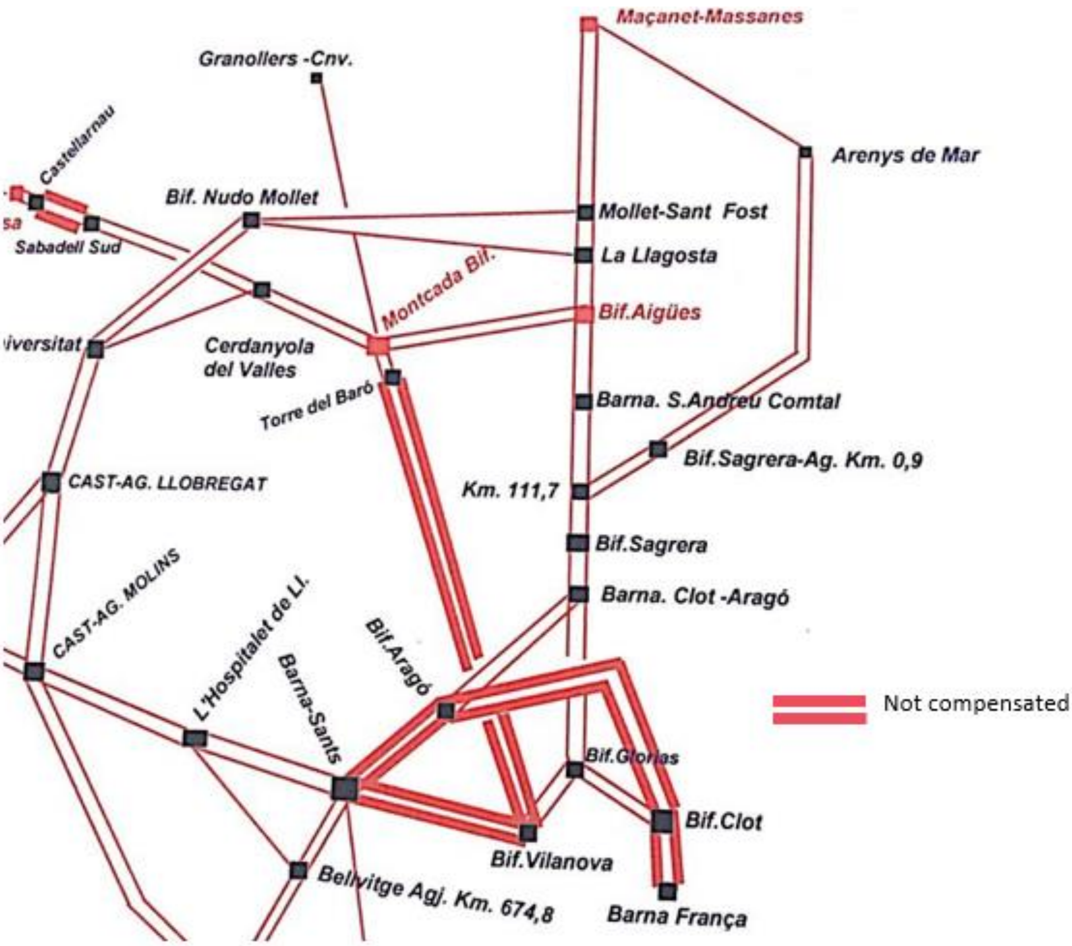

Figure 17. Electrification System, Overhead Wire plan

These are the main properties of the track line, so they'll be taking in count for future approaches. In order to easily find all the properties of each section of the line, the following summary *Table 2. R1 Section properties* has been made, it contains the properties mentioned before but organised into the renamed sections.

SECTION		Blocking	Security Syst.	Communication Syst.	Velocity		Interlocking Syst.	Overhead wire
#	# CIRTRA				Min.	Max.		
1	022400130	BAL	ASFA	Tren-Tierra	100	130	E-MI	COMP.
2	022200110	BAL	ASFA	Tren-Tierra	70	70	EI	COMP.
3	022200100	BAL	ASFA	Tren-Tierra	60	60	EI	NOT COMP.
4	022660010	AL	ASFA	Tren-Tierra	60	60	E-MI	COMP.
5	022620020	AL	ASFA	Tren-Tierra	85	85	-	COMP.
6	022620025	AL/BAL	ASFA	Tren-Tierra	120	120	EI	COMP.
7	022760005	BAL	ASFA	Tren-Tierra	70	120	E-MI	COMP.
8	**022760020**	**BAL**	**ASFA**	**Tren-Tierra**	**70**	**140**	**E-MI**	**COMP.**
9	022760030	BAL	ASFA	Tren-Tierra	130	140	E-MI	COMP.
10	022760040	ARL	ASFA	Tren-Tierra	85	120	EI	COMP.
11	022760050	ARL	ASFA	Tren-Tierra	95	135	EI	COMP.
12	022760060	ARL	ASFA	Tren-Tierra	100	105	EI	COMP.

Table 2. R1 Section properties

Now, having reviewed all the parameters that affect the entire railway line we can focus on the main studied section (Section 8; BIF.SAG.AG. KM 0,9 – Mataró).

2.4. Section 8: BIF. SAGRERA – MATARÓ

2.4.1. Circulation Flow

As it has said before, this section 8 is one of the most important railway sections in North-eastern zone of the national territory due to its daily traffic and its localization (it connects all the coastal villages with the Catalonian capital, Barcelona). Regarding to the circulation flow in this section, the real circulation values are comparable to the line sections within the capital, which attributes to the coastal section the same behaviour in terms of flow passengers than sections 1 to 7.

In fact, taken values from the CITRA documents, in 2010 the real amount of circulations in section 8 was the highest value of the entire R1 line with a monthly average of 7509 circulations/month (see *Figure 18. Real Circulations (weekly average)*). This number increases up to 9741 circulations/month in summer season, from April to August because of the tourists going to the Catalan coast on holydays and traveling from Barcelona to La Costa Brava mostly. The values in case of weekly and daily averages are 1728 and 247 circulations respectively. The tendency through the years has been the same, so these values from 2010 can be extrapolated to current days.

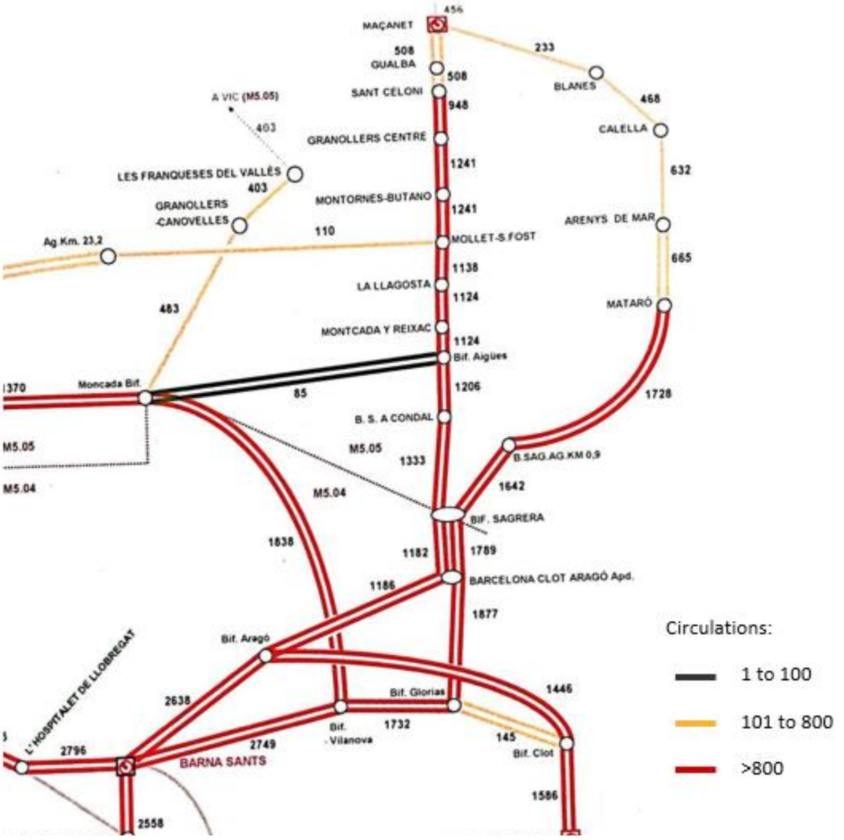

Figure 18. Real Circulations (weekly average)

2.4.2. Kilometres-Train

In case of the kilometres travelled per train, the Section Bif. Sag. Ag. Km 0,9 – Mataró has also the maximum values of the R1 line and other lines connecting nearby Barcelona city centre areas as *Figure 19. Real Kilometres-Train (weekly average)* shows below. The monthly average is 151694,6 km/train which is the highest value in the North-East zone. This is due to its high circulation flow as it has been explained above, but also due to the length of the Section 8, about 25km, also the largest section of the R1 railway line. The other values like the weekly average and the daily average are 34910,5 and 4987,2 kilometres respectively as it can be seen in the following figure.

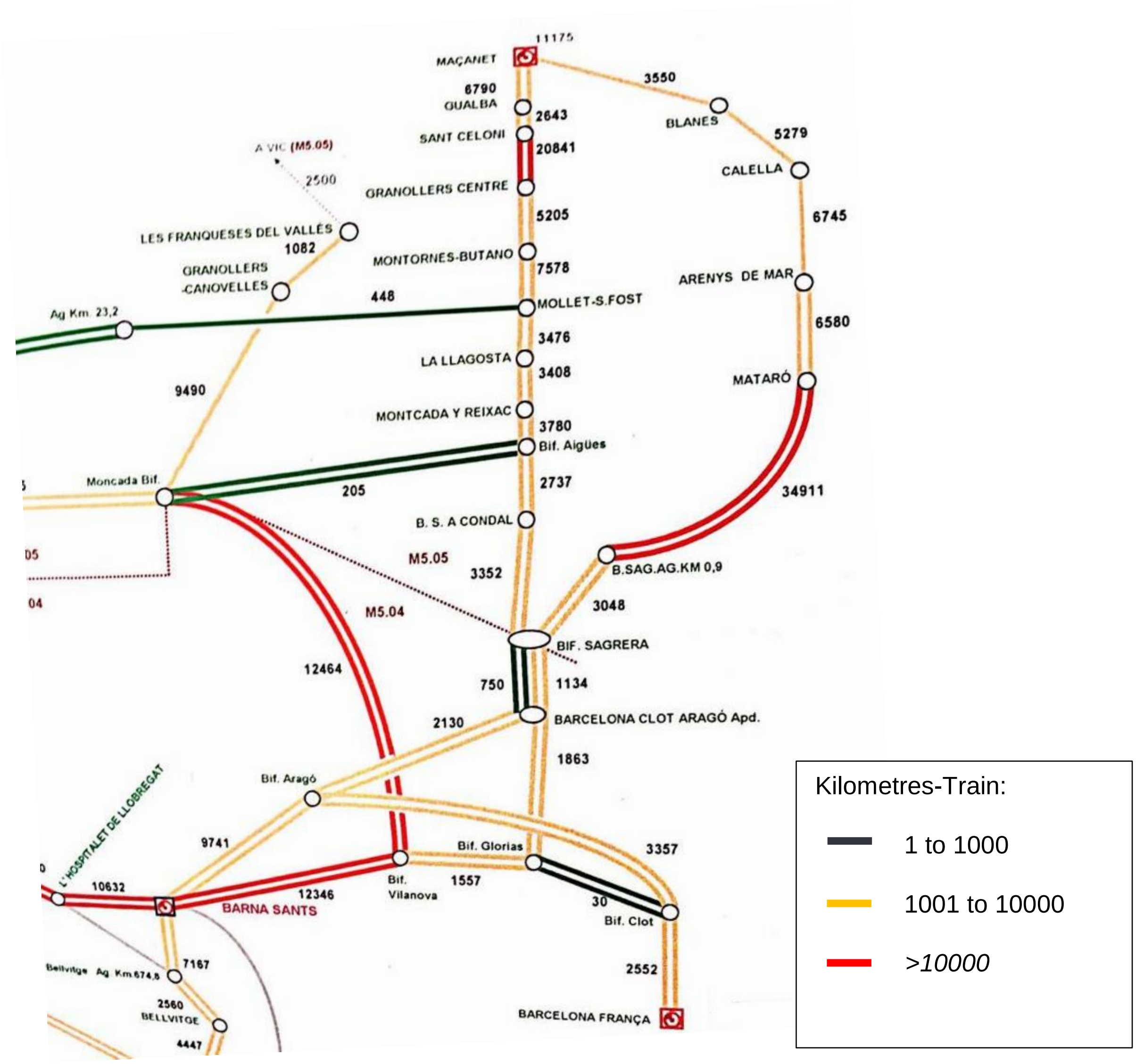

Figure 19. Real Kilometres-Train (weekly average)

2.5. Problems of the railway line

The study focuses now on the problems that occur every day on line R1 from *Molins de Rey* to *Maçanet-Massanes*, but with more emphasis on Section 8 from Mataró to the entrance to Barcelona city. The main problem of the railway seems to be because of the line layout, that remains the same for almost 30 years. The ageing in the original layout could cause many problems on the line's behaviour and serviceability as in some design parameters like Maximum Velocity permitted in the sections or the Geographical Location of the track in the coastal territory.

In terms of **Maximum Speed Restrictions**, in the previous section have been compared these maximum values between different lines arriving to the Catalan capital, more specifically, R1 railway line has been directly compared to R2 line going through the inland area in an almost parallel path. As it is observed, line R1 has maximum speeds slightly lower than line R2. The fact that two parallel routes, starting and ending in the same point have those differences in their maximum speed and in consequence in its travel time, is definitely one of the most alarming problems of the line.

These speed restrictions due to the original layout may have been caused by three mainly reasons, first the *track sketch* characterizes the speeds that can be acquired on it since the maximum speed depends largely on the curve radius found in the route. The magnitude of this parameter represents a useful indicator to measure the difficulty of a path (for speeds of 100 km/h the minimum radius of the curve in the plant should be in about 500 m). The second reason would be due to the *condition of the rail track* itself. In this case, it doesn't seem that the railway is in poor condition, so we will assume that this factor wouldn't affect too much on the speed restrictions. Finally, the third reason because maximum velocities can be reduced would be the *train vehicles fleet* used for the circulations. In the R1 railway line mainly 2 types of trains are in service as it can be seen in *Figure 20. Civia unit* and *Figure 21. 447 unit*):

- ***46X or CIVIA series***, a new type of self-propelled rolling stock used to transport passengers on commuter trains entered in service during 2004. The original concept of this type of trains is based on the design of RENFE emphasizing the comfort of the traveller.

Figure 20. Civia unit

They are the first low ground level trains designed for people with reduced mobility, for these people an adapted train modulus has been added to the machinery (named A3 modulus) with the height of the floor levelled to the same height of the platform of the Rodalies network in order to facilitate the entry. In addition, this modulus-designed type of trains allows to adapt the number of modules to the circulation train according to demand, then, trains with two, three, four or five modules can be obtained. Usually the average capacity of these trains is about 600 people and of which 200 are sitting, these values depend on the inside box model. Most of CIVIA trains have already the ASFA technology, meanwhile new signallizing systems as ASFA Digital or ERTMS are being installed progressively. These trains are also equiped with Tren-Tierra comuniction system and CAF or Alstom train monitoring control equipment.

- ***447** series*: Its design began to be planned in the early 1980s and materialized in the original 445 series prototype that evolved through the 446 to the current 447. These trains are a great example of the speed restrictions due to the design, since the train would be designed mainly to offer multi-stopping services in short distances and a large number of travellers, then, they were given a great acceleration capacity by penalizing the maximum speed. It is considered one of the best commuter trains, due to its great power and reliability, exceeding the new Civia model. The 447 series are equipped with new asynchronous three-phasic motors with better performance than the 446 ones, with greater acceleration, greater tractor effort, and a maximum speed of 120 km / h. The units are composed by three coaches per train, where the ends are motorized and have control cabin and the middle one acts only as a trailer. Their capacities are about 555 places and 243 of them sitting.

Figure 21. 447 unit

All these factors affect drastically on the maximum speed of the line, but what about the real speed of these trains in the circulations? We know that the maximum speed is usually not reached because of the starting and braking times between stations or because of the insufficient length of stretches. The study then proceeds to analyse the actual circulation speeds in each section from the length data and the schedule information R1 line. The data of main sections (from *Barna-Sants* to *Mataró* stations) have been taken by field research during afternoon and morning rush hours in the two directions in a working day (see *Annex B. Schedule field data in sections 3,4,5 and Sections 6,7,8)*. The average values have been taken, while the other sections have been studied from the timetables available on Rodalies de Catalunya website, see *Annex A. “R1. Working and weekend days Schedule”*.

Length data between stations and also the time of travel of the train between them had been taken, with these two values, the average speed can be calculated. A single speed is determined for the entire stretch, knowing that, although the actual average speed is not uniform, it corresponds to the equivalent speed with accelerations and decelerations.

These speeds are compared in *Table 3. Comparison between real and maximum speeds* with the maximum speeds allowed in the section, taking a percentage of them (real in comparison to maximum values) that allows to get an idea of the relationship between these two. Sections 6, 7, 8, and 3, 4, 5 are grouped in the same set from which information has been obtained directly from field data as it is the most influential section of the study (shown in *Table 4. Real and Max. speeds, Sections 3, 4 and 5* and *Table 5. Real and Max. speeds, Sections 6, 7 and 8*).

#	Origin	Destination	Length (km)	Travel Time (min)	Real avg Speed (Km/h)	Max. Speed (Km/h)	%
1	**Molins de Rei**	St. Feliu de Llobregat	3,8	4	57,00	120	48
	St. Feliu de Llobregat	St. Joan d'Espí	1,9	3	38,00	130	29
	St. Joan d'Espí	Cornellà	1,5	2	45,00	100	45
	Cornellà	**L'Hospitalet de Llobregat**	0,71	2	21,30	100	21
2	**L'Hospitalet de Llobregat**	**Barcelona-Sants**	3,9	7	33,43	70	48
9	**Mataró**	St. Andreu de Llavaneras	5,1	5	61,20	130	47
	St. Andreu de Llavaneras	Caldes d'Estrac	2,8	3	56,00	140	40
	Caldes d'Estrac	**Arenys de Mar**	2,1	2	63,00	140	45
10	**Arenys de Mar**	Canet de Mar	2,9	4	43,50	85	51
	Canet de Mar	St. Pol de Mar	4	5	48,00	110	44
	St. Pol de Mar	**Calella**	3,7	4	55,50	120	46
11	**Calella**	Santa Susanna	4,6	6	46,00	135	34
	Santa Susanna	Malgrat de Mar	2,5	3	50,00	95	53
	Malgrat de Mar	**Blanes**	4,4	4	66,00	105	63
12	**Blanes**	Tordera	5,8	5	69,60	105	66
	Tordera	**Maçanet-Massanes**	9,4	7	80,57	100	81

Table 3. Comparison between real and maximum speeds

Station	Event	Time	Length (km)	Travel time	Time (h)	Avg. speed (km/h)	Max. Speed (km/h)	%
Barna-Sants	Initial Time	0:00:00						
Barna-Sants	Train departure	0:00:59	2,70	0:04:46	0,08	33,94	60	57
Plaça de Catalunya	Train doors opening	0:04:46						
Plaça de Catalunya	Train departure	0:00:34	0,96	0:01:56	0,03	29,70	60	50
Arc de Triomf	Train doors opening	0:01:56						
Arc de Triomf	Train departure	0:00:34	2,20	0:04:51	0,08	27,20	85	32
Barna-El Clot	Train doors opening	0:04:51						
	Total Time	0:13:42						

Table 4. Real and Max. speeds, Sections 3, 4 and 5

Station	Event	Time	Length (km)	Travel time	Time (h)	Avg. speed (km/h)	Max. Speed (km/h)	%
Barna-El Clot	Initial Time	0:00:00						
Barna-El Clot	Train departure	0:00:44	5,9	0:08:04	0,13	43,87	120	37
Sant Adrià de Besòs	Train doors opening	0:08:04						
Sant Adrià de Besòs	Train departure	0:00:40	2,8	0:02:36	0,04	64,60	90	72
Badalona	Train doors opening	0:02:36						
Badalona	Train departure	0:00:32	2,7	0:02:12	0,04	73,46	90	82
Montgat	Train doors opening	0:02:12						
Montgat	Train departure	0:00:25	1,4	0:01:34	0,03	53,58	70	77
Montgat N	Train doors opening	0:01:34						
Montgat N	Train departure	0:00:23	3	0:01:58	0,03	91,88	140	66
Masnou	Train doors opening	0:01:58						
Masnou	Train departure	0:00:26	0,81	0:01:05	0,02	45,04	140	32
Ocata	Train doors opening	0:01:05						
Ocata	Train departure	0:00:35	3,1	0:02:24	0,04	77,24	140	55
Premia de Mar	Train doors opening	0:02:24						
Premia de Mar	Train departure	0:00:36	3,3	0:02:58	0,05	66,55	140	48
Vilassar de Mar	Train doors opening	0:02:58						
Vilassar de Mar	Train departure	0:00:27	1,2	0:02:08	0,04	33,62	140	24
Cabrera de Mar	Train doors opening	0:02:08						
Cabrera de Mar	Train departure	0:00:26	4,7	0:04:52	0,08	57,86	140	41
Mataró	Train doors opening	0:04:52						
Mataró	Train departure	0:00:47						
	Total Time	0:35:54						

Table 5. Real and Max. speeds, Sections 6, 7 and 8

Therefore, the reduction of these maximum speeds must be because of to the proximity of the stations in the route and the environment of the lines where safety limits must be respected. This is why the most severe restrictions are found at stations near the sea as in section between *Vilassar de Mar* and *Cabrera de Mar* with the minimum value of 24% use of the maximum speed of the track. The problem of the railroad is the waste of the maximum speed in its journey.

In *Chart 1. Speed comparison in the R1 line,* a graphical representation between the two speeds can be seen. In this graph are represented the Maximum speed allowed in every section of the railway line as the Real average speed of them, it can be also seen that the greater the distance between speed lines, the greater the difference between them, and therefore a smaller percentage of similarity corresponds to speeds in each stretch.

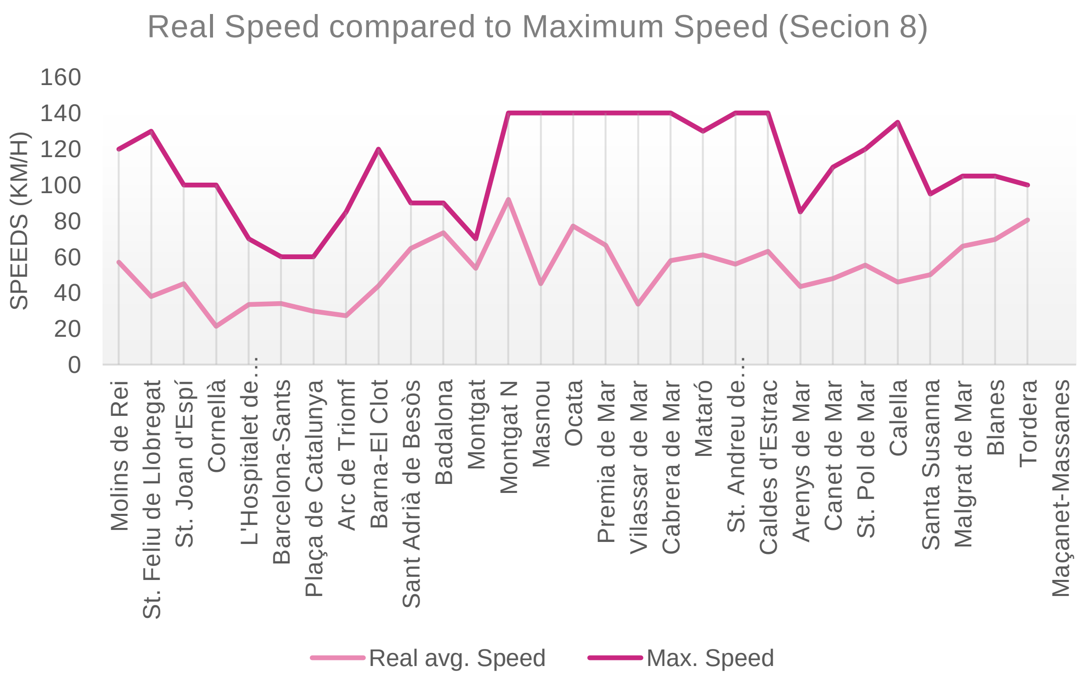

Chart 1. Speed comparison in the R1 line

On the other hand, the thing that the **Geographical Location of the path** is so close to the sea creates alterations in the service when there are storms in coastal towns, especially in the Maresme area (between *Tordera* and *Montgat*) as it can be shown in *Figure 22. Train passing Cabrera-Mataró section.*

Figure 22. Train passing Cabrera-Mataró section

This happens when due to the waves, the train tracks that are closer to the water lose their base ballast. As result, the lines are not able to be transited due to the risk of sinking because of the train weight, and the whole line is paralyzed in the north direction, which is usually the direction of the affected track. Sometimes, only one way is enabled for the trains in both directions, which reduces notably the capacity of the railway and causes important delays in the daily schedules. The worst case scenario is when both directions are blocked and the trains are not allowed to circulate, then Rodalies de Catalunya has to provide alternative services to the train as buses following the railway route along the parallel road, which entails rapid response and large management expenses.

Another problem is the **Single-Track layout** at the northern part of the R1 line between *Maçanet-Massanes* and *Arenys de Mar*. Although it is not the busiest part of the line, many travellers go through this section at rush hours to go to work to Barcelona. This fact means that if there is any complication in this section in the morning rush hours, all the following route to the capital will be affected and the delays will continue throughout the day. When these delays occur, it is almost impossible to recover them due to the small margin of speed and float times that trains have in their route between stations and that the routes are, in turn, too short so the delay will accumulate along the day. However, this factor is not the biggest problem of the network, as it is known, the capacity of a network is determined by the capacity of its bottlenecks and the main bottleneck in the R1 railway line its located in the access tunnels to Barcelona, more specifically the **Sagrera-Clot tunnel** going through *Plaça de Catalunya* station.

In the whole railroad there are 10 tunnels according to CIRTRA documents published in 2010, 8 of which are in the stretch between *Maçanet-Massanes* and *Bif. Sagrera*. These do not affect too much the capacity of the railroad, however the other two tunnels located between the *Bif. Sagrera* and *Bif. Glories*, are the restrictive ones because they pass through areas where the R1 crosses with other railway routes in its path and the mesh of lines become more complex.

The situation is the following, when a R1 train enters to the tunnel in *Barcelona-El Clot Aragó* in its direction to *Arc de Triomf* has to wait up to 3 minutes for another train to pass (trains going through *Plaça Catalunya* tunnel from other railway lines). This happens with every single train that enters to this tunnel mesh at the Barcelona entrance, which causes that, if any train is delayed a few minutes in a previous station for some external reasons, the next train will have to delay its entry 3 extra minutes more, and the same will happen with all the following trains. It is also necessary to add the possible incidents in the circulation due to technical failures or the time spent to make the driver change in *Barcelona-Sants* station, which may exacerbate the compliance with schedules. As it has said before, this delay is almost irreversible, and it's the main issue to be solved in the R1 line. Then, the solutions to this problem are focused on the reduction of the waiting time between trains, which will be studied later. This reduction could increase the capacity of the trains that circulate along the line, especially during peak hours, since another issue of the line is that at that time the trains are **excessively full** and passengers feel uncomfortable during their journey.

According to the CIRTRA documents, there are also 13 **Grade Crossings** in the whole R1 line, most of them in coastal areas where the train track is located between the coast and the adhered populations. These grade crossings do not seriously condition the capacity of route, so they will not be problematic by now.

2.5.1. Indicators for the characterization of the railway quality and service

As result of the problems mentioned in the previous section, a list of the indicators that relate these problems with the service and the quality of the route can be obtained. These indicators are the most relevant conditioners on the behaviour of the line, traffic flows and also the user's satisfaction with the service.

- ***Circulation Speed*** *(measured in km/h)* depending on:
    - Track Sketch (restrictions due to the path morphology).
    - Types of Train used.
- ***Geographical location*** *(measured in km)* in the coastal zone, length of railway line dangerously near to the Maresme littoral, specifically during the journey through towns like *Vilassar de Mar* and *Cabrera de Mar*.
- ***Single-track layout section*** *(measured in km)* at the northern end of the line between *Maçanet-Massanes* and *Arenys de Mar.*
- ***Waiting time at the Barcelona entrance*** *(measured in minutes)* in order to ensure a safety circulation through the *Plaça de Catalunya* tunnel.
- ***Passenger's Capacity of trains*** *(measured in passengers/train)* which is insufficient to supply the demand of the railway line. In addition, on average, only 39% of places in the train have seats, which means that a huge amount of passengers is traveling standing and this affects to the traveller's comfort.

With all these indicators, in the following chapter a diagnosis about the consequences of these problems has been made. In the diagnosis, the indicators and their response, both by the railway and by the environment, are analysed.

3. DIAGNOSIS ACCORDING TO THE INDICATORS

Once the indicators have been identified, there is a need to know the consequences that they entail. In this section, these factors have been analysed one by one and a study of the response of the environment towards them has been prepared.

Circulation Speed

As previously studied, the actual speed of trains traveling in the railway line is significantly lower than the maximum speed that the line allows, this fact is due to two main factors; the type of line and the type of trains that circulate through it.

Because of the type of road, as a commuter railroad, it has many stops that are very close to each other, this causes that the route between stations does not allow to reach the designed maximum speed. On the other hand, the types of trains used, also explained below, are specifically designed to supply commuter lines, which sacrifices the high speeds for a better service. But the question is, with this speed values, is the line competitive with other means of transportation in the area?

If we think in terms of environmental sustainability, definitely yes. The railway is one of the least aggressive means of transport to the environment (see *Figure 23. Comparison between private and public transport*). According to the Department of Territory and Sustainability of Catalonia, a train with capacity for approximately 400 users during 5km of travel is equivalent to the use of 300 cars, 7 buses or 3 light trains (General Dictatoriate of environmental quality and Climate change, Territory and sustainability department, 2017).

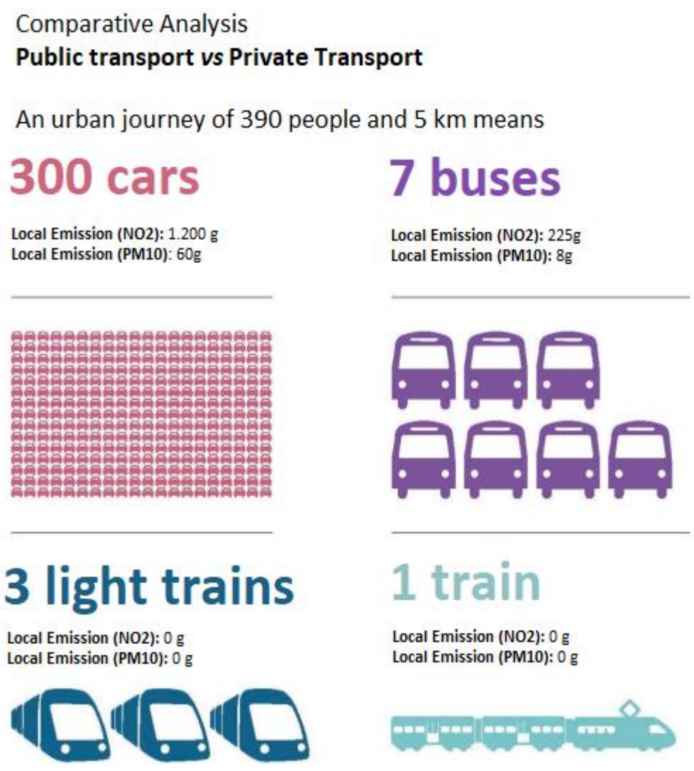

Figure 23. Comparison between private and public transport

In terms of pollution values, it is observed that while trains do not emit harmful particles, combustion vehicles such as cars and buses can emit up to 1200 g of NO2 and 60 g of PM10. These particles are especially harmful to human's health, some of their effects are the inflammation of the respiratory tracks and reduction of the pulmonary function or risk of cardiovascular disease, respiratory and lung cancer. In addition, the same report publishes that traffic constitutes the largest source of pollutants for air pollution and has a brutal impact on climate change. These pollution values are, nowadays, one of the most serious problems in Barcelona city, where even the entry of the most polluting private vehicles has been regulated during high level pollution days. During these days, only the least polluting vehicles are allowed to enter to the city.

Taking into account these values, why private transport is still so present in daily journeys to the capital city? An article from the ARA newspaper said that "*Only 17% of drivers consider pollution a sufficient reason to leave the private vehicle*" but at the same time, the study showed that "*59.6% of drivers would be willing to stop using the car on their journeys if significant improvements were made to public transport*" (Vicens, 2017). Then, how can we improve the characteristics of the R1 line (specifically Section 8) to make users choose the railroad instead of the private vehicle? Below, several comparatives between different types of public transport are shown Basically three parameters are studied: the travel time (related to the circulation speed), the price and the frequency in the service.

3.1. Comparative analysis with other transportation methods

Currently, the route from Mataró to Barcelona centre can be done with 4 main transport systems:

- **Rodalies de Catalunya commuter train** (R1 railway line)
- **Bus,** operated by the *Moventis Casas Company* that offers users the possibility of traveling between the different towns and cities of the Maresme, and those with Barcelona city.
- **Taxi,** a rental vehicle with driver, which offers transport services for one person or for a small group of passengers.
- **Private transport,** usually cars or motorcycles.

In the comparative data of the following *Table 6. Prices and Travel times for transports*, the fastest and cheapest route for each transport method has been chosen.

The route is the same for all 4 types, going from *Mataró* to *Barcelona-Sants* (an important central station in Barcelona with connections with connections to other lines and transport services).

		Total Travel time (min)	Price (€/person)	Service frequency
Public Transport	R1 railway line	50	3.5	10'
	CASAS Bus	54	3.1	30'
	Taxi	43	56.9	on demand
Private transport	Private Car	35	3.78*	on demand
	Private Motorcycle	30	1.89	on demand

*price when only 1 person is travelling in the car, if the car is full the price will be 0.76€/person.

Table 6. Prices and Travel times for transports

Observations:

- In case of the CASAS Bus, the destiny is not *Barcelona-Sants* but *Plaça de Catalunya* station, with this option it would be necessary to transfer to a subway or bus in order to arrive to *Sants*.
- The consumption for the Private Car and the Private Motorcycle is estimated in 8L/100km and 4L/100km respectively, and the petrol price taken is 1,350€/L for unleaded gasoline 95.
- The Service frequencies and the Total travel times from the public transport have been taken from the online timetables available at their web pages (see *Annex A. R1 Working Days Timetable* and *Annex C. Casas Bus Timetable*).

Then, the fastest way to arrive to Barcelona is with private vehicle, reducing almost half the travel time in comparison to public system, meanwhile the slowest method would be the bus, due to its many stops in several towns during the journey. In terms of price, the most expensive transportation is by taxi because it's the only public transport that allows door-to-door journeys, this means exclusive and personal service, which is always expensive. The cheapest public transport type is either the Bus or the train, due to its insignificant difference, even so, these prices are not far from the cost of the private vehicle as the comparison shows.

From these parameters, one can conclude that the reason why the population chooses Private Transport instead of Public Transport is because the reduction in Travel Time.

Geological location by the coast

As for the damage caused by periods of storm in the coastal areas where the railway passes very close to the sea, the greatest impact falls on the satisfaction of the user. The Spanish newspaper *EL PAÍS* said that "*Rodalies breakdowns affect more than 1.5 million passengers per year*" (Cordero, 2016).

The most problematic zone is found in the towns before Mataró, such as Vilassar de Mar and Cabrera de mar, in this area the railway route is not protected against the strong waves and it's damaged due to the impact with water. This means that, during these periods, the line is not safe and its circulation is restricted or prohibited. If the damages are not very serious, Temporal Speed Limitations are usually applied in affected areas, whereas if the damages are more severe, *Rodalies de Catalunya* enables alternative services as buses stopping at R1 train stations along the N-II road that is adjacent to the train tracks. This occurs two or three times per year, mainly in winter and spring months when these stormy periods appear, and the average when this happens is about 45 minutes.

The response from Rodalies management is usually fast but insufficient from the user's perspective, who demand safety measures to protect the railroads in these sections. These preventive measures are proposed for the sections without delimitation between the railroad and its surroundings. Not only for protection against adverse weather conditions, but also against road kill, another factor that causes common incidents in this line. In consequence, there is a general discontent in habitual users of the line, and of the entire Rodalies railway network.

The digital newspaper *MésEconomia* published in April 2017 that "*Rodalies de Catalunya registered 135 million passengers in 2017, while 10 years later the number dropped to 118 million*." This is a worrying fact if we compare it with other mobility systems in the city, such as the Metro or the Light Rail, which have had an increase in users during the last few years. (Fernández, E., 2017)

Single-track layout section

Something similar happens with the 37,3 km of Single-tracked line between *Maçanet-Massanes* and *Arenys de Mar* stations, which directly affects the circulation traffic of Section 8 between Mataró and Barcelona. Being a long segment of the line with only one way it is not strange that incidents occur during circulation, thus altering the schedules of the entire route.

However, by being a line with several origin and destination stations, these problems are easy and relatively quick to solve and don't usually carry many consequences. The trains can leave from the stations of *Mataró*, *Calella* or *Blanes* in case the service is inaccessible in *Maçanet*, so the circulation is easily restarted in Barcelona direction. Also, when this happens, Rodalies de Catalunya replaces the bus service as in the previous case.

Waiting time at the Barcelona entrance

As it has been studied previously, one of the most influential problems that causes incidences in the system is the capacity of the line, expressed as the number of circulations assumable by the track line per unit time. The capacity of any line is restricted by the capacity of its bottlenecks, defined as a narrow section of a road or a line that impedes somehow the traffic flow, and in case of R1 railway line the bottleneck is found at the Barcelona entrance. As it can be seen in *Figure 24. Outline of the R1 line on its way through Barcelona,* from the entrance in *El Clot-Aragó* to *Barcelona-Sants* station, the route enters to the tunnel that passes through *Arc de Triomf* and *Plaça Catalunya* stations.

Figure 24. Outline of the R1 line on its way through Barcelona

Through the underground route are several crossing points between railway lines as well as other tunnels used by different types of transport as the Metro (interchange with lines L1 and L3 of the Barcelona Metro). Is constituted, therefore, a mesh of tunnels under the centre of the city that supposes a huge challenge for the management of the circulation especially during rush hours.

The indicator that characterizes this situation is the waiting time of the trains that enter the tunnel through the Clot entrance to ensure that the crossings with other trains are safe. This waiting time, which usually lasts between 1 and 3 minutes, takes place between *El Clot Aragó* and *Arc de Triomf* stations. The wait ensures that the traffic through the meshing area is efficient and reduces the risk of collision between trains.

The problems appear when trains coming from Mataró direction accumulate delays before this conflict point, in that case, the delay modifies the order of the trains passing through the joints, causing longer waiting times. Nowadays, it's estimated that with a 3 min. average waiting time, the capacity of the tunnel at rush hour is 16 trains/hour to leave Barcelona and 19 trains/hour to entering the city.

These measurements have been made with the schedules established by Rodalies de Catalunya for lines R1, R3 and R4 that circulate through the Plaça de Catalunya tunnel from 8 to 9 AM (see *Annex A. R1 Working Days Timetable, Annex D. R3 Working Days Timetable* and *Annex E. R4 Working Days Timetable*).

However, if we could decrease the waiting time between circulations, the capacity of the tunnel would increase, and in turn, also the R1 railway capacity. In addition, it would be possible to increase de frequency in the service, that lead us to the next indicator.

Passenger's Capacity of trains

With a higher circulation frequency on the railway line, there would be more trains circulating per unit time, which means that trains will be more empty. The consequence of few users using the same train is reflected in the proportion of users who can access a seat. The comfort of the user, therefore, increases notably especially at peak flow hours where the current trains are almost reaching their maximum capacity.

Finally, the diagnosis concludes that the greater impact of the indicators on the line translates into unpunctuality by the trains and the non-compliance of schedules. According to Xavier Flores (General Director of Mobility Infrastructures of the Generalitat de Catalunya) during the seminar 'The Future of Rodalies' organized by the College of Civil Engineers of Catalonia, the Rodalies service has an average delay of 37 seconds per trip (Flores, 2017). This value does not seem very high until the daily delay of the line is calculated, since there are approximately 100 trains per direction every day, the daily delay becomes 1h per day and direction.

It is also important to mention that, although there is not yet a technical report, the effects caused by the La Sagrera Station, in current construction, should be studied when this operable one is in place. This station will become the connection point of commuter lines in order to release the circulation blockage in Barcelona-Sants station, so its management would also cause changes in the behaviour of the line.

4. SOLUTIONS AND IMPLEMENTATIONS

In this chapter some solutions to the problems mentioned above are proposed. The aim is to give a clear and effective response to the daily circulation incidents suffered in the Rodalies R1 railway line.

- **Improvement of the line layout**

A new geometry of the route is proposed, less incidents and softer bifurcations and curves. With this implementation, a more comfortable and natural route layout is achieved, to prevent geometrical driving difficulties and thus reach higher speeds that take advantage of the speed capacity of the railway.

- **Transfer of the railway to urban centres**

This proposal consists of completely change the layout of the current route, which runs along the original route almost 30 years ago for the creation of a new layout more logical and comfortable for the user (see *Figure 25. New proposed route for the R1 by urban centres*). The remodelling seeks to modernize the layout of the road in the section from *Mataró* to *Barcelona-El Clot Aragó*, which corresponds to Sections 6, 7 and 8 in this thesis. The aim is to replace the current route that runs along the coast line, parallel to the N-II road to Mataro, by a railway variant between Mataró and Badalona with a more central layout in the towns.

Figure 25. New proposed route for the R1 by urban centres

In the new proposed route, two integrated projects are differentiated, on one hand, there is the transfer of the railway line to the centre of the municipalities between Montgat and Mataró. This action would affect 11 of the stations in the railway line, which would move to urban centers, giving greater territorial coverage to the line. In addition, by eliminating the barrier that today represents the train line to the coast, it is expected to improve access to the beach in these affected populations. On the other hand, with the construction of the railway variant in Badalona it would be possible to shorten the route of the line, for not having limitations in the territory, which would also mean a shorter total time of the route.

In this implementation several things are achieved, on the one hand the speed of the road is no longer limited by security measures due to the proximity to the towns of Maresme since it will go underground and can have a new design of speeds adapted to the demand of the line. In addition, the storm period problem is solved since the line would pass through the centre of the towns and underground, thus avoiding one of the main external risk factors in its proper functioning.

- **Design of a new train fleet model**

This implementation would mean solving two different problems, on the one hand, if we take into account the project of the modernization of the layout to the urban centres, it would be necessary also the modernization of the trains that would operate in it, the vehicles, designed for the new railroad, could withstand a greater speed, approaching substantially the maximum, creating a more efficient route.

In addition, in the new model, it could also be designed a new interior box with more capacity of users and more number of seats, this would increase the proportion of passengers who travel seated and increasing their sense of comfort.

- **Construction of the double track on the *Maçanet-Massanes* - *Arenys de Mar* section**

This measure involves the construction of the second road in the single-track line of the sections 10, 11 and 12 between *Maçanet-Massanes* and *Arenys de Mar* stations, thus the entire R1 line would have one way per direction, facilitating the circulation and reducing the risk of collision. Furthermore, the probability of incidents in this section due to the single line would also be reduced, and the frequency of trains passing through the northern end of the R1 could be increased, since currently the frequency is only 1 train every 30 minutes.

- **Reduction of waiting time at Barcelona city entrance**

In order to solve the greatest capacity problem of the line, and therefore the waiting time in the Plaza Catalunya tunnel, this measure proposes the implementation of a new signalling system at this conflict point. For this, the current problem of the R1 is compared with the situation of the Budapest-Székesfehérvár line in 2005 shown in *Figure 26. Budapest-Szekesfehérvár line path*.

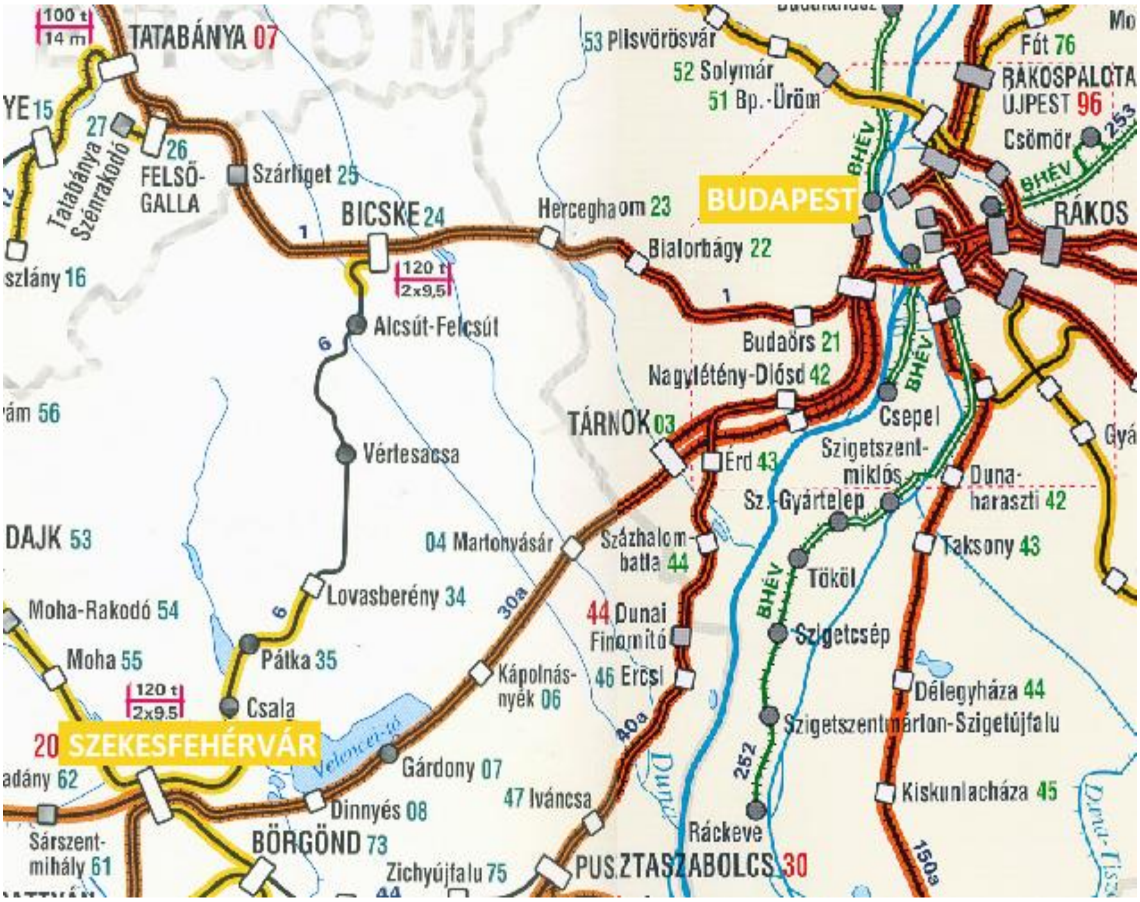

Figure 26. Budapest-Szekesfehérvár line path

This line, with similar features to the Rodalies line, currently connects the city of Budapest, capital of Hungary, with towns and cities found as it passes through Lake Velence towards Lake Balaton. Its behaviour, therefore, is very similar to that of the Catalan line because of its multiple stops along its route, although these are further away from each other.

Below, a study of the remodelling project of the line and the changes made in it has been made.

4.1. Budapest-Székesfehérvár Railway line

The 60.5 km long railway line is part of the V Corridor of the Trans European Network, as well as the analysed R1 Rodalies railway line. It connects Budapest with the city of Szekesfehervar seen in *Figure 27. Szekesfehérvár Old town square*, at south west of the Hungarian capital, and is colloquially known as Fehérvár (white castle in Hungarian).

Located in the central zone of Hungary, it's the ninth largest city in the country and constitutes the regional capital of the so-called Central Transdanubia zone. Because of its location between the lakes Velence and Balaton, it is an important rail and road junction and therefore an important passage point for tourists and locals who are looking for coldest weather in hot summer months.

Figure 27. Szekesfehérvár Old town square

4.1.1. Original condition of the line and motivation for the renovation

In 2005 it was decided to start with the improvement and rehabilitation project of the line, which was in deplorable conditions.

The fact of being an important line of passage, and the lacking of Systems and maintenance measures for many years, made that were in a worrying state of signalling, state of the roads and structure of the stations. As a result, the traffic suffered assiduously significant delays and the quality of service became inadequate, so the traveling conditions. For this reason, a modernization project of the line in order to match the European Measures for the modern transport systems is undertaken.

The modernization tasks would contribute to the implementation of a high level of rail service in the corridor thus offering an attractive option to passengers facing the road, and also ensure interoperability with European railroads following the implementation of a powerful and effective signage level. The modernization work, which is expected to last from 2008 to 2012, includes both the implantation of the new Signalling System, as well as the reconstruction of the original tracks, the renewal of stations, new electrification equipment and important improvements in telecommunications.

4.1.2. Renovation project

To facilitate the construction process and cause the minimum damage in the affected areas, the length of the road was divided into 4 different sections that would be renewed one by one. However, the remodelling characteristics were approximately the same for the entire railway line.

The main problems to be solved were:

- **Track conditions**, which caused permanent speed restrictions and poor drainage during periods of heavy rains and snow.
- **Single-track line sections** in Section 1 from Budapest - Kelenföld to Tarnok, 19.1 km length.
- **Rudimentary narrow platforms** in some stations, which can only be accessed by crossing the tracks (also poor safety protection at level crossings).
- **Obsolete Signalling System**, most of the stations did not have a Signalling System or had become obsolete, which was the cause of serious accidents. Due to this poor signalling system, the National Railway Authority had to regulate the speed limit to 100 km/h in the dangerous sections.
- **Overhead wire badly worn** in most of the route.
- **Noise level exceeding maximum** permissible levels.
- **Bus stations and parking places too far away** from the stations or in an obsolete condition.

The modernization tasks that were carried out were:

- **Renewal of the track** along the line to increase the speed up to 160 km/h or 120 km/h depending on the section.

- **Duplication of the track** between Budapest Kelenföld and Tárnok stations.

- **Wider platforms and connecting underpasses** were constructed at most of the stations, improving passenger safety and reduce train delays at stations.

- Improvement of **level crossing signalling system**.

- **Implementation of ETCS 2** in order to achieve interoperability with the European network in the entire line.

- **New catenary system.**
- **Noise protection walls** will be erected to improve the environmental quality situation along the line.

These tasks were used to modernize the layout and improve the conditions of the track and the stations. The biggest challenge was the implementation of the ETCS system (European Train Control System) in the whole railway line (called ERTMS in this thesis). Specifically, a Level 2 was acquired with the "digital radio-based system", this level of implementation includes Movement authority in the cab for the driver, indicator panels and trackside signalling. Train movements are monitored continually by the radio block centre using this trackside-derived information. The movement authority is transmitted to the vehicle continuously via GSM-R or GPRS together with speed information and route data. The Eurobalises are used at this level as passive positioning beacons or "electronic milestones" and the train determines its position by sensors. A visual scheme of the system is shown in *Figure 28. ERTMS Level 2 scheme*.

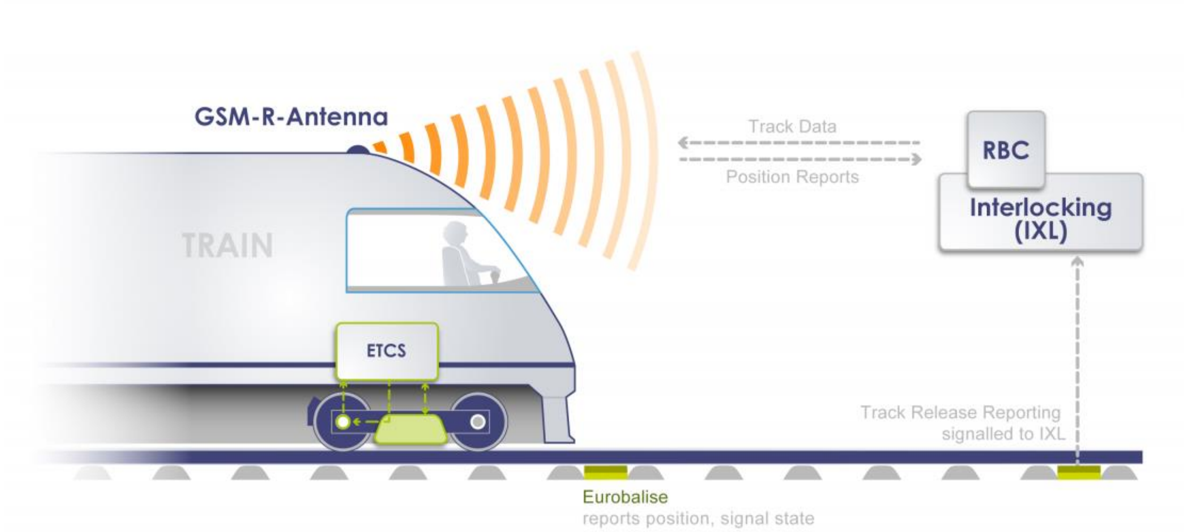

Figure 28. ERTMS Level 2 scheme

Therefore, the implementation of the ERTMS system is proposed in the R1 railway line, mainly in the section running through the Plaça Catalunya tunnel at the Barcelona entrance. This measure provides greater precision in the continuous location of the trains, thus allowing the crossing between them to be more exact and fluid. With this we will be able to shorten the waiting times, since the trains with this system would be better synchronized and would provide a more efficient circulation.

For example, if we reduce the 3 minutes waiting time down to 2’5 minutes, the capacity of the bottleneck would increase in 4 trains/hour/direction. This fact would also affect to the frequency of circulations and then de delay would decrease in the whole line.

- **Creation of one tunnel exclusively for the Rodalies line**

Another option that has already been contemplated is the construction of a tunnel for the exclusive use of Rodalies lines in the entrance of Barcelona by *El Clot-Aragó* station. However, this measure is difficult to carry out due to the complexity of the underground zone of Barcelona, more specifically in this part of the South-East of the city. As explained above, several tunnels of different transport systems, such as trains and metro, converge at this point, which makes it difficult to design another tunnel without compromising the safety of the existent ones.

- **Union of R1 and R2 lines by a new railway line**

The option of connecting the two lines at their mid-point would provide the users of the R1 the possibility of joining the R2 and entering Barcelona through the Passeig de Gràcia area that is located further north. This option would imply the circulation release of the R1 line by users who would take the R2 to enter Barcelona.

As the R2 reaches higher speeds than the R1 railway line, their travel time would be less and the R1 line would be more decongested. This would result in a lower number of passengers in each train, in turn increasing the capacity for new users of the coastline. In addition, R2 travellers could transfer also to R1 to reach coastal destinations more quickly, mostly in summer holydays when this area becomes a usual summer resort.

5. VIABILITY OF THE IMPLEMENTATIONS

However, not all of these proposals have the same economic or constructive viability. The following is an analysis of them taking into account factors such as the cost of implementation, the social and operational impact or the time necessary to carry them out.

Viable solutions to the current state of the line has been proposed in order that they can be implemented progressively to the layout, so that will gradually improve the quality of the service. Therefore, the solutions have been valued both in their viability and in the effectiveness of solving the underlying problem.

At first, it may seem that the most viable implementations are those that do not have a very high execution complexity or that do not require any constructive process, for example the *Design of a new train fleet model* or the *Construction of the Double-track* in sections 10, 11 and 2 between *Maçanet-Massanes* and *Arenys de Mar* stations. However, these solutions, even if they are fast to design and relatively economic, they aren't very effective. The fact that new train model would circulate by the R1 line with the actual path route will not make many changes in the total travel time, but instead, we would be able to provide more users capacity per train which is also an actual issue. Something similar happens with the Double-track construction, as we would be increasing the capacity at the northern end of the line but not at the main capacity restricted area which is still the Clot-Sagrera tunnel. These, then, are good implementations if we are looking for some temporary and economic solutions to the line, they are easy to perform and they will cause a rapid user response, but they wouldn't change the railway line behaviour.

Solutions that involve a low complexity constructive project, such as the *Improvement of the line layout* or the *Construction of a union railway line between R1 and R2*, although more expensive, they are more long-term effective implementations. The improvement of the actual track layout in order to design a more ergonomic and geometrically easy to drive track, would involve relatively low costs of construction and will provide the line with a more competitive path in terms of velocity.

By avoiding some rough intersections or low curve radius the driver would be able to manage the machinery in a more efficient way. This will also decrease the total travel time but not very significantly.

Also the construction of a union line between the two parallel coastal lines entering to Barcelona wouldn't decrease significantly the travel time, thus the reached velocities would be the R2 line velocities. However, it would mean a step further in the renewal planning, since these measures would change the R1 circulations flow slightly and therefore its general behaviour.

On the other hand, the more effective implementations would be the ones that significantly transform the behaviour of the line. They are often related to huge construction projects, as the *Transfer of the R1 railway to the urban centres* or the *Construction of a new tunnel at the Barcelona entrance* operated exclusively by Rodalies de Catalunya.

The project of transferring the road that now runs along the coastline to the centre of the adjacent urban centres involves a large civil work, which would also involve large costs and a long period of construction. The project consists of an excavated tunnel through the Maresme area that connects the centres of the towns, in addition, new well-equipped stations should also be built in central locations of the cities, as well as all the support equipment that a rail underground network needs. It is, therefore, a project with a high design and execution cost, but which in turn would provide solutions to several current problems such as speed restriction when the storm periods occur or the improving of the cruising speed between the stations. Furthermore, a complex interoperability between the responsible authorities of the construction and the different town councils involved in the project would be necessary to ensure a well project execution.

The construction of a new exclusive tunnel for Rodalies operation is an even more difficult project to be executed if we take into account that the underground soil in Barcelona is already overexploited. The complexity of the underground soil specifically in the Plaça de Catalunya zone would cause the main challenges in the design project, as well as most part of the total costs. Then, also the constructive execution would also become a huge issue for the construction company due to the existing tunnels and the danger of causing structural damage to them.

However, it would suppose the most effective implementation by now, given that if Rodalies had its own tunnel, the waiting time to ensure safety at the train crossing would become zero because they wouldn't have to share space with any other transport service. This is so far the most effective solution but also the most expensive and most constructively unfeasible one.

That's why the most long-term effective and viable solution seems to be the *Implementation of a new Signalling System* at the bottleneck tunnel. In fact, this implementation is already taking place nowadays, it’s an invisible solution for the user, since it does not involve the construction of any new structure or the excavation of land, but it is a very important action to increase the efficiency of the railroad.

The implementation is part of the Rodalies Plan for Catalonia contemplates a total investment of 3.895 million and the aim is to equip, both the road's engine material and the infrastructure itself, with the ETRSM Level 2 system, which would provide an excellent precision in the positioning of the train and reduce the waiting time in the tunnel to the minimum, thus increasing its capacity to the maximum. Then, the line would eliminate the bottleneck un the tunnels sections, and therefore its main delay issue.

It is expected that in 2022 the ETRSM Level 2 will be implemented at Rodalies in Barcelona, although it’s a very complex and expensive project, it was awarded in 2006 to a consortium formed by the French and Canadian multinationals Alstom and Bombardier.

The consortium led by Alstom will be responsible for the design, supply, installation, testing, commissioning and subsequent maintenance of signalling and communications, which will implement its ERMTS level 2 (Atlas 200) equipment in the whole line. Then, Bombardier will be responsible for electronic interlocks with its Bombardier EBI Lock 950 equipment. The implementation of this security system will be carried out on the 56 km line linking *L'Hospitalet de Llobregat* and *Mataró* stations. The contract includes both the supply of the ERTMS level 2 signalling system and 20 years of maintenance service.

This is, therefore, the most effective solution with a relatively reasonable cost that will be carried out in the coming years. It is expected, then, a significant augment of the capacity of the R1 line especially in the section between Mataró and the city of Barcelona, reducing in a significant way the incidents that this presents and the delays that characteristically characterize it.

CONCLUSIONS

It is concluded, therefore, that although the line R1 of Rodalies de Catalunya that runs along the Catalan coast has a complicated layout, especially due to Section 8 that constitutes the first railway line of the Spanish territory with an age of almost 30 years, it is still one of the busiest railway lines in the North-East zone of the Iberian Peninsula.

It is a complicated situation, which entails problems of network exploitation, that results in unpunctuality in circulations and accumulations in the delays of daily journeys. These delays, caused in part by the characteristics of the railroad and the effects of the lines adjoined to it, make the current situation of the line almost reach the total collapse of the service (such as the recent construction of via RG1 that extends the R1 towards the north of the territory that cause that the flows of passengers are even more abundant, especially in rush hour where the greater number of incidences in the circulations take place).

To solve these problems of exploitation of the route and try to create a more efficient circulation and without delays have been studied the proposed improvements to the line, together with its feasibility in terms of costs, time of execution of work, complexity both constructive and administrative management and final effectiveness on the system. As a result, a list is prepared according to the feasibility of the different solutions (from basic construction projects such as the splitting of the single-track sections or the new design of a motor vehicle that meets all the characteristics required for a better service, to projects of great importance such as the transfer of the new line to a more logical and efficient route through the centre of the towns far away from the coast).

Finally, coming to the conclusion that the most viable solution is the improvement of the signalling systems along the way, and more especially in the areas where the capacity is more limited as at the entrance of the city of Barcelona through the Plaça Catalunya tunnel, the proposal is studied taking into account that its implementation has already been started and is currently being carried out.

The implementation of Level 2 of the ERTMS system that is found in the majority of railways in Europe and that leads to greater interoperability between lines, also promises to end the waiting time of trains at the entrance to Barcelona, as it provides constant information on the positioning of the vehicles and this allows greater coordination of entrances and exits through the tunnel. According to the current data this system would be fully implemented in the year

2022, finally ending with the capacity restrictions of the line and providing greater efficiency in the system.

This concludes the analysis of the R1 Rodalies of Catalonia and opens the possibility to study new research projects related to this thesis, such as the study of the impact that the installation of this new signalling system can entail Regarding the behaviour of the railway line and its new traffic flows, the management of the work of this implementation along the stretches of the line from the tunnels of Barcelona to the city of Mataró, or the economic-social analysis of the project of renovation that is currently taking place (final result on travel time in relation to the cost of the new infrastructure and the response of users to these changes).

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ANNEXES

Annex A. R1 Working Days Timetable

Rodalies de Catalunya — Operat per renfe — Generalitat de Catalunya Transports públics

R1

Molins de Rei → Maçanet-Massanes
Per Por *By* **Mataró**

Feiners Laborables *Weekdays* **10 / 3 / 2018**

	Molins de Rei	St. Feliu de Llobregat	St. Joan Despí	Cornellà	L'Hospitalet de Llobregat	Barcelona - Sants	Barcelona - Pl. Catalunya	Barcelona - Arc de Triomf	Barcelona - El Clot Aragó	St. Adrià de Besòs	Badalona	Montgat	Montgat Nord	El Masnou	Ocata	Premià de Mar	Vilassar de Mar	Cabrera de Mar - Vilassar de Mar	Mataró	St. Andreu de Llavaneres	Caldes d'Estrac	Arenys de Mar	Canet de Mar	St. Pol de Mar	Calella	Pineda de Mar	Santa Susanna	Malgrat de Mar	Blanes	Tordera	Maçanet Massanes	
					5.38	5.46	5.51	5.53	5.57	6.05	6.09	6.12	6.14	6.17	6.19	6.22	6.25	6.27	6.32	6.36	6.39	6.42	6.47	6.52	6.56	7.00	7.04	7.08	7.16	7.22	7.29	
RG1					6.08	6.16	6.21	6.23	6.27	6.36	6.40	6.43	6.45	6.48	6.50	6.54	6.57	6.59	7.04	7.08	7.11	7.13	7.19	7.24	7.28	7.33	7.36	7.38	7.45	7.52	8.00	>>Figueres
					6.17	6.25	6.30	6.32	6.37	6.46	6.50	6.53	6.55	6.58	7.00	7.04	7.07	7.09	7.14	7.18	7.22	7.25										
					6.28	6.36	6.41	6.43	6.47	6.56	7.00	7.03	7.05	7.08	7.10	7.14	7.17	7.19	7.24	7.28	7.31	7.34	7.38	7.43	7.47							
					6.38	6.46	6.51	6.53	6.57	7.06	7.10	7.13	7.15	7.18	7.20	7.24	7.27	7.29	7.34	7.38	7.41	7.44	7.48	7.53	7.59	8.03	8.06	8.10	8.16	8.22	8.29	
	6.31	6.36	6.39	6.42	6.46	6.55	7.00	7.02	7.07	7.16	7.20	7.23	7.25	7.28	7.30	7.34	7.37	7.39	7.44	7.48	7.51	7.53										
					6.58	7.06	7.11	7.13	7.17	7.26	7.30	7.33	7.35	7.38	7.40	7.44	7.47	7.49	7.54	7.58	8.01	8.04	8.08	8.13	8.17							
					7.08	7.16	7.21	7.23	7.27	7.36	7.40	7.43	7.45	7.48	7.50	7.54	7.57	7.59	8.04	8.08	8.11	8.15	8.19	8.24	8.30	8.34	8.37	8.40	8.46	8.51	8.58	
	7.01	7.06	7.09	7.12	7.16	7.25	7.30	7.32	7.37	7.46	7.50	7.53	7.55	7.58	8.00	8.04	8.07	8.09	8.14	8.18	8.21	8.23										
					7.28	7.36	7.41	7.43	7.47	7.56	8.00	8.03	8.05	8.08	8.10	8.14	8.17	8.19	8.24	8.28	8.31	8.34	8.39	8.44	8.48							
RG1					7.38	7.46	7.51	7.53	7.57	8.06	8.10	8.13	8.15	8.18	8.20	8.24	8.27	8.29	8.34	8.38	8.41	8.45	8.49	8.53	8.59	9.04	9.07	9.10	9.14	9.21	9.30	>>Portbou
	7.31	7.36	7.39	7.43	7.47	7.55	8.00	8.02	8.07	8.16	8.20	8.23	8.25	8.28	8.30	8.34	8.37	8.39	8.44	8.48	8.51	8.53										
					7.57	8.05	8.10	8.12	8.17	8.25	8.29	8.32	8.34	8.37	8.39	8.43	8.46	8.48	8.53	8.57	9.00	9.04	9.09	9.14	9.18							
					8.08	8.16	8.21	8.23	8.27	8.36	8.40	8.43	8.45	8.48	8.50	8.54	8.57	8.59	9.04	9.08	9.11	9.15	9.20	9.25	9.30	9.33	9.36	9.39	9.45	9.51	9.58	
	8.01	8.06	8.09	8.13	8.17	8.25	8.30	8.32	8.37	8.46	8.50	8.53	8.55	8.58	9.00	9.04	9.07	9.09	9.14	9.18	9.21	9.24										
					8.27	8.35	8.40	8.42	8.47	8.55	8.59	9.02	9.04	9.07	9.09	9.13	9.16	9.18	9.23	9.27	9.30	9.34	9.38	9.43	9.47							
					8.38	8.46	8.51	8.53	8.57	9.06	9.10	9.13	9.15	9.18	9.20	9.24	9.27	9.29	9.34	9.38	9.41	9.44	9.48	9.53	9.59	10.03	10.06	10.09	10.15	10.21	10.28	
	8.33	8.37	8.40	8.43	8.47	8.55	9.00	9.02	9.07	9.16	9.20	9.23	9.25	9.28	9.30	9.34	9.37	9.39	9.44	9.48	9.51	9.54										
					8.58	9.06	9.11	9.13	9.17	9.26	9.30	9.33	9.35	9.38	9.40	9.44	9.47	9.49	9.54	9.58	10.01	10.04	10.08	10.13	10.17							
					9.08	9.16	9.21	9.23	9.27	9.36	9.40	9.43	9.45	9.48	9.50	9.54	9.57	9.59	10.04	10.08	10.11	10.14	10.18	10.23	10.29	10.33	10.36	10.39	10.44			
					9.08	9.16	9.21	9.23	9.27	9.36	9.40	9.43	9.45	9.48	9.50	9.54	9.57	9.59	10.04	10.08	10.11	10.14	10.18	10.23	10.29	10.33	10.36	10.39	10.44			
	9.01	9.06	9.09	9.12	9.16	9.25	9.30	9.32	9.37	9.46	9.50	9.53	9.55	9.58	10.00	10.04	10.07	10.09	10.13													
					9.28	9.36	9.41	9.43	9.47	9.56	10.00	10.03	10.05	10.08	10.10	10.14	10.17	10.19	10.23													
RG1					9.38	9.46	9.51	9.53	9.57	10.06	10.10	10.13	10.15	10.18	10.20	10.24	10.27	10.29	10.34	10.38	10.41	10.44	10.48	10.52	10.58	11.03	11.06	11.10	11.15	11.22	11.30	>>Figueres
	9.31	9.36	9.39	9.42	9.47	9.55	10.00	10.02	10.07	10.16	10.20	10.23	10.25	10.28	10.30	10.34	10.37	10.39	10.43													
					9.58	10.06	10.11	10.13	10.17	10.26	10.30	10.33	10.35	10.38	10.40	10.44	10.47	10.49	10.53													
					10.08	10.16	10.21	10.23	10.27	10.36	10.40	10.43	10.45	10.48	10.50	10.54	10.57	10.59	11.04	11.08	11.11	11.14	11.19	11.24	11.29	11.33	11.36	11.39	11.44			
	10.01	10.06	10.09	10.12	10.17	10.25	10.30	10.32	10.37	10.46	10.50	10.53	10.55	10.58	11.00	11.04	11.07	11.09	11.13													
					10.28	10.36	10.41	10.43	10.47	10.56	11.00	11.03	11.05	11.08	11.10	11.14	11.17	11.19	11.23													
					10.38	10.46	10.51	10.53	10.57	11.06	11.10	11.13	11.15	11.18	11.20	11.24	11.27	11.29	11.34	11.38	11.41	11.44	11.49	11.54	11.59	12.03	12.06	12.10	12.16	12.22	12.29	
	10.31	10.36	10.39	10.42	10.47	10.55	11.00	11.02	11.07	11.16	11.20	11.23	11.25	11.28	11.30	11.34	11.37	11.39	11.43													
					10.58	11.06	11.11	11.13	11.17	11.26	11.30	11.33	11.35	11.38	11.40	11.44	11.47	11.49	11.53													
					11.08	11.16	11.21	11.23	11.27	11.36	11.40	11.43	11.45	11.48	11.50	11.54	11.57	11.59	12.04	12.08	12.11	12.14	12.19	12.24	12.29	12.33	12.36	12.39	12.44			
	11.01	11.06	11.09	11.12	11.17	11.25	11.30	11.32	11.37	11.46	11.50	11.53	11.55	11.58	12.00	12.04	12.07	12.09	12.13													
					11.28	11.36	11.41	11.43	11.47	11.56	12.00	12.03	12.05	12.08	12.10	12.14	12.17	12.19	12.23													
RG1					11.38	11.46	11.51	11.53	11.57	12.06	12.10	12.13	12.15	12.18	12.20	12.24	12.27	12.29	12.34	12.38	12.41	12.44	12.49	12.54	12.58	13.03	13.06	13.10	13.15	13.22	13.30	>>Portbou
	11.31	11.36	11.39	11.42	11.46	11.55	12.00	12.02	12.07	12.16	12.20	12.23	12.25	12.28	12.30	12.34	12.37	12.39	12.43													
					11.58	12.06	12.11	12.13	12.17	12.26	12.30	12.33	12.35	12.38	12.40	12.44	12.47	12.49	12.53													
					12.08	12.16	12.21	12.23	12.27	12.36	12.40	12.43	12.45	12.48	12.50	12.54	12.57	12.59	13.04	13.08	13.11	13.14	13.19	13.24	13.29	13.33	13.36	13.39	13.44			
	12.01	12.06	12.09	12.12	12.16	12.25	12.30	12.32	12.37	12.46	12.50	12.53	12.55	12.58	13.00	13.04	13.07	13.09	13.13													
					12.28	12.36	12.41	12.43	12.47	12.56	13.00	13.03	13.05	13.08	13.10	13.14	13.17	13.19	13.23													
					12.38	12.46	12.51	12.53	12.57	13.06	13.10	13.13	13.15	13.18	13.20	13.24	13.27	13.29	13.34	13.38	13.41	13.44	13.49	13.54	13.59	14.03	14.06	14.09	14.14	14.19	14.26	
	12.31	12.36	12.39	12.42	12.46	12.55	13.00	13.02	13.07	13.16	13.20	13.23	13.25	13.28	13.30	13.34	13.37	13.39	13.44	13.48	13.51	13.54										
					12.58	13.06	13.11	13.13	13.17	13.26	13.30	13.33	13.35	13.38	13.40	13.44	13.47	13.49	13.54	13.58	14.01	14.04										
					13.08	13.16	13.21	13.23	13.27	13.36	13.40	13.43	13.45	13.48	13.50	13.54	13.57	13.59	14.04	14.08	14.11	14.14	14.18	14.23	14.28	14.31	14.34	14.37	14.42			
	13.01	13.06	13.09	13.12	13.16	13.25	13.30	13.32	13.37	13.46	13.50	13.53	13.55	13.58	14.00	14.04	14.07	14.09	14.14	14.18	14.21	14.25										
					13.28	13.36	13.41	13.43	13.47	13.56	14.00	14.03	14.05	14.08	14.10	14.14	14.17	14.19	14.24	14.28	14.31	14.34	14.38	14.43	14.47							
RG1					13.38	13.46	13.51	13.53	13.57	14.06	14.10	14.13	14.15	14.18	14.20	14.24	14.27	14.29	14.34	14.38	14.41	14.44	14.48	14.53	14.57	15.02	15.05	15.09	15.14	15.21	15.30	>>Figueres
	13.31	13.36	13.39	13.42	13.46	13.55	14.00	14.02	14.07	14.16	14.20	14.23	14.25	14.28	14.30	14.34	14.37	14.39	14.44	14.48	14.51	14.53										
					13.58	14.06	14.11	14.13	14.17	14.26	14.30	14.33	14.35	14.38	14.40	14.44	14.47	14.49	14.54	14.58	15.01	15.04	15.08	15.12	15.16							

					14.02	14.10	14.15	14.17	14.23	14.32	14.36	14.39	14.41	14.44	14.46	14.50	14.53	14.55	15.00	15.04	15.07	15.10										
					14.09	14.17	14.22	14.24	14.29	14.38	14.42	14.45	14.47	14.50	14.52	14.56	14.59	15.01	15.06	15.10	15.13	15.16	15.20	15.25	15.30	15.33	15.36	15.39	15.45	15.50	15.57	
					14.12	14.20	14.25	14.27	14.35	14.44	14.48	14.51	14.53	14.56	14.58	15.02	15.05	15.07	15.12	15.16	15.19	15.22										
	14.07	14.11	14.13	14.15	14.18	14.26	14.31	14.33	14.41	14.50	14.54	14.57	14.59	15.02	15.04	15.08	15.11	15.13	15.18	15.22	15.25	15.28										
					14.28	14.36	14.41	14.43	14.47	14.56	15.00	15.03	15.05	15.08	15.10	15.14	15.17	15.19	15.24	15.28	15.31	15.34	15.38	15.43	15.47							
					14.31	14.39	14.44	14.46	14.53	15.02	15.06	15.09	15.11	15.14	15.16	15.20	15.23	15.25	15.30	15.35	15.39	15.42	15.48	15.53	15.59	16.03	16.06	16.09	16.15	16.21	16.28	
					14.40	14.48	14.53	14.55	14.59	15.08	15.12	15.15	15.17	15.20	15.22	15.26	15.29	15.31	15.35													
	14.31	14.36	14.39	14.42	14.46	14.55	15.00	15.02	15.07	15.16	15.20	15.23	15.25	15.28	15.30	15.34	15.37	15.39	15.43													
					14.58	15.06	15.11	15.13	15.17	15.26	15.30	15.33	15.35	15.38	15.40	15.44	15.47	15.49	15.54	15.58	16.01	16.04	16.08	16.13	16.17							
					15.08	15.16	15.21	15.23	15.27	15.36	15.40	15.43	15.45	15.48	15.50	15.54	15.57	15.59	16.04	16.08	16.11	16.14	16.18	16.23	16.30	16.33	16.36	16.39	16.44			
	15.01	15.06	15.09	15.12	15.16	15.25	15.30	15.32	15.37	15.46	15.50	15.53	15.55	15.58	16.00	16.04	16.07	16.09	16.13													
					15.28	15.36	15.41	15.43	15.47	15.56	16.00	16.03	16.05	16.08	16.10	16.14	16.17	16.19	16.24	16.28	16.31	16.34	16.38	16.43	16.47							
RG1					15.38	15.46	15.51	15.53	15.57	16.06	16.10	16.13	16.15	16.18	16.20	16.24	16.27	16.29	16.34	16.38	16.41	16.44	16.49	16.54	16.58	17.03	17.06	17.09	17.14	17.21	17.30	>>*Portbou*
	15.31	15.36	15.39	15.42	15.46	15.55	16.00	16.02	16.07	16.16	16.20	16.23	16.25	16.28	16.30	16.34	16.37	16.39	16.43													
					15.58	16.06	16.11	16.13	16.17	16.26	16.30	16.33	16.35	16.38	16.40	16.44	16.47	16.49	16.53													
					16.08	16.16	16.21	16.23	16.27	16.36	16.40	16.43	16.45	16.48	16.50	16.54	16.57	16.59	17.04	17.08	17.11	17.14	17.19	17.24	17.29	17.33	17.36	17.39	17.44			
	16.01	16.06	16.09	16.12	16.17	16.25	16.30	16.32	16.37	16.45	16.49	16.52	16.54	16.57	16.59	17.03	17.06	17.08	17.12													
					16.28	16.36	16.41	16.43	16.47	16.56	17.00	17.03	17.05	17.08	17.10	17.14	17.17	17.19	17.23													
					16.38	16.46	16.51	16.53	16.57	17.06	17.10	17.13	17.15	17.18	17.20	17.24	17.27	17.29	17.34	17.38	17.41	17.44	17.49	17.54	17.59	18.03	18.06	18.09	18.15	18.21	18.28	
	16.31	16.36	16.39	16.42	16.46	16.55	17.00	17.02	17.07	17.16	17.20	17.23	17.25	17.28	17.30	17.34	17.37	17.39	17.43													
					16.58	17.06	17.11	17.13	17.17	17.26	17.30	17.33	17.35	17.38	17.40	17.44	17.47	17.49	17.53													
					17.08	17.16	17.21	17.23	17.27	17.36	17.40	17.43	17.45	17.48	17.50	17.54	17.57	17.59	18.04	18.08	18.11	18.14	18.19	18.24	18.29	18.33	18.36	18.39	18.44			
	17.01	17.06	17.09	17.12	17.16	17.25	17.30	17.32	17.37	17.46	17.50	17.53	17.55	17.58	18.00	18.04	18.07	18.09	18.13													
					17.28	17.36	17.41	17.43	17.47	17.56	18.00	18.03	18.05	18.08	18.10	18.14	18.17	18.19	18.24	18.28	18.31	18.34	18.38	18.43	18.47							
RG1					17.38	17.46	17.51	17.53	17.57	18.06	18.10	18.13	18.15	18.18	18.20	18.24	18.27	18.29	18.34	18.38	18.41	18.44	18.49	18.54	18.58	19.03	19.06	19.09	19.14	19.21	19.30	>>*Figueres*
	17.31	17.36	17.39	17.42	17.47	17.55	18.00	18.02	18.07	18.16	18.20	18.23	18.25	18.28	18.30	18.34	18.37	18.39	18.44	18.48	18.51	18.53										
					17.58	18.06	18.11	18.13	18.17	18.26	18.30	18.33	18.35	18.38	18.40	18.44	18.47	18.49	18.54	18.58	19.01	19.04	19.08	19.13	19.17							
					18.07	18.15	18.20	18.22	18.26	18.35	18.39	18.42	18.44	18.47	18.49	18.53	18.56	18.58	19.03	19.07	19.11	19.14	19.18	19.23	19.29	19.33	19.36	19.39	19.45	19.50	19.57	
	18.01	18.06	18.09	18.12	18.16	18.24	18.29	18.31	18.35	18.44	18.48	18.51	18.53	18.56	18.58	19.02	19.05	19.07	19.12	19.16	19.19	19.21										
					18.25	18.33	18.38	18.40	18.44	18.53	18.57	19.00	19.02	19.05	19.07	19.11	19.14	19.16	19.21	19.25	19.28	19.32	19.37	19.42	19.46							
					18.34	18.42	18.47	18.49	18.53	19.02	19.06	19.09	19.11	19.14	19.16	19.20	19.23	19.25	19.30	19.35	19.39	19.43	19.48	19.53	19.58	20.02	20.05	20.08	20.14	20.19	20.26	
					18.40	18.48	18.53	18.55	18.59	19.08	19.12	19.15	19.17	19.20	19.22	19.26	19.29	19.31	19.36	19.40	19.43	19.46										
	18.31	18.36	18.39	18.42	18.46	18.54	18.59	19.01	19.05	19.14	19.18	19.21	19.23	19.26	19.28	19.32	19.35	19.37	19.42	19.46	19.49	19.51										
					18.52	19.00	19.05	19.07	19.11	19.20	19.24	19.27	19.29	19.32	19.34	19.38	19.41	19.43	19.48	19.52	19.55	19.58										
					18.58	19.06	19.11	19.13	19.17	19.26	19.30	19.33	19.35	19.38	19.40	19.44	19.47	19.49	19.54	19.58	20.01	20.04	20.08	20.12	20.16							
					19.04	19.12	19.17	19.19	19.23	19.32	19.36	19.39	19.41	19.44	19.46	19.50	19.53	19.55	20.00	20.05	20.08	20.11	20.16	20.21	20.27	20.31	20.34	20.37	20.42			
					19.10	19.18	19.23	19.25	19.29	19.38	19.42	19.45	19.47	19.50	19.52	19.56	19.59	20.01	20.06	20.10	20.13	20.15										
	19.01	19.06	19.09	19.12	19.16	19.24	19.29	19.31	19.35	19.44	19.48	19.51	19.53	19.56	19.58	20.02	20.05	20.07	20.12	20.16	20.19	20.21										
					19.25	19.33	19.38	19.40	19.44	19.51	19.55	19.58	20.00	20.03	20.05	20.09	20.12	20.14	20.19	20.23	20.27	20.30	20.36	20.41	20.45							
					19.28	19.36	19.41	19.43	19.47	19.56	20.00	20.03	20.05	20.08	20.10	20.14	20.17	20.19	20.24	20.28	20.31	20.34										
RG1					19.34	19.42	19.47	19.49	19.53	20.02	20.06	20.09	20.11	20.14	20.16	20.20	20.23	20.25	20.30	20.34	20.37	20.39	20.45	20.49	20.55	21.00	21.03	21.06	21.09	21.20	21.30	>>*Portbou*
	19.31	19.35	19.38	19.40	19.43	19.51	19.56	19.58	20.02	20.11	20.15	20.18	20.20	20.23	20.25	20.29	20.32	20.34	20.39	20.43	20.46	20.48										
					19.52	20.00	20.05	20.07	20.11	20.20	20.24	20.27	20.29	20.32	20.34	20.38	20.41	20.43	20.48	20.52	20.55	20.57										
					20.01	20.09	20.14	20.16	20.20	20.29	20.33	20.36	20.38	20.41	20.43	20.47	20.50	20.52	20.57	21.02	21.05	21.08	21.13	21.18	21.22							
					20.10	20.18	20.23	20.25	20.29	20.38	20.42	20.45	20.47	20.50	20.52	20.56	20.59	21.01	21.06	21.11	21.14	21.17	21.21	21.26	21.31	21.34	21.37	21.40	21.45			
	20.03	20.08	20.11	20.14	20.19	20.27	20.32	20.34	20.38	20.47	20.51	20.54	20.56	20.59	21.01	21.05	21.08	21.10	21.15	21.19	21.22	21.25										
					20.28	20.36	20.41	20.43	20.47	20.56	21.00	21.03	21.05	21.08	21.10	21.14	21.17	21.19	21.24	21.28	21.31	21.34	21.38	21.43	21.47							
					20.37	20.45	20.50	20.52	20.56	21.05	21.09	21.12	21.14	21.17	21.19	21.23	21.26	21.28	21.33	21.37	21.40	21.44	21.48	21.53	21.59	22.03	22.09	22.12	22.18	22.23	22.30	
	20.37	20.41	20.44	20.46	20.49	20.57	21.02	21.04	21.08	21.17	21.21	21.24	21.26	21.29	21.31	21.35	21.38	21.40	21.45	21.49	21.52	21.54										
					21.01	21.09	21.14	21.16	21.20	21.29	21.33	21.36	21.38	21.41	21.43	21.47	21.50	21.52	21.57	22.01	22.04	22.06										
					21.16	21.24	21.29	21.31	21.35	21.44	21.48	21.51	21.53	21.56	21.58	22.02	22.05	22.07	22.12	22.16	22.19	22.23	22.26	22.31	22.37	22.40	22.43	22.46	22.52	22.57	23.04	
					21.31	21.39	21.44	21.46	21.50	21.59	22.03	22.06	22.08	22.11	22.13	22.17	22.20	22.22	22.26													
					21.46	21.54	21.59	22.01	22.05	22.14	22.18	22.21	22.23	22.26	22.28	22.32	22.35	22.37	22.42	22.46	22.49	22.52	22.56	23.01	23.06	23.09	23.12	23.15	23.21	23.26	23.33	
					22.16	22.24	22.29	22.31	22.35	22.44	22.48	22.51	22.53	22.56	22.58	23.02	23.05	23.07	23.12	23.16	23.19	23.22	23.26	23.31	23.36	23.39	23.42	23.45	23.50			
					22.46	22.54	22.59	23.01	23.05	23.14	23.18	23.21	23.23	23.26	23.28	23.32	23.35	23.37	23.42	23.46	23.49	23.52	23.56	0.01	0.06	0.09	0.12	0.15	0.20			
	23.05	23.09	23.12	23.14	23.17	23.25	23.30	23.32	23.36	23.45	23.49	23.52	23.54	23.57	23.59	0.03	0.06	0.08	0.12													
					23.46	23.54	23.59	0.01	0.05	0.14	0.18	0.21	0.23	0.26	0.28	0.32	0.35	0.37	0.41													

R1 Maçanet-Massanes → Molins de Rei

Per Por *By* **Mataró**

Feiners Laborables *Weekdays* 10 / 3 / 2018

Maçanet - Massanes	Tordera	Blanes	Malgrat de Mar	Santa Susanna	Pineda de Mar	Calella	St. Pol de Mar	Canet de Mar	Arenys de Mar	Caldes d'Estrac	St. Andreu de Llavaneres	Mataró	Cabrera de Mar - Vilassar de Mar	Vilassar de Mar	Premià de Mar	Ocata	El Masnou	Montgat Nord	Montgat	Badalona	St. Adrià de Besòs	Barcelona - El Clot Aragó	Barcelona - Arc de Triomf	Barcelona - Pl. Catalunya	Barcelona - Sants	L'Hospitalet de Llobregat	Cornellà	St. Joan Despí	St. Feliu de Llobregat	**Molins de Rei**
												4.50	4.54	4.56	5.00	5.03	5.06	5.08	5.10	5.13	5.16	5.25	5.29	5.32	5.37	5.44				
												5.14	5.18	5.20	5.24	5.27	5.30	5.32	5.34	5.37	5.40	5.49	5.54	5.57	6.02	6.10	6.13	6.15	6.18	6.22
						5.20	5.24	5.29	5.33	5.36	5.39	5.44	5.48	5.50	5.54	5.57	6.00	6.02	6.04	6.07	6.10	6.19	6.23	6.26	6.31	6.39	6.42	6.44	6.47	6.51

							5.46	5.50	5.55	5.59	6.02	6.05	6.10	6.14	6.16	6.20	6.23	6.26	6.28	6.30	6.33	6.38	6.50	6.54	6.57	7.02	7.10	7.13	7.15	7.17	7.21
													6.30	6.34	6.36	6.40	6.43	6.46	6.48	6.50	6.53	6.57	7.09	7.13	7.16	7.21	7.30	7.33	7.35	7.38	7.42
			6.05	6.09	6.12	6.15	6.18	6.22	6.27	6.31	6.33	6.36	6.41	6.45	6.47	6.51	6.54	6.57	6.59	7.01	7.04	7.07	7.16	7.20	7.23	7.28	7.35				
										6.37	6.40	6.43	6.49	6.53	6.55	6.59	7.02	7.05	7.07	7.09	7.12	7.15	7.25	7.29	7.32	7.37	7.44				
	6.05	6.12	6.17	6.21	6.24	6.27	6.30	6.34	6.39	6.43	6.47	6.51	6.57	7.01	7.03	7.07	7.10	7.13	7.15	7.17	7.20	7.23	7.31	7.35	7.38	7.43	7.50				
										6.52	6.55	7.00	7.05	7.09	7.11	7.15	7.18	7.21	7.23	7.25	7.28	7.31	7.42	7.46	7.49	7.54	8.01	8.04	8.06	8.09	8.13
			6.33	6.37	6.40	6.43	6.46	6.51	6.57	7.01	7.04	7.08	7.13	7.17	7.19	7.23	7.26	7.29	7.31	7.33	7.36	7.39	7.48	7.52	7.55	8.00	8.07				
										7.08	7.11	7.15	7.21	7.25	7.27	7.31	7.34	7.37	7.39	7.41	7.44	7.47	7.57	8.01	8.04	8.09	8.16				
	6.36	6.43	6.48	6.52	6.55	6.59	7.03	7.07	7.11	7.15	7.18	7.22	7.29	7.33	7.35	7.39	7.42	7.45	7.47	7.49	7.51	7.54	8.03	8.07	8.10	8.15	8.22				
										7.22	7.25	7.29	7.35	7.39	7.41	7.45	7.48	7.51	7.53	7.55	7.58	8.01	8.09	8.13	8.16	8.21	8.28	8.31	8.33	8.36	8.40
			7.05	7.09	7.12	7.15	7.18	7.23	7.28	7.31	7.33	7.36	7.41	7.45	7.47	7.51	7.54	7.57	7.59	8.01	8.04	8.07	8.16	8.20	8.23	8.28	8.35				
										7.37	7.39	7.42	7.47	7.51	7.53	7.57	8.00	8.03	8.05	8.07	8.10	8.13	8.22	8.26	8.29	8.34	8.41				
RG1	7.04	7.11	7.17	7.21	7.24	7.27	7.30	7.34	7.39	7.43	7.45	7.48	7.53	7.57	7.59	8.03	8.06	8.09	8.11	8.13	8.16	8.19	8.28	8.32	8.35	8.40	8.47				
										7.49	7.51	7.54	7.59	8.03	8.05	8.09	8.12	8.15	8.17	8.19	8.22	8.25	8.35	8.39	8.42	8.47	8.54				
										7.55	7.57	8.00	8.05	8.09	8.11	8.15	8.18	8.21	8.23	8.25	8.28	8.31	8.41	8.45	8.48	8.53	9.00	9.03	9.05	9.08	9.12
			7.35	7.40	7.43	7.46	7.49	7.54	7.58	8.01	8.03	8.06	8.11	8.15	8.17	8.21	8.24	8.27	8.29	8.31	8.34	8.37	8.47	8.51	8.54	8.59	9.06				
										8.07	8.09	8.12	8.17	8.21	8.23	8.27	8.30	8.33	8.35	8.37	8.40	8.44	8.56	9.00	9.03	9.08	9.15				
	7.34	7.41	7.47	7.51	7.54	7.57	8.00	8.04	8.09	8.13	8.15	8.18	8.23	8.27	8.29	8.33	8.36	8.39	8.41	8.43	8.46	8.49	9.01	9.06	9.09	9.14	9.21				
										8.19	8.21	8.24	8.29	8.33	8.35	8.39	8.42	8.45	8.47	8.49	8.52	8.55	9.05	9.09	9.12	9.17	9.24				
										8.27	8.29	8.32	8.37	8.41	8.43	8.47	8.50	8.53	8.55	8.57	9.00	9.04	9.14	9.18	9.21	9.26	9.33	9.36	9.38	9.41	9.45
							8.20	8.25	8.29	8.33	8.36	8.40	8.45	8.49	8.51	8.55	8.58	9.01	9.03	9.05	9.08	9.11	9.20	9.24	9.27	9.32	9.39				
	8.04	8.11	8.17	8.22	8.25	8.28	8.31	8.35	8.39	8.43	8.45	8.48	8.53	8.57	8.59	9.03	9.06	9.09	9.11	9.13	9.16	9.20	9.31	9.36	9.39	9.44	9.51				
										8.51	8.53	8.56	9.01	9.05	9.07	9.11	9.14	9.17	9.19	9.21	9.24	9.28	9.40	9.46	9.49	9.54	10.02	10.05	10.07	10.10	10.14
										8.59	9.01	9.04	9.09	9.13	9.15	9.19	9.22	9.25	9.27	9.29	9.32	9.35	9.44	9.49	9.52	9.57	10.04				
							8.50	8.55	8.59	9.03	9.06	9.10	9.17	9.21	9.23	9.27	9.30	9.33	9.35	9.37	9.40	9.43	9.54	9.58	10.01	10.06	10.13				
			8.48	8.52	8.55	8.58	9.01	9.05	9.10	9.14	9.17	9.20	9.25	9.29	9.31	9.35	9.38	9.41	9.43	9.45	9.48	9.51	10.00	10.04	10.07	10.12	10.19				
										9.23	9.25	9.28	9.33	9.37	9.39	9.43	9.46	9.49	9.51	9.53	9.56	9.59	10.09	10.13	10.16	10.21	10.30	10.33	10.35	10.38	10.42
							9.19	9.24	9.29	9.33	9.35	9.38	9.43	9.47	9.49	9.53	9.56	9.59	10.01	10.03	10.06	10.09	10.18	10.22	10.25	10.30	10.37				
RG1	9.04	9.11	9.16	9.20	9.23	9.26	9.29	9.34	9.39	9.43	9.45	9.48	9.53	9.57	9.59	10.03	10.06	10.09	10.11	10.13	10.16	10.19	10.29	10.33	10.36	10.41	10.48				
										9.53	9.55	9.58	10.03	10.07	10.09	10.13	10.16	10.19	10.21	10.23	10.26	10.29	10.39	10.43	10.46	10.51	11.00	11.03	11.05	11.08	11.12
							9.49	9.54	9.58	10.02	10.05	10.08	10.13	10.17	10.19	10.23	10.26	10.29	10.31	10.33	10.36	10.39	10.48	10.52	10.55	11.00	11.07				
	9.34	9.41	9.46	9.51	9.54	9.57	10.00	10.04	10.09	10.13	10.15	10.18	10.23	10.27	10.29	10.33	10.36	10.39	10.41	10.43	10.46	10.49	11.00	11.04	11.07	11.12	11.19				
										10.23	10.25	10.28	10.33	10.37	10.39	10.43	10.46	10.49	10.51	10.53	10.56	10.59	11.10	11.14	11.17	11.22	11.30	11.33	11.35	11.38	11.42
							10.19	10.24	10.28	10.32	10.35	10.38	10.43	10.47	10.49	10.53	10.56	10.59	11.01	11.03	11.06	11.09	11.18	11.22	11.25	11.30	11.37				
	10.04	10.11	10.17	10.21	10.24	10.27	10.30	10.34	10.39	10.43	10.45	10.48	10.53	10.57	10.59	11.03	11.06	11.09	11.11	11.13	11.16	11.19	11.30	11.34	11.37	11.42	11.49				
										10.53	10.55	10.58	11.03	11.07	11.09	11.13	11.16	11.19	11.21	11.23	11.26	11.29	11.40	11.44	11.47	11.52	12.00	12.03	12.05	12.08	12.12
							10.49	10.54	10.59	11.03	11.05	11.08	11.13	11.17	11.19	11.23	11.26	11.29	11.31	11.33	11.36	11.39	11.48	11.52	11.55	12.00	12.07				
	10.35	10.42	10.47	10.51	10.54	10.57	11.00	11.04	11.09	11.13	11.15	11.18	11.23	11.27	11.29	11.33	11.36	11.39	11.41	11.43	11.46	11.49	11.58	12.02	12.05	12.10	12.17				
													11.33	11.37	11.39	11.43	11.46	11.49	11.51	11.53	11.56	11.59	12.10	12.14	12.17	12.22	12.30	12.33	12.35	12.38	12.42
													11.43	11.47	11.49	11.53	11.56	11.59	12.01	12.03	12.06	12.09	12.18	12.22	12.25	12.30	12.37				
RG1	11.04	11.11	11.17	11.21	11.24	11.27	11.30	11.34	11.39	11.43	11.45	11.48	11.53	11.57	11.59	12.03	12.06	12.09	12.11	12.13	12.16	12.19	12.30	12.34	12.37	12.42	12.49				
													12.03	12.07	12.09	12.13	12.16	12.19	12.21	12.23	12.26	12.29	12.40	12.44	12.47	12.52	13.00	13.03	13.05	13.08	13.12
													12.13	12.17	12.19	12.23	12.26	12.29	12.31	12.33	12.36	12.39	12.48	12.52	12.55	13.00	13.07				
			11.47	11.51	11.54	11.57	12.00	12.04	12.09	12.13	12.15	12.18	12.23	12.27	12.29	12.33	12.36	12.39	12.41	12.43	12.46	12.49	12.58	13.02	13.05	13.10	13.17				
													12.33	12.37	12.39	12.43	12.46	12.49	12.51	12.53	12.56	12.59	13.10	13.14	13.17	13.22	13.30	13.33	13.35	13.38	13.42
													12.43	12.47	12.49	12.53	12.56	12.59	13.01	13.03	13.06	13.09	13.18	13.22	13.25	13.30	13.37				
	12.04	12.11	12.17	12.21	12.24	12.27	12.30	12.34	12.39	12.43	12.45	12.48	12.53	12.57	12.59	13.03	13.06	13.09	13.11	13.13	13.16	13.19	13.28	13.32	13.35	13.40	13.47				
													13.03	13.07	13.09	13.13	13.16	13.19	13.21	13.23	13.26	13.29	13.40	13.44	13.47	13.52	14.00	14.03	14.05	14.08	14.12
													13.13	13.17	13.19	13.23	13.26	13.29	13.31	13.33	13.36	13.39	13.48	13.52	13.55	14.00	14.07				
			12.47	12.51	12.54	12.57	13.00	13.04	13.09	13.13	13.15	13.18	13.23	13.27	13.29	13.33	13.36	13.39	13.41	13.43	13.46	13.49	14.00	14.04	14.07	14.12	14.19				
													13.33	13.37	13.39	13.43	13.46	13.49	13.51	13.53	13.56	13.59	14.10	14.14	14.17	14.22	14.30	14.33	14.35	14.38	14.42
													13.43	13.47	13.49	13.53	13.56	13.59	14.01	14.03	14.06	14.09	14.20	14.24	14.27	14.32	14.39				
RG1	13.04	13.11	13.17	13.21	13.24	13.27	13.30	13.34	13.39	13.43	13.45	13.48	13.53	13.57	13.59	14.03	14.06	14.09	14.11	14.13	14.16	14.19	14.28	14.32	14.35	14.40	14.47				
													14.03	14.07	14.09	14.13	14.16	14.19	14.21	14.23	14.26	14.29	14.40	14.44	14.47	14.52	15.00	15.03	15.05	15.08	15.12
													14.13	14.17	14.19	14.23	14.26	14.29	14.31	14.33	14.36	14.39	14.48	14.52	14.55	15.00	15.07				
			13.47	13.51	13.54	13.57	14.00	14.04	14.09	14.13	14.15	14.18	14.23	14.27	14.29	14.33	14.36	14.39	14.41	14.43	14.46	14.49	15.00	15.04	15.07	15.12	15.19				
										14.23	14.25	14.28	14.33	14.37	14.39	14.43	14.46	14.49	14.51	14.53	14.56	14.59	15.10	15.14	15.17	15.22	15.30	15.33	15.35	15.38	15.42
										14.31	14.34	14.37	14.41	14.45	14.47	14.51	14.54	14.57	14.59	15.01	15.04	15.07	15.16	15.20	15.23	15.28	15.35				
	14.00	14.07	14.13	14.18	14.21	14.24	14.27	14.32	14.37	14.41	14.43	14.46	14.51	14.55	14.57	15.01	15.04	15.07	15.09	15.11	15.14	15.17	15.26	15.30	15.33	15.38	15.45				
										14.55	14.57	15.00	15.05	15.09	15.11	15.15	15.18	15.21	15.23	15.25	15.28	15.31	15.42	15.46	15.49	15.54	16.01	16.04	16.06	16.09	16.13
										15.01	15.05	15.08	15.13	15.17	15.19	15.23	15.26	15.29	15.31	15.33	15.36	15.39	15.48	15.52	15.55	16.00	16.07				
			14.46	14.50	14.53	14.56	14.59	15.03	15.07	15.11	15.13	15.16	15.21	15.25	15.27	15.31	15.34	15.37	15.39	15.41	15.44	15.47	15.57	16.01	16.04	16.09	16.16				
													15.29	15.33	15.35	15.39	15.42	15.45	15.47	15.49	15.52	15.55	16.04	16.08	16.11	16.16	16.23				
										15.26	15.29	15.32	15.37	15.41	15.43	15.47	15.50	15.53	15.55	15.57	16.00	16.03	16.13	16.17	16.20	16.25	16.32	16.35	16.37	16.40	16.44
							15.19	15.24	15.29	15.33	15.36	15.40	15.45	15.49	15.51	15.55	15.58	16.01	16.03	16.05	16.08	16.11	16.20	16.24	16.27	16.32	16.39				
RG1	15.04	15.11	15.16	15.20	15.23	15.26	15.29	15.34	15.39	15.43	15.45	15.48	15.53	15.57	15.59	16.03	16.06	16.09	16.11	16.13	16.16	16.19	16.29	16.33	16.36	16.41	16.48				
										15.53	15.55	15.58	16.03	16.07	16.09	16.13	16.16	16.19	16.21	16.23	16.26	16.29	16.40	16.44	16.47	16.52	17.00	17.03	17.05	17.08	17.12
							15.49	15.53	15.57	16.01	16.04	16.08	16.13	16.17	16.19	16.23	16.26	16.29	16.31	16.33	16.36	16.39	16.48	16.52	16.55	17.00	17.07				
			15.47	15.51	15.54	15.57	16.00	16.04	16.09	16.13	16.15	16.18	16.23	16.27	16.29	16.33	16.36	16.39	16.41	16.43	16.46	16.49	16.58	17.02	17.05	17.10	17.17				
										16.23	16.25	16.28	16.33	16.37	16.39	16.43	16.46	16.49	16.51	16.53	16.56	16.59	17.09	17.13	17.16	17.21	17.30	17.33	17.35	17.38	17.42
							16.19	16.23	16.27	16.31	16.34	16.38	16.43	16.47	16.49	16.53	16.56	16.59	17.01	17.03	17.06	17.09	17.18	17.22	17.25	17.30	17.37				
	16.04	16.11	16.16	16.20	16.23	16.26	16.29	16.34	16.39	16.43	16.45	16.48	16.53	16.57	16.59	17.03	17.06	17.09	17.11	17.13	17.16	17.19	17.28	17.32	17.35	17.40	17.47				
													17.03	17.07	17.09	17.13	17.16	17.19	17.21	17.23	17.26	17.29	17.40	17.44	17.47	17.52	18.00	18.03	18.05	18.08	18.12
							16.48	16.53	16.58	17.02	17.04	17.08	17.13	17.17	17.19	17.23	17.26	17.29	17.31	17.33	17.36	17.39	17.48	17.52	17.55	18.00	18.07				
	16.35	16.42	16.47	16.51	16.54	16.57	17.00	17.04	17.09	17.13	17.15	17.18	17.23	17.27	17.29	17.33	17.36	17.39	17.41	17.43	17.46	17.49	17.59	18.04	18.07	18.12	18.19				
													17.33	17.37	17.39	17.43	17.46	17.49	17.51	17.53	17.56	17.59	18.09	18.13	18.16	18.21	18.30	18.33	18.35	18.38	18.42
							17.18	17.23	17.28	17.32	17.34	17.38	17.43	17.47	17.49	17.53	17.56	17.59	18.01	18.03	18.06	18.09	18.18	18.22	18.25	18.30	18.37				
RG1	17.04	17.11	17.16	17.21	17.24	17.27	17.30	17.34	17.39	17.43	17.45	17.48	17.53	17.57	17.59	18.03	18.06	18.09	18.11	18.13	18.16	18.19	18.30	18.35	18.38	18.43	18.50				
													18.03	18.07	18.09	18.13	18.16	18.19	18.21	18.23	18.26	18.29	18.39	18.43	18.46	18.51	19.00	19.03	19.05	19.08	19.12
													18.13	18.17	18.19	18.23	18.26	18.29	18.31	18.33	18.36	18.39	18.48	18.52	18.55	19.00	19.07				
			17.47	17.51	17.54	17.57	18.00	18.04	18.09	18.13	18.15	18.18	18.23	18.27	18.29	18.33	18.36	18.39	18.41	18.43	18.46	18.49	19.00	19.05	19.08	19.13	19.20				
													18.33	18.37	18.39	18.43	18.46	18.49	18.51	18.53	18.56	18.59	19.11	19.16	19.19	19.24	19.32	19.35	19.37	19.40	19.44
													18.43	18.47	18.49	18.53	18.56	18.59	19.01	19.03	19.06	19.09	19.18	19.22	19.25	19.30	19.37				
	18.04	18.11	18.16	18.21	18.24	18.27	18.30	18.34	18.39	18.43	18.45	18.48	18.53	18.57	18.59	19.03	19.06	19.09	19.11	19.13	19.16	19.19	19.30	19.34	19.37	19.42	19.49				
													19.03	19.07	19.09	19.13	19.16	19.19	19.21	19.23	19.26	19.29	19.39	19.43	19.46	19.51	20.00	20.03	20.05	20.08	20.12
													19.13	19.17	19.19	19.23	19.26	19.29	19.31	19.33	19.36	19.39	19.48	19.52	19.55	20.00	20.07				
			18.47	18.51	18.54	18.57	19.00	19.04	19.09	19.13	19.15	19.18	19.23	19.27	19.29	19.33	19.36	19.39	19.41	19.43	19.46	19.49	19.58	20.02	20.05	20.10	20.17				
										19.23	19.25	19.28	19.33	19.37	19.39	19.43	19.46	19.49	19.51	19.53	19.56	19.59	20.10	20.14	20.17	20.22	20.29				
							19.19	19.23	19.27	19.31	19.35	19.38	19.43	19.47	19.49	19.53	19.56	19.59	20.01	20.03	20.06	20.09	20.18	20.22	20.25	20.30	20.37				
							21.12	21.17	21.22	21.28	21.32	21.37	21.43	21.47	21.49	21.53	21.56	21.59	22.01	22.03	22.06	22.09	22.19	22.23	22.26	22.31	22.38				
RG1	21.03	21.10	21.15	21.20	21.23	21.26	21.30	21.35	21.39	21.43	21.45	21.48	21.53	21.57	21.59	22.03	22.06	22.09	22.11	22.13	22.16	22.19	22.30	22.34	22.37	22.42	22.49				
							21.49	21.54	21.59	22.03	22.05	22.08	22.13	22.17	22.19	22.23	22.26	22.29	22.31	22.33	22.36	22.39	22.48	22.52	22.55	23.00	23.07				
	21.43	21.50	21.55	21.59	22.02	22.06	22.09	22.13	22.17	22.21	22.24	22.28	22.33	22.37	22.39	22.43	22.46	22.49	22.51	22.53	22.56	22.59	23.10	23.14	23.17	23.22	23.29				
							22.27	22.32	22.38	22.42	22.45	22.48	22.53	22.57	22.59	23.03	23.06	23.09	23.11	23.13	23.16	23.19	23.28	23.32	23.35	23.40	23.47				
													23.13	23.17	23.19	23.23	23.26	23.29	23.31	23.33	23.36	23.39	23.48	23.52	23.55	0.00	0.07				

Annex B. Schedule field data in sections 3,4,5 and Sections 6,7,8

8:00 AM

Station	Event	Time	Length (km)	Travel time	Time (h)	Avg speed (km/h)	Max. Speed (km/h)	%
Mataró	Initial Time	0:00:00						
Mataró	Train departure	0:00:49	4,7	0:04:47	0,08	58,95	140	42
Cabrera de Mar	Train doors opening	0:04:47						
Cabrera de Mar	Train departure	0:00:28	1,2	0:02:08	0,04	33,75	140	24
Vilassar de Mar	Train doors opening	0:02:08						
Vilassar de Mar	Train departure	0:00:27	3,3	0:02:59	0,05	66,37	140	47
Premia de Mar	Train doors opening	0:02:59						
Premia de Mar	Train departure	0:00:30	3,1	0:02:36	0,04	71,68	140	51
Ocata	Train doors opening	0:02:36						
Ocata	Train departure	0:00:36	0,81	0:01:00	0,02	48,42	140	34
Masnou	Train doors opening	0:01:00						
Masnou	Train departure	0:00:27	3	0:02:00	0,03	89,66	140	64
Montgat N	Train doors opening	0:02:00						
Montgat N	Train departure	0:00:21	1,4	0:01:34	0,03	53,80	70	76
Montgat	Train doors opening	0:01:34						
Montgat	Train departure	0:00:23	2,7	0:02:17	0,04	70,84	90	78
Badalona	Train doors opening	0:02:17						
Badalona	Train departure	0:00:31	2,8	0:02:48	0,05	59,92	90	66
Sant Adrià de Besòs	Train doors opening	0:02:48						
Sant Adrià de Besòs	Train departure	0:00:31	5,9	0:06:20	0,11	55,84	120	46
Barna-El Clot	Train doors opening	0:06:20						
Barna-El Clot	Total Time	0:33:33						

Comparison between Real and Maximum Speeds in Sections 6, 7 and 8.

Station	Event	Time	Length (km)	Travel time	Time (h)	Avg speed (km/h)	Max. Speed (km/h)	%
Barna-El Clot	Initial Time	0:00:00						
Barna-El Clot	Train departure	0:00:44	2,2	0:07:04	0,12	18,66	85	21
Arc de Triomf	Train doors opening	0:07:04						
Arc de Triomf	Train departure	0:00:36	0,96	0:01:56	0,03	29,87	60	49
Plaça de Catalunya	Train doors opening	0:01:56						
Plaça de Catalunya	Train departure	0:00:36	2,7	0:04:55	0,08	32,97	60	54
Barna-Sants	Train doors opening	0:04:55						
Barna-Sants	Train departure	0:00:43						
	Total Time	0:16:34						

Comparison between Real and Maximum Speeds in Sections 3, 4 and 5.

9:00 PM

Station			Length (km)	Travel time	Time (h)	Avg speed (km/h)	Max. Speed (km/h)	%
Barna-Sants	Initial Time	0:00:00						
Barna-Sants	Train departure	0:01:15	2,7	0:04:38	0,08	34,97	60	58
Plaça de Catalunya	Train doors opening	0:04:38						
Plaça de Catalunya	Train departure	0:00:33	0,96	0:01:57	0,03	29,57	60	49
Arc de Triomf	Train doors opening	0:01:57						
Arc de Triomf	Train departure	0:00:32	2,2	0:02:38	0,04	50,15	85	59
Barna-El Clot	Train doors opening	0:02:38						
	Total Time	0:11:33						

Comparison between Real and Maximum Speeds in Sections 3, 4 and 5.

Station			Length (km)	Travel time	Time (h)	Avg speed (km/h)	Max. Speed (km/h)	%
Barna-El Clot	Initial Time	0:00:00						
Barna-El Clot	Train departure	0:00:45	5,9	0:10:16	0,17	34,47	120	29
Sant Adrià de Besòs	Train doors opening	0:10:16						
Sant Adrià de Besòs	Train departure	0:00:51	2,8	0:02:25	0,04	69,64	90	77
Badalona	Train doors opening	0:02:25						
Badalona	Train departure	0:00:33	2,7	0:02:08	0,04	76,18	90	85
Montgat	Train doors opening	0:02:08						
Montgat	Train departure	0:00:26	1,4	0:01:34	0,03	53,36	70	76
Montgat N	Train doors opening	0:01:34						
Montgat N	Train departure	0:00:24	3	0:01:55	0,03	94,16	140	67
Masnou	Train doors opening	0:01:55						
Masnou	Train departure	0:00:26	0,81	0:01:10	0,02	41,91	140	30
Ocata	Train doors opening	0:01:10						
Ocata	Train departure	0:00:34	3,1	0:02:14	0,04	83,23	140	59
Premia de Mar	Train doors opening	0:02:14						
Premia de Mar	Train departure	0:00:43	3,3	0:02:58	0,05	66,74	140	48
Vilassar de Mar	Train doors opening	0:02:58						
Vilassar de Mar	Train departure	0:00:28	1,2	0:02:09	0,04	33,49	140	24
Cabrera de Mar	Train doors opening	0:02:09						
Cabrera de Mar	Train departure	0:00:24	4,7	0:04:58	0,08	56,78	140	41
Mataró	Train doors opening	0:04:58						
Mataró	Train departure	0:00:45						
	Total Time	0:38:06						

Comparison between Real and Maximum Speeds in Sections 6, 7 and 8.

Annex C. Casas Bus Timetable

Horaris e11.1

Els horaris que s'especifiquen corresponen a les parades principals.

Barcelona - Mataró Centre

Sortides Barcelona - Rda. Universitat, 21

De dilluns a divendres feiners (excepte agost)

06.55 - 07.15 - 07.20 - 07.25 - 07.35 - 07.45 - 07.55 - 08.05 - 08.10 - 08.15 - 08.25 - 08.30 - 08.35 - 08.45 - 08.55 - 09.05 - 09.10 - 09.15 - 09.35 - 10.05 - 10.35 - 11.05 - 11.35 - 12.05 - 12.35 - 13.05 - 13.35 - 14.00 - 14.05 - 14.20 - 14.35 - 14.50 - 15.05 - 15.10 - 15.30 - 15.35 - 16.05 - 16.20 - 16.35 - 16.50 - 17.05 - 17.20 - 17.35 - 17.50 - 18.05 - 18.20 - 18.35 - 18.50 - 19.05 - 19.20 - 19.35 - 19.50 - 20.05 - 20.20 - 20.35 - 21.05 - 21.35 - 22.05 - 22.35

Dissabtes (tot l'any)

09.20 - 10.20 - 11.20 - 12.20 - 13.20 - 14.20 - 15.20 - 16.20 - 17.20 - 18.20 - 19.20 - 20.20 - 21.20 - 22.00 - 23.00

Diumenges i festius (tot l'any)

10.20 - 11.20 - 12.20 - 13.20 - 14.20 - 15.20 - 16.20 - 17.20 - 18.20 - 19.20 - 20.20 - 21.20 - 22.00 - 23.00

De dilluns a divendres d'agost

07.35 - 08.35 - 09.35 - 10.35 - 11.35 - 12.35 - 13.35 - 14.35 - 15.35 - 16.35 - 17.35 - 18.35 - 19.35 - 20.35 - 21.35 - 22.35

Sortides Barcelona - Pl. de Tetuan

De dilluns a divendres feiners (excepte agost)

06.59 - 07.19 - 07.24 - 07.29 - 07.39 - 07.49 - 07.59 - 08.09 - 08.14 - 08.19 - 08.29 - 08.34 - 08.39 - 08.49 - 08.59 - 09.09 - 09.14 - 09.19 - 09.39 - 10.09 - 10.39 - 11.09 - 11.39 - 12.09 - 12.39 - 13.09 - 13.39 - 14.04 - 14.09 - 14.24 - 14.39 - 14.54 - 15.09 - 15.14 - 15.34 - 15.39 - 16.09 - 16.24 - 16.39 - 16.54 - 17.09 - 17.24 - 17.39 - 17.54 - 18.09 - 18.24 - 18.39 - 18.54 - 19.09 - 19.24 - 19.39 - 19.54 - 20.09 - 20.24 - 20.39 - 21.09 - 21.39 - 22.09 - 22.39

Dissabtes (tot l'any)

09.24 - 10.24 - 11.24 - 12.24 - 13.24 - 14.24 - 15.24 - 16.24 - 17.24 - 18.24 - 19.24 - 20.24 - 21.24 - 22.04 - 23.04

Diumenges i festius (tot l'any)

10.24 - 11.24 - 12.24 - 13.24 - 14.24 - 15.24 - 16.24 - 17.24 - 18.24 - 19.24 - 20.24 - 21.24 - 22.04 - 23.04

De dilluns a divendres d'agost

07.39 - 08.39 - 09.39 - 10.39 - 11.39 - 12.39 - 13.39 - 14.39 - 15.39 - 16.39 - 17.39 - 18.39 - 19.39 - 20.39 - 21.39 - 22.39

El compliment d'aquests horaris està subjecte a les incidències i contratemps de la via pública

Mataró Centre - Barcelona

Sortides Mataró - Plaça de les Tereses

De dilluns a divendres feiners (excepte agost)

06.05 - 06.25 - 06.35 - 06.50 - 07.00 - 07.05 - 07.15 - 07.25 - 07.35 - 07.40 - 07.50 - 08.00 - 08.05 - 08.15 - 08.20 - 08.45 - 09.15 - 09.45 - 10.15 - 10.45 - 11.15 - 11.45 - 12.15 - 12.45 - 13.10 - 13.15 - 13.30 - 13.45 - 14.00 - 14.15 - 14.20 - 14.40 - 14.45 - 15.15 - 15.30 - 15.45 - 15.55 - 16.15 - 16.30 - 16.45 - 17.00 - 17.15 - 17.30 - 17.45 - 18.00 - 18.15 - 18.30 - 18.45 - 19.00 - 19.15 - 19.30 - 19.45 - 20.15 - 20.45 - 21.15 - 21.45

Dissabtes (tot l'any)

08.00 - 09.00 - 10.00 - 11.00 - 12.00 - 13.00 - 14.00 - 15.00 - 16.00 - 17.00 - 18.00 - 19.00 - 20.00 - 21.00 - 22.00

Diumenges i festius (tot l'any)

09.00 - 10.00 - 11.00 - 12.00 - 13.00 - 14.00 - 15.00 - 16.00 - 17.00 - 18.00 - 19.00 - 20.00 - 21.00 - 22.00

De dilluns a divendres d'agost

06.15 - 07.15 - 08.15 - 09.15 - 10.15 - 11.15 - 12.15 - 13.15 - 14.15 - 15.15 - 16.15 - 17.15 - 18.15 - 19.15 - 20.15 - 21.15

Sortides Mataró - C. de Jaume Isern

De dilluns a divendres feiners (excepte agost)

06.06 - 06.26 - 06.36 - 06.51 - 07.01 - 07.06 - 07.16 - 07.26 - 07.36 - 07.41 - 07.51 - 08.01 - 08.06 - 08.16 - 08.21 - 08.46 - 09.16 - 09.46 - 10.16 - 10.46 - 11.16 - 11.46 - 12.16 - 12.46 - 13.11 - 13.16 - 13.31 - 13.46 - 14.01 - 14.16 - 14.21 - 14.41 - 14.46 - 15.16 - 15.31 - 15.46 - 15.56 - 16.16 - 16.31 - 16.46 - 17.01 - 17.16 - 17.31 - 17.46 - 18.01 - 18.16 - 18.31 - 18.46 - 19.01 - 19.16 - 19.31 - 19.46 - 20.16 - 20.46 - 21.16 - 21.46

Dissabtes, diumenges i festius (tot l'any)

NO HI HA SERVEI EN AQUESTA PARADA

De dilluns a divendres d'agost

06.16 - 07.16 - 08.16 - 09.16 - 10.16 - 11.16 - 12.16 - 13.16 - 14.16 - 15.16 - 16.16 - 17.16 - 18.16 - 19.16 - 20.16 - 21.16

Sortides Mataró - Plaça de Granollers

De dilluns a divendres feiners (excepte agost)

06.08 - 06.20 - 06.28 - 06.38 - 06.40 - 06.53 - 07.03 - 07.08 - 07.18 - 07.28 - 07.35 - 07.38 - 07.43 - 07.53 - 08.03 - 08.08 - 08.18 - 08.23 - 08.48 - 09.18 - 09.48 - 10.18 - 10.48 - 11.18 - 11.48 - 12.18 - 12.48 - 13.13 - 13.18 - 13.33 - 13.48 - 14.03 - 14.18 - 14.23 - 14.43 - 14.48 - 15.18 - 15.33 - 15.48 - 15.58 - 16.18 - 16.33 - 16.48 - 17.03 - 17.18 - 17.33 - 17.48 - 18.03 - 18.18 - 18.33 - 18.48 - 19.03 - 19.18 - 19.33 - 19.48 - 20.18 - 20.48 - 21.18 - 21.48

Dissabtes (tot l'any)

08.08 - 09.08 - 10.08 - 11.08 - 12.08 - 13.08 - 14.08 - 15.08 - 16.08 - 17.08 - 18.08 - 19.08 - 20.08 - 21.08 - 22.08

Sortides Mataró - Rda. d'Alfons XII / c. de Miquel Biada

De dilluns a divendres feiners (excepte agost)

06.11 - 06.23 - 06.31 - 06.41 - 06.43 - 06.56 - 07.06 - 07.11 - 07.21 - 07.31 - 07.38 - 07.41 - 07.46 - 07.56 - 08.06 - 08.11 - 08.21 - 08.24 - 08.51 - 09.21 - 09.51 - 10.21 - 10.51 - 11.21 - 11.51 - 12.21 - 12.51 - 13.16 - 13.21 - 13.36 - 13.51 - 14.06 - 14.21 - 14.26 - 14.46 - 14.51 - 15.21 - 15.36 - 15.51 - 16.01 - 16.21 - 16.36 - 16.51 - 17.06 - 17.21 - 17.36 - 17.51 - 18.06 - 18.21 - 18.36 - 18.51 - 19.06 - 19.21 - 19.36 - 19.51 - 20.21 - 20.51 - 21.21 - 21.51

Dissabtes (tot l'any)

08.11 - 09.11 - 10.11 - 11.11 - 12.11 - 13.11 - 14.11 - 15.11 - 16.11 - 17.11 - 18.11 - 19.11 - 20.11 - 21.11 - 22.11

Diumenges i festius (tot l'any)

09.11 - 10.11 - 11.11 - 12.11 - 13.11 - 14.11 - 15.11 - 16.11 - 17.11 - 18.11 - 19.11 - 20.11 - 21.11 - 22.11

De dilluns a divendres d'agost

06.21 - 07.21 - 08.21 - 09.21 - 10.21 - 11.21 - 12.21 - 13.21 - 14.21 - 15.21 - 16.21 - 17.21 - 18.21 - 19.21 - 20.21 - 21.21

Sortides Mataró - Camí Ral / c. Pizarro (Jutjats)

De dilluns a divendres feiners (excepte agost)

06.13 - 06.25 - 06.33 - 06.43 - 06.45 - 06.58 - 07.08 - 07.13 - 07.23 - 07.33 - 07.40 - 07.43 - 07.48 - 07.58 - 08.08 - 08.13 - 08.23 - 08.28 - 08.53 - 09.23 - 09.53 - 10.23 - 10.53 - 11.23 - 11.53 - 12.23 - 12.53 - 13.18 - 13.23 - 13.38 - 13.53 - 14.08 - 14.23 - 14.28 - 14.48 - 14.53 - 15.23 - 15.38 - 15.53 - 16.03 - 16.23 - 16.38 - 16.53 - 17.08 - 17.23 - 17.38 - 17.53 - 18.08 - 18.23 - 18.38 - 18.53 - 19.08 - 19.23 - 19.38 - 19.53 - 20.23 - 20.53 - 21.23 - 21.53

Dissabtes (tot l'any)

08.13 - 09.13 - 10.13 - 11.13 - 12.13 - 13.13 - 14.13 - 15.13 - 16.13 - 17.13 - 18.13 - 19.13 - 20.13 - 21.13 - 22.13

Diumenges i festius (tot l'any)

09.13 - 10.13 - 11.13 - 12.13 - 13.13 - 14.13 - 15.13 - 16.13 - 17.13 - 18.13 - 19.13 - 20.13 - 21.13 - 22.13

De dilluns a divendres d'agost

06.23 - 07.23 - 08.23 - 09.23 - 10.23 - 11.23 - 12.23 - 13.23 - 14.23 - 15.23 - 16.23 - 17.23 - 18.23 - 19.23 - 20.23 - 21.23

Sortides Mataró - Camí Ral (Porta Laietana)

De dilluns a divendres feiners (excepte agost)

06.15 - 06.27 - 06.35 - 06.45 - 06.47 - 07.00 - 07.10 - 07.15 - 07.25 - 07.35 - 07.42 - 07.45 - 07.50 - 08.00 - 08.10 - 08.15 - 08.25 - 08.30 - 08.55 - 09.25 - 09.55 - 10.25 - 10.55 - 11.25 - 11.55 - 12.25 - 12.55 - 13.20 - 13.25 - 13.40 - 13.55 - 14.10 - 14.25 - 14.30 - 14.50 - 14.55 - 15.25 - 15.40 - 15.55 - 16.05 - 16.25 - 16.40 - 16.55 - 17.10 - 17.25 - 17.40 - 17.55 - 18.10 - 18.25 - 18.40 - 18.55 - 19.10 - 19.25 - 19.40 - 19.55 - 20.25 - 20.55 - 21.25 - 21.55

Dissabtes (tot l'any)

08.15 - 09.15 - 10.15 - 11.15 - 12.15 - 13.15 - 14.15 - 15.15 - 16.15 - 17.15 - 18.15 - 19.15 - 20.15 - 21.15 - 22.15

Diumenges i festius (tot l'any)

09.15 - 10.15 - 11.15 - 12.15 - 13.15 - 14.15 - 15.15 - 16.15 - 17.15 - 18.15 - 19.15 - 20.15 - 21.15 - 22.15

De dilluns a divendres d'agost

06.25 - 07.25 - 08.25 - 09.25 - 10.25 - 11.25 - 12.25 - 13.25 - 14.25 - 15.25 - 16.25 -

Annex D. R3 Working Days Timetable

R3 **L'Hospitalet de Llobregat → Puigcerdà**
Per Por *By* **Vic**

Feiners Laborables *Weekdays* **1 / 5 / 2018**

L'Hospitalet de Llobregat	Barcelona Sants	Barcelona Pl. Catalunya	Barcelona Arc de Triomf	Barcelona La Sagrera-Meridiana	Barcelona St. Andreu Arenal	Barcelona Torre del Baró	Montcada Bifurcació	Montcada Ripollet	Sta. Perpètua de Mogoda	Mollet Sta. Rosa	Parets del Vallès	Granollers - Canovelles	Les Franqueses del Vallès	La Garriga	Figaró	St. Martí de Centelles	Centelles	Balenyà - Els Hostalets	Balenyà - Tona - Seva	Vic	Manlleu	Torelló	Borgonyà	St. Quirze de Besora	La Farga de Bebié	Ripoll	Campdevànol	Ribes de Freser	Planoles	Toses	La Molina	Urtx - Alp	Puigcerdà	La Tor de Querol
4.38	4.46	4.51	4.53	4.59	5.01	5.04	5.07	5.13	5.16	5.19	5.23	5.30	5.33	5.39																				
5.03	5.11	5.16	5.18	5.24	5.26	5.29	5.32	5.38	5.41	5.44	5.48	5.56	6.00	6.07	6.12	6.19	6.24	6.27	6.31	6.38														
5.54	6.02	6.07	6.09	6.15	6.17	6.20	6.22	6.28	6.31	6.34	6.38	6.45	6.48	6.54	6.59	7.04	7.08	7.10	7.14	7.22	7.29	7.36	7.40	7.45	7.51	8.01								
6.14	6.22	6.27	6.29	6.36	6.39	6.42	–	–	–	6.56	6.59	7.06	–	7.14	–	–	–	–	–	7.43	7.57	8.05	–	8.13	–	8.29	8.36	8.47	8.55	9.05	9.12	9.25	9.34	9.40
6.53	7.01	7.06	7.08	7.14	7.16	7.19	7.22	7.27	7.30	7.33	7.37	7.44	7.47	7.54	8.00	8.06	8.11	8.13	8.17	8.25														
7.41	7.49	7.54	7.56	8.02	8.04	8.07	8.12	8.18	8.21	8.24	8.28	8.37	8.41	8.50	8.54	9.00	9.06	9.08	9.12	9.24	9.31	9.38	9.43	9.49	9.55	10.06	10.12	10.23						
8.14	8.22	8.27	8.29	8.35	8.37	8.40	8.43	8.49	8.52	8.55	9.00	9.07	9.11	9.22	9.27	9.35	9.40	9.43	9.47	9.54														
8.53	9.01	9.06	9.08	9.14	9.16	9.19	9.21	9.26	9.29	9.33	9.36	9.43	9.47	9.53	9.59	10.04	10.09	10.12	10.16	10.23														
9.24	9.32	9.37	9.39	9.45	9.47	9.50	9.52	9.58	10.02	10.04	10.08	10.15																						
9.43	9.51	9.56	9.58	10.04	10.06	10.09	–	–	–	10.22	10.26	10.33	–	10.42	–	–	–	–	–	11.15	11.23	11.29	–	11.38	–	11.56	12.03	12.14	12.23	12.33	12.40	12.50	12.59	13.05
10.14	10.22	10.27	10.29	10.35	10.37	10.40	10.43	10.48	10.54	10.57	11.00	11.08	11.11	11.17	11.22	11.27	11.32	11.35	11.39	11.47	11.54	12.02	12.05	12.11	12.18	12.28								
10.43	10.51	10.56	10.58	11.04	11.06	11.09	11.13	11.21	11.24	11.27	11.32	11.38																						
11.14	11.22	11.27	11.29	11.35	11.37	11.40	11.43	11.49	11.52	11.55	11.59	12.09	12.12	12.19	12.25	12.32	12.37	12.39	12.43	12.52	12.59	13.05	13.08	13.14	13.20	13.30								
11.54	12.02	12.07	12.09	12.15	12.17	12.20	12.22	12.28	12.31	12.34	12.37	12.44	12.47	12.53	12.58	13.03	13.08	13.11	13.15	13.22														
12.25	12.33	12.38	12.40	12.46	12.48	12.51	–	–	–	13.05	13.08	13.15	–	13.25	–	–	–	–	–	13.53	14.00	14.08	–	14.19	–	14.36	14.47	14.58	15.07	15.17	15.23	15.33	15.42	15.48
12.55	13.03	13.08	13.10	13.16	13.18	13.21	13.23	13.29	13.33	13.35	13.39	13.47	13.50	13.56	14.02	14.08	14.12	14.14	14.18	14.26	14.34	14.41	14.45	14.51	15.03	15.13								
13.25	13.33	13.38	13.40	13.46	13.48	13.51	13.54	14.01	14.04	14.07	14.11	14.18	14.23	14.29																				
13.54	14.02	14.07	14.09	14.15	14.17	14.20	–	–	–	14.32	14.37	14.44	–	14.52	–	–	–	–	–	15.19	15.28	15.35	–	15.43	–	15.59								
14.22	14.30	14.35	14.37	14.43	14.45	14.48	14.50	14.57	15.00	15.03	15.07	15.19	15.22	15.28	15.34	15.40	15.45	15.47	15.50	15.57														
14.53	15.01	15.06	15.08	15.14	15.16	15.19	–	–	–	15.30	15.34	15.42	–	15.50	–	–	–	–	–	16.17	16.24	16.32	–	16.41	–	16.58	17.04	17.15	17.24	17.34	17.40	17.51	18.00	18.06
15.23	15.31	15.36	15.38	15.44	15.46	15.49	15.51	15.57	16.00	16.03	16.07	16.13																						
15.41	15.49	15.54	15.56	16.02	16.04	16.07	16.10	16.16	16.20	16.23	16.26	16.33	16.37	16.44	16.49	16.54	16.59	17.02	17.06	17.14	17.22	17.30	17.35	17.41	17.47	17.57								
16.02	16.10	16.15	16.17	16.23	16.25	16.28	16.30	16.36	16.39	16.42	16.46	16.54	16.57	17.03	17.09	17.16	17.21	17.23	17.27	17.34														
16.23	16.31	16.36	16.38	16.44	16.46	16.49	16.51	16.57	17.00	17.03	17.07	17.13																						
16.54	17.02	17.07	17.09	17.15	17.17	17.20	–	–	–	17.31	17.34	17.41	–	17.49	–	–	–	–	–	18.13	18.20	18.27	–	18.37	–	18.56	19.03	19.16	19.26	19.43	19.49	19.59	20.07	
17.24	17.32	17.37	17.39	17.45	17.47	17.50	17.52	17.58	18.01	18.04	18.09	18.17	18.21	18.29	18.34	18.40	18.46	18.48	18.52	19.00	19.09	19.16	19.19	19.25	19.32	19.42								
17.55	18.03	18.08	18.10	18.16	18.18	18.21	18.23	18.29	18.32	18.35	18.39	18.46	18.49	18.54																				
18.19	18.27	18.32	18.34	18.40	18.42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19.35	–	–	–	–	–	20.10	–	–	–	–	–	–	21.06	
18.28	18.36	18.41	18.43	18.49	18.51	18.54	18.57	19.03	19.06	19.09	19.13	19.21	19.24	19.30	19.37	19.43	19.48	19.51	19.55	20.04														
18.49	18.57	19.02	19.04	19.10	19.12	19.15	–	–	–	19.28	19.32	19.39	–	19.48	–	–	–	–	–	20.17	20.28	20.36	–	20.45	–	21.02	21.08	21.19	21.28	21.38	21.43	21.53	22.01	
19.13	19.21	19.26	19.28	19.34	19.36	19.39	19.41	19.47	19.50	19.53	19.56	20.03	20.07	20.13	20.19	20.25	20.30	20.34	20.38	20.45														
19.37	19.45	19.50	19.52	19.58	20.00	20.03	20.05	20.10	20.13	20.16	20.21	20.28	20.36	20.41																				
20.04	20.12	20.17	20.19	20.25	20.27	20.30	–	–	–	20.42	20.47	20.54	–	21.04	–	–	–	–	–	21.28	21.36	21.43	21.46	21.52	21.58	22.08								
20.22	20.30	20.35	20.37	20.43	20.45	20.48	20.51	20.59	21.02	21.05	21.09	21.15																						
20.54	21.02	21.07	21.09	21.15	21.17	21.20	21.22	21.28	21.31	21.34	21.38	21.45	21.48	21.54	21.59	22.05	22.10	22.12	22.16	22.23														
21.24	21.32	21.37	21.39	21.45	21.47	21.50	21.53	21.59	22.03	22.06	22.10	22.17	22.21	22.28	22.33	22.38	22.43	22.45	22.49	22.56														
22.22	22.30	22.35	22.37	22.43	22.45	22.48	22.50	22.56	22.59	23.02	23.05	23.12	23.15	23.21	23.26	23.31	23.36	23.38	23.42	23.49														
23.49	23.57	0.02	0.04	0.10	0.12	0.15	0.18	0.24	0.27	0.30	0.33	0.39																						

No circula del 30 de juliol al 26 d'agost. No circula del 30 de julio al 26 de agosto. *Does not run from 30th july to 26th of August.*

R3 Puigcerdà → L'Hospitalet de Llobregat

Per Por *By* **Vic**

Feiners Laborables *Weekdays* 1 / 5 / 2018

La Tor de Querol	Puigcerdà	Urtx - Alp	La Molina	Toses	Planoles	Ribes de Freser	Campdevànol	Ripoll	La Farga de Bebié	St. Quirze de Besora	Borgonyà	Torelló	Manlleu	Vic	Balenyà - Tona - Seva	Balenyà - Els Hostalets	Centelles	St. Martí de Centelles	Figaró	La Garriga	Les Franqueses del Vallès	Granollers - Canovelles	Parets del Vallès	Mollet Sta. Rosa	Sta. Perpètua de Mogoda	Montcada Ripollet	Montcada Bifurcació	Barcelona Torre del Baró	Barcelona St. Andreu Arenal	Barcelona La Sagrera-Meridiana	Barcelona Arc de Triomf	Barcelona Pl. Catalunya	Barcelona Sants	L'Hospitalet de Llobregat
																						5.07	5.14	5.18	5.21	5.24	5.33	5.36	5.40	5.43	5.48	5.51	5.56	6.03
																						5.40	5.47	5.52	5.54	5.57	6.03	6.05	6.08	6.11	6.16	6.19	6.24	6.31
																				5.48	5.53	5.57	6.05	6.09	6.11	6.14	6.20	6.22	6.25	6.28	6.33	6.36	6.41	6.48
														5.48	5.55	5.58	6.01	6.05	6.11	6.17	6.22	6.25	6.31	6.34	6.36	6.39	6.46	6.48	6.51	6.54	6.59	7.02	7.07	7.14
								5.30	–	5.46	–	5.55	6.03	6.11	6.19	6.22	6.25	6.30	6.36	6.41	6.47	6.52	6.59	7.03	7.05	7.08	7.14	7.16	7.19	7.22	7.26	7.29	7.34	7.41
														6.46	6.53	6.56	6.59	7.04	7.10	7.15	7.20	7.24	7.30	7.34	7.36	7.39	7.45	7.47	7.50	7.53	7.58	8.01	8.06	8.13
								6.25	6.36	6.42	6.48	6.51	6.57	7.05	7.13	7.17	7.20	7.25	7.31	7.36	7.41	7.44	7.50	7.54	7.56	7.59	8.04	8.06	8.09	8.12	8.17	8.20	8.25	8.32
														7.26	7.34	7.38	7.41	7.45	7.50	7.55	8.00	8.03	8.09	8.12	8.14	8.18	8.26	8.28	8.32	8.35	8.42	8.45	8.50	8.57
	6.17	–	–	–	–	–	–	7.13	–	–	–	–	–	7.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.43	8.47	8.54	8.57	9.02	9.09
														8.08	8.16	8.20	8.23	8.27	8.32	8.37	8.43	8.46	8.52	8.56	8.58	9.02	9.08	9.10	9.13	9.16	9.21	9.24	9.29	9.36
														8.40	8.48	8.51	8.54	8.59	9.05	9.10	9.16	9.21	9.28	9.32	9.36	9.40	9.47	9.49	9.52	9.55	10.01	10.04	10.09	10.16
	7.29	7.37	7.47	7.52	8.03	8.12	8.24	8.30	–	8.45	–	8.54	9.01	9.08	–	–	–	–	–	9.34	–	9.42	9.50	9.54	–	–	–	10.07	10.10	10.13	10.18	10.21	10.26	10.33
														9.25	9.33	9.36	9.39	9.44	9.49	9.54	9.59	10.02	10.08	10.11	10.13	10.17	10.24	10.26	10.29	10.32	10.37	10.40	10.45	10.52
								9.13	9.24	9.30	9.36	9.40	9.47	9.55	10.04	10.07	10.10	10.15	10.20	10.25	10.30	10.34	10.40	10.44	10.46	10.49	10.54	10.56	10.59	11.02	11.07	11.10	11.15	11.22
																						10.52	10.59	11.04	11.06	11.09	11.15	11.17	11.20	11.23	11.28	11.31	11.36	11.43
8.50	8.56	9.04	9.15	9.22	9.34	9.44	9.58	10.04	–	10.21	–	10.28	10.34	10.41	–	–	–	–	–	11.05	–	11.15	11.23	11.27	–	–	–	11.38	11.41	11.44	11.49	11.52	11.57	12.04
								10.36	10.47	10.53	10.59	11.02	11.09	11.17	11.25	11.28	11.31	11.37	11.42	11.47	11.52	11.55	12.02	12.06	12.08	12.11	12.16	12.18	12.21	12.23	12.28	12.31	12.36	12.43
																						12.22	12.29	12.33	12.36	12.39	12.45	12.47	12.50	12.53	12.58	13.01	13.06	13.13
						11.03	11.15	11.21	11.32	11.39	11.46	11.49	11.55	12.03	12.11	12.14	12.17	12.21	12.27	12.34	12.39	12.43	12.51	12.54	12.56	13.00	13.05	13.07	13.10	13.12	13.17	13.20	13.25	13.32
10.48	10.55	11.03	11.13	11.18	11.28	11.37	11.49	11.55	–	12.12	–	12.22	12.29	12.36	–	–	–	–	–	13.04	–	13.12	13.22	13.25	–	–	–	13.36	13.39	13.42	13.47	13.50	13.55	14.02
														12.53	13.01	13.04	13.07	13.12	13.18	13.24	13.30	13.33	13.39	13.42	13.44	13.48	13.54	13.56	13.59	14.02	14.07	14.10	14.15	14.22
																						13.57	14.04	14.08	14.10	14.14	14.21	14.24	14.27	14.30	14.35	14.38	14.43	14.50
														13.36	13.44	13.49	13.52	13.57	14.03	14.09	14.15	14.19	14.27	14.31	14.34	14.38	14.45	14.47	14.50	14.53	14.58	15.01	15.06	15.13
								13.42	13.53	14.00	14.06	14.10	14.18	14.25	14.34	14.37	14.40	14.45	14.50	14.56	15.01	15.05	15.12	15.17	15.19	15.23	15.31	15.33	15.36	15.38	15.43	15.46	15.51	15.58
																				15.16	15.22	15.27	15.35	15.38	15.40	15.44	15.50	15.52	15.55	15.58	16.04	16.07	16.12	16.19
13.34	13.41	13.49	13.59	14.04	14.14	14.23	14.35	14.41	–	14.57	–	15.07	15.14	15.21	–	–	–	–	–	15.49	–	15.58	16.06	16.11	–	–	–	16.24	16.27	16.30	16.36	16.39	16.44	16.51
														16.01	16.09	16.13	16.16	16.20	16.25	16.30	16.36	16.40	16.47	16.50	16.52	16.56	17.03	17.05	17.08	17.11	17.16	17.19	17.24	17.31
																						16.59	17.06	17.10	17.12	17.15	17.22	17.24	17.27	17.30	17.35	17.38	17.43	17.50
								16.04	16.15	16.21	16.27	16.31	16.38	16.46	16.54	16.57	17.00	17.05	17.11	17.18	17.23	17.27	17.34	17.39	17.41	17.44	17.49	17.51	17.54	17.56	18.01	18.04	18.09	18.16
																						17.54	18.01	18.05	18.08	18.11	18.17	18.19	18.22	18.25	18.30	18.33	18.38	18.45
								17.05	17.16	17.22	17.28	17.32	17.38	17.46	17.54	17.57	18.00	18.06	18.11	18.16	18.22	18.26	18.32	18.36	18.38	18.41	18.46	18.48	18.51	18.53	18.58	19.01	19.06	19.13
														18.23	18.31	18.34	18.37	18.42	18.49	18.54	19.00	19.04	19.12	19.17	19.19	19.23	19.31	19.33	19.37	19.40	19.46	19.49	19.54	20.01
17.13	17.20	17.28	17.39	17.45	17.56	18.05	18.17	18.23	–	18.39	–	18.48	18.55	19.02	–	–	–	–	–	19.29	–	19.38	19.47	19.51	–	–	–	20.06	20.09	20.12	20.17	20.20	20.25	20.32
																				19.55	20.00	20.04	20.13	20.17	20.20	20.24	20.31	20.34	20.38	20.41	20.47	20.50	20.55	21.02
								19.06	19.17	19.24	19.30	19.33	19.40	19.49	19.57	20.00	20.03	20.09	20.15	20.24	20.29	20.33	20.39	20.42	20.44	20.47	20.53	20.55	20.58	21.01	21.06	21.09	21.14	21.21
														20.18	20.26	20.29	20.32	20.37	20.42	20.47	20.52	20.56	21.02	21.05	21.07	21.11	21.16	21.18	21.21	21.24	21.29	21.32	21.37	21.44
18.52	18.59	19.07	19.17	19.22	19.33	19.43	19.57	20.04	–	20.26	–	20.35	20.42	20.49	–	–	–	–	–	21.16	–	21.24	21.31	21.35	–	–	–	21.48	21.51	21.54	21.59	22.02	22.07	22.14
																				21.35	21.40	21.44	21.51	21.54	21.56	22.00	22.07	22.09	22.12	22.15	22.20	22.23	22.28	22.35
																						22.02	22.09	22.14	22.16	22.19	22.25	22.27	22.30	22.33	22.38	22.41	22.46	22.53
								21.04	21.15	21.21	21.27	21.30	21.37	21.45	21.53	21.56	21.59	22.04	22.10	22.16	22.22	22.27	22.33	22.37	22.39	22.42	22.48	22.50	22.53	22.56	23.01	23.04	23.09	23.16

No circula del 30 de juliol al 26 d'agost. No circula del 30 de julio al 26 de agosto. *Does not run from 30th july to 26th of August.*

Annex E. R4 Working Days Timetable

R4 Sant Vicenç de Calders → Manresa

Per Por *By* **Vilafranca del Penedès**

Feiners Laborables *Weekdays* **1 / 5 / 2018**

	St. Vicenç de Calders	El Vendrell	L'Arboç	Els Monjos	Vilafranca del Penedès	La Granada	Lavern-Subirats	St. Sadurní d'Anoia	Gelida	Martorell	Castellbisbal	El Papiol	Molins de Rei	St. Feliu de Llobregat	St. Joan Despí	Cornellà	L'Hospitalet de Llobregat	Barcelona Sants	Barcelona Pl. Catalunya	Barcelona Arc de Triomf	Barcelona La Sagrera-Meridiana	Barcelona St.Andreu Arenal	Barcelona Torre del Baró	Montcada Bifurcació	Montcada i Reixac-Manresa	Montcada i Reixac-Sta. Maria	Cerdanyola del Vallès	Barberà del Vallès	Sabadell Sud	Sabadell Centre	Sabadell Nord	Terrassa Est	Terrassa	St. Miquel de Gonteres	Viladecavalls	Vacarisses-Torreblanca	Vacarisses	Castellbell i el Vilar-Monistrol de Montserrat	St. Vicenç de Castellet	Manresa
										4.51	4.56	5.02	5.07	5.11	5.14	5.17	5.20	5.28	5.33	5.35	5.41	5.43	5.46	5.48	5.51	5.54	5.57	6.00	6.04	6.07	6.10	6.14	6.17							
										5.21	5.26	5.32	5.37	5.41	5.44	5.47	5.50	5.58	6.03	6.05	6.11	6.13	6.16	6.18	6.21	6.24	6.27	6.30	6.34	6.37	6.40	6.44	6.47							
																	6.05	6.13	6.18	6.20	6.26	6.28	6.31	6.33	6.36	6.39	6.42	6.45	6.49	6.52	6.55	6.59	7.03	7.07	7.09	7.16	7.19	7.24	7.31	7.40
										5.51	5.56	6.02	6.07	6.11	6.14	6.17	6.20	6.28	6.33	6.35	6.41	6.43	6.46	6.48	6.51	6.54	6.57	7.00	7.04	7.07	7.10	7.14	7.17							
	5.19	5.24	5.30	5.36	5.41	5.44	5.48	5.52	5.57	6.04	6.09	6.15	6.20	6.25	6.28	6.32	6.35	6.43	6.48	6.50	6.56	6.58	7.01	7.03	7.06	7.09	7.12	7.15	7.19	7.22	7.25	7.29	7.33	7.37	7.39	7.46	7.49	7.54	8.01	8.10
	5.34	5.39	5.45	5.51	5.56	5.59	6.03	6.07	6.12	6.19	6.24	6.30	6.35	6.40	6.43	6.47	6.50	6.58	7.03	7.05	7.11	7.13	7.16	7.18	7.21	7.24	7.27	7.30	7.34	7.37	7.40	7.44	7.47							
	5.49	5.54	6.00	6.06	6.11	6.14	6.18	6.22	6.27	6.34	6.39	6.45	6.50	6.55	6.58	7.02	7.05	7.13	7.18	7.20	7.26	7.28	7.31	7.33	7.36	7.39	7.42	7.45	7.49	7.52	7.55	7.59	8.03	–	–	–	–	–	8.27	8.36
	6.04	6.09	6.15	6.21	6.26	6.29	6.33	6.37	6.42	6.49	6.54	7.00	7.05	7.10	7.13	7.17	7.20	7.28	7.33	7.35	7.41	7.43	7.46	7.48	7.51	7.54	7.57	8.00	8.04	8.07	8.10	8.14	8.17							
	6.19	6.24	6.30	6.36	6.41	6.44	6.48	6.52	6.57	7.04	7.09	7.15	7.20	7.24	7.27	7.30	7.33	7.41	7.46	7.48	7.55	7.58	8.01	8.03	8.06	8.09	8.12	8.15	8.19	8.22	8.25	8.29	8.33	8.37	8.39	8.46	8.49	8.54	9.01	9.10
										7.12	7.17	7.23	7.27	7.31	7.34	7.38	7.40	7.52	7.57	7.59	8.05	8.07	8.10	8.12	8.15	8.17	8.20	>>> Cerdanyola Universitat												
	6.34	6.39	6.45	6.51	6.56	6.59	7.03	7.07	7.12	7.19	7.24	7.30	7.35	7.40	7.43	7.47	7.50	7.58	8.03	8.05	8.11	8.13	8.16	8.18	8.21	8.24	8.27	8.30	8.34	8.37	8.40	8.44	8.47	-						
R12																	7.54	8.02	8.07	8.09	8.15	8.17	8.20	8.22	8.25	8.28	8.31	8.34	8.38	8.41	8.44	8.48	8.52	–	–	–	–	–	9.16	9.26 >>Lleida
										7.31	7.36	7.42	7.47	7.51	7.54	7.57	8.00	8.08	8.13	8.15	8.21	8.23	8.26	8.28	8.31	8.34	8.37	>>> Cerdanyola Universitat												
					7.16	–	–	7.24	7.29	7.36	7.41	7.47	7.52	7.56	7.59	8.02	8.05	8.13	8.18	8.20	8.26	8.28	8.31	8.33	8.36	8.39	8.42	8.45	8.49	8.52	8.55	8.59	9.03	–	–	–	–	–	9.27	9.36
										7.42	7.47	7.53	7.57	8.01	8.04	8.08	8.11	8.19	8.24	8.26	8.32	8.34	8.37	8.39																
	7.04	7.09	7.15	7.21	7.26	7.29	7.33	7.37	7.42	7.49	7.54	8.00	8.05	8.10	8.13	8.17	8.20	8.28	8.33	8.35	8.41	8.43	8.46	8.48	8.51	8.54	8.57	9.00	9.04	9.07	9.10	9.14	9.17							
										8.01	8.06	8.12	8.17	8.21	8.24	8.27	8.30	8.38	8.43	8.45	8.51	8.53	8.56	8.58	9.01	9.04	9.07	>>> Cerdanyola Universitat												
	7.21	7.26	7.32	7.38	7.43	7.46	7.50	7.54	7.59	8.06	8.11	8.17	8.22	8.26	8.29	8.32	8.35	8.43	8.48	8.50	8.56	8.58	9.01	9.03	9.06	9.09	9.12	9.15	9.19	9.22	9.25	9.29	9.33	9.37	9.39	9.46	9.49	9.54	10.01	10.10
										8.13	8.18	8.24	8.28	8.32	8.35	8.39	8.42	8.50	8.55	8.57	9.03	9.05	9.08	9.10																
										8.21	8.26	8.32	8.37	8.41	8.44	8.47	8.50	8.58	9.03	9.05	9.11	9.13	9.16	9.18	9.21	9.24	9.27	9.30	9.34	9.37	9.40	9.44	9.47							
					8.16	–	–	8.24	8.29	8.36	8.41	8.47	8.52	8.56	8.59	9.02	9.05	9.13	9.18	9.20	9.26	9.28	9.31	9.33	9.36	9.39	9.42	9.45	9.49	9.52	9.55	9.59	10.03	–	–	–	–	–	10.27	10.36
										8.51	8.56	9.02	9.07	9.11	9.14	9.17	9.20	9.28	9.33	9.35	9.41	9.43	9.46	9.48	9.51	9.54	9.57	10.00	10.04	10.07	10.10	10.14	10.17							
	8.21	8.26	8.32	8.38	8.43	8.46	8.50	8.54	8.59	9.06	9.11	9.17	9.22	9.26	9.29	9.32	9.35	9.43	9.48	9.50	9.56	9.58	10.01	10.03	10.06	10.09	10.12	10.15	10.19	10.22	10.25	10.29	10.33	10.37	10.39	10.46	10.49	10.54	11.01	11.10
										9.21	9.26	9.32	9.37	9.41	9.44	9.47	9.50	9.58	10.03	10.05	10.11	10.13	10.16	10.18	10.21	10.24	10.27	10.30	10.34	10.37	10.40	10.44	10.47							
					9.16	–	–	9.24	9.29	9.35	9.40	9.47	9.52	9.56	9.59	10.02	10.05	10.13	10.18	10.20	10.26	10.28	10.31	10.33	10.36	10.39	10.42	10.45	10.49	10.52	10.55	10.59	11.03	–	–	–	–	–	11.27	11.36
										9.51	9.56	10.02	10.07	10.11	10.14	10.17	10.20	10.28	10.33	10.35	10.41	10.43	10.46	10.48	10.51	10.54	10.57	11.00	11.04	11.07	11.10	11.14	11.17							
	9.21	9.26	9.32	9.38	9.43	9.46	9.50	9.54	9.59	10.06	10.11	10.17	10.22	10.26	10.29	10.32	10.35	10.43	10.48	10.50	10.56	10.58	11.01	11.03	11.06	11.09	11.12	11.15	11.19	11.22	11.25	11.29	11.33	11.37	11.39	11.46	11.49	11.54	12.01	12.10
										10.21	10.26	10.32	10.37	10.41	10.44	10.47	10.50	10.58	11.03	11.05	11.11	11.13	11.16	11.18	11.21	11.24	11.27	11.30	11.34	11.37	11.40	11.44	11.47							
					10.16	–	–	10.24	10.29	10.36	10.41	10.47	10.52	10.56	10.59	11.02	11.05	11.13	11.18	11.20	11.26	11.28	11.31	11.33	11.36	11.39	11.42	11.45	11.49	11.52	11.55	11.59	12.03	–	–	–	–	–	12.27	12.36
										10.51	10.56	11.02	11.07	11.11	11.14	11.17	11.20	11.28	11.33	11.35	11.41	11.43	11.46	11.48	11.51	11.54	11.57	12.00	12.04	12.07	12.10	12.14	12.17							
	10.21	10.26	10.32	10.38	10.43	10.46	10.50	10.54	10.59	11.06	11.11	11.17	11.22	11.26	11.29	11.32	11.35	11.43	11.48	11.50	11.56	11.58	12.01	12.03	12.06	12.09	12.12	12.15	12.19	12.22	12.25	12.29	12.33	12.37	12.39	12.46	12.49	12.54	13.01	13.10
										11.21	11.26	11.32	11.37	11.41	11.44	11.47	11.50	11.58	12.03	12.05	12.11	12.13	12.16	12.18	12.21	12.24	12.27	12.30	12.34	12.37	12.40	12.44	12.47							
					11.16	–	–	11.24	11.29	11.36	11.41	11.47	11.52	11.56	11.59	12.02	12.05	12.13	12.18	12.20	12.26	12.28	12.31	12.33	12.36	12.39	12.42	12.45	12.49	12.52	12.55	12.59	13.03	–	–	–	–	–	13.27	13.36
										11.51	11.56	12.02	12.07	12.11	12.14	12.17	12.20	12.28	12.33	12.35	12.41	12.43	12.46	12.48	12.51	12.54	12.57	13.00	13.04	13.07	13.10	13.14	13.17							
	11.21	11.26	11.32	11.38	11.43	11.46	11.50	11.54	11.59	12.06	12.11	12.17	12.22	12.26	12.29	12.32	12.35	12.43	12.48	12.50	12.56	12.58	13.01	13.03	13.06	13.09	13.12	13.15	13.19	13.22	13.25	13.29	13.33	13.37	13.39	13.46	13.50	13.56	14.05	14.14
										12.21	12.26	12.32	12.37	12.41	12.44	12.47	12.50	12.58	13.03	13.05	13.11	13.13	13.16	13.18	13.21	13.24	13.27	13.30	13.34	13.37	13.40	13.44	13.47							
																	13.02	13.10	13.15	13.17	13.23	13.25	–	–	–	–	–	–	–	13.43	–	–	13.53	–	–	–	–	–	14.16	14.25
					12.16	–	–	12.24	12.29	12.36	12.41	12.47	12.52	12.56	12.59	13.02	13.05	13.13	13.18	13.20	13.26	13.28	13.31	13.33	13.36	13.39	13.42	13.45	13.49	13.52	13.55	13.59	14.02							
										12.51	12.56	13.02	13.07	13.11	13.14	13.17	13.20	13.28	13.33	13.35	13.41	13.43	13.46	13.48	13.51	13.54	13.57	14.00	14.04	14.07	14.10	14.14	14.17							
	12.21	12.26	12.32	12.38	12.43	12.46	12.50	12.54	12.59	13.06	13.11	13.17	13.22	13.26	13.29	13.32	13.35	13.43	13.48	13.50	13.56	13.58	14.01	14.03	14.06	14.09	14.12	14.15	14.19	14.22	14.25	14.29	14.33	14.37	14.39	14.46	14.49	14.54	15.01	15.10
										13.21	13.26	13.32	13.37	13.41	13.44	13.47	13.50	13.58	14.03	14.05	14.11	14.13	14.16	14.18	14.21	14.24	14.27	14.30	14.34	14.37	14.40	14.44	14.47							
					13.16	–	–	13.24	13.29	13.36	13.41	13.47	13.52	13.56	13.59	14.02	14.05	14.13	14.18	14.20	14.26	14.28	14.31	14.33	14.36	14.39	14.42	14.45	14.49	14.52	14.55	14.59	15.03	–	–	–	–	–	15.27	15.36
										13.46	13.51	13.57	14.02	14.06	14.09	14.12	14.15	14.23	14.28	14.30	14.36	14.38	14.41	14.43	14.46	14.49	14.52	14.55	14.59	15.02	15.05	15.09	15.12							
																	14.25	14.33	14.38	14.40	14.46	14.48	14.51	14.53	14.56	14.59	15.02	15.05	15.09	15.12	15.15	15.19	15.22							
	13.21	13.26	13.32	13.38	13.43	13.46	13.50	13.54	13.59	14.06	14.11	14.17	14.22	14.26	14.29	14.32	14.35	14.43	14.48	14.50	14.56	14.58	15.01	15.03	15.06	15.09	15.12	15.15	15.19	15.22	15.25	15.29	15.33	15.37	15.39	15.46	15.49	15.54	16.01	16.10
										14.21	14.26	14.32	14.37	14.41	14.44	14.47	14.50	14.58	15.03	15.05	15.11	15.13	15.16	15.18	15.21	15.24	15.27	15.30	15.34	15.37	15.40	15.44	15.47							
					14.16	–	–	14.24	14.29	14.36	14.41	14.47	14.52	14.56	14.59	15.02	15.05	15.13	15.18	15.20	15.26	15.28	15.31	15.33	15.36	15.39	15.42	15.45	15.49	15.52	15.55	15.59	16.03	–	–	–	–	–	16.27	16.36
R12																	15.11	15.19	15.24	15.26	15.32	15.34	15.37	15.39	15.42	15.45	15.48	15.51	15.55	15.58	16.01	16.05	16.09	–	–	–	–	–	16.33	16.43 >>Lleida
										14.51	14.56	15.02	15.07	15.11	15.14	15.17	15.20	15.28	15.33	15.35	15.41	15.43	15.46	15.48	15.51	15.54	15.57	16.00	16.04	16.07	16.10	16.14	16.17							
	14.21	14.26	14.32	14.38	14.43	14.46	14.50	14.54	14.59	15.06	15.11	15.17	15.22	15.26	15.29	15.32	15.35	15.43	15.48	15.50	15.56	15.58	16.01	16.03	16.06	16.09	16.12	16.15	16.19	16.22	16.25	16.29	16.33	16.37	16.39	16.46	16.49	16.54	17.01	17.10
										15.21	15.26	15.32	15.37	15.41	15.44	15.47	15.50	15.58	16.03	16.05	16.11	16.13	16.16	16.18	16.21	16.24	16.27	16.30	16.34	16.37	16.40	16.44	16.47							

					15.16	–	–	15.24	15.29	15.36	15.41	15.47	15.52	15.56	15.59	16.02	16.05	16.13	16.18	16.20	16.26	16.28	16.31	16.33	16.36	16.39	16.42	16.45	16.49	16.52	16.55	16.59	17.02							
																	16.14	16.22	16.27	16.29	16.35	16.38	–	–	–	–	–	–	–	16.56	–	–	17.06	–	–	–	–	–	17.30	17.39
										15.51	15.56	16.02	16.07	16.11	16.14	16.17	16.20	16.28	16.33	16.35	16.41	16.43	16.46	16.48	16.51	16.54	16.57	17.00	17.04	17.07	17.10	17.14	17.17							
	15.21	15.26	15.32	15.38	15.43	15.46	15.50	15.54	15.59	16.06	16.11	16.17	16.22	16.26	16.29	16.32	16.35	16.43	16.48	16.50	16.56	16.58	17.01	17.03	17.06	17.09	17.12	17.15	17.19	17.22	17.25	17.29	17.33	17.37	17.39	17.46	17.49	17.54	18.01	18.10
										16.21	16.26	16.32	16.37	16.41	16.44	16.47	16.50	16.58	17.03	17.05	17.11	17.13	17.16	17.18	17.21	17.24	17.27	17.30	17.34	17.37	17.40	17.44	17.47							
					16.16	–	–	16.24	16.29	16.36	16.41	16.47	16.52	16.56	16.59	17.02	17.05	17.13	17.18	17.20	17.26	17.28	17.31	17.33	17.36	17.39	17.42	17.45	17.49	17.52	17.55	17.59	18.03	–	–	–	–	–	18.27	18.36
										16.51	16.56	17.02	17.07	17.11	17.14	17.17	17.20	17.28	17.33	17.35	17.41	17.43	17.46	17.48	17.51	17.54	17.57	18.00	18.04	18.07	18.10	18.14	18.17							
	16.21	16.26	16.32	16.38	16.43	16.46	16.50	16.54	16.59	17.06	17.11	17.17	17.22	17.26	17.29	17.32	17.35	17.43	17.48	17.50	17.56	17.58	18.01	18.03	18.06	18.09	18.12	18.15	18.19	18.22	18.25	18.29	18.33	18.37	18.39	18.46	18.49	18.54	19.01	19.10
										17.21	17.26	17.32	17.37	17.41	17.44	17.47	17.50	17.58	18.03	18.05	18.11	18.13	18.16	18.18	18.21	18.24	18.27	18.30	18.34	18.37	18.40	18.44	18.47							
					17.15	–	–	17.23	17.28	17.35	17.40	17.46	17.51	17.55	17.58	18.01	18.04	18.12	18.17	18.19	18.25	18.27	18.30	18.32	18.35	18.38	18.41	18.44	18.48	18.51	18.54	18.58	19.02	–	–	–	–	–	19.26	19.35
																	18.13	18.21	18.26	18.28	18.34	18.36	18.39	18.41	18.44	18.47	18.50	18.53	18.57	19.00	19.03	19.07	19.10							
										17.53	17.58	18.04	18.09	18.13	18.16	18.19	18.22	18.30	18.35	18.37	18.43	18.45	18.48	18.50	18.53	18.56	18.59	19.02	19.06	19.09	19.12	19.16	19.19							
																	18.31	18.39	18.44	18.46	18.52	18.54	18.57	18.59	19.02	19.05	19.08	19.11	19.15	19.18	19.21	19.25	19.28							
	17.23	17.28	17.34	17.40	17.45	17.48	17.52	17.56	18.01	18.08	18.13	18.19	18.24	18.28	18.31	18.34	18.37	18.45	18.50	18.52	18.58	19.01	19.04	19.06	19.09	19.12	19.15	19.18	19.22	19.25	19.28	19.32	19.36	19.40	19.42	19.49	19.52	19.57	20.04	20.13
																	18.43	18.51	18.56	18.58	19.04	19.06	19.09	19.11	19.14	19.17	19.20	19.23	19.27	19.30	19.33	19.37	19.40							
										18.26	18.31	18.37	18.42	18.46	18.49	18.52	18.55	19.03	19.08	19.10	19.16	19.18	19.21	19.23	19.26	19.29	19.32	19.35	19.39	19.42	19.45	19.49	19.52							
R12																	19.01	19.09	19.14	19.16	19.22	19.24	19.27	19.29	19.32	19.35	19.38	19.41	19.45	19.48	19.51	19.55	19.59	–	–	–	–	–	20.23	20.33 >>Lleida
					18.18	–	–	18.26	18.31	18.38	18.43	18.49	18.54	18.58	19.01	19.04	19.07	19.15	19.20	19.22	19.28	19.30	19.33	19.35	19.38	19.41	19.44	19.47	19.51	19.54	19.57	20.01	20.05	–	–	–	–	–	20.29	20.38
										18.52	18.57	19.03	19.07	19.11	19.14	19.16	19.19	19.27	19.32	19.34	19.40	19.42	19.45	19.52	19.55	19.58	20.01	20.04	20.08	20.11	20.14	20.18	20.21							
																	19.22	19.30	19.35	19.37	19.43	19.46	–	–	–	–	–	–	–	20.03	–	–	20.13	–	–	–	–	–	20.36	20.45
																	19.31	19.39	19.44	19.46	19.52	19.54	19.57	19.59	20.02	20.05	20.08	20.11	20.15	20.18	20.21	20.25	20.29	–	–	–	–	–	20.53	21.02
	18.24	18.29	18.35	18.41	18.46	18.49	18.53	18.57	19.02	19.09	19.14	19.20	19.25	19.29	19.32	19.36	19.40	19.48	19.53	19.55	20.01	20.03	20.06	20.08	20.11	20.14	20.17	20.20	20.24	20.27	20.30	20.34	20.38	20.42	20.44	20.51	20.54	20.59	21.06	21.15
										19.22	19.27	19.33	19.37	19.41	19.44	19.46	19.49	19.57	20.02	20.04	20.10	20.12	20.15	20.17	20.20	20.23	20.26	20.29	20.33	20.36	20.39	20.43	20.46							
																	19.58	20.06	20.11	20.13	20.19	20.21	20.24	20.26	20.29	20.32	20.35	20.38	20.42	20.45	20.48	20.52	20.55							
					19.15	19.18	19.22	19.26	19.31	19.38	19.43	19.49	19.54	19.58	20.01	20.04	20.07	20.15	20.20	20.22	20.28	20.30	20.33	20.35	20.38	20.41	20.44	20.47	20.51	20.54	20.57	21.01	21.05	–	–	–	–	–	21.29	21.38
																	20.16	20.24	20.29	20.31	20.37	20.39	20.42	20.44	20.47	20.50	20.53	20.56	21.00	21.03	21.06	21.10	21.13							
										19.56	20.01	20.07	20.12	20.16	20.19	20.22	20.25	20.33	20.38	20.40	20.46	20.48	20.51	20.53	20.56	20.59	21.02	21.05	21.09	21.12	21.15	21.19	21.22							
																	20.34	20.42	20.47	20.49	20.55	20.57	21.00	21.02	21.05	21.08	21.11	21.14	21.18	21.21	21.24	21.28	21.31							
	19.29	19.34	19.40	19.46	19.51	19.54	19.58	20.02	20.07	20.14	20.19	20.25	20.30	20.34	20.37	20.40	20.43	20.51	20.56	20.58	21.04	21.06	21.09	21.11	21.14	21.17	21.20	21.23	21.27	21.30	21.33	21.37	21.41	21.45	21.47	21.54	21.57	22.02	22.09	22.18
										20.29	20.34	20.40	20.45	20.49	20.52	20.55	20.58	21.06	21.11	21.13	21.19	21.21	21.24	21.26	21.29	21.32	21.35	21.38	21.42	21.45	21.48	21.52	21.55							
					20.24	–	–	20.32	20.37	20.44	20.49	20.55	21.00	21.04	21.07	21.10	21.13	21.21	21.26	21.28	21.34	21.36	21.39	21.41	21.44	21.47	21.50	21.53	21.57	22.00	22.03	22.07	22.11	–	–	–	–	–	22.35	22.44
										20.59	21.04	21.10	21.15	21.19	21.22	21.25	21.28	21.36	21.41	21.43	21.49	21.51	21.54	21.56	21.59	22.02	22.05	22.08	22.12	22.15	22.18	22.22	22.25							
	20.29	20.34	20.40	20.46	20.51	20.54	20.58	21.02	21.07	21.14	21.19	21.25	21.30	21.34	21.37	21.40	21.43	21.51	21.56	21.58	22.04	22.06	22.09	22.11	22.14	22.17	22.20	22.23	22.27	22.30	22.33	22.37	22.41	–	–	–	–	–	23.05	23.14
					21.24	–	–	21.32	21.37	21.44	21.49	21.55	22.00	22.04	22.07	22.10	22.13	22.21	22.26	22.28	22.34	22.36	22.39	22.41	22.44	22.47	22.50	22.53	22.57	23.00	23.03	23.07	23.11	23.15	23.17	23.24	23.27	23.32	23.39	23.48
	21.27	21.32	21.38	21.44	21.49	21.52	21.56	22.00	22.05	22.12	22.17	22.23	22.28	22.33	22.36	22.40	22.43	22.51	22.56	22.58	23.04	23.06	23.09	23.11	23.14	23.17	23.20	23.23	23.27	23.30	23.33	23.37	23.40							
					22.24	–	–	22.32	22.37	22.44	22.49	22.55	23.00	23.04	23.07	23.10	23.13	23.21	23.26	23.28	23.34	23.36	23.39	23.41	23.44	23.47	23.50	23.53	23.57	0.00	0.03	0.07	0.10							
										23.14	23.19	23.25	23.30	23.34	23.37	23.40	23.43	23.51	23.56	23.58	0.04	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40							

R4

Manresa → Sant Vicenç de Calders

Per Por *By* **Vilafranca del Penedès**

Feiners Laborables *Weekdays* **1 / 5 / 2018**

Manresa	St. Vicenç de Castellet	Castellbell i el Vilar-Monistrol de M.	Vacarisses	Vacarisses-Torreblanca	Viladecavalls	St. Miquel de Gonteres	Terrassa	Terrassa Est	Sabadell Nord	Sabadell Centre	Sabadell Sud	Barberà del Vallès	Cerdanyola del Vallès	Montcada i Reixac-Sta. Maria	Montcada i Reixac-Manresa	Montcada Bifurcació	Barcelona Torre del Baró	Barcelona St.Andreu Arenal	Barcelona La Sagrera-Meridiana	Barcelona Arc de Triomf	Barcelona Pl. Catalunya	Barcelona Sants	L'Hospitalet de Llobregat	Cornellà	St. Joan Despí	St. Feliu de Llobregat	Molins de Rei	El Papiol	Castellbisbal	Martorell	Gelida	St. Sadurní d'Anoia	Lavern-Subirats	La Granada	Vilafranca del Penedès	Els Monjos	L'Arboç	El Vendrell	St. Vicenç de Calders
							6.00	6.03	6.07	6.10	6.13	6.16	6.19	6.21	6.24	6.27	6.29	6.32	6.35	6.40	6.43	6.48	6.55	6.58	7.00	7.02	7.06	7.09	7.14	7.19	7.24	7.29	7.32	7.36	7.41	7.46	7.51	7.57	8.03
							6.09	6.12	6.17	6.20	6.23	6.26	6.29	6.31	6.34	6.37	6.39	6.42	6.45	6.50	6.53	6.58	7.05	7.08	7.10	7.12	7.17	7.21	7.25	7.30	7.35	7.40	–	–	7.48				
							6.20	6.23	6.28	6.31	6.34	6.37	6.40	6.42	6.45	6.49	6.51	6.54	6.57	7.02	7.05	7.10	7.17																
5.52	6.02	6.08	6.13	6.16	6.23	6.25	6.30	6.33	6.37	6.40	6.43	6.46	6.49	6.51	6.54	6.57	6.59	7.02	7.05	7.10	7.13	7.18	7.25	7.28	7.30	7.32	7.36	7.39	7.44	7.49	7.54	7.59	8.02	8.06	8.11	8.16	8.21	8.27	8.33
							6.40	6.43	6.48	6.51	6.54	6.57	7.02	7.04	7.07	7.10	7.12	7.15	7.18	7.23	7.26	7.31	7.39	7.43	7.45	7.48	7.52	7.55	7.59	8.03									
							6.50	6.53	6.58	7.01	7.04	7.07	7.11	7.13	7.16	7.19	7.21	7.24	7.27	7.32	7.35	7.40	7.48	7.52	7.54	7.57	8.01	8.04	8.08	8.12									
6.31	6.41	–	–	–	–	–	7.05	–	–	7.12	–	–	–	–	–	–	–	7.29	7.32	7.38	7.41	7.46	7.53																
							6.57	7.00	7.05	7.08	7.12	7.19	7.22	7.24	7.27	7.30	7.32	7.35	7.38	7.43	7.46	7.51	7.58	8.01	8.03	8.05	8.10	8.14	8.18	8.23	8.28	8.33	8.36	8.40	8.43				
							7.08	7.11	7.16	7.19	7.22	7.25	7.28	7.30	7.33	7.36	7.38	7.41	7.44	7.49	7.52	7.57	8.04																
							7.14	7.17	7.22	7.25	7.28	7.31	7.34	7.36	7.39	7.42	7.44	7.47	7.50	7.55	7.58	8.03	8.11	8.15	8.17	8.20	8.24	8.27	8.31	8.35									
							7.23	7.26	7.31	7.34	7.37	7.40	7.43	7.45	7.48	7.51	7.53	7.56	7.59	8.04	8.07	8.12	8.19																
6.52	7.02	7.08	7.13	7.16	7.23	7.25	7.30	7.33	7.37	7.40	7.43	7.46	7.49	7.51	7.54	7.57	7.59	8.02	8.05	8.10	8.13	8.18	8.25	8.28	8.30	8.32	8.36	8.39	8.44	8.49	8.54	8.59	9.02	9.06	9.11	9.16	9.21	9.27	9.33
7.09	7.19	–	–	–	–	–	7.43	7.46	7.50	7.53	7.56	7.59	8.02	8.04	8.07	8.10	8.12	8.15	8.18	8.23	8.26	8.31	8.38	8.42	8.44	8.47	8.51	8.55	9.00	9.04									
							7.48	7.51	7.56	7.59	8.02	8.05	8.08	8.10	8.13	8.16	8.18	8.21	8.24	8.29	8.32	8.37	8.44																

	7.22	7.32	–	–	–	–	–	7.56	7.59	8.03	8.06	8.09	8.12	8.15	8.17	8.20	8.23	8.25	8.28	8.31	8.36	8.39	8.44	8.52	8.55	8.57	8.59	9.03	9.07	9.12	9.16									
	7.31	7.41	–	–	–	–	–	8.05	8.08	8.13	8.16	8.19	8.22	8.25	8.27	8.30	8.34	8.36	8.40	8.43	8.48	8.51	8.56	9.04	9.08	9.10	9.12	9.17	9.20	9.24	9.29	9.34	9.39	–	–	9.47				
								8.12	8.15	8.20	8.23	8.26	8.29	8.32	8.34	8.37	8.41	8.43	8.47	8.50	8.57	9.00	9.05	9.12																
								8.21	8.24	8.29	8.32	8.35	8.38	8.41	8.43	8.46	8.49	8.51	8.55	8.58	9.03	9.06	9.11	9.19	9.23	9.25	9.28	9.32	9.35	9.39	9.43									
	7.54	8.04	8.10	8.15	8.18	8.25	8.27	8.32	8.35	8.39	8.42	8.45	8.48	8.51	8.53	8.56	8.59	9.01	9.04	9.07	9.12	9.15	9.20	9.27	9.30	9.32	9.35	9.39	9.42	9.47	9.52	9.57	10.02	10.05	10.09	10.14	10.19	10.24	10.30	10.36
								8.36	8.39	8.43	8.46	8.49	8.52	8.55	8.57	9.00	9.02	9.04	9.07	9.10	9.15	9.18	9.23	9.30																
	8.11	8.21	–	–	–	–	–	8.45	8.48	8.52	8.55	8.58	9.01	9.04	9.06	9.09	9.12	9.14	9.18	9.21	9.27	9.30	9.35	9.42	9.46	9.48	9.51	9.55	9.59	10.04	10.08									
								8.51	8.54	8.59	9.02	9.05	9.08	9.11	9.13	9.16	9.19	9.21	9.24	9.27	9.32	9.35	9.40	9.47																
	8.26	8.36	–	–	–	–	–	9.00	9.03	9.08	9.11	9.14	9.17	9.20	9.22	9.25	9.29	9.31	9.35	9.38	9.43	9.46	9.51	9.59	10.02	10.04	10.06	10.11	10.14	10.18	10.23	10.28	10.33	–	–	10.41				
								9.14	9.17	9.22	9.25	9.28	9.31	9.34	9.36	9.39	9.42	9.44	9.47	9.50	9.55	9.58	10.03	10.11	10.15	10.17	10.20	10.24	10.27	10.31	10.35									
	8.52	9.02	9.08	9.13	9.16	9.23	9.25	9.30	9.33	9.37	9.40	9.43	9.46	9.49	9.51	9.54	9.57	9.59	10.02	10.05	10.10	10.13	10.18	10.25	10.28	10.30	10.32	10.36	10.39	10.44	10.49	10.54	10.59	11.02	11.06	11.11	11.16	11.21	11.27	11.33
								9.44	9.47	9.52	9.55	9.58	10.01	10.04	10.06	10.09	10.12	10.14	10.17	10.20	10.25	10.28	10.33	10.41	10.45	10.47	10.50	10.54	10.57	11.01	11.05									
	9.25	9.35	–	–	–	–	–	9.59	10.02	10.07	10.10	10.13	10.16	10.19	10.21	10.24	10.27	10.29	10.32	10.35	10.40	10.43	10.48	10.56	10.59	11.01	11.03	11.08	11.11	11.15	11.20	11.25	11.30	–	–	11.38				
								10.14	10.17	10.22	10.25	10.28	10.31	10.34	10.36	10.39	10.42	10.44	10.47	10.50	10.55	10.58	11.03	11.11	11.15	11.17	11.20	11.24	11.27	11.31	11.35									
	9.52	10.02	10.08	10.13	10.16	10.23	10.25	10.30	10.33	10.37	10.40	10.43	10.46	10.49	10.51	10.54	10.57	10.59	11.02	11.05	11.10	11.13	11.18	11.25	11.28	11.30	11.32	11.36	11.39	11.44	11.49	11.54	11.59	12.02	12.06	12.11	12.16	12.21	12.27	12.33
								10.44	10.47	10.52	10.55	10.58	11.01	11.04	11.06	11.09	11.12	11.14	11.17	11.20	11.25	11.28	11.33	11.41	11.45	11.47	11.50	11.54	11.57	12.01	12.05									
	10.23	10.33	–	–	–	–	–	10.57	11.00	11.05	11.08	11.11	11.14	11.17	11.19	11.22	11.26	11.28	11.32	11.35	11.40	11.43	11.48	11.56	11.59	12.01	12.03	12.08	12.11	12.15	12.20	12.25	12.30	–	–	12.38				
								11.14	11.17	11.22	11.25	11.28	11.31	11.34	11.36	11.39	11.42	11.44	11.47	11.50	11.55	11.58	12.03	12.11	12.15	12.17	12.20	12.24	12.27	12.31	12.35									
R12	10.48	10.58	–	–	–	–	–	11.22	11.25	11.29	11.32	11.36	11.39	11.43	11.46	11.49	11.52	11.54	11.57	12.00	12.05	12.08	12.13	12.20																
	10.52	11.02	11.08	11.13	11.16	11.23	11.25	11.30	11.33	11.37	11.40	11.43	11.46	11.49	11.51	11.54	11.57	11.59	12.02	12.05	12.10	12.13	12.18	12.25	12.28	12.30	12.32	12.36	12.39	12.44	12.49	12.54	12.59	13.02	13.06	13.11	13.16	13.21	13.27	13.33
								11.44	11.47	11.52	11.55	11.58	12.01	12.04	12.06	12.09	12.12	12.14	12.17	12.20	12.25	12.28	12.33	12.41	12.45	12.47	12.50	12.54	12.57	13.01	13.05									
	11.24	11.34	–	–	–	–	–	11.58	12.01	12.06	12.09	12.12	12.15	12.18	12.20	12.23	12.26	12.28	12.32	12.35	12.40	12.43	12.48	12.56	12.59	13.01	13.03	13.08	13.11	13.15	13.20	13.25	13.30	13.33	13.37	13.40				
								12.14	12.17	12.22	12.25	12.28	12.31	12.34	12.36	12.39	12.42	12.44	12.47	12.50	12.55	12.58	13.03	13.11	13.15	13.17	13.20	13.24	13.27	13.31	13.35									
	11.52	12.02	12.08	12.13	12.16	12.23	12.25	12.30	12.33	12.37	12.40	12.43	12.46	12.49	12.51	12.54	12.57	12.59	13.02	13.05	13.10	13.13	13.18	13.25	13.28	13.30	13.32	13.36	13.39	13.44	13.49	13.54	13.59	14.02	14.06	14.11	14.16	14.21	14.27	14.33
								12.44	12.47	12.52	12.55	12.58	13.01	13.04	13.06	13.09	13.12	13.14	13.17	13.20	13.25	13.28	13.33	13.41	13.45	13.47	13.50	13.54	13.57	14.01	14.05									
	12.24	12.34	–	–	–	–	–	12.58	13.01	13.06	13.09	13.12	13.15	13.18	13.20	13.23	13.26	13.28	13.32	13.35	13.40	13.43	13.48	13.56	13.59	14.01	14.03	14.08	14.11	14.15	14.20	14.25	14.30	–	–	14.38				
								13.14	13.17	13.22	13.25	13.28	13.31	13.34	13.36	13.39	13.42	13.44	13.47	13.50	13.55	13.58	14.03	14.11	14.15	14.17	14.20	14.24	14.27	14.31	14.35									
	12.52	13.02	13.08	13.13	13.16	13.23	13.25	13.30	13.33	13.37	13.40	13.43	13.46	13.49	13.51	13.54	13.57	13.59	14.02	14.05	14.10	14.13	14.18	14.25	14.28	14.30	14.32	14.36	14.39	14.44	14.49	14.54	14.59	15.02	15.06	15.11	15.16	15.21	15.27	15.33
								13.44	13.47	13.52	13.55	13.58	14.01	14.04	14.06	14.09	14.13	14.15	14.19	14.22	14.27	14.30	14.35	14.42	14.45	14.47	14.50	14.54	14.57	15.01	15.05									
	13.24	13.34	–	–	–	–	–	13.58	14.01	14.06	14.09	14.12	14.15	14.18	14.20	14.23	14.26	14.28	14.32	14.35	14.40	14.43	14.48	14.56	14.59	15.01	15.03	15.08	15.11	15.15	15.20	15.25	15.30	–	–	15.38				
								14.14	14.17	14.22	14.25	14.28	14.31	14.34	14.36	14.39	14.42	14.44	14.47	14.50	14.55	14.58	15.03	15.11	15.15	15.17	15.20	15.24	15.27	15.31	15.35									
	13.52	14.02	14.08	14.13	14.16	14.23	14.25	14.30	14.33	14.37	14.40	14.43	14.46	14.49	14.51	14.54	14.57	14.59	15.02	15.05	15.10	15.13	15.18	15.25	15.28	15.30	15.32	15.36	15.39	15.44	15.49	15.54	15.59	16.02	16.06	16.11	16.16	16.21	16.27	16.33
								14.44	14.47	14.52	14.55	14.58	15.01	15.04	15.06	15.09	15.12	15.14	15.17	15.20	15.25	15.28	15.33	15.41	15.45	15.47	15.50	15.54	15.57	16.01	16.05									
								14.53	14.56	15.01	15.04	15.08	15.15	15.18	15.20	15.23	15.26	15.28	15.31	15.34	15.39	15.42	15.47	15.55	15.58	16.00	16.02	16.07	16.11	16.15	16.20	16.25	16.30	16.33	16.37	16.40				
	14.26	14.36	–	–	–	–	–	15.00	–	–	15.07	–	–	–	–	–	–	–	15.24	15.27	15.33	15.36	15.41	15.48																
								15.14	15.17	15.22	15.25	15.28	15.31	15.34	15.36	15.39	15.42	15.44	15.47	15.50	15.55	15.58	16.03	16.11	16.15	16.17	16.20	16.24	16.27	16.31	16.35									
	14.53	15.03	15.09	15.14	15.17	15.24	15.26	15.31	15.34	15.38	15.41	15.44	15.47	15.50	15.52	15.55	15.58	16.00	16.03	16.06	16.11	16.14	16.19	16.26	16.29	16.31	16.33	16.37	16.40	16.45	16.50	16.55	17.00	17.03	17.07	17.12	17.17	17.22	17.28	17.34
								15.39	15.42	15.47	15.50	15.53	15.56	15.59	16.01	16.04	16.07	16.09	16.12	16.15	16.20	16.23	16.28	16.35																
								15.49	15.52	15.57	16.00	16.03	16.06	16.09	16.11	16.14	16.17	16.19	16.22	16.25	16.30	16.33	16.38	16.45	16.48	16.50	16.53	16.57	17.00	17.04	17.08									
	15.25	15.35	–	–	–	–	–	15.59	16.02	16.07	16.10	16.13	16.16	16.19	16.21	16.24	16.27	16.29	16.32	16.35	16.40	16.43	16.48	16.56	16.59	17.01	17.03	17.08	17.11	17.15	17.20	17.25	17.30	–	–	17.38				
								16.14	16.17	16.22	16.25	16.28	16.31	16.34	16.36	16.39	16.42	16.44	16.47	16.50	16.55	16.58	17.03	17.11	17.15	17.17	17.20	17.24	17.27	17.31	17.35									
	15.52	16.02	16.08	16.13	16.16	16.23	16.25	16.30	16.33	16.37	16.40	16.43	16.46	16.49	16.51	16.54	16.57	16.59	17.02	17.05	17.10	17.13	17.18	17.25	17.28	17.30	17.32	17.36	17.39	17.44	17.49	17.54	17.59	18.02	18.06	18.11	18.16	18.21	18.27	18.33
								16.44	16.47	16.52	16.55	16.58	17.01	17.04	17.06	17.09	17.12	17.14	17.17	17.20	17.25	17.28	17.33	17.41	17.45	17.47	17.50	17.54	17.57	18.01	18.05									
	16.24	16.34	–	–	–	–	–	16.58	17.01	17.06	17.09	17.12	17.15	17.18	17.20	17.23	17.26	17.28	17.32	17.35	17.40	17.43	17.48	17.56	17.59	18.01	18.03	18.08	18.11	18.15	18.20	18.25	18.30	–	–	18.38				
								17.14	17.17	17.22	17.25	17.28	17.31	17.34	17.36	17.39	17.42	17.44	17.47	17.50	17.55	17.58	18.03	18.11	18.15	18.17	18.20	18.24	18.27	18.31	18.35									
	16.52	17.02	17.08	17.13	17.16	17.23	17.25	17.30	17.33	17.37	17.40	17.43	17.46	17.49	17.51	17.54	17.57	17.59	18.02	18.05	18.10	18.13	18.18	18.25	18.28	18.30	18.32	18.36	18.39	18.44	18.49	18.54	18.59	19.02	19.06	19.11	19.16	19.21	19.27	19.33
								17.59	18.02	18.07	18.10	18.13	18.16	18.19	18.21	18.24	18.27	18.29	18.32	18.35	18.40	18.43	18.48	18.55	18.58	19.00	19.02	19.07	19.11	19.15	19.20	19.25	19.30	19.33	19.37	19.40				
	17.42	17.52	–	–	–	–	–	18.16	–	–	18.24	–	–	–	–	–	–	–	18.40	18.43	18.49	18.52	18.57	19.04																
								18.09	18.12	18.17	18.20	18.28	18.31	18.34	18.36	18.39	18.42	18.44	18.47	18.50	18.55	18.58	19.03	19.11	19.15	19.17	19.20	19.24	19.27	19.31	19.35									
	17.52	18.02	18.08	18.13	18.16	18.23	18.25	18.30	18.33	18.37	18.40	18.43	18.46	18.49	18.51	18.54	18.57	18.59	19.02	19.05	19.10	19.13	19.18	19.25	19.28	19.30	19.32	19.36	19.39	19.44	19.49	19.54	19.59	20.02	20.06	20.11	20.16	20.21	20.27	20.33
R12	18.05	18.15	–	–	–	–	–	18.39	18.42	18.46	18.49	18.52	18.55	18.58	19.00	19.03	19.06	19.08	19.11	19.14	19.19	19.22	19.27	19.34																
								18.44	18.47	18.52	18.55	18.58	19.01	19.04	19.06	19.09	19.12	19.14	19.17	19.20	19.25	19.28	19.33	19.41	19.45	19.47	19.50	19.54	19.57	20.01	20.05									
	18.22	18.32	18.38	18.43	18.46	18.53	18.55	19.00	19.03	19.07	19.10	19.13	19.16	19.19	19.21	19.24	19.27	19.29	19.32	19.35	19.40	19.43	19.48	19.55	19.58	20.00	20.02	20.06	20.09	20.14	20.19	20.24	20.29	20.32	20.36	20.41	20.46	20.51	20.57	21.03
								19.14	19.17	19.22	19.25	19.28	19.31	19.34	19.36	19.39	19.42	19.44	19.47	19.50	19.55	19.58	20.03	20.10	20.13	20.15	20.17	20.22	20.26	20.30	20.35	20.40	20.45	20.48	20.52	20.55				
	18.56	19.06	–	–	–	–	–	19.30	19.33	19.37	19.40	19.43	19.46	19.49	19.51	19.54	19.57	19.59	20.02	20.05	20.10	20.13	20.18	20.25	20.28	20.30	20.32	20.36	20.39	20.44	20.49	20.54	20.59	21.02	21.06	21.11	21.16	21.21	21.27	21.33
								19.44	19.47	19.52	19.55	19.58	20.01	20.04	20.06	20.09	20.12	20.14	20.17	20.20	20.25	20.28	20.33	20.41	20.45	20.47	20.50	20.54	20.57	21.01	21.05									
	19.22	19.32	19.38	19.43	19.46	19.53	19.55	20.00	20.03	20.07	20.10	20.13	20.16	20.19	20.21	20.24	20.27	20.29	20.32	20.35	20.40	20.43	20.48	20.55	20.58	21.00	21.02	21.06	21.09	21.14	21.19	21.24	21.29	21.32	21.36	21.41	21.46	21.51	21.57	22.03
								20.14	20.17	20.22	20.25	20.28	20.31	20.34	20.36	20.39	20.42	20.44	20.47	20.50	20.55	20.58	21.03	21.10	21.13	21.15	21.17	21.22	21.26	21.30	21.35	21.40	21.45	21.48	21.52	21.55				
	19.56	20.06						20.30	20.33	20.37	20.40	20.43	20.46	20.49	20.51	20.54	20.58	21.00	21.03	21.06	21.11	21.14	21.19	21.26	21.29	21.31	21.33	21.37	21.40	21.45	21.50	21.55	22.00	22.03	22.07	22.12	22.17	22.22	22.28	22.34
								20.44	20.47	20.52	20.55	20.58	21.01	21.04	21.06	21.09	21.12	21.14	21.17	21.20	21.25	21.28	21.33	21.40	21.44	21.46	21.49	21.53	21.56	22.00	22.04									
	20.22	20.32	20.38	20.43	20.46	20.53	20.55	21.00	21.03	21.07	21.10	21.13	21.16	21.19	21.21	21.24	21.27	21.29	21.32	21.35	21.40	21.43	21.48	21.55	21.58	22.00	22.02	22.06	22.09	22.14	22.19	22.24	22.29	22.32	22.36	22.41	22.46	22.51	22.57	23.03
								21.14	21.17	21.22	21.25	21.28	21.31	21.34	21.36	21.39	21.42	21.44	21.48	21.51	21.56	21.59	22.04	22.11	22.15	22.17	22.20	22.24	22.27	22.31	22.35									
	21.11	21.21	–	–	–	–	–	21.45	21.48	21.52	21.55	21.58	22.01	22.04	22.06	22.09	22.12	22.14	22.18	22.21	22.26	22.29	22.34	22.41	22.44	22.46	22.48	22.52	22.55	23.00	23.05	23.10	23.15	23.18	23.22	23.27	23.32	23.37	23.43	23.49
								22.29	22.32	22.36	22.39	22.42	22.45	22.49	22.52	22.55	22.58	23.00	23.03	23.06	23.11	23.14	23.19	23.26	23.29	23.31	23.33	23.37	23.41	23.46	23.51	23.56	0.01	0.04	0.08	0.13	0.18	0.23	0.29	0.35
R12	21.55	22.05	22.11	22.16	22.19	22.26	22.28	22.33	22.36	22.41	22.44	22.48	22.51	22.55	22.58	23.01	23.04	23.06	23.10	23.13	23.18	23.21	23.26	23.33																
								23.14	23.17	23.22	23.25	23.28	23.31	23.34	23.36	23.39	23.42	23.44	23.47	23.50	23.55	23.58	0.03	0.10	0.13	0.15	0.17	0.21	0.24	0.28	0.32									