



Bus Network Design Considering the Transfer Stations

A. Shariat Mohaymany^{1*}, M. Shalforoush²

1- Associate Professor, Iran University of Science and Technology

2- M.Sc. Student, Iran University of Science and Technology

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ABSTRACT

Bus network design is the first step in the urban transportation planning process, and due to its influence on the consequent steps, such as timetabling, vehicle scheduling and crew scheduling, this step plays an important role in the process of transportation planning. One of the important issues in the transit network design is locating the transfer points. However, in the previous studies, this issue was not considered, and it has only been paid attention to optimize the parameters such as travel time. This study is focused on defining the location of the transfer points, as a result of transit network design, such that transfers are performed at points with higher capacities. Applying the genetic algorithm, the presented methodology is implemented on a virtual network, and the results showed that considering transfer constraint affects defining the location of transfer points.

KEYWORDS

Bus Network Design, Genetic Algorithm, Transfer Points, Transfer Capacity.

* Corresponding Author, Email: shariat@iust.ac.ir

1- INTRODUCTION

Bus network design was first started with Patz at 1926, but the main structure was developed by Seder at 1986[7]. Transferring nodes are one of the most important points in the bus network layout. Up to now, no attention has been taken to these points in designing the bus network layout. In this study, designing the bus network design has taken place by considering the transfer points.

2- METHODOLOGY

This study introduces a framework for the bus network layout design and frequency determined by minimizing the objective function and consideration of the transfer points. Bus network design is a nonlinear and non-convex problem and can't be solved by ordinary methods. A genetic algorithm technique is applied in this study that uses three basic parts: generation procedure, crossover procedure and mutation procedure. The main structure of this research comes from a methodology that was first presented by "Chakroborty" in 2003. There are some novelties in the generation procedure, in crossover procedure and even in mutation, but the basic framework has been preserved. The crossover procedure has two parts: inter-string crossover intra-string crossover. The objective function consists of six terms that are: total waiting time costs, total riding time costs, total operating costs, total social costs, total fixed costs, and total maintenance costs. Selecting new generation is based on the tournament selection. In this method, even the weak individuals have the chance for selection. The best

individual is considered as an elite individual in all generations. A new operation named as modification operation is introduced in this research; this operation eliminates the unsuitable individuals and generates new individuals instead of them that improves the optimum performance.

In this study, the transfer point capacity limitation is introduced as a new constraint that can affect the bus network layout. Other constraints are maximum and minimum of the bus frequencies, bus fleet size, maximum transfer points, maximum number of points in each line and maximum length of bus lines in time.

3- RESULT

This research uses a case study to examine the impact of the consideration of transfer points on the bus network design. The case study comes from a study conducted by Mandle (figure 1). The case study has two parts; at the first part, network is designed without considering any transfer limitation (table 1), but at the second part, the transfer limitation is considered as one of the constraints in the designing process (table 2). This study demonstrates that the considering limitation for the transfer capacity with transfer points can affect the bus network layout. The cost of a network increases when the transfer limitation is considered in the network design process and the average travel time for the passenger increases but networks that have been designed with this constraint are more homogenous and have a better distribution of passenger in the network.

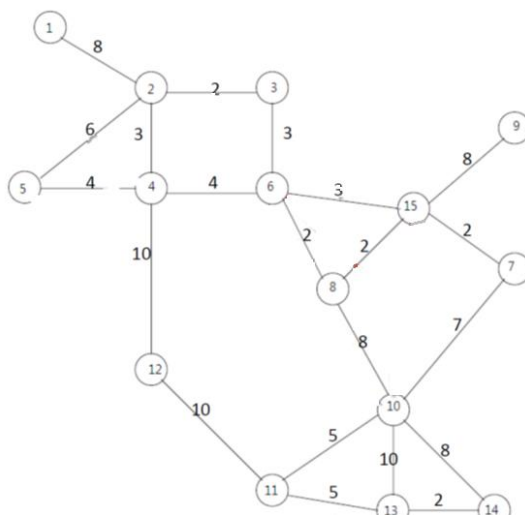


Figure 1

TABLE 1

Network cost (Rials)	Uncovered demand	Fleet size	Network length (min)	Average travel time (min)	Demand covered by one transfer	Demand covered directly
10720000	2.46%	23	98	9.23	88.24%	9.2%

TABLE 2

Network cost (Rials)	Uncovered demand	Fleet size	Network length (min)	Average travel time (min)	Demand covered by one transfer	Demand covered directly
14536000	6.74%	74	123	9.68	44.81	48.45%

4- DISCUSSION

It seems, considering transfer points location in bus network design process changes the layout of bus network and the total length of network. Considering transfer points in layout design causes avoiding too

crowded locations and decreasing the additional social costs because of transfer demands. Nevertheless the tradeoff between a little increase in network cost and the social costs of crowded population must be considered.

5- REFERENCES

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