A Study of the Actual Application and Behavior of Passing Places in Wide Pavements for Pedestrians and Bicycle Users

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Much of the pavement in Japan utilizes the same space for pedestrians and bicycle users. Accidents have increased by 4.5 times in the past ten years. The Japanese government has designated 98 areas as Bicycle-Friendly Model Areas. In this study, we try to understand through a survey the relationship between the passing position of pedestrians and bicycle users by improvement of the pavement environment and we observe the passing positions of each. The investigation area is two Bicycle-Friendly Model Areas in Shiga, and the investigation types are the pole separation type, the fence separation type, and the visual separation type. As a result, we consider that the fence separation type is effective build for both pedestrians and bicycle users from the three types. However we consider that the pole separation type may be desirable when we consider the risk of separation structure built continually and the rate of actual application.

Key Words： Pedestrians, Bicycle Users, Bicycle-Friendly Model Area, Wide pavement, Passing Place

1. INTRODUCTION

Recently Japan has experienced a jump in gasoline prices and an energy insufficiency since The Great East Japan Earthquake. For that reason, transportation in Japan will need to move toward sustainability and a low environmental impact in the near future. These factors have helped the bicycle traffic focus become the spotlight of public attention, because the environmental impact of the bicycle is lower than other modes of transportation, and the bicycle is a good fit for use over a short distance. But the cycling environment readjustment of Japan (for example; cycling pass space etc.) is falling behind that of Western countries. That is the reason why many bicycle users in Japan cycle on the pavement. This is the present situation in Japan: Firstly the social background. The Japan government made a law in the 1970s relating to bicycle users passing on the pavement, and this law continues to the present. Because the amount of cars has increased rapidly since the 1960s, the amount of accidents between cars and bicycles has increased rapidly. For that reason, a lot of the present pavement utilizes the same space for pedestrians and bicycle users. The number of accidents between pedestrians and bicycle users shown in a 2008 report for the National Police Agency shows they have increased by 4.5 times in the past ten years. In these circumstances, pedestrians cannot safely use the pavement.

The Japanese government has designated 98 areas as Bicycle-Friendly Model Areas (here after called Bicycle Model Area) in which efforts to improve the cycling environment are concentrated. Therefore, the Japanese government will promote building passing spaces to separate pedestrians, bicycles and cars. The Japanese government will aim at decreasing bicycle related accidents. This government model was to make part of the pavement into roadway for bicycles. But the government also built areas where bicycle users would pass pedestrians on the pavement and they made signs saying: 'Bicycle users can be passing on the pavement'.

Previous studies on the passing environment of pedestrians and bicycles, for example, Ogawa (2007) studied the passing position of bicycle users and pedestrians on the pavement, and analysed differences of peoples

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passing position according to the traffic, the installation situation of the physical separation, the road marking and the sign. Lee et al. clarified the problems to user's consciousness and the factors to affect user consciousness for the bicycle environment. Moreover they suggested the direction of improvement that considered the actual condition of user's consciousness to the bicycle environment. In a previous study by our research group, we (2011) investigated the effect of the improvement of the wide pavement in a Bicycle Model Area in Fukui city, and we showed the improvement of the pavement environment readjustment method to the future in this area.

In this study, we try to understand through a survey the relationship between the passing position of pedestrians and bicycle users by improvement of the pavement environment and we observe the passing positions of each. Thus, we intended to explore whether they are able to pass safely without making the situation more complicated. In order to explore this, we target three types Bicycle Model Area in Shiga Prefecture. First we understood the actual application of the pavement passing place for pedestrians and bicycle users through the published results of a questionnaire survey from the Shiga National Highway Office (here after called Shiga Office). Next we understood the actual behavior of the pavement passing place for pedestrians and bicycle users by an On-The-Spot survey that we conducted. From this study we can see the building problems and practical issues of using wide pavement passing spaces and we can get a fundamental knowledge of the potential reduction in traffic accidents related to bicycles in the future.

2. SUMMARY OF THE SURVEY

The target of the survey is pedestrians and bicycle users that pass each other on the National highway route 1 in Seta area, Otsu city, Shiga, and Otsu-Kusatsu line of the prefectural road. In addition we look at the municipal road in South Kusatsu area, Kusatsu city, Shiga, next we will outline the survey we conducted.

2.1 Questionnaire Survey Relating to The Application of Passing Places between Pedestrians and Bicycle Users

This survey analysed the readjustment effect of the pavement with relation to pedestrians and users of a parking lot for bicycles around the Seta JR station and South Kusatsu JR station from 7:00 a.m. to 6:00 p.m. in November 2010 by Shiga Office. The valid distribution vote of the questionnaire in Seta area was 1080 votes, the valid response vote was 317 votes and the valid response rate was 29.4%. The valid distribution vote of the questionnaire in South Kusatsu area was 1166 votes, the valid response vote was 298 votes and the valid response rate was 25.6%.

2.2 On-The-Spot Survey Showing The Actual Usage of Passing Places for Pedestrians and Bicycle Users

The survey was conducted between 7:30 a.m. and 5:30 p.m. for three days (each route is one day) in and around the middle of March 2012 by the authors. The method of this survey was to look at different behavior of users between pedestrian lanes and cycling lanes. We observed and judged the behavior of people in a straight pre-defined section by visual recognition, we also distinguished by age group.

3. INVESTIGATION INTO THE EFFECT OF PAVEMENT READJUSTMENT ON A TARGET AREA

The readjustment of the pavement in the Bicycle Model Area in this study targeted two types of change. Visual separation and structural separation combined, and visual separation only. For the visual separation build method, all investigation types in this study use blue color on the cycling lane, and signs for pedestrians and bicycle users. Investigation of a separate build method in the area of the National highway Route 1 has poles at regular intervals, and the investigation area of Otsu-Kusatsu line of the prefectural road utilizes

consecutive fences. The municipal road in Kusatsu is not built to be structurally separate. For the purposes of this study, the Bicycle Model Area of the National highway Route 1 is called the pole separation type, the Bicycle Model Area of Otsu-Kusatsu line of the prefectural road is called the fence separation type and the Bicycle Model Area of the municipal road in Kusatsu is called the visual separation type. The Pole separation type and the fence separation type have 200cm or over width for the passing place of bicycles and the pedestrians. The visual separation type has 200cm or over width for pedestrians, but the width of the passing place for bicycles is around 120cm. The width of the passing place for bicycles in the visual separation type is the narrowest of the three types. All investigation types included a signboard to indicate to users what it was. (Table 1)

The situation around the pavement we investigated was this: There is the JR station and a lot of educational institutions such as the high school, commercial facilities such as shopping centers and residential facilities such as the apartment house etc.

Table 1 The readjustment conditions and build type of the investigation pavements

Build Type	The Visual Separation and Structural Separation Type		The Visual Separation Type
	The Pole Separation Type	The Fence Separation Type	
Pedestrian Lane Width (cm)	about 215	about 200	about 220
Bicycle Lane Width (cm)	about 215	about 225	about 120
Road Color	Pedestrian Lane:No Cycling Lane:Blue (flow in place only)	Pedestrian Lane:Green Cycling Lane:Blue	Pedestrian Lane:No Cycling Lane:Blue (flow in place only)
Separatation Line	White Line	White Line	White Line
Structual Separate	The pole at regular intervals	The fence at consecutive	×
Indicate of road	○	○	○
Sign	○	○	○
Sign Board for Pavement user	○	○	○
Readjustment Condition			

4. RESULT OF THE INVESTIGATION

4.1 Traffic of Pedestrians and Bicycle Users in the Investigation Area

Total traffic of pedestrians and bicycle users in the visual separation type area was 2310 persons, the pole separation type area was 1955 persons and the fence separation type area was 998 persons. Traffic at the fence separation type area that lies on the west side of the South Kusatsu JR Station is lower than the other areas. Traffic in the visual separation type area that lies on the east side of the South Kusatsu JR Station was the greatest. It is thought that it is because of the existence of various commercial establishments such as the station and the commercial establishments on the station east side. There is a lot of uses for school-commuting roads by high school students in addition on the east side. The amount of traffic on the east side decreased due to the position away from the station, and the children and students who go to school at educational institutions such as the high schools are few compared with the west side. On the east side though exists also in the west side the commercial establishment and the high school, etc. The bicycle users showed a rate that was about 15% higher in the pole separation type compared with the pedestrians, and the pedestrians showed a rate that was about 10% higher in the fence separation type compared with the bicycle users. (Table 2)

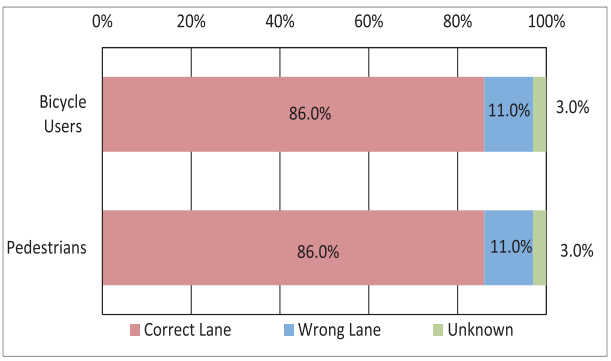
Table 2　Traffic of pedestrians and bicycle users in the investigation area

	Pedestrians	Bycycle users	Total(100%)
The Pole Separation Type			
Less than high school students	203 (45.4%)	244 (54.6%)	447
Adults	506 (43.3%)	663 (56.7%)	1169
Person of advanced age	120 (35.4%)	219 (64.6%)	339
Generation Total	829 (42.4%)	1126 (57.6%)	1955
The Fence Separation Type			
Less than high school students	172 (64.7%)	94 (35.3%)	266
Adults	314 (52.4%)	285 (47.6%)	599
Person of advanced age	68 (51.1%)	65 (48.9%)	133
Generation Total	554 (55.5%)	444 (44.5%)	998
The Visual Separation Type			
Less than high school students	116 (19.3%)	486 (80.7%)	602
Adults	943 (61.2%)	598 (38.8%)	1541
Person of advanced age	91 (54.5%)	76 (45.5%)	167
Generation Total	1150 (49.8%)	1160 (50.2%)	2310

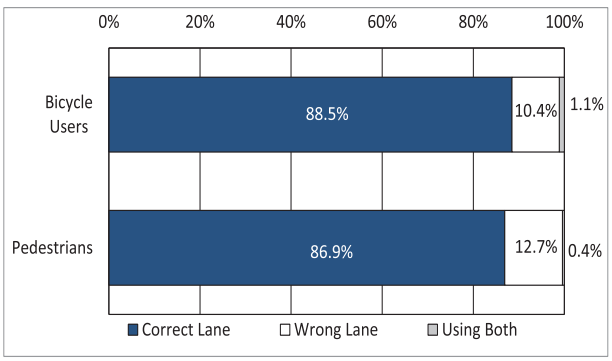
4.2 Actual Application and Behavior with Passing Place in Each Investigation Area

Correct lane for bicycle users is a cycling lane, and correct lane for pedestrians is a pedestrian lane. We think the accidents relating to pedestrians and bicycle users decreases by using the correct lane which they should to pass. Based on these thoughts, we examine the results of the investigation.

For the actual application rate of passing place in the pole separation type, the rate of pedestrians is just the actual application rate of bicycle users. The rate of the correct lane for pedestrians and bicycle users is 86.0%. For the actual behavior rate of passing places, the correct lane rate of bicycle users is 88.5%, the correct lane rate of pedestrians is 86.9%. Correct lane rate of pedestrians is about 1.5% lower than the correct lane rate of bicycle users. Correct lane rate of actual behavior of bicycle users is 2.5% higher than correct lane rate of actual application of bicycle users. Correct lane rate of actual behavior of pedestrians is about the same volume as correct lane rate of actual application of pedestrians. (Fig.1)



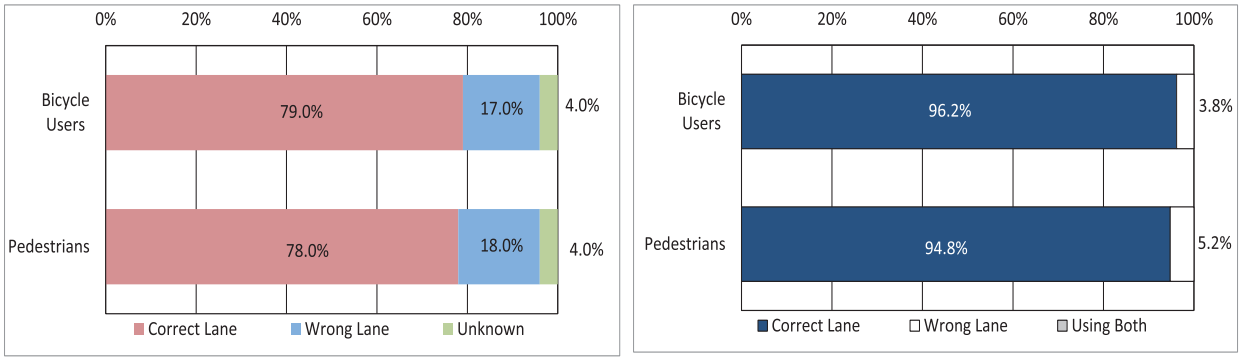
(Actual application of passing places)



(Actual behavior of passing places)

Fig.1　Actual application and behavior of passing places (The pole separation type)

For the actual application rate of passing places in the fence separation type, the rate of pedestrians is almost the actual application rate of bicycle users, and the rate of correct lane for pedestrians is 78.0%, and bicycle users is 79.0%. For the actual behavior rate of passing places, correct lane rate of bicycle users is 96.2%, correct lane rate of pedestrians is 94.8%. Correct lane rate of pedestrians is about the same rate as bicycle users. Correct lane rate of the actual behavior of bicycle users is 17% higher than correct lane rate of the actual application of bicycle users. Correct lane rate of the actual behavior of pedestrians is 12% higher than correct lane rate of the actual application of pedestrians. (Fig.2)



(Actual application of passing places)　　(Actual behavior of passing places)

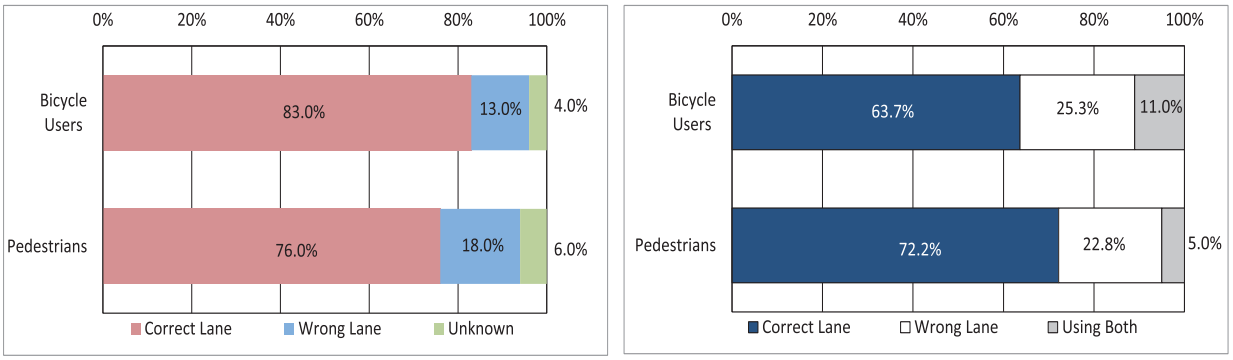
Fig. 2　Actual application and behavior of passing places (The fence separation type)

For the actual application rate for passing places in the visual separation type, the correct lane rate of pedestrians is lower than correct lane rate of bicycle users, the rate of correct lane for pedestrians is 76.0% and bicycle users is 83.0%. For the actual behavior rate of passing places, correct lane rate of bicycle users is 63.7%, correct lane rate of pedestrians is 72.2%. Correct lane rate of pedestrians is about 10% higher than correct lane rate of bicycle users. Correct lane rate of the actual behavior of bicycle users is 20% lower than the correct lane rate of the actual application of bicycle users, and correct lane rate of the actual behavior of pedestrians is about 4% lower than correct lane rate of the actual application of pedestrians. (Fig. 3)

In these circumstances, correct lane rate of actual behavior of pedestrians and bicycle users in the visual separation type is lower than the correct lane rate of the actual application of pedestrians and bicycle users. But the correct lane rate of the actual behavior of pedestrians and bicycle users in the structural separation type is higher than correct lane rate of the actual application of pedestrians and bicycle users. The correct lane rate of actual behavior at pedestrians and bicycle users in the visual separation type is the lowest of the three types. The cause of this is that traffic of pedestrians and bicycle users in this area is the most of the three types. However the staying space for pedestrians and bicycle users in the intersection is small. That was why an investigator looked carefully at the scene where the standing pedestrians and bicycle users obstruct the way, when an investigator was conducting an on-the-spot survey. The pedestrians and bicycle users that passed in the correct lane avoid it when they are passing in the not correct lane. So we think, correct lane rate of actual behavior is lower than other types. The width of cycling lane in this type is 120cm however the other types are 200cm or over, this means that there is a low actual behavior rate for the bicycle users especially. This width is an inadequate width for bicycle users cycling on the side of the cycling lane on the pavement facing oncoming bicycle, and it is difficult to pass each other for bicycle users. Because the bicycle width is 60 cm (The width with rider is 100cm). Therefore, we consider that one bicycle users pass on the pedestrian lane to avoid them.

On the other hand, correct lane rate of actual behavior for pedestrians and bicycle users in the fence separation type is the highest of the three types. From this, we consider that the technique to separate

pedestrians and bicycle users visually and by fence are similarly effective. However we consider that the bicycle users in particular will be at a high risk of colliding with the fence as it is not possible for danger avoidance when cars suddenly rush out to enter the garage or to take a car out of the garage, because the separation fence is built next to it.



(Actual application of passing places)

Significance Test : Significant at 1% level

(Actual behavior of passing places)

Fig.3 Actual application and behavior of passing places (The visual separation type)

5. CONCLUDING REMARKS

We got the following knowledge about the actual application and behavior of passing place by pedestrians and bicycle users for the Bicycle Model Area of three types in Shiga prefecture in this study.

5.1 The Pole Separation Type

The rate of actual application for passing places for pedestrians and bicycle users is 86.0%. For the rate of actual behavior for passing places, pedestrians are 86.9% and bicycle users are 88.5%. Therefore, the actual application is almost the same rate as actual behavior. The separation method of pedestrians and bicycle users is visual and structural. We consider that it is the bicycle users in particular that will have a low risk of colliding with structures and that it is possible for danger avoidance when cars suddenly rush to enter the garage or take a car out of the garage, because the structural separation is built at regular intervals. We consider the cycling lane width to not be any problem for passing each other between bicycle users because width of the cycling lane is secured at 200cm or over.

5.2 The Fence Separation Type

For the rate of actual application of passing place pedestrians is 78.0%. The rate for bicycle users is 79.0%. For the rate of actual behavior of passing places, pedestrians are 63.7% and bicycle users are 88.5%. From this, there is a big difference with actual application and behavior, and in fact the rate of actual behavior is 17% higher than the rate of application with both. The separation method of pedestrians and bicycle users is visual and structural. The differences of the pole separation type, we consider that it is the bicycle users in particular that will have a high risk of colliding with structures that it is not possible for danger avoidance when cars suddenly rush to enter the garage or take a car out of the garage, because a structural separation is built consecutively. The same as the pole separation type, we consider the cycling lane width to not be any problem for passing each other between bicycle users because width of the cycling lane is secured at 200cm or over.

5.3 The Visual Separation Type

For the rate of actual application of passing place pedestrians is 76.0%. The rate for bicycle users is 83.0%. The rate of actual behavior of passing place for pedestrians is 72.2%, bicycle users is 63.7%. This result is the opposite result of the fence separation type, and the rate of actual behavior is lower than a rate of application with both. Especially, we know the rate of actual behavior for bicycle users is about 20% lower than the rate of application. We know whether the rate of actual application and the rate of actual behavior became low rate compared with other types as for this type because it has stayed in the visual separation of the method of separation of bicycle users and pedestrians. We consider that there is difficulty about passing each other for bicycle users because the width of cycling lanes is about 120cm.

5.4 Conclusion and Problems In The Future

We know that bicycle users tend not to pass toward the correct lane compared with pedestrians at only the visual separation type but the width of the cycling lane may influence it. Furthermore, we consider that pedestrians and bicycle users tend not to pass toward the correct lane at only the visual separation type because of the low rate that passes in the correct lane for pedestrians compared with other types. The rate of actual behavior at visual and structural separation type is higher than the visual separation type, and it especially became a result that was about 10% higher in the fence type compared with the pole type. Therefore, we consider that the fence separation type is effective build for both pedestrians and bicycle users from the three types that we investigated in this study. Moreover we consider that the fence separation type is the most practical in reducing pedestrians and bicycles accidents. However the fence separation type can cause problems with cars parking. Therefore we consider that the pole separation type may be desirable when we consider the risk of separation structure built continually and the rate of actual application in the fence separation type.

We will investigate other routes carrying out the three types of build that were carried out as an investigation in this study in the future, and we must verify whether they tend to be similar to the result that we obtained in this study. Furthermore, it will be necessary for us to analyse the tendency for actual behavior according to the age group in detail in the future because in this study an investigator observed according to age group by on-the-spot survey of the actual behavior.

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