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T2 ________________		F2 ________________
T3 ________________	Problem Chosen	F3 ________________
T4 ________________	**B**	F4 ________________

2017
MCM/ICM
Summary Sheet

The LaTeX Template for MCM Version v6.2.1

Summary

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Keywords: keyword1; keyword2

Contents

1 Introduction

1.1 Background

Lewis Mumford, a famous sociologist and literary critic, once said in a metaphorical manner, "Adding highway lanes to deal with traffic congestion is like loosening your belt to cure obesity." Fortunately, he did not experience the worse congestion around today's highway toll plaza.

Currently, with roaring number of vehicles, rising construction costs and constrained available areas, traffic jam becomes more and more serious but future toll-plaza construction opportunities are limited to improve this situation markedly. Figure 1 shows the congestion in the toll plaza near Tappan Zee Bridge.

Figure 1: Toll plaza congestion

Subject to the constraints referred above, neither increasing highway lanes nor building more tollbooths seems practical enough to relieve traffic jam around a toll plaza nowadays, particularly for some heavily-traveled roads such as the Garden State Parkway, New Jersey. Therefore, looking for some innovative design improvements on the geometric parameters of the extent toll plaza is an effective solution.

1.2 Restatement of the Problem

In this paper, we are required to explore if there is a better-than-ever toll plaza model with specific shape, size, and merging pattern. In this model, the prerequisite is that vehicles fan in from B tollbooth egress lanes down to L (B>L) lanes of traffic (i.e., the number of both tollbooths and the lanes after merging are fixed).

We aim to construct a model that can optimize the arrangement according to the following conditions.

- Enhance the capability of the accident prevention(A).
- Maximize the throughput(T).
- Minimize the cost of the land and road construction(C).

Through our analysis, we determine if there are better solutions than any toll plaza in common use. Afterwards, the performance of our solution in light and heavy traffic and other various situations along with corresponding sensitivity analysis is discussed.

2 Notations

3 Model 1: The Traffic Throughput Model

3.1 Overview

We manage to design two sub-models to analyze and calculate the maximum throughput in three parts (i.e., the approach zone, the tollbooth area, and the departure zone) of the toll plaza. And we define this throughput as Q_{1max} and Q_{2max} together, Q_{3max} respectively. Q_{1max} and Q_{2max} can be viewed as the properties of upstream, while Q_{3max} is for downstream. We assume corresponding ideal conditions to apply on respective calculation, and related assumptions will be displayed in the following chapters. In view of the Buckets Effect, the overall the maximal traffic flow Q_{max} is determined by the minimum among the three values, that is:

$$Q_{\max} = \min\left\{Q_{1\max}, Q_{2\max}, Q_{3\max}\right\}$$

Figure 2 illustrates the schematic diagram of the whole.

We need to further explain that Q_i is the number of vehicles passing through the cross-section S_i within a certain time, where i = 1,2,3. Because our main subject is Q_3, which relates directly to subsequent analysis of the shape, size and merging pattern of the departure zone, sub-model 2(the downstream flow model) is more complicated than the former. Relatively simple as sub-model 1(the upstream flow model) is, it still acts as an indispensable tool to help define crucial parameters in sub-mode 2.

The first model is determined to simulate the maximum flow Q_1 in the approach, which is also interpreted as the vehicle flow under the "optimal occupancy" of the approach zone. The "optimal occupancy" is set to describe a critical ratio of real-time cars amount to the maximum capacity in the approach zone.

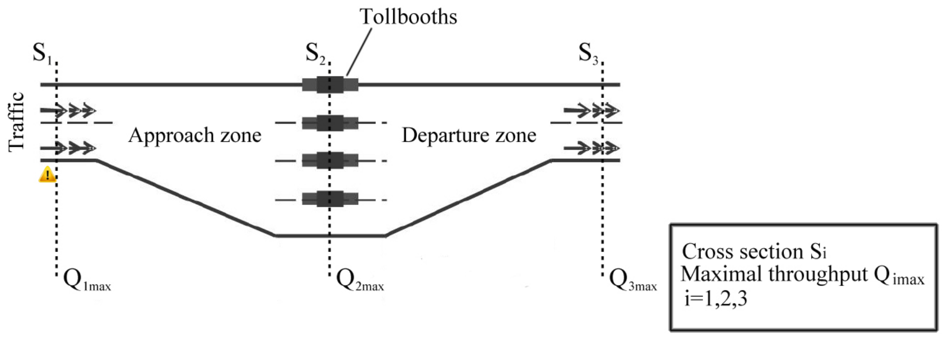

Figure 2: the schematic diagram of the whole

If the real-time radio is higher than the critical value, the upstream tends to congest gradually next time. While lower, the situation is defined as a smooth or normal one. In other words,

$$p_j = \begin{cases} 0, & \text{if } j \text{ is odd} \\ r!\,(-1)^{j/2}, & \text{if } j \text{ is even} \end{cases}$$

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$$\arcsin\theta = \oiiint_{\varphi} \lim_{x\to\infty} \frac{n!}{r!\,(n-r)!} \tag{1}$$

4 Calculating and Simplifying the Model

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5 The Model Results

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6 Validating the Model

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7 Conclusions

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8 A Summary

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9 Evaluate of the Mode

10 Strengths and weaknesses

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10.1 Strengths

- **Applies widely**
  This system can be used for many types of airplanes, and it also solves the interference during the procedure of the boarding airplane,as described above we can get to the optimization boarding time.We also know that all the service is automate.

- **Improve the quality of the airport service**
  Balancing the cost of the cost and the benefit, it will bring in more convenient for airport and passengers.It also saves many human resources for the airline.

-

References

[1] D. E. KNUTH The TEXbook the American Mathematical Society and Addison-Wesley Publishing Company , 1984-1986.

[2] Lamport, Leslie, LATEX: " A Document Preparation System ", Addison-Wesley Publishing Company, 1986.

[3] `http://www.latexstudio.net/`

[4] http://www.chinatex.org/

Appendices

Appendix A First appendix

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Here are simulation programmes we used in our model as follow.

Input matlab source:

```
function [t,seat,aisle]=OI6Sim(n,target,seated)
pab=rand(1,n);
for i=1:n
    if pab(i)<0.4
       aisleTime(i)=0;
    else
        aisleTime(i)=trirnd(3.2,7.1,38.7);
    end
end
```

Appendix B Second appendix

some more text **Input C++ source:**

```
//===============================================================================
// Name        : Sudoku.cpp
// Author      : wzlf11
// Version     : a.0
// Copyright   : Your copyright notice
// Description : Sudoku in C++.
//===============================================================================

#include <iostream>
#include <cstdlib>
#include <ctime>

using namespace std;
```

```
int table[9][9];

int main() {

    for(int i = 0; i < 9; i++){
        table[0][i] = i + 1;
    }

    srand((unsigned int)time(NULL));

    shuffle((int *)&table[0], 9);

    while(!put_line(1))
    {
        shuffle((int *)&table[0], 9);
    }

    for(int x = 0; x < 9; x++){
        for(int y = 0; y < 9; y++){
            cout << table[x][y] << " ";
        }

        cout << endl;
    }

    return 0;
}
```