

MAKE METRORAIL WORK BETTER (Dutch measures for Durban MetroRail)

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ABSTRACT

MetroRail's quality is not to world standards, but still serves an important passengers market in metropolitan areas. Until recently it receives little priority. But there is a worldwide revival of passenger rail transport, also in South Africa with introduction of the Gautrain.

Compared to some of the World's best rail countries (like the Netherlands), a lot can be done to improve the quality of rail service. Not only by providing extra infrastructure but also on better service quality and planning on existing infrastructure. In this paper some examples are given, related to improving travel time and convenience; based upon best practises from the Netherlands.

A different design of timetable, with a frequent and clockwise train service, results in shorter waiting times. This reduction of travel time and convenience can lead to additional passengers. It also enables more efficient use of the existing infrastructure and thus provides a higher capacity. Analyses done for two of Durban's MetroRail corridors show that 2 (of present 11) train sets can be saved without reduction of levels of service. These assets can be used to expand the service.

A higher quality of service increases travel experience of existing train passengers and could also attract new passengers. An improved passenger rail system may help to develop the South African economy and could support the restructuring of existing low density cities through Transit Oriented (corridor) Development. Improved passenger rail quality indirectly helps to concentrate job opportunities near public transport nodes, supporting social objectives.

1 RAILWAY DEVELOPMENT IN SOUTH AFRICA

1.1 Present poor rail quality is bound to improve

Rail serves an important travellers market in metropolitan areas. In South Africa there are three major urban regions with a dense passenger MetroRail network: Gauteng, Cape Town and eThekweni. There are also passenger rail services in Eastern Cape, but not intensely used. On others parts of the South African rail network, regional passenger rail transport hardly exists.

Together with Egypt, South Africa's MetroRail serves the most passengers on the African continent, but many European and Asian countries have more rail passengers / passenger kilometres per capita (UIC, Railisa database).

MetroRail's quality is not to world standards. At present MetroRail transport is considered 'poor-man's transport', especially in KZN. You hardly encounter higher-income passengers / choice users using MetroRail train service. The situation in the Cape Town region is slightly better.

MetroRail passenger transit has developed little over the last decades, with a few new commuter rail stations and introduction of Business Express services in 2007. Major improvements are foreseen in the next decade. There is a worldwide revival of passenger rail transport, also in South Africa with introduction of the Gautrain in 2011. Due to concerns regarding sustainability, transportation policy in South Africa is in favour of public (rail) transport and major investment is foreseen (NDOT, Public Transport Strategy, 2007).

Also knowledge on rail transport has hardly developed, and is in the minds of a few specialists. Rail planning and technical skills are hardly developed at universities, with only a few specific rail courses as part of a generic civil engineering program.

A lot can be learned from international experience. A brief (but incomplete) overview of practise in some of the World's best rail countries shows:

- The Netherlands is known for its high network density and frequent train services. The country was the first to introduce a clockwise timetable in the 1970's: train services departing with regular intervals, at the same times every hour.
- Switzerland has a high train use. The government focussed on raising awareness of environmental issues and has positioned public transport (and especially rail) as a sustainable way of transportation.
- Japan has a dense High Speed network "Shinkansen", with frequent trains between major cities running up to 300 km/hr. In addition Japan is also known for its high standard of reliability and the high usage of infrastructure, with sometimes up to 24 trains/hr per direction, on a mostly double-track line.

1.2 Aim and scope of this paper

The main question of this paper is: can South African passenger rail quality be improved, with only limited resources? And are there lessons to be learned from overseas?

Due to the limited size of this paper, it will focus on the comparison of the rail service quality in the Dutch province of South Holland and the eThekweni situation, two regions the author has worked for extensively. The examples given, indicate that a higher passenger quality (in travel time and convenience) is possible within the limited resources, it will generate more passengers in a more cost efficient way.

2 CASE SOUTH HOLLAND – ETHEKWINI

Although South Africa and the Netherlands differ in many ways, the South African regions with an extensive rail network (Gauteng, Cape Town and eThekweni) can be compared with the Dutch situation in terms of size, population and network density.

2.1 Province of South Holland

The population of South Holland (in the western part of the Netherlands) is some 3.5 million, living in two major towns Rotterdam and The Hague, some smaller towns, suburbs and semi-urban villages. The land in between these nodes is wet agricultural lowlands, hardly suitable for urban development and now mostly assigned as green buffer space. The region is situated at the North Sea, which beaches attract millions of tourists. Rotterdam is Europe's largest port, also serving the German 'Ruhrgebiet' economy some 250km east.

The region has a major north – south corridor, a hinterland corridor eastwards and some regional corridors inland (see figure 1).

2.2 Metropolitan Municipality of eThekweni

The population of eThekweni region is some 3.5 million, living in Durban, some secondary nodal towns, suburbs and major townships. The land in between these nodes is hilly agricultural or non-developed land, hardly suitable for urban development.

The region is situated at the Indian Ocean, which beaches attract millions of tourists. Durban is Africa’s largest port, also serving the Gauteng hinterland some 500km northwest.

The region has a major north – south corridor, a hinterland corridor westwards and some regional corridors inland (see figure 2).

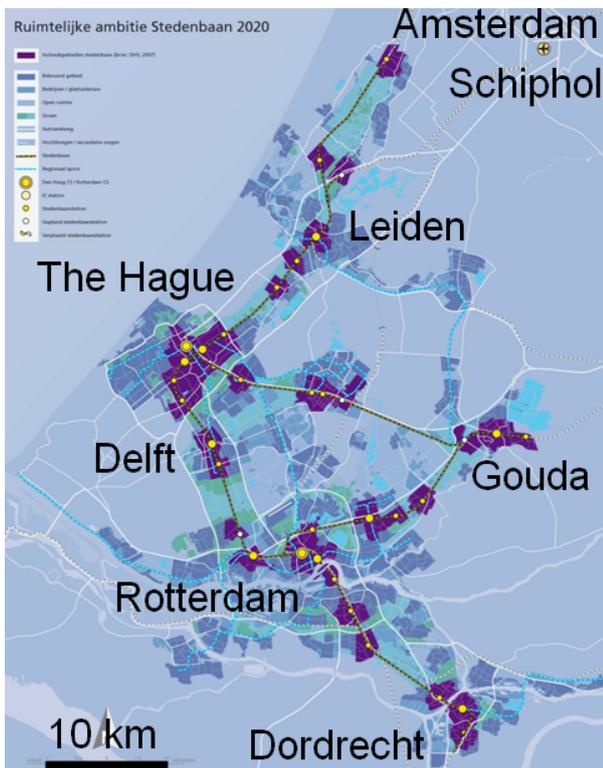


Figure 1: Rail network in South Holland. Based on: Stedenbaan 2006 (Province of South Holland).

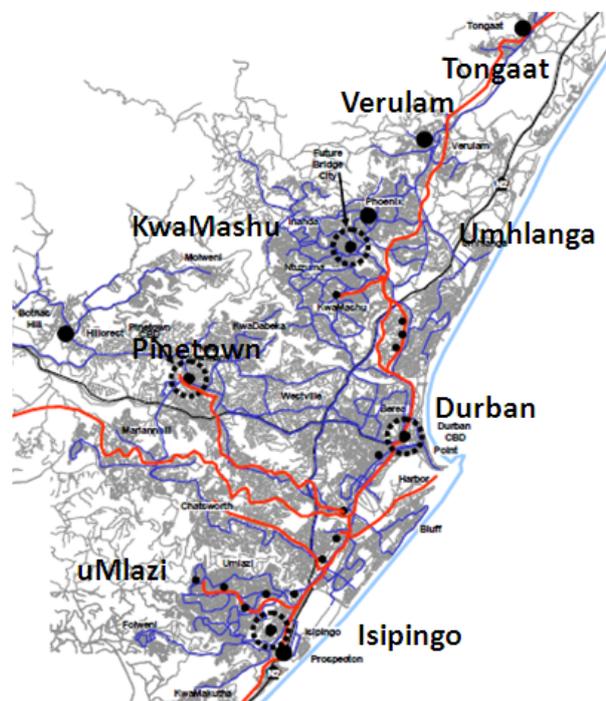


Figure 2: Rail network in eThekweni. Based on: Integrated Transport Plan 2011 (eThekweni Transport Authority).

3 PASSENGER QUALITY

3.1 Quality aspects

The quality of a rail network should be determined by two major goals:

- Providing of a good quality / level of service for passengers.
- Cost-efficient use of operational assets and infrastructure.

Quality aspects can be grouped, following the passenger quality pyramid used by Dutch National Railways (Van Hagen, 2002). See figure 3.

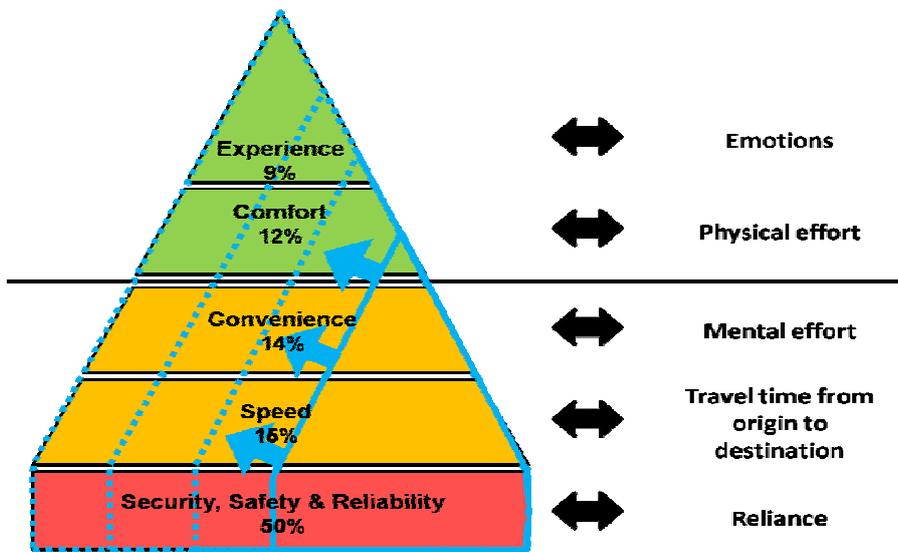


Figure 3: Passenger quality pyramid.

Based on: Van Hagen 2002 (Dutch National Railways).

3.2 Dutch rail quality

The Dutch railway system is known for its high standard of quality; it is in the 'left side' of the pyramid.

In the Netherlands different train types cater for different market segments: Intercity trains run between the major stations (CBD central stations, secondary metropolitan nodes and bigger town). In the province of South Holland Intercity trains stop at stations with more than some 10.000 daily passengers, in total some 12 stations. These Intercity stations are also important public transport nodes. All other stations (some 60 in South Holland) are served by Sprinter trains.

Travel time is short due to high performance of rolling stock: high maximum speeds (140km/h), fast acceleration / deceleration, and short stop times at stations. This results in an average travel speed of 80-100km/h for Intercity trains and 50-60km/h for Sprinter trains. Frequencies are high with every 30 (or sometimes even every 15) minutes an Intercity train and a Sprinter train.

Rail transport is convenient with long service times (between 6:00 and 24:00), providing a clockwise timetable (every hour the same train connections and departure times), with some extra service in peak hours. Operation is reliable: with about 90% punctuality (< 3 minutes delay). And there are sufficient facilities for bicycle and car parking close to the station and a feeder system by other means of Public Transport.

Comfort standards are high with comfortable trains and station facilities, accessibility, travel information, etc.

Due to these qualities there is a sense of 'Public Transport experience'. Many passengers prefer rail over congested road transport and rail is seen as a sustainable way of transportation. Transit Oriented Development is an accepted policy with a major part of new urban developments planned within station influence areas.

Some 75% of the Dutch train passengers give a rating of 7 or more (on a scale of 10) for different quality aspects (NS, Klantwaardering / customer rating). Most international tourists visiting the Netherlands and using the train system are highly impressed by its quality.

Although the Netherlands rail system is already viewed as one of the world's best railway systems, there are plans for improvement.

'Stedenbaan' is the name of the multi disciplinary program to improve the regional rail service on the main rail corridors in the western part of the Netherlands. The program is a coordinated initiative from the Province of South Holland, the city regions of Rotterdam and The Hague and other regional and local governments. Implementation is coordinated with Dutch National Railway Company and the infra-provider ProRail.

Phased from 2007 to 2012 higher train frequencies were introduced: on the main corridors 4 Intercity and 4 Sprinter trains per hour in a strict 15min pattern, while introduction of a 10min frequency per 2020 is studied. New rolling stock is introduced and three new stations are being investigated; one has already opened.

Stedenbaan will form the back bone for new urban development and will be better integrated with other means of transport, like cycling facilities and Park&Ride.

With these improvements a growth of passenger volumes of more than 50% is foreseen for 2020.

3.3 South African rail quality

South African MetroRail service is scoring in the 'right or middle' side of the passenger quality pyramid. Security is (perceived to be) poor, travel speed is not high and convenience and comfort partly absent. As a result MetroRail attracts 'captive' users only; people who have no (private) travel alternative. The market however is still big and fares are low compared to other means of transportation (private car, bus, taxi).

In 2007 Prasa has introduced Business Express services on three corridors in Gauteng (Naledi, Tshwane) and Cape Town (Khayelitsha). On these trains security is better, travel time is shorter and travel is more convenient and comfortable (coffee or tea and newspapers are available). The fares are slightly higher than for traditional MetroRail.

In 2012 a similar Business Express service is planned in KZN, between Durban and Pietermaritzburg. This service should attract choice travellers and thereby alleviate the traffic pressure on the N3.

Gautrain scores better on all aspects: it is secure, with high speeds, comfortable and it has introduced public transport as a 'way of life' experience. Gautrain attracts 'choice' passengers; people that could also travel with their own car but prefer Gautrain because of its high quality, and to avoid congestion on Gauteng's road network or parking costs at OR Tambo International Airport. The fares however are much higher than for regular MetroRail train service.

4 POTENTIAL IMPROVEMENTS FOR ETHEKWINI

As an example some of the Dutch measures (related to travel time and convenience) are proposed for two of Durban's rail corridors:

- Durban – Pinetown (complicating factor is the partly single track).
- Durban – Cato Ridge (complicating factor is the common use with freight trains to Gauteng).

Travel time is an important key to improve passenger quality. Train service is only attractive to choice users if it is competitive with private car travel. In the Netherlands a regional train trip is considered competitive (for choice users) if the travel time is not more than 50 to 100% longer than the same trip by car. This travel time includes walking to the station, waiting, actual in-vehicle time and walking to the final destination.

4.1 Reduction of travel time by higher speeds is difficult

In the eThekwini situation it is difficult to decrease travel time by higher train speed as the infrastructure is very winding (due to hilly conditions) and is designed for approx 80km/h. The average speed on these MetroRail corridors is 30 to 35 km/h.

Some improvement is possible with introduction of new rolling stock (which is foreseen from 2015) and technical improvements on infrastructure, but the average speed of the Dutch 'Sprinter' trains at 50 to 60 km/h (which is partly possible due to a maximum speed of 140km/h) seems out of reach.

But with the introduction of savings on other travel time aspects, large improvement is possible. These are explained in the next paragraphs.

4.2 Reduce travel time by higher train frequencies

Train frequency determines the passenger's waiting time. As a rule the average waiting time is half of the frequency / headway. An hourly service results in an average waiting time of 30 minutes. A 30min frequency reduces this average waiting time to 15 minutes.

The shorter the trip, relatively more time is spent on waiting and the higher the train frequency should be. In the Netherlands it is common that a maximum of 1/6th of the total travel time is spend on waiting. This implicates that for regional trips of about 30km (= approx 1½ hour door-to-door travel time), on average 15 minutes may be spend on waiting, so a frequency of 2 trains/hr is required. On longer trips an hourly service is sufficient, but for shorter trips a higher frequency is desired.

The frequency is also determined by passenger volumes. Both rail lines considered in this example are not too busy:

- On the Pinetown line the passenger load is limited to the equivalent of 1½ trains/hr in peak period, although the above 'quality rule' requires for 2 trains/hr. It could be considered to run more frequent (but shorter) trains.
- The eastern part of the Cato Ridge line needs to be served by 2 trains/hr in peak period, but on the end section towards Cato Ridge this provides far too much seating capacity. Therefore it is suggested that part of the trains end halfway the line, like in Dassenhoek (see figure 4).

In off-peak the passenger volume is lower and the current service is reduced. However it can be considered to run a more frequent service, as rolling stock (the main asset) and

personnel is available. Additional services at off-peak can run at marginal cost (personnel, traction energy, maintenance), and could attract new passenger markets (like shopping) and queues.

4.3 Improve convenience by a clockwise timetable

The current timetable frequency is irregular with peak hour's headways of 40 to 50min on the Pinetown line and 25 to 60min on the Cato Ridge line. Off-peak headways drop back to 1 or even more than 2 hours.

As an example the present departure times from Pinetown are: 04:10 - 04:48 - 05:39 - 06:17 - 07:10 - 07:58 - 09:56 - 11:25 - 13:24 - 14:23 - 15:14 - 16:04 - 16:45 - 17:26 - 18:17 (MetroRail, 2008, Durban Timetable). Due to capacity problems on this partly single-track line, crossings need to be planned and travel time varies from 52 minutes to 60 minutes.

Such a skew timetable is difficult to memorise for the passengers, and this irregularity is a blockade for some passengers to use train service.

The origin of such a skew timetable lies in the fact that it is planned in an 'organic' way. The timetable was prepared for past passenger demands and quality, planning of crossing of trains was complicated and planned individually, with irregular service as result. As the situation has changed over the years, trains were added or reduced from this timetable, leaving gaps in the service and introducing more irregularity.

For passenger's convenience a clockwise timetable is proposed, with same train connections and departure times every hour. For example: with a clockwise timetable the departure times for Pinetown could be: 03:39 - 04:39 - 05:39 - 06:39 - 07:39 - 08:39 - 09:39 - 10:39 - 11:39 - 12:39 - 13:39 - 14:39 - 15:39 - 16:39 - 17:39 - 18:39. This timetable is planned with crossings on this partly single track line taken in consideration, and travel time can be reduced to 52 minutes for all hours. Additional peak hour trains can be added in between, providing 2 trains/hr.

With the introduction of a strict (half-) hourly train pattern, passengers will easily memorise train times and will leave for the station just before the train is due to depart. Firm knowledge of the timetable (with a clockwise timetable as condition) can reduce the average waiting time to 5-10 minutes.

4.4 Introduction of Express Trains

Another possibility to increase travel speed is to reduce the number of stations. On the Pinetown line for example there are many small stations with just 500 to 1000 passengers a day. However, the closure of stops is not a popular solution and should be considered with some hesitation.

A further option is to introduce Express trains. For example a higher frequency in peak hours on the Pinetown line can be implemented by additional express trains that only serve the six or seven busiest stations, providing these main stations with a half-hourly service (see figure 4). Travel time can be reduced by 15 minutes to less than 40 minutes.

The present partly single-track infrastructure allows for such a train service with an hourly MetroRail train plus an additional hourly Express train.

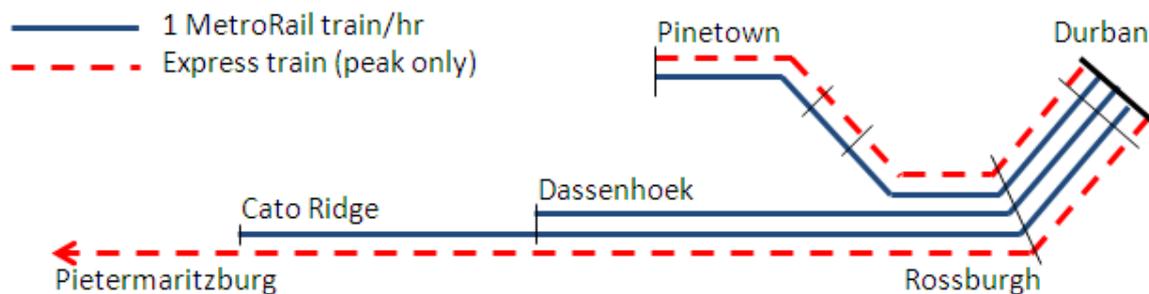


Figure 4: Summary of proposed train network on the Durban – Pinetown / Cato Ridge corridors.

4.5 Effect on passenger numbers

The effect on passenger numbers can be calculated based upon improvements of travel time. Higher frequencies result in shorter waiting time and therewith in shorter travel time. The above proposed clockwise (half-) hourly timetable and also the introduction of Express trains for the main stations will reduce the waiting time (and thereby the travel time) by some 10 to 20 minutes.

General rule in the Netherlands is that each 1% shorter travel time results in 1% passenger's growth:

- Present 'captive' users will experience better quality and therefore will get opportunity to travel more frequent or longer distances.
- New 'choice' users will find the improved train service more attractive than their former mode of transport and will change to train.
- In the longer term, development of new economic opportunities (due to better train accessibility) will attract new passengers.

With these assumptions a reduction of 10 to 20 minutes of travel time could attract 10 or even 20% additional passengers.

4.6 Effect on operations

For the operator a clockwise timetable is easy to plan: once you have made an operational plan for one hour, you can more or less copy it to the whole day, using the same resources in terms of rolling stock and personnel in an efficient way. Capacity conflicts once solved for one occasion will suit for the whole train service.

The example of above proposed clockwise (half-) hourly timetable on the two Durban rail corridors show a decrease of required train sets. With more-or-less the same level of service (or even a better quality), 2 of the 11 present train sets can be saved. These assets can be used to improve quality on these lines. For example, the additional hourly express service on the Pinetown line can operate with 2 train sets (see figure 5).

	Durban – Pinetown		Durban – Cato Ridge	
	<i>present</i>	<i>proposed</i>	<i>present</i>	<i>proposed</i>
Line length	27 km		71 km	
Stations	17		23	
Travel time	52 - 60min	52min Express: <40	2h.02 – 2h.06min (up-, downhill)	2h.02min (or less?)
Frequency peak / midday	Irregular: 40'-50' / 60'-2h45'	60' / 60' Express: 60' / -	Irregular: 25'-60' / 1h20'-2h10'	Short: 30' / 60' Long: 60' / 120'
Service time	04.00 – 19.30	3.30 – 20.30	03.30 – 21.00	03.00 – 21.00
Trips per day	15	16 + 6 (Exp)	14 (long) / 15	10 (long) / 20
Train sets	3	2½ + 2 (Exp)	8	6½

Figure 5: Effect of proposed measures on the two eThekweni rail corridors.

4.7 Other improvements

The above discussed measures relate to travel time and convenience. As the quality pyramid shows also improvements on safety, security and comfort are required. These measures include investments (new rolling stock, station refurbishment, chain mobility, etc) and operations (maintenance, service personnel, security guards, etc).

And some of these measures are subject to the image from the public opinion. Safety and security is perceived to be poor, but in practise very few accidents happen (it is much safer than road based transport) and security issues are also greatly subjectively than only objectively; positive marketing can help.

All these measures will eventually result in a more positive sense of security, better convenience and higher comfort; in the end it will increase travel experience of existing train passengers and could also attract new choice passengers.

5 **CONCLUSION: SOUTH AFRICA PASSENGER RAIL CAN WORK BETTER**

In this paper some improvements are proposed and assessed on two of eThekweni's rail corridors. Equal measures can apply for other corridors (like Chatsworth, North Coast, and South Coast); some improvements on the uMlazi – Durban – kwaMashu corridor are already planned (eThekweni, Integrated Transport Plan). In other regions, like Gauteng, Cape Town or even Eastern Cape, similar results seem possible.

The above presented measures serve both goals for passenger rail transport: a good passenger's quality / level of service and a more cost efficient operation. In general a shorter trip time is the key to more efficient operation. In regional train transport every 1 minute reduction of trip time will potentially:

- Increase the passenger numbers and revenues by 1%.
- Decrease the operation costs by 1% on average. Bigger improvements will save an equal percentage of assets as rolling stock and staff, which can be added as additional service.

As shown in above examples, improvements of passenger rail transport will not always require additional infrastructure, but can also be reached by smarter planning on existing infrastructure and others measures for better service quality.

In the present context the scarce MetroRail asset is the rolling stock; as staff is available or can be employed and trained. The above presented measures provide a more efficient use

of rolling stock, but might need more staff. Also other required improvements might need some extra staff capacity. This serves the national policy of job creation. To cover the extra staff costs and increase of marginal operational costs (as traction energy, maintenance), an improved train service will attract more passengers and more revenues.

It will also connect different areas in the region with each other and therefore open up opportunities for work for the population. An improved passenger rail system may help to develop the South African economy and could support the restructuring of existing low density cities through Transit Oriented (corridor) Development: improved passenger rail quality indirectly helps to concentrate job opportunities near public transport nodes, supporting social objectives, in a sustainable way.

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