JIM: Jurnal Ilmu Multidisiplin
E-ISSN : 2829-4580
P-ISSN : 2829-4599
GREENATION PUBLISHER
+62 812 1046 7572 http://greenpub.org greenation.info@gmail.com
DOI: https://doi.org/10.38035/jim.v3i4

Analysis of Feeder Train Travel Planning to Support Service (Whoosh) on the Bandung – Padalarang Line

Agus Nugroho[1], Prayudi[2], Ahmad Fauzan Gunawan[3]
[1]Faculty of Management and Business, Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia
[2]Faculty of Management and Business, Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia
[3]Faculty of Management and Business, Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, afggoen@gmail.com

Corresponding Author: afggoen@gmail.com[3]

Abstract: Transportation makes the backbone of a country's economic and social development In Indonesia, improving transportation infrastructure is one of the priorities to support prolonged economic growth. One of the major breakthroughs in the field of transportation in Indonesia is the development of high speed trains (fast trains), which is expected to provide a solution to the mobility needs that are currently very high between big cities. In reality, the train does not route from the center of Jakarta and the center of Bandung City, so a supporting mode is needed, which in this case is the Bandung-Padalarang feeder train. In order to facilitate the process of designing the feeder train travel line/adwal, this study uses JtrainGraph software. This study also uses a quantitative descriptive method. The results of the analysis show that the current Bandung-Padalarang crossing capacity is sufficient to accommodate the increase in the frequency of feeder train trips. However, it is necessary to adjust the schedule and operation arrangements to ensure optimal connectivity between the feeder train and the high-speed train service (Whoosh), so that the journey/operation of the feeder train has been planned in the form of travel lines or schedules using the Jtraingraph software as mentioned above. This study provides input on the adjustment of feeder train schedules/trips and related trains that are important for the development of railway operations on the Bandung-Padalarang route to support better service integration.

Keywords : Feeder, Cross Capacity, Jtraingraph, Whoosh

INTRODUCTION

Trains are a means of transportation in the form of vehicles with kinetic energy, either running alone or coupled with other vehicles, which will or are moving on rails. Trains are a means of mass transportation that generally consists of a locomotive (a vehicle with kinetic energy that runs alone) and a series of trains or carriages (coupled with other vehicles). The series of trains or carriages are relatively large in size so that they can accommodate many passengers or goods on a large and large scale. (Hidayat, 2019)

Transportation is the backbone of a country's economic and social development. In Indonesia, improving transportation infrastructure is one of the priorities to support sustainable economic growth. One of the major breakthroughs in the field of transportation in Indonesia is the development of high-speed trains, which are expected to provide solutions to the need for mobility which is currently very high between big cities.However, there is a problem faced by high speed trains, namely that the high speed train does not enter the heart of Bandung or Jakarta. Therefore, there is a need for intermodal, namely feeders to support the high speed train service (whoosh) in order to facilitate and accommodate passengers to go to the city center, so feeder trains play an important role in completing the high speed train journey, ideally the number of feeder train trips is the same as the number of high speed train trips.

Feeder trains are trains operated by PT. Kereta Api Indonesia, Operational Area II Bandung as the operator with a route from Bandung to Padalarang. So that sufficient capacity is needed to support the smoothness and service of fast trains, this is the reason the author conducted a cross-capacity analysis which is also for the operation of feeder trains. This aims to support fast train passenger services so that they are more easily accessible to passengers, so that they are accommodated from and to the heart of Bandung.

Taking advantage of technological advances and to facilitate the creation of travel planning (lines), in this case the existence of relevant software technology, namely Jtrainsgraph, is the author's choice in completing this thesis.

To find out whether the available capacity of the line between Bandung and Padalarang is sufficient for the needs of feeder train travel so that it is able to support fast train (whoosh) travel services, the author conducted research and analysis with the title "Analysis Of Feeder Train Travel Planning To Support (Whoosh) Services On The Bandung - Padalarang Line"

Literature Review

The results of the research conducted (Hidayat, 2019) entitled Development of a Model to Calculate Railway Line Capacity in Indonesia (Case Study of the North Java Line Pasarturi Station-Bojonegoro Station) discuss the capacity of single and double tracks between Surabaya Pasar Turi - Bojonegoro on the double track is quite large, with the smallest capacity value on the Babat - Bojonegoro line, which is 39 trains/day. While the largest capacity value is on the line between Surabaya Pasarturi - Kandangan, which is 131 trains/day.

The results of the research conducted (Jamaludin et al., 2019) entitled Analysis of Electric Train Trips on the Manggarai-Bogor Line, which discusses the number of Electric Train trips on the Manggarai-Bogor line as many as 321 trains/day with a maximum capacity of 403 trains/day. Of the total number of trips, there are 3 types of stamformations, namely stamformation 8, stamformation 10, stamformation 12. The total transport capacity of all stamformations reaches 455,904 passengers every day.

The results of the research that has been conducted (Darojat & Ramdan, 2021) entitled Double Track Crossing Capacity discusses the Lampung-Palembang Railway line as a line with a very high crossing capacity. This capacity is measured from the number of train sets passing through the line, which has been planned to reach more than 59 sets. Currently, the density of the line reaches up to 100 train sets.

The results of the research that has been conducted (Fadhlan, 2023) with the title Analysis of Capacity Development Planning Based on Replacing Mechanical Signals with Electrical Signals at Merapi Station, where the use of electrical signaling can increase the crossing capacity with a total increase of 28% on each section of the Banjarsari - Merapi road by: 15 capacity and the Merapi - Sukacinta road section by: 12 capacity and for Merapi Station it is in accordance with the prepared railway program

TrainTravel grafik

According to the Ministry of Transportation, 2017 In (Dewi, 2020) Train travel scheduling in Indonesia is stated in the Train Travel Chart (Gapeka) made by the infrastructure owner, for the railway network operated by PT. Kereta Api Indonesia (Persero), Gapeka is made by the government in this case the Directorate General of Railways. However, if the infrastructure is owned by a business entity, then Gapeka is prepared by the business entity and approved by the Minister, Governor, or Regent/Mayor according to their authority.

The data required to compile Gapeka consists of various types, including:

a. data on the availability and condition of railway infrastructure
b. data on the availability and condition of railway facilities
c. data on railway traffic; and
d. data on demand for passenger and goods transportation

Cross capacity

According to the Ministry of Transportation in (Hidayat, 2019) the capacity of a railway line can be interpreted as the maximum capacity of a railway line to accommodate a number of train trips within 24 hours or within a certain time period. In addition, the term maximum capacity of a station is known to accommodate a number of train trips within 24 hours or a certain time period. Supriadi stated in (Budhi, 2020) that the capacity of a railway line is the ability of a railway line to accommodate train operations within a period of 1440 minutes. The unit of calculation of the capacity of the line can be expressed in trains/hour or trains/day

Formula review

Every formula or formula must have a purpose and must be applied according to that purpose. This is the result of the railroad capacity formula. This formula must be applicable to the design of the right train journey.

1. Single track

$K = \frac{1440}{H} x\ n$

2. Doubel track

$K = \frac{1440}{H} x\ 2\ x\ n$

3. Headway value

$H = t_{a-b} + t_p + C$

K = which is the capacity of the calculated road section or the capacity of the route if the lowest K value is taken with 1440 which is the total time
H = is the headway (minutes)
N = is the multiplier factor after deducting the time factor for maintenance and time due to the train travel operation pattern of 60% (single track) and 70% (double track)
t_(a-b) = is the train travel time between station A and station B (minutes).
t_p = is the travel time from before the front signal of station A for the second train (distance 3 km) (minutes).
C = is the block and signal service time (minutes)

The Objectives of the Study

In this study, there are several objectives to be achieved to find answers to the questions mentioned in the sub-problems above, including the following:

a. To analyze and determine the capacity of the Bandung-Padalarang route.

b. To determine the availability of slots and the need for train travel slots, based on the capacity of the route, the number of existing train trips, and the need for additional feeder train trips.
c. To prepare feeder train travel planning to support the Fast Train (Whoosh) service and formulate feeder train trips.

METHOD

This research is a descriptive study with a quantitative approach. According to V Sujarweni Wiratna in (Fadlan, 2023) Quantitative research is a type of research that produces findings that can be obtained through statistical procedures or other methods of quantification (measurement). Meanwhile, the definition of Qualitative Research Method, according to Sugiyono in (Fadlan, 2023) is a research method based on the philosophy of positivism, used for research on certain populations or samples, data collection using research instruments, data analysis is quantitative or statistical. This research method uses a quantitative method because the data to be processed is a data ratio and the focus of this research is to determine the magnitude of the influence between the variables studied.

The method used in this study is a quantitative descriptive method, quantitative descriptive analysis is by analyzing data by describing the data that has been collected in the form of a table which will later be calculated. In the research method there is a procedure/steps that will be related to each other, the steps that are arranged correctly will determine the solution to the problem later.

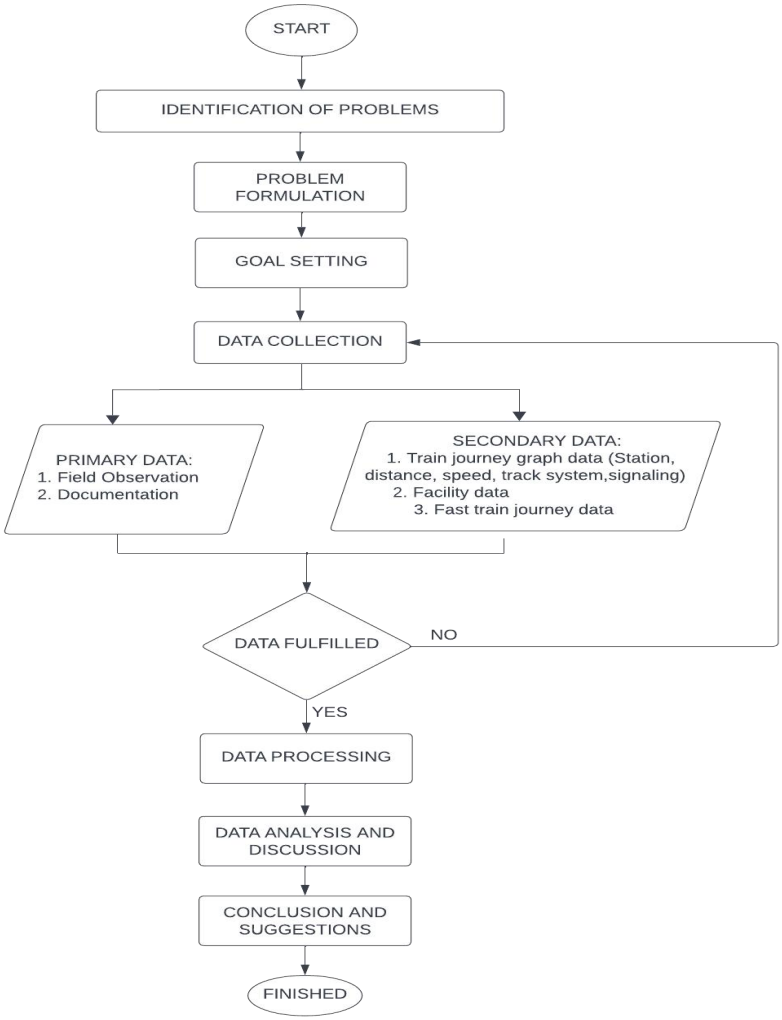

Figure 1 Research Path

RESULT AND DISCUSSION

This chapter contains the data that has been obtained, both primary and secondary data, as well as the analysis and discussion process. What is explained and discussed in this chapter is the calculation of the Crossing Capacity on the Bandung - Padalarang road section

Cross Capacity Analysis

Train Travel Chart (Gapeka) is used to represent the movement of trains along with the time to the position of each train. Headway is the most important part to analyze the capacity of the crossing. In this Headway formulation, it is attached to the track system and also the type of signaling used, the existing conditions in Gapeka 2023 will be used to manage the calculation of time intervals.

Table 1.Traffic Data and Infrastructure Speed at GAPEKA 2023

Section	Railway Segment	Distance (km)	Infrastructure Speed
Bandung - Padalarang	Bandung – Andir	2.729	105 km/h
	Andir – Cimindi	2.393	
	Cimindi – Cimahi	3.055	
	Cimahi – Gadobangkong	3.331	
	Gadobangkong – Padalarang	3.154	

Source : (Daop II Bandung Operations Unit, 2023)

Table 2 Graph Speed Data (Vops)

No	Train Type	Speed (Vops) (km/h)
1	Passenger Train	90 km/h
2	Freight Train	80 km/h
3	Optional Train	90 km/h

Source : (Daop II Bandung Operations Unit, 2023)

Cross Capacity and Headway Calculation

Based on the 2023 Railway Travel Chart (Gapeka) data on sheets II-1A (04.00-08.00), II-1B (08.00-16.00) and II-1C (16.00-24.00). Researchers limit the calculation of headway and crossing capacity as follows:

a) only on the Bandung – Padalarang route

As for the determining road section (is a part of the rail line located between two adjacent stations and determines the capacity of the crossing), which is used in this study is the Cimahi-Gadobangkong road section. This determining road section was chosen because the travel time is the longest on the route, it is influenced by:

a. Distance
b. Speed

As for data on the number of train trips on the route, there were 77 train trips.

Table 3 Number of Trains Data

No	Train Type	Quantity	Remarks
1	Passenger Train	73	(30 Long-Distance Trains and 43 Local Trains)
2	Freight Train	2	
3	Service Train	-	
4	Optional Train	2	
TOTAL		77 Trains/Day	

Source : (Gapeka, 2023)

Based on the data above, in this analysis the researcher only uses Gapeka 2023 and assumes all trains are running (Regular Trains and Optional Trains are running) to calculate the line capacity and headway from Bandung to Padalarang.

Calculation

a. For the calculation of the speed of Cimahi – Gadobangkong

Vrata2= $v = \frac{(2\ x\ 50)+(2\ x\ 46)+(30x60)+(43\ x\ 39{,}5)}{77}$

$v = \frac{100+92+1800+1698}{77}$

$v = \frac{3690}{77}$

v = 48 Km/ jam

b. Headway Calculation Cimahi - Gadobangkong

In this calculation it is assumed that C = 1 minute (electrical signal),
with the value rounded up.

$H = \frac{0{,}06\ x\ (S_{A-B} + S_P)}{v} + C$

$H = \frac{0{,}06\ x\ 3331 + 2750)}{48} + 1$

$H = \frac{0{,}06\ x\ 6081}{48} + 1$

$H = \frac{364{,}86}{48} + 1$

H = 7.6 + 1= 9 menit

The value for calculating the Headway on the Bandung – Andir road section is 9 minutes.

c. Calculation of 24-Hour Crossing Capacity of Cimahi - Padalarang

With rounded down values.

$K = \frac{1440}{H} x\ 2\ x\ 0{,}7$

$K = \frac{1440}{9}\ x\ 2\ x\ 0{,}7$

K = 160 x 2 x 0,7

K = 320 x 0,7

K = 224 KA/hari

As for the capacity of the Cimahi – Gadobangkong route, it is 224 trains/day.

Table 4 Headway and cross capacity table

No	Section	Critical Track Segment	Headway (minutes)	Capacity (24 hours) (trains/day)
1	Bandung - Padalarang	Cimahi - Padalarang	9	224

Source : (Researcher, 2024)

realistic travel time Cikuray Train departuring Pasar Senen - Garut to predetermined schedule.

Calculation of Used Capacity and Remaining Capacity

a. Capacity Used

The capacity that has been used for travel or the actual picture of the actual traffic that applies to the operation of a route. This picture is in the form of the number of trips in Gapeka 2023 with the maximum capacity that can pass through the route within a period of 1 (one) day.

Table 5 Used Capacity

No	Lintas	Petak Jalan penentu	Kapasitas		Total Kapasitas Tersisa
			Kapasitas Maksismum	Kapasitas Terpakai	
1	Bandung-Padalarang	Cimahi - Gadobangkong	224	77	99

Source : (Researcher, 2024)

The table above shows that the capacity used on the Cimahi – Gadobangkong determining road section is 77 trains/day. Where there is still remaining capacity that can be used for other train trips.

b. Remaining Capacity

The remaining capacity is the remaining capacity on the road section or is still available to add train trips, the remaining capacity is calculated from the maximum capacity with the used capacity. Therefore, the remaining capacity uses the following formula:

Remaining capacity = Maximum capacity – Used capacity – Feeder requirements

Remaining capacity = KA/day

1. Cimahi – Gadobangkong road section

   Remaining capacity = 224 - 77 - 48

   Remaining capacity = 99 trains/day

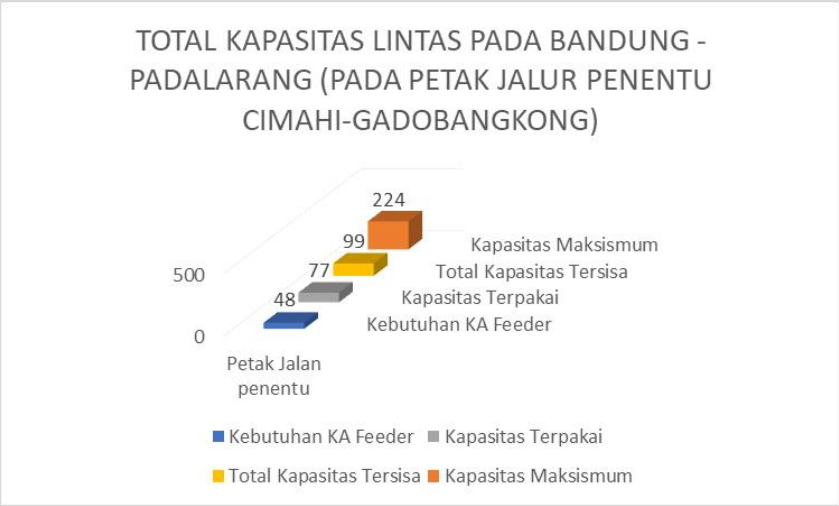

Figure 2 Total Capacity on the Bandung-Padalarang Crossing

Source : (Researcher, 2024)

Based on the Table and calculation of Crossing Capacity, the calculation results are as follows:

a. Crossing Capacity : 224 trains
b. Running trains (Regular + Optional) : 77 trains
c. Remaining Capacity : 99 trains
d. Feeder Travel Needs : 48 trains

From that, the total remaining crossing capacity from the reduction of Crossing capacity, running trains, remaining capacity and feeder train travel needs on the Cimahi - Padalarang determining road section is 99 trains

CONCLUSION

a. The results of the analysis of the Bandung-Padalarang line capacity data, with the capacity of the determining road section being Cimahi - Gadobangkong, which is 224 trains, with trains running according to Gapeka, which is 77 trains, then the total available line capacity from the determining road section Cimahi-Gadobangkong is 147 trains/day.
b. The number of feeder train trips needed to adjust to the number of fast train trips of 48
c. With the availability of a Crossing Capacity of 147 trains/day, it ensures that 48 feeder trains can be operated.

REFERENCES

Budhi, W. S. (2020). Analisa Kapasitas Lintas Jalan Rel Metode Indonesia dan Metode UIC Code 405 Segmen Surabaya - Madiun.

Darojat, A., & Ramdan, S. D. (2021). Kapasitas Lintas Jalur Double Track. Ilmuteknik.Org, 1(2), 2021–2022.

Dewi, P. (2020). SURABAYA-YOGYAKARTA DENGAN ANALISIS COST BENEFIT OPTIMASI GRAFIK PERJALANAN KERETA API RUTE SURABAYA-YOGYAKARTA DENGAN ANALISIS COST BENEFIT.

Fadlan. (2023). ANALISIS PERENCANAAN PENGEMBANGAN KAPASITAS BERDASARKAN PENGGANTIAN SINYAL MEKANIK MENJADI SINYAL ELEKTRIK PADA STASIUN MERAPI.

Gunawan, A. (2017). Pengelolaan Tabloid Kontak Sebagai Media Internal PT Kereta Api Indonesia (Persero) Edisi Januari - Desember Tahun 2016. September, 118.

Hidayat, M. N. (2019). Pengembangan Model Untuk Menghitung Kapasitas Jalur Kereta Api di Indonesia (Studi Kasus Lintas Utara Pulau Jawa Stasiun Pasarturi–Stasiun Bojonegoro). Rekayasa Teknik Sipil. https://jurnalmahasiswa.unesa.ac.id/index.php/23/article/view/30195%0Ahttps://jurnalmahasiswa.unesa.ac.id/index.php/23/article/download/30195/27672

Jamaludin, Sadili, R., & Alfisyahrin, A. (2019). Analisis Perjalanan Kereta Api Rel Listrik Pada Lintas Manggarai - Bogor. Psychology Applied to Work: An Introduction to Industrial and Organizational Psychology, Tenth Edition Paul, 53(9), 1689–1699.

Nurdiansyah, I., Wicaksono, A., Bowoputro JurusanTeknikSipil, H., Teknik, F., Brawijaya JalanMTHaryono, U., & Timur, J. (2019). KAJIAN KINERJA OPERASIONAL KERETA API JENGGALA JURUSAN MOJOKERTO-SIDOARJO (A Study On Operational Performance of Jenggala Train, Mojokerto-Sidoarjo Route).

Permenhub. (2011). PERMENHUB. 2011. Peraturan Menteri Perhubungan No.10 Tahun 2011 Tentang Persyaratan Teknis Peralatan Persinyalan Perkeretaapian.

Undang-Undang Nomor 23 Tahun 2007 Tentang Perkeretaapian, Pub. L. No. 23, 21 Combustion Science and Technology 508 (2007).

(Nurdiansyah et al., 2019) KAJIAN KINERJA OPERASIONAL KERETA API JENGGALA JURUSAN MOJOKERTO-SIDOARJO (A Study On Operational Performance of Jenggala Train, Mojokerto-Sidoarjo Route)