THE EVOLUTION OF ACCESSIBLE TRAIN STATIONS IN MADRID

A MAP STUDY APPROACH (2009-2020)

LA EVOLUCIÓN DE LAS ESTACIONES DE TREN ACCESIBLES EN MADRID
APROXIMACIÓN A TRAVÉS DEL ESTUDIO DE MAPAS (2009-2020)

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La mayor parte del territorio de la Comunidad de Madrid está cubierto por una extensiva red ferroviaria que permite a miles de personas viajar en tren en su día a día. Sin embargo, algunos colectivos que presentan discapacidades, ya sean permanentes o temporales, pueden encontrar diferentes obstáculos que limitan su acceso a la estación o a los propios trenes que circulan por ellas. A través del estudio de la información disponible en formato de mapas esquemáticos, los cuales son la fuente principal para que los viajeros conozcan de antemano si una estación es accesible o no, se ha estudiado el número de estaciones accesibles, y como éste ha evolucionado desde 2009 a 2020. El análisis ha arrojado luz sobre el grado de inclusividad – completamente accesible, ajustes parciales, y si los vagones que llegaban eran accesibles – que la red madrileña de tren proporcionaba en el periodo anteriormente mencionado. Como resultado, tanto el análisis de los mapas como la recolección de datos cualitativos muestran que, aunque la cantidad de estaciones accesibles aumentó durante el periodo estudiado, las variaciones irregulares de éstas pueden ser reflejo de las modificaciones en las regulaciones públicas. Así, Madrid puede servir de ejemplo para el estudio de la accesibilidad en la red de trenes para así determinar las consecuencias de la dispersión en la accesibilidad urbana, y como ello pueden entorpecer el pleno acceso a cualquier parte de la ciudad para todas las personas.

Palabras clave: accesibilidad, movilidad urbana, personas con discapacidad, transporte público, red ferroviaria

Most of Madrid is covered by an extensive train network that allows thousands of people to commute by train daily. However, some collectives with either permanent or temporary disabilities, may find obstacles that limit their access to the station, the carriages, or both. By studying the information available on graphic maps, which is the common source for passengers to know whether a station is accessible or not before reaching it, the number of accessible stations, and how they have evolved from 2009 to 2020, has been studied. The study has analyzed the degree of inclusiveness that Madrid's train network provided in the aforementioned period regarding complete accessibility, partial accommodations, and whether the carriages of the arriving trains were accessible. As a result, both the map analysis and quantitative data collection have shown that although the total number of accessible stations increased over the studied period, their irregular variations may reflect the modifications in public regulations. Thus, Madrid can be an example of how to study the level of accessibility in the train network in order to determine the consequences of sprawl in urban accessibility, and how this can hinder full access for all people to every point of the city.

Keywords: accessibility, urban mobility, people with disabilities, public transport, train network

I. INTRODUCTION

Commuting in Madrid can be a challenge. With an extensive metropolitan physiognomy, the Madrid Autonomous Community had a total of 95 train stations in 2020, split into 9 radial lines that converged at Atocha Station (Adif et al., 2018). The train network also connects with another 12 underground lines, and hundreds of inner and intercity bus routes.

This kind of infrastructure tends to be complex and poorly optimized for today's needs (Wang et al., 2015), often lacking universal access. In the case of Madrid, multiple user associations have claimed that this is key for several essential stations, such as those serving hospitals, when updating the city for more inclusive environments (CERMI Madrid, 2020). Despite the projects of recent years to handle these shortcomings, petitions for more coherent measures and not just temporary fixes, have been a constant throughout (Blanca Abella, 2015; Hernández Galán, 2013; Redacción prnoticias, 2017; Servimedia, 2021), including from the Annual Report of the Disability Attention Office (OADIS & Ministerio de Sanidad, Consumo y Bienestar Social, 2018). However, Cercanías, which manages Madrid's train network, has failed to accommodate these demands as has happened in other cities.

This lack of universal design for end-to-end journeys has consolidated social discrimination toward people with disabilities (PWD) or of different ages (Gleeson, 2001; Mckercher & Darcy, 2018; Venter et al., 2002). Contemporary cities, far from being inclusive and accessible for every city user, still have mobility barriers (Barnes, 2011; Ferreira et al., 2021). Public transportation must favour universal design for a better urban experience for citizens and tourists on being an essential service to provide universal access to all parts of the city for all people (Rebstock, 2017).

In this context, this article seeks to answer the question of how Madrid's train network has evolved between 2009 and 2020 in terms of accessibility, looking to represent the whole context of macrocities and the impact that sprawl has had on them. The analysis has been based on the information found in network maps, the reference documents for anybody wishing to know whether a station is accessible before arriving there. In addition, edited graphical material will show the evolution of accessible stations in Madrid's train infrastructure.

II. THEORETICAL FRAMEWORK

International context and related concepts in terms of urban and public transport accessibility

Many modern cities have been affected by sprawl. Although the USA is the most well-known case (Sturm & Cohen, 2004), this problem has spread across many countries since the car became the primary means of transport in capital cities, such as Paris (Gilli, 2009), Berlin (Schmidt, 2011), Melbourne (Geschke et al., 2018) and Shanghai (Tian et al., 2017).

One of its consequences is the lack of urban accessibility (Bullard et al., 2000; Tikoudis et al., 2018). In this context, the city becomes inaccessible for people who cannot have access or drive due to their disabilities, age, or other reasons, especially when commuting from intermediate distances (Hernández Galán, 2013). Public transport has tried to solve this problem, making a wider variety of essential services accessible by train or bus (Montarzino et al., 2007; van Holstein et al., 2020). Thus, the implementation of accessibility measures becomes vital for people living anywhere in this complex suburbanization that sprawl has created, especially for vulnerable collectives, such as PWD, but also for the elderly, kids, and youngsters (Biglieri, 2018; Katzman et al., 2020).

The urban contexts where entrances or stops are found, their architectural characteristics, and their level of inclusivity in terms of services can be decisive to achieve urban accessibility (Montarzino et al., 2007; Peña Cepeda et al., 2018). However, none of the aforementioned cases of sprawls indicated the level of inclusiveness of the stops on their maps, preventing people from knowing beforehand whether a certain stop is going to be accessible for all people or not.

For this article, 3 concepts related to accessibility are being considered to guide the analysis of how inclusive all these different environments are:

- Accessibility (Americans with Disabilities Act (ADA), 2002): the collection of characteristics of a space that allows equity, comfort, and safety for all users, particularly for people with disability.
- Partial accommodations (Consejo Superior de Investigaciones Científicas & Ministerio de Fomento, 2019): referring to those spaces that were not built under accessible criteria, but that have incorporated a limited number of measures to improve accessibility, although neglecting to

Figure 1. Map 2020. Source: Cercanías Madrid.

accomplish a complete accessibility chain.
- Inclusive design (Clarkson et al., 2013): the set of characteristics of a place designed under design for all criteria, to provide no discrimination or segregation of any kind towards anyone, regardless of their age or abilities.

In this context, Madrid is going to be analysed as an example of these accessibility deficits in their public transport networks. Thus, Madrid's case can serve as a model to analyse the impact of inaccessibility tendencies and the role of public transport on helping or hindering people's urban mobility, since their network maps do present graphic information on the level of inclusiveness of their stops.

III. CASE STUDY

The development of Madrid's train network has been greatly influenced by changes in the city's demography and urban fabric, using it to connect all its sectors. Ageing, immigration, and new city developments constitute the main concerns in Madrid's urban accessibility.

In the 1990s, Spain started suffering the consequences of the 'inverted pyramid phenomena' and people living longer (Jiménez, 2015; Pérez Díaz, 2010). The number of people with diseases caused by, or resulting in, disabilities due to ageing increased in a very short period (Galarza & Díaz, 2010; Gutiérrez et al., 2001). These people commonly experience a reduction in
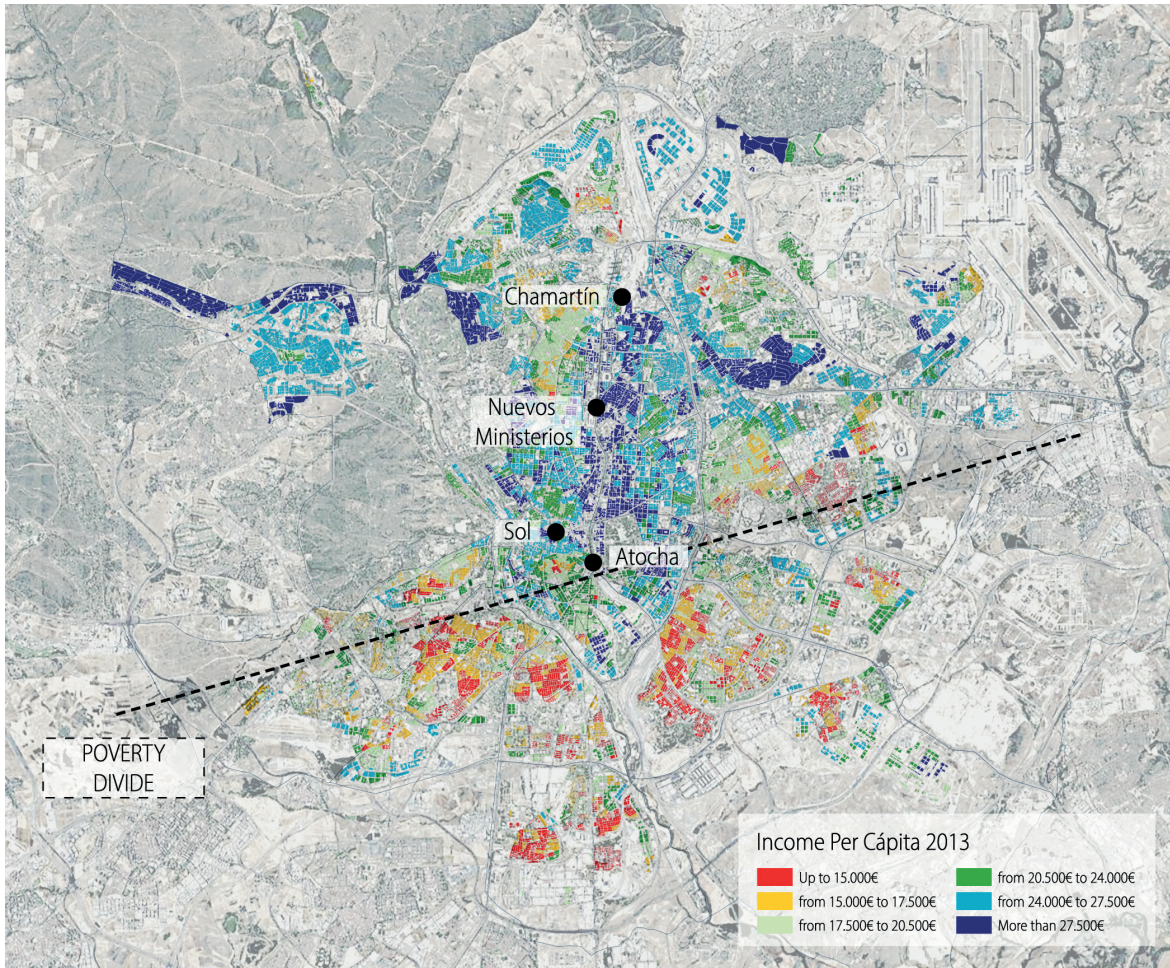
Figure 2. North-South Poverty Divide in Madrid, with the main train stations highlighted. Source: Ayuntamiento de Madrid, 2013. Preparation by the Author, 2021.

mobility, sensorial, or cognitive capacities (Palacios-Ceña et al., 2012), forcing governments to raise awareness of their needs to accommodate everyone.

In parallel, the population of Madrid increased from 2,293,742 in 1960 (de Terán, 1993), to 5,378,750 in 2010 (Comunidad de Madrid, 2011), mainly domestic migrants and international immigrants, who opted to live in the suburbs, 30 to 50 kilometres away from the city centre, because of its low urbanization and construction costs.

In 1982, the first Railway Masterplan for Madrid sought to create new stations that could accommodate these new developments (Lerma Rueda, 2002). Brand-new public transport hubs drew people into the city centre, where the major infrastructures and services were located (Carrillo

Jiménez, 1998; Lamíquiz Daudén et al., 2017). Its result is still patent today with a complete and complex railway network that connects multiple urban areas using a spiderweb pattern that stretches out from the city centre into the suburbs (Figure 1).

However, the "Madrid North-South Poverty Divide" or "Diagonal de la pobreza de Madrid" in Spanish (Oficina del Sur y Este de Madrid & Ayuntamiento de Madrid, 2019) (Figure 2) has fostered disparities between richer northern districts and poorer southern ones, which have been examined from multiple angles: sociological (Leal, 2004; Ruiz Chasco, 2018), economic (Leal & Sorando, 2015), and environmental (Ajuriaguerra Escudero & Ramírez Saiz, 2021). It has also made the southern districts more likely to have deficiencies in their commuting services and infrastructures, including quality of the urban space, train services, and accessibility levels in stations.

Applicable regulations for Madrid's train network

There are different Spanish and Madrilenian regulations from multiple fields that affect train stations. While some apply directly to people and their rights, others refer to the minimum measures required for construction and public works, the most relevant ones for this article being the following three:

- In 2007, specific criteria on train stations and carriages were registered in RD 1544/2007 "Basic conditions of accessibility and non-discrimination for access and use of all means of transport for people with disabilities" (Condiciones Básicas de Accesibilidad y No Discriminación Para El Acceso y Utilización de Los Modos de Transporte Para Personas Con Discapacidad, 2007).
- In 2010, the government published an accessibility appendix for the Technical Building Code (CTE, in Spanish) for indoor and outdoor spaces, which mostly relies on the application of reasonable accommodations (Ministerio de Fomento, 2019).
- In 2013, the General Law on PWD's rights and their social inclusion (Ley General de Derechos de las personas con discapacidad y de su inclusión social., 2013) was approved to boost social inclusion and the addition of inclusive design to accommodate all people, regardless of their abilities.

In parallel, Renfe and Adif, the operators of Cercanías' train services, have implemented numerous projects to improve accessibility measures in their stations in recent years (Adif et al., 2018; Juncà Ubierna, 2013). Although major investment has been made, many reports have pointed out the level of inaccessibility that Cercanías Madrid still has (CERMI, 2020).

IV. METHOD

The analysis has been based on studying different Cercanías maps from July 2009, when the first map showing accessible stations was published, to September 2020. By revising them, it was possible to examine the evolution that Cercanías has provided through their maps over the period.

For this, both the percentage and number of stations considered accessible under Cercanías' criteria have been added up. These data are supported by the creation of "accessible train network maps", where the non-accessible stations have been removed, as they present challenges for PWD. This process triggered conclusions about the

Figure 3. Accessibility icons reflecting the 4 categories contemplated in Cercanías maps for their train stations. Source: Prepared by the Author, 2021.

accessibility situation in Madrid's train network and its evolution, both quantitative and graphic, and sets a methodological example to analyse other contexts.

Materials

The maps for this study were provided by Cercanías Madrid via email. Only schematic maps have been considered in this study. Both geographical and multimodal graphics were excluded from the analysis for not showing information regarding accessibility or displaying too much unnecessary information, respectively.

Additionally, Cercanías has published reports with information on which stations and lines are inclusive since 2009, indicating the train models that had accessibility measures (Adif et al., 2009, 2018). Cercanías also use different kinds of icons to show whether they consider a station accessible or not, as well as if the trains running through them are designed considering accessibility criteria (Ministerio de Fomento, 2019). In this way, some stations may be accessible whilst the carriages running through them are not. These aspects will be taken into consideration while classifying the different stations.

All the maps considered were processed using editing tools to highlight the stations and train lines that had accessibility measures. This will provide a time-lapse of the accessible train network.

Collecting quantitative data

According to the information provided by Cercanías Renfe, there are four different categories in which train
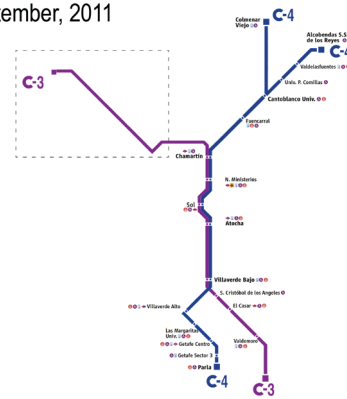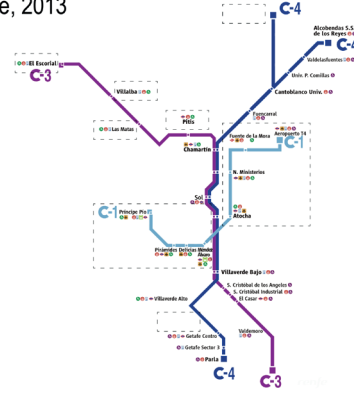
July, 2009 · January, 2010 · September, 2011 · April, 2012 · June, 2013 · December, 2015

Advances in the train network

Figure 4a. Summary of map analysis 2009-2015. Source: Cercanías Madrid. Edited by the author, 2021

stations can be classified in terms of accessibility (Figure 3):

- Completely accessible stations: these refer to those stations that have adopted all the required accessibility measures, aligned with local and national regulations.
- Accessible stations without accessible train carriages: here the train that runs through them cannot be guaranteed to have the required accessibility mechanisms.
- Stations with some accommodations: such

as lifts or lifting platforms, but no other inclusive mechanisms.
- Non-accessible stations: without even partial accessibility measures.

The procedure involved adding up the total number of stations in each of the 4 categories, and presenting the results in numeric and percentage form. A further discussion on the suitability of these categories will be undertaken in the discussion section, as well as their connection to regulatory changes.

April, 2016
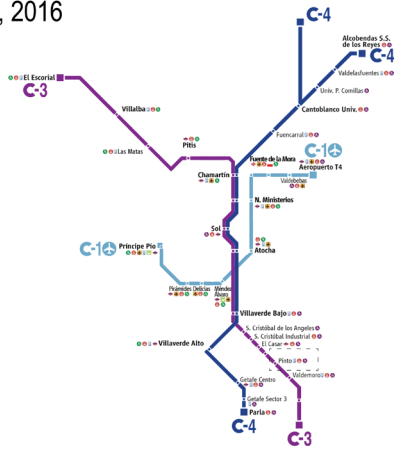
February, 2018

November, 2018
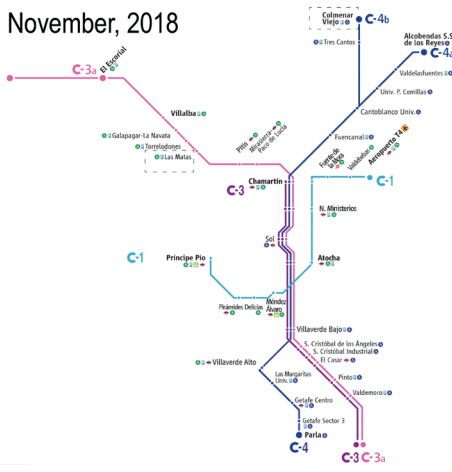
September, 2020
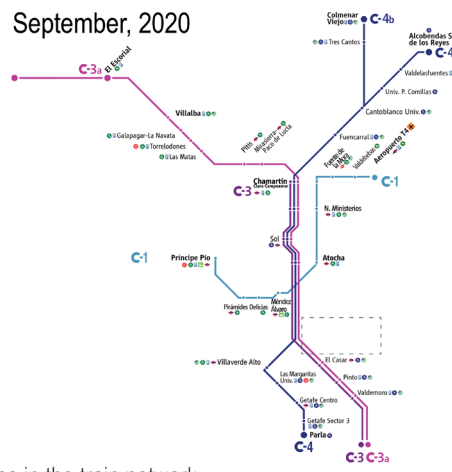
$\boxed{}$ Advances in the train network

Figure 4b. Summary of map analysis 2016-2020. Source: Cercanías Madrid. Edited by the author, 2021

V. RESULTS

Map analysis

The first map from July 2009 emerged from the Cercanías Accessibility Plan for 2007-2010. It was the first map to show some information regarding accessibility measures in the network. Previously, there had been no mention of partial or complete accommodations in any other previous maps or plans.

Each separate map, as shown in the next figure (Figure 4), was analyzed graphically, removing all the stations and lines except for the accessible ones. Thus, each of those maps only displays the stations that could be used by everyone.

The comparison of all the maps from 2009 to 2020 reveals that accessibility, in general terms, has improved.

In 2009, the accessible stations were mainly on lines C3 and C4, connecting the northwest and south of Madrid. The southern half has greater development, generating multimodal

Map date	Total number of stations	1. Accessible Stations (with and without accessible trains)	2. Accessible stations with accessible trains	3. Stations with some accommodations	5. Non-accessible stations
July 2009	97	19 de 97	19 de 97	32 de 97	45 de 97
		20%	20%	33%	46%
January 2010	96	19 de 96	19 de 96	32 de 96	44 de 96
		20%	20%	33%	46%
September 2010	89	21 de 89	19 de 89	30 de 89	38 de 89
		24%	21%	34%	43%
April 2012	89	21 de 89	19 de 89	30 de 89	38 de 89
		24%	21%	34%	43%
June 2013	89	33 de 89	16 de 89	17 de 89	37 de 89
		37%	18%	19%	42%
December 2015	92	33 de 92	17 de 92	17 de 92	42 de 92
		36%	18%	18%	46%
April 2016	92	34 de 92	19 de 92	19 de 92	39 de 92
		37%	21%	21%	42%
February 2018	92	39 de 92	17 de 92	19 de 92	35 de 92
		41%	18%	21%	38%
November 2018	95	56 de 95	18 de 95	11 de 95	28 de 95
		59%	19%	12%	29%
September 2020	95	54 de 95	15 de 95	14 de 95	27 de 95
		57%	16%	15%	28%

Table 1. Data summary on level of accessibility in each map studied between 2009 and 2020. Source: Prepared by the author, 2021.

connections with tram services at Parla Station and underground at Villaverde Alto.

From that moment up to 2013, the south of Madrid shows no sign of improvement, while the city centre and North upgrades sped up and even incorporated a new accessible train line that connects the east and west of Madrid. Line C1 became accessible too, including strategic stations like Principe Pio's hub and Adolfo Suárez T4 Airport, which represent key connection points for visitors (tourism and business-related).

From 2013 to 2018, there are no major variations, except for the inclusion of different stations, and the exclusion of others. In 2015, there seems to be a decrease in the number of accessible stations, before these recover their status again in later years. This is the case of Las Margaritas in the South, or Tres Cantos in the North.

In 2018, Cercanías Madrid presented an accessible train map with a high proportion of accessible stations. However, some of them disappear in September 2020 in the southern half of the C3 line. The resulting map of 2020 shows a greater process with accessible stations in the north of Madrid, while the south presents fewer accessible stations than in other periods.

Quantitative data

After analyzing the different train maps from 2009 to 2020, the data extracted has been presented as follows (Table 1), and has been graphically interpreted (Figure 5):

Regarding the number of accessible stations, out of 95, only 15 stations are considered completely accessible today, including both the station and the trains themselves. This means that all people, regardless of
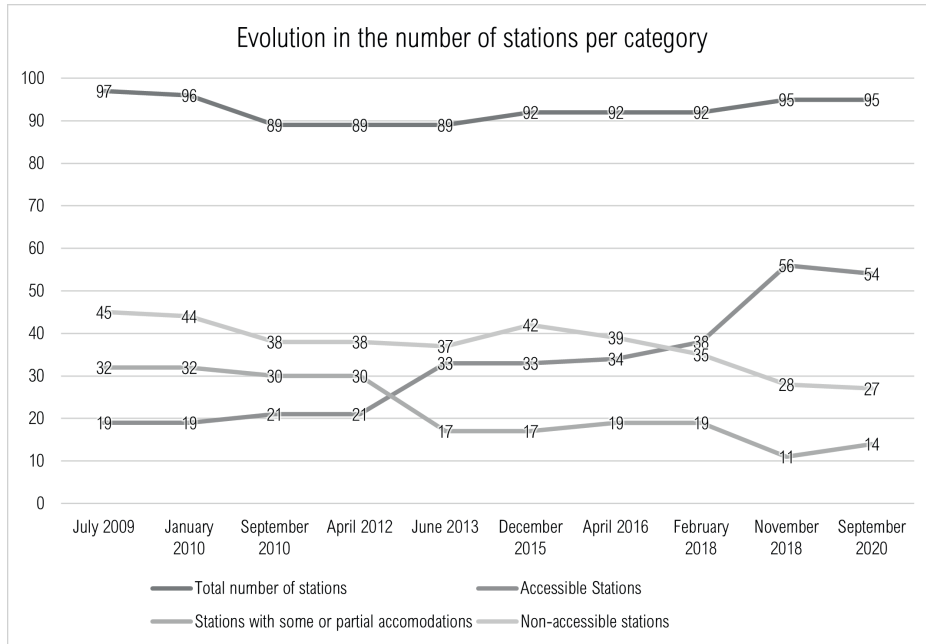
Evolution in the number of stations per category

Figure 5. Evolution in the number of stations per main categories of study in Cercanías Madrid. Source: Preparation by the author, 2021.

their physical, sensorial, or cognitive characteristics, could move using less than 16% of the entire train network.

The variation in the chosen period has been minimal between maps, except for June 2013 and November 2018. It is also clear that 2018 was a tipping point in the studied period, since previous years had suffered few variations in the number of accessible stations (Figure 5).

From November 2018 to September 2020 the upward trend reversed, and the number of accessible stations decreased from 56 to 54. Likewise, the number of accessible stations covered by accessible lines also descended from 18 to 15 (Table 1).

In 2020, 14 stations offer partial accommodations, meaning 15% of the network is partially accessible. These measures guarantee a minimal accessibility in the built surroundings, but not for the entire route inside the station. Most of these stations managed to install either a lift or a lifting platform to guarantee that PWD can change platforms. However, the station as a whole is not accessible, which will often mean that some services would be difficult to reach and, therefore, that the area is not provided with accessible mobility infrastructures.

VI. DISCUSSION

Looking at the graphic representation of the number of accessible stations in Madrid's train network, as shown in Figure 4, it is clear that in 2009 most stations were either not or just partially accessible. However, as time went by, those stations adopted accessibility measures, which is the dominant category represented in the last version of the train network map. The level of accessibility has increased from 19 accessible stations in 2009 to 54 in September 2020.

From February 2018 to November 2018, the number of accessible stations went from 38 to 56. This increase was also materialized in the number of non-accessible stations, decreasing from 35 to 28 between those months. It must be considered for a better understanding of this sudden change that the RD 1544/2007 *"Basic conditions of accessibility and non-discrimination for the access and use of all means of transport for people with disabilities"* established the end of 2018 as the deadline to implement major accessibility measures in stations with 1,000 or more passengers per day. This target date seemed to have had a greater effect on the improvement of these

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	07-2009	01-2010	09-2011	04-2012	06-2013	12-2015	04-2016	02-2018	11-2018	09-2020
El Escorial					■	■	■	■	■	■
Las Zorreras					■	■	■	■	■	■
Villalba					■	■	■	■	■	■
Galapagar – La Navata					■	■	■	■	■	■
Torrelodones					■	■	■	■	■	■
Las Matas					■	■	■	■	■	■
Colmenar Viejo	■	■	■	■					■	■
Tres Cantos					■	■	■	■	■	■
Alcobendas S.S de los Reyes	■	■	■	■	■	■	■	■	■	■
Valdelasfuentes	■	■	■	■	■	■	■	■	■	■
Univ. P. Comillas	■	■	■	■	■	■	■	■	■	■
Cantoblanco Univ.	■	■	■	■	■	■	■	■	■	■
Fuencarral	■	■	■	■	■	■	■	■	■	■
Pitis									■	
Paco de Lucía								■	■	■
Fuente de la Mora			■	■	■	■	■	■	■	■
Valdebebas								■	■	■
Aeropuerto T4			■	■	■	■	■	■	■	■
Chamartín	■	■	■	■	■	■	■	■	■	■
N. Ministerios	■	■	■	■	■	■	■	■	■	■
Sol	■	■	■	■	■	■	■	■	■	■
Atocha	■	■	■	■	■	■	■	■	■	■
Príncipe Pío					■	■	■	■	■	■
Diagonal de pobreza de Madrid										
Méndez Álvaro					■	■	■	■	■	■
Delicias					■	■	■	■	■	■
Pirámides					■	■	■	■	■	■
Villaverde Bajo	■	■	■	■	■	■	■	■	■	
S. Cristóbal de los Ángeles	■	■	■	■	■	■	■	■	■	
S. Cristóbal Industrial					■	■	■	■	■	
Villaverde Alto	■	■	■	■	■	■	■	■	■	■
El Casar	■	■	■	■	■	■	■	■	■	■
Las Margaritas	■	■	■	■	■		■	■	■	■
Getafe Centro	■	■	■	■	■	■	■	■	■	■
Pinto							■	■	■	■
Valdemoro	■	■	■	■	■	■	■	■	■	■
Getafe Sector 3	■	■	■	■	■	■	■	■	■	■
Parla	■	■	■	■	■	■	■	■	■	■

Table 2. Year-by-year evolution of completely accessible stations in the Train Network of Madrid from July 2009 to September 2020, divided by the North-South Poverty Divide in Madrid. Source: Preparation by the author, 2021.
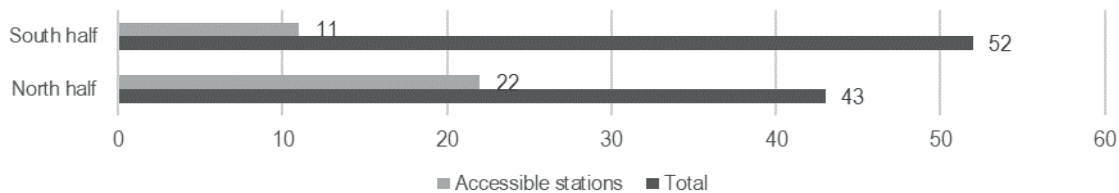
Figure 6. Ratio of accessible stations run by at least one line of accessible lines on both sides of the Madrid poverty divide. Source: Preparation by the author, 2021.

public transport accessibility measures. On the other hand, it could be discussed whether the increase was due to real accessibility improvements, or due to an easing in accessibility standards.

A similar scenario could be found earlier in 2012-2013, when there was another noticeable increase in the number of accessible stations, which also overlaps with the approval of RD 1/2013 for the General Law of PWD rights and their social inclusion (Ley General de Derechos de Las Personas Con Discapacidad y de Su Inclusión Social, 2013). However, in this case, the impact was softer, raising the number from 21 to 33 in one year.

It is also important to highlight that by 2020 there are still some lines with few accessible stations, such as the C5 line, and others that cannot provide accessible trains, such as lines C2, C7, C8, and C10. Some key stations still have no accessibility services, as happens in Recoletos, Aranjuez, or Ramón y Cajal, although all of them have a high use for different reasons, such as centrality, tourism, or healthcare. This represents a problem, inasmuch as citizens cannot access these public services by train because of low inclusivity in their services.

Looking at the number of non-accessible stations, some stations can still be categorized as non-accessible despite the number of Masterplans that Madrid has implemented. In more than a decade, the percentage of non-accessible stations has only decreased from 46% to 28%. This contradicts several national regulations which state that accessibility measures must have been implemented in every type of public transportation before the specified deadlines.

By developing different plans and regulations, the implementation of more accessibility actions was undertaken in multiple stations to meet the requirements. As Table 2 suggests, the moments

where things have sped up, have managed to create a more inclusive train network, although it was due to government imposition.

As shown in the table (Table 2), most of the stations that are currently accessible were built under those regulations, and have maintained their status through the years. So, although some have appeared and disappeared on the schematic maps as seen in previous sections, the reality is that the train network in Madrid is a consequence of the approval of those regulations.

However, there have been some variations in the consideration of some stations as accessible or non-accessible. There have been 6 cases in the studied period, that have varied their accessibility status :

- Torrelodones (2013, 2018-2020)
- Tres Cantos (2013, 2018-2020)
- Villaverde Bajo (2009-2018)
- San Cristóbal de los Ángeles (2009-2018)
- San Cristóbal Industrial (2012-2018)
- Las Margaritas (2009-2013, 2016-2020)

As it was suggested in previous sections, and having a closer look at the dates, it is clear that the publishing of the different regulations had a remarkable influence on the stations being categorized as accessible. The constant approval of different local, national, and international regulations is bound to have had an impact on the criteria under which stations were labeled as accessible. It is necessary to highlight that many guides and handbooks were published and many main city halls across the country were advised to follow them, which may result in different indicators each time these documents were changed or updated.

This table also reveals the accessibility disparities between the South and the North of the Madrid poverty divide, which was summed up in Figure 6.

Figure 7. Poverty Divide on 2020 map, adjusted to the real geographical situation. Source: Prepared by the author (2021) based on material provided by Cercanías Madrid (personal communication, January 29, 2021) and the Poverty Diagonal (South and East Madrid Office and Madrid City Hall, 2019). Madrid and Madrid City Council, 2019).

Even though there were earlier accessibility measures in the South of the Community, in later years, the differences between these two poles have broadened, and the North has developed as the area with a higher number of accessible infrastructures (Figure 6). This problem is also visible when comparing the maps in Figure 4, which shows greater development of the network in the North than in the South, and in the following map representing the divide over the Cercanías map (Figure 7).

Although there were a similar number of accessible stations at the beginning, as time went by, the North of that divide developed a higher number of accessible stations. In other words, the resulting accessible train network provides greater mobility for people from the North than from the South of Madrid, highlighting the inequalities there are between these two poles. This has also led to higher discrimination rates since the opportunity to access different services is lower for people

living in the South than for those living in the North of this divide (Figure 2).

VII. CONCLUSION

Currently, the accessible train network of Madrid is limited and unconnected, offering insufficient accessible coverage for all the users demanding the service in Madrid. This situation creates mobility inequalities throughout the territory and, especially, between the North and South urban areas of Madrid.

As this study has shown, although the evolution has been positive up to November 2018, there are consistency issues that the analysis has highlighted, such as the accessibility status changing between periods. The fluctuations presented in very short periods must also be revised to maintain a consistent level of accessibility. In other words, further objectives in terms of accessibility measures may need to be implemented, so that any updated criteria do not affect the physiognomy of Cercanías Madrid's maps as much as they currently do.

All these points must be considered without losing sight of the fact that several deadlines have gone by for the train network to be accessible. However, the reality is that only around half the stations guarantee full access to their services, and only 1 out of 4 of these are served by accessible trains.

As a whole, this study has shown that even populated cities, with accessibility train plans, may have deficits in their inclusion management. This can reduce urban mobility for all people, worsening the effects of sprawl for vulnerable collectives who need public transport.

The socio-economic differences between different sections of the city also create disparities in how inclusive mobility can be, since monetary status may determine the provision of adequate accessible infrastructure.

The methodology used to reach this conclusion seems to have delivered specific results for one of the multiple cities suffering the consequences of city-expansion trends. Furthermore, it can provide a source of information for people of different ages and abilities through the graphical information provided.

However, it has been clear that the variations between different periods may be the result of deadlines that had to be met, but that really had real little impact on the actual level of accessibility in the train network. Therefore, this methodology must be combined with further research, and case studies should be undertaken to determine the exact level of accessibility the train network has, thus creating a clearer map of how inclusive this infrastructure is.

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