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# IMPLEMENTATION OF BRT SYSTEM IN PESHAWAR CITY(PAKISTAN) : A METHODOLOGY FOR CASE STUDY ANALYSIS

**Raza Hussain[1], Mudasir Hussain[2], Mushahid Hussain[3], Ram Chand[4], Sohail Asghar[5]**

[1,3,4,5]University of Engineering and Technology Peshawar, Pakistan
[2]Sungkyunkwan University South Korea

[1]15pciv4383@uetpeshawar.edu.pk, [2]mudasir@g.skku.edu, [3]15pwele4793@uetpeshawar.edu.pk, [4]15pwciv4386@uetpeshawar.edu.pk, [5]16pwciv4717@uetpeshawar.edu.pk

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## Abstract

*Large cities have increasing mobility problems due to a large number of vehicles on the streets and roads, which results in traffic jams and thus a waste of time and money. An alternative to improve traffic is to prioritize the public transportation system. Many cities across the world have recently launched ambitious programs of BRT system implementation with varying success. And Peshawar is also one of them which has launched a BRT system in 2017. This paper presents the planning management and importance of Bus rapid transit (BRT) for the city like Peshawar as it is more cost-effective mode, and to examine the level of accessibility, perception/acceptability of users on the operations of BRT in Peshawar in terms of distances, safety, affordability, reliability, travel time and waiting time at the BRT bus stops. Creating a safe corridor by combining the existing physical infrastructure and the use of communications systems in all components of the BRT system is to improve passenger safety factors in urban trips. For the study, data for all the cities have been collected from different sources such as local authority websites, organizations involved in the projects, published reports and studies, and the media.*

**Keywords**: Bus Rapid Transit; passengers; Corridor; Stations; Planning and Management; Peshawar city.

## I. Introduction

Transportation is essential for the movement of people and objects within a nation and outside it. As far as the movement of people is concerned, a considerable number of people, particularly those on the lowest rung of the ladder (the masses) in urban and suburban areas of different countries, depend largely on mobility for public transport (PT). Nonetheless, an increasing number of people owing vehicles may choose to do trips through a personal mode or a public mode. Peshawar, Pakistan is one of those cities that face congestion due to the high number of car ownership and sub-optimal public transport systems in its dense urban areas. The congestion issue at

Peshawar is tackled through a variety of infrastructure and public transport systems policies and investments. There is a bus / wagon public transport system running mixed with private vehicles in Peshawar, Pakistan which has not only resulted in unnecessarily increased travel time but also decreased road capacity. Many specific problems have been reported, such as traffic congestion, long waiting times at stop, non-punctuality of public transport buses, driving at speeds below design speed, increased travel time, private vehicle intervention. The effect of congestion, carbon emissions and road collisions on road traffic is also significant in terms of time, pollution, and economic losses. To enable more drivers to turn to public transport, cities today are increasingly concerned with upgrading their transit services because of these mentioned problems.

Developing cities in Asia and Latin America have several urban features, which are distinct from established cities that have introduced BRT systems. The Government of Khyber Pakhtunkhwa took a bold and laudable move in 2017 and implemented BRT into the metropolis of Peshawar (LAMATA, 2009; Moberola, 2009; World Bank, 2012). BRT is a transportation option that uses dedicated, interference-free segregated lanes to ensure a quick and reliable journey (LAMATA, 2016).The system at Peshawar is known as Peshawar BRT and will represent a large proportion of the population of Peshawar (estimated to be over 17 million). BRT provides cost-effective, ecologically friendly and high-performance mass transit where population density does not often warrant the development of costly fixed rail systems. The goal of this paper is first to provide an overview of the current state of local public transport in Peshawar and then to explore how to upgrade the existing state to the improved state in the near future by outlining ways to achieve this.Peshawar's scheme is known as Peshawar BRT and will represent a large proportion of the population of Peshawar (estimated to be over 17 million). BRT provides cost-effective, environmentally sound and high performance mass transit where population density often does not warrant the development of expensive fixed rail systems. The goal of this paper is first to provide an overview of the current state of local public transport in Peshawar and then to explore how to upgrade the existing state to the improved state in the near future by outlining ways to achieve this.This is the subject of a systematic literature review eater versatility is better served by wheel-to-road transport systems in route mapping. Lastly, the paper ends with the key findings from the literature review. The paper is presented with examples from BRT systems implementations around the globe. Data for all the cities were obtained from various sources, such as websites of local authorities, project associations, published reports and studies, and the media.

## II. Objectives of Project

The goal of this project is to build a sustainable bus rapid transit corridor to help improve the urban transportation system in Peshawar and facilitate the citizens of Peshawar City by solving the logistical difficulties they face on a daily basis.

## III. Peshawar City Profile

Peshawar is the capital of Khyber Pakhtunkhwa Province (KPK), and is one of the region's main administrative and economic centers. It has an estimated

3.7million populations. Spread over an area of 1,275 sq. Kilometer. Also the provincial capital is Peshawar, and a town bordering the turbulent Federally Administered Tribal Areas (FATA). Peshawar is like a wide valley between the eastern edge of the Iranian plateau and the Indus Valley. Bordered on its western end by the famed Khyber Pass, Peshawar is renowned as the frontier town.The strategic location on the Central Asia and South Asia crossroads has made it one of the region's most dynamic and vivacious cities in terms of community as shown in figure 1.

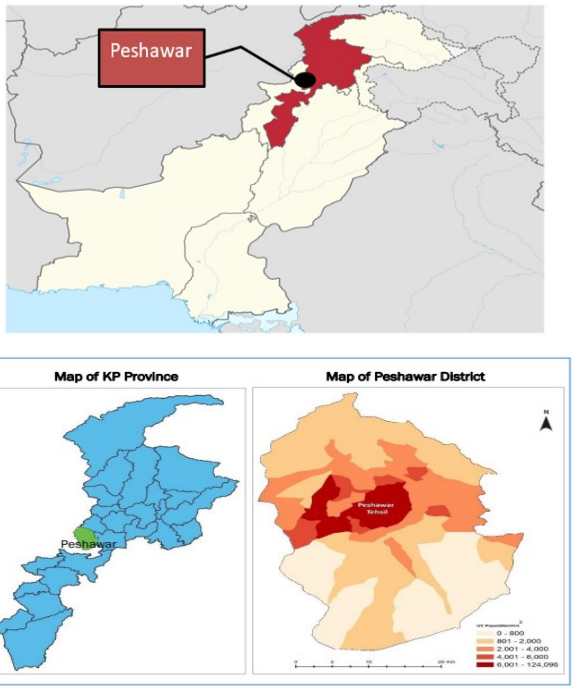


**Fig.1:** Map of District Peshawar, KhyberPakhtunKhwaPakistan

## IV. WHAT IS BRT?

BRT is a high-quality, high-capacity rapid transit system which improves on traditional rail transit systems in many ways. In exclusive lanes, vehicles drive, while avoiding jams. Passengers walk to convenient stations, pay at the station for their free, and board like a train through several doors. Service is very frequent and passengers can often choose between express and local routes, which is not an option on most train systems [II] as shown in figure 2.

**Fig.2:** Bus Rapid Transit BRT system

### A. Justification and Need for BRT Project

For its people, Peshawar City is in great need of a good quality mass transit system that faces many logistical challenges on a daily basis.The main problems in the public transport sector in Peshawar are, for example, that passengers are exposed to serious accidents due to poor driving behavior, especially during the boarding and lifting of passengers from vehicles, that buses are poorly maintained and lead to high fuel consumption, that bus stops are non-existent and that buses stop randomly whenever a passenger is on the route, that buses are over-cropping.

Although there are many reasons to explain the need for BRT at Peshawar, the main goal of introducing the proposed project is to save time for passengers. BRT lanes will increase the speed of bus travel, and should be installed on a corridor where many users of public transport ride and experience delays. The BRT scheme can be used to restructure the entire public transport sector from Minibus to Bedford bus, Wagon and Suzuki.The planned BRT project is projected to have a positive impact on the environment due to the use in the BRT of a cleaner and more fuel-efficient fleet, as well as the reduction in vehicle exhaust emissions due to the reduction in kilometers traveled by private vehicles. There are also a number of economic benefits associated with the planned BRT project due to time savings for both public and private riders in the vehicles.Even, as there is no formal bus industry in town yet, the BRT would open up more formal BRT-related jobs such as security guards, bus drivers, mechanics, etc. But most significantly, buses will run inside and outside the BRT corridor with BRT, allowing for strong citywide coverage.

## V. Proposed Project Activities

Installation of a total of 31 BRT stations with 3 stations constructed as elevated BRT stations based on the BRT alignment as shown in Figure 3.1. The project includes the development of a dedicated BRT network with Development of a dedicated corridor of 25.8 km BRT, Creation of 20 channels of commercial area at staging facilities, Construction of a total of 31 BRT stations with five (05) stations designed as elevated BRT stations based on BRT alignment. Station access pedestrian bridges will be of steel construction with four concrete pedestrian bridges with shopping area at Hasnagri bridge, Firdous Cinema bridge, Khyber road and Tehkal 102 High standard Bus Stops at 68 Km feeder routes with shelter.

### A. Design Features

- 26 Kilometer Main Corridor
- 15 KM at Grade
- 8 KM Flyover
- 3 KM Underpass
- 31 Stations
- Avg. distance between station 850m
- 3 Bus Depots (Should be represented in infographics at Chamkani, Hayatabad, and Dabgari)
- 3 Park and Ride Facility
- Bicycle lane
- Complete revamp of Footpaths
- Secure
- Efficient
- Fast Journey
- Comfortable
- Reliable
- Cost effective
- 3rd Generation
- 5 Feeder routes

### B. Design of BRT (BRT Route)

To ensure the fast track implementation, the BRT Project Route is divided into threeReaches:

**Reach–I:** The alignment of Reach–I starts from Chamkani, near theChamkani train station. It follows the GT Road at-grade until the junction with Ashrafroad where it will enter into a tunnel connecting both approaches of GT Road andMalik Saad Shaheed Road.

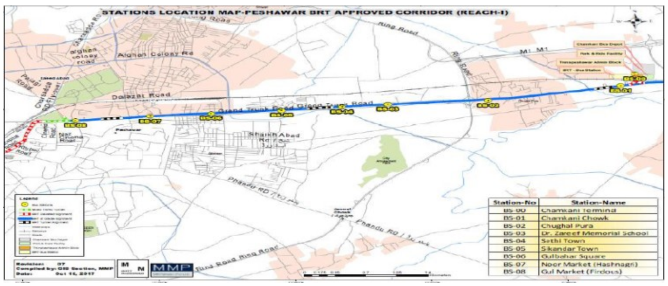


**Fig. 3:**Reach – I BRT Corridor and Station Locations

**Reach–II:** begins at the junction to cinema road from the GT road and entersthe cinema road through a tunnel and proceeds at grade through hospital road and isthen elevated through the Khyber Bazar through Shoearkano Chowk and falls to grade along the railway road. A new bridge is proposed across the existing railwayline to Saddar Road where BRT turns right along the Khadam Hassan Road where itcrosses the Mall road via an overpass onto Sir Syed road. At the end of the Sir Syedroad, the BRT makes a 90 degree right turn onto the airport road through a tunneland Reach–II finally terminates at Aman Chowk via another tunnel.

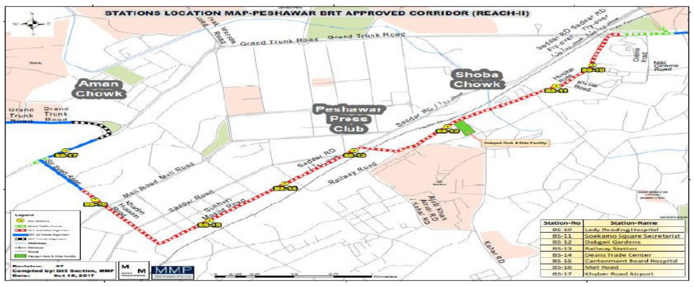


**Fig.4:** Reach – II BRT Corridor and Station Locations

**Reach–III:** corridor commences from the tunnel at AmanChowk and continues along the GT Road and Jamrud Road. The BRT does not pass through theBab-e-Peshawar Bridge but instead is directed through the Board dry streambed asan elevated structure as far as the PDA officers Mess where it is brought back tograde as far as the Hayatabad terminal, which is the end of Reach–III.

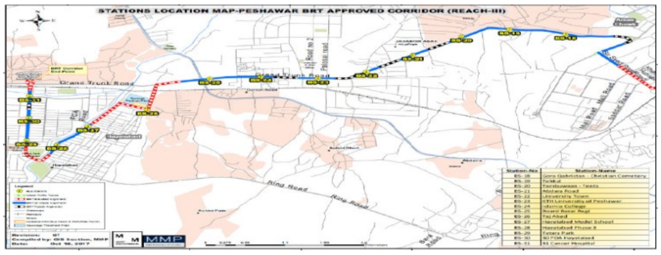


**Fig.5**: Reach – III BRT Corridor and Station Locations

Total length of BRT is 25.8 km some segments that will be built elevated, which is 5.6 km long, and tunnel with 4.7 km long. The average distance between stations is 922 meters, but there are few stations that are less than 700 meters apart, while on the other hand, several stations are also quite far from each other e.g. It goes along the GT Road at-grade until the junction with Ashraf road where it will enter into a tunnel connecting both approaches of GT Road, Malik Saad Shaheed road and Cinema road. After the tunnel, the main BRT route follows,Cinema Road at-grade where it goes elevated to bypass the junction with Hospital road. It stays elevated on Khyber Bazaar road and Railway road, and passes the Soekarno and SubaChowk, the two most congested intersections in the Khyber Bazaar area. After the railway road, the elevated BRT section turns right at Anwar Saeed medical center to cross the railway station, where a BRT-only bridge will be constructed.

### C. Off-Corridor Bus Stops

Off-corridor bus stops are required outside the BRT corridor segments, so that the BRT buses can pick up passengers. For the 8 direct-service routes, 100 off-corridor bus stops are proposed. Since practically no existing bus stops are adequate to be used as proper bus stop, new bus stops will be constructed with consideration of three main principles; location and placement of bus stops, type of bus stops, and their physical dimensions. The proposed off-corridor bus stop locations are provided in **Figure**below.

**Fig.6:**Off-Corridor Bus Stop Locations

Shelters will be used on the side mainly used for boarding and shall be 2 meters wide and 9 meters long. On this side, many passengers alight from the buses during evening peak period and will immediately walk towards their final destination and thus will not require waiting spaces in the bus stops.

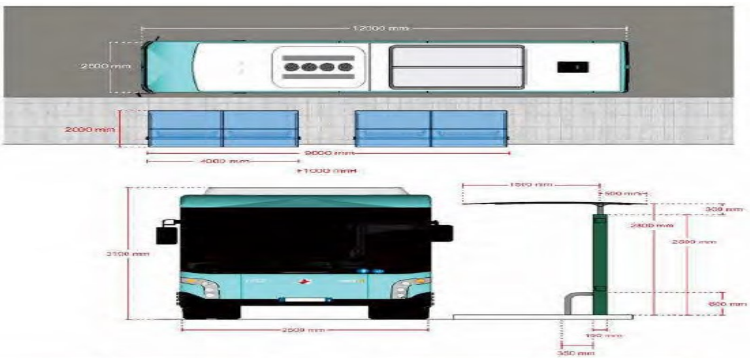

**Fig.7:**Bus Shelter dimensions for Off-Corridor Bus Stop

### D. Sub-Stop Concept

The sub-stop calculation is determined by the number of boarding and alighting passengers, bus frequency per hour per direction as well as the type of bus and number of doors used per bus. Each sub-stop works independently and buses stopping at the second sub-stop do not have to wait for the buses stopping on the first sub-stop to be able to move.


**Fig.8:** Illustration of a Sub-Stop

## VI. BRT Station Design & Configuration

The proposed station design features includes the following components: Wide station platform (5 to 6 meter wide) and open air to allow good air circulation , Multiple stopping bays (up to 4 buses can stop at the same time) , Passing Lane to allow overtaking at stations , Space for overtaking at stations with minimum length of 13 meters to allow 18- meter bus to overtake in the future , Fast and universal access to BRT station with all kinds of access provided (stairs, elevator, escalator) and special gate to allow wheelchair to enter station , Tactile ground surface indicator/paving for visually impaired users , Lane separator with guard-rail.

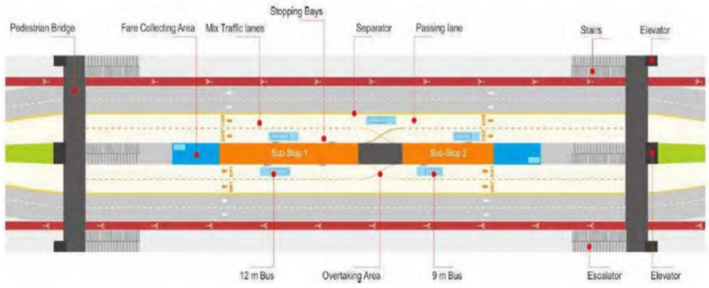


**Fig.9:**BRT Station Key Design Components

### E. Two Sub-Stops with split configuration (150 meters)

Where the road is neither wide enough for standard station nor long enough for offset station, split configuration will be used. With the split configuration, the space required for station area will be less in length than offset configuration, but this innovation will include a novel movement set up for buses, which would require clear signage to avoid any confusion.

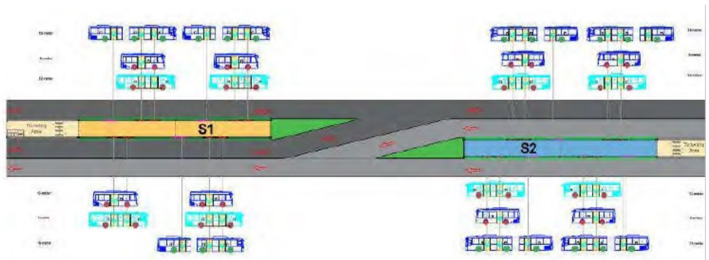


**Fig.10:**Two Sub-Stops Station Configuration with split Module

### F. Vehicle Design and Configuration

Two types of buses will be introduced for Peshawar BRT: 9-meter buses and 12-meter buses. With direct-service BRT operation, the BRT buses will be plying on the smaller road outside the corridor, such as Kohat Road, Bara Road, and residential roads at Hayatabad, where 9-meter buses with 2.2-2.5-meter width would be ideal to operate. The bus configurations for the 9 meter and 12 meter buses are provided as Figures 11 respectively. These buses will contain batteries that shall store energy and recharge when the bus decelerates through braking. The detailed functioning of a diesel-electric hybrid bus is as follows:

- The diesel engine powers a traction generator that provides primary power through the propulsion control system to the traction motor and recharges the batteries.
- The propulsion control system manages the flow of power to make the bus move as the driver commands and uses regenerative braking to slow the bus and simultaneously recharge the batteries. During acceleration, power flows from the traction generator and battery pack to the traction motor, during cruise mode, power flows from the traction generator to drive the traction motor and recharge the batteries as needed.

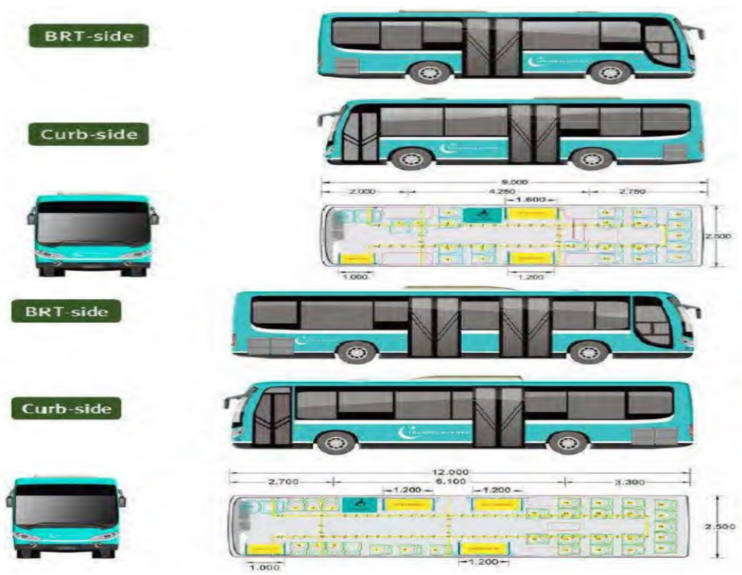


**Fig.11:** Bus Configuration (9 meters), (12 meters)

## G. Station Access and Pedestrian Facility

Access to station is very important to improve the connectivity from the BRT station to the surrounding area. Universal access is also promoted in Peshawar BRT, where all type of access, such as stairs, escalator and elevators are provided for all users with different abilities. To access the station, passengers are provided an overpass bridge, pedestrian tunnel or an at-grade crossing with a pedestrian signal with a combination between any of those options also available in certain locations. An an example, at Board Bazar Regi Station (BS-25), at one end, a pedestrian bridge will be provided, and at the other end, an existing tunnel will be improved for access to the station.

## H. Operational Plan and Fleet

The 8 specified BRT lines will travel in and outside the corridor, and depending on their routes, will use 9 meter or 12meter buses. The selection of the bus type, as well as the daily ridership, determines the necessary bus frequency for passengers to be picked up without long waiting times. The proposed route length and detail is provided in **Figure.12**and **Table.1**below. With an average portion of 57% inside the corridor, the routes are obviously expected to travel faster in traffic-less lanes. Nonetheless, travelling outside the corridor will also be crucial in order to pick up passengers. In a matter of efficiency and comfort, the maximal peak hour headway is fixed to 5 minutes for all BRT routes.At the beginning, with mixed of 9-meter and 12-meter fleet, the carrying capacity of the system will be between 5,800 passengers per hour per direction (pphpd) up to 8,500 pphpd. However, if later on 18-meter buses are introduced, it could even carry up to 15,000 pphpd, or even bigger, since express services are also possible to run with the current infrastructure design. The total BRT fleet strength is planned to be 383 buses consisting of 131 buses of 9-meter length and 252 buses of 12-meter length.


**Fig. 12:**BRT Route Plan

**Table 1:Proposed BRT Route length and details**

| BRT | Route Length (km) | Length in Corridor (km) | | Length off Corridor (km) | | One way time (min) | Bus type (m) |
|---|---|---|---|---|---|---|---|
| 1A | 27.5 | 27.5 | 100% | 0 | 0% | 61 | 12 |
| 1B | 12.9 | 6.2 | 48% | 6.7 | 52% | 41 | 9 |
| 1C | 25.8 | 14.98 | 58% | 10.82 | 42% | 77 | 12 |
| 1D | 29.3 | 15.88 | 54% | 13.42 | 46% | 89 | 12 |
| 1E | 28.4 | 20.4 | 72% | 8.0 | 28% | 77 | 12 |
| 1F | 20.5 | 10.2 | 50% | 10.3 | 50% | 64 | 9 |
| 1G | 14.8 | 7.3 | 49% | 7.5 | 51% | 46 | 9 |
| 1H | 15.8 | 4.5 | 28% | 11.3 | 72% | 55 | 9 |
| **Average** | **21.9 km** | | **57%** | | **43%** | **64 min** | |

## VII. Conclusions

Construction of the proposed BRT project in Peshawar is of great importance given the urgent need to change the urban transport landscape of the city of Peshawar. This project is expected to contribute to the region's economic and social development and pave the way for the upliftment of this region as a whole by creating economic opportunities and growing investor interest in Peshawar.Without this initiative, the population of nearly two million residing in the city of Peshawar would not benefit from a reliable, more efficient and healthier transportation system and would continue to be at the risk of congestion and traffic accidents in the region. Peshawar would not have an effective public transportation system that would minimize transportation costs, serve the central urban area or encourage intermodal interchange, or make the city's jobs and services more available. As for road safety and traffic management, Peshawar would also lose the benefits of behavioral change.With dedicated lanes and stops the BRT system will streamline the operation of public transport making bus services more efficient. Without the BRT route, when entering and out of stops in congested traffic, public buses will continue to fight for lanes with other motor vehicles, resulting in road safety threats and longer travel time for passengers. Without the BRT network, carbon emissions from road traffic in Peshawar city will continue to increase and the expected reductions in $CO_2$ emissions from the BRT project of 62.145 tons by 2026 would not occur.In the event that the BRT system is not established, given the inadequate and highly congested road network within the city of Peshawar, potential improvements could be delayed due to incomplete road network and lack of road connection. Potential residents would also lack public open space with no scenic, aesthetic, and recreational interest sites. All of these could have an effect on urban socio-economic development, resident employment opportunities and quality of living conditions and climate.

**VIII. Acknowledgement**

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