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# A study on the role and limitations of motorcycles as a means of urban transport in Southeast Asia

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## 1. Background and goals

Motorcycle ownership and use has advanced rapidly in Southeast Asian regions in recent years, making motorcycles a major mode of urban transport. Because cities in developed countries have not previously experienced such a phenomenon, the positioning of motorcycles with regards to traffic planning, design of transportation facilities, and transport operation is unclear, and focus has instead been placed on the negative aspects of motorcycles, such as increases in traffic accidents. However, motorcycles are compact, highly maneuverable, and have a relatively low environmental impact; thus, they may be a potentially beneficial mode of urban transportation by clarifying their positioning.

Given this situation, this project investigated the actual conditions of motorcycle usage from a variety of viewpoints and elucidated the issue. Specifically, we investigated subjects such as trends in motorcycle dissemination, the effects of motorcycles on traffic flow, traffic operation at intersections according to the motorcycle ratio, usage of motorcycles as taxis and delivery vehicles, and efforts toward increasing motorcycle safety. Through on-site investigations, analysis of statistical data, and interviews with experts in Thailand, Cambodia, and Vietnam, we were able to obtain much new knowledge.

As a representative example, below we present our findings resulting from investigations on actual traffic operation at intersections according to motorcycle ratios. Based on our findings, we make a proposal for efficient traffic operation at intersections and analyze the effects of conversion from motorcycles to four-wheeled vehicles on transport volumes.

## 2. Research content

### 2-1. Investigation of traffic operation at intersections according to motorcycle ratio and a proposal for efficient operation

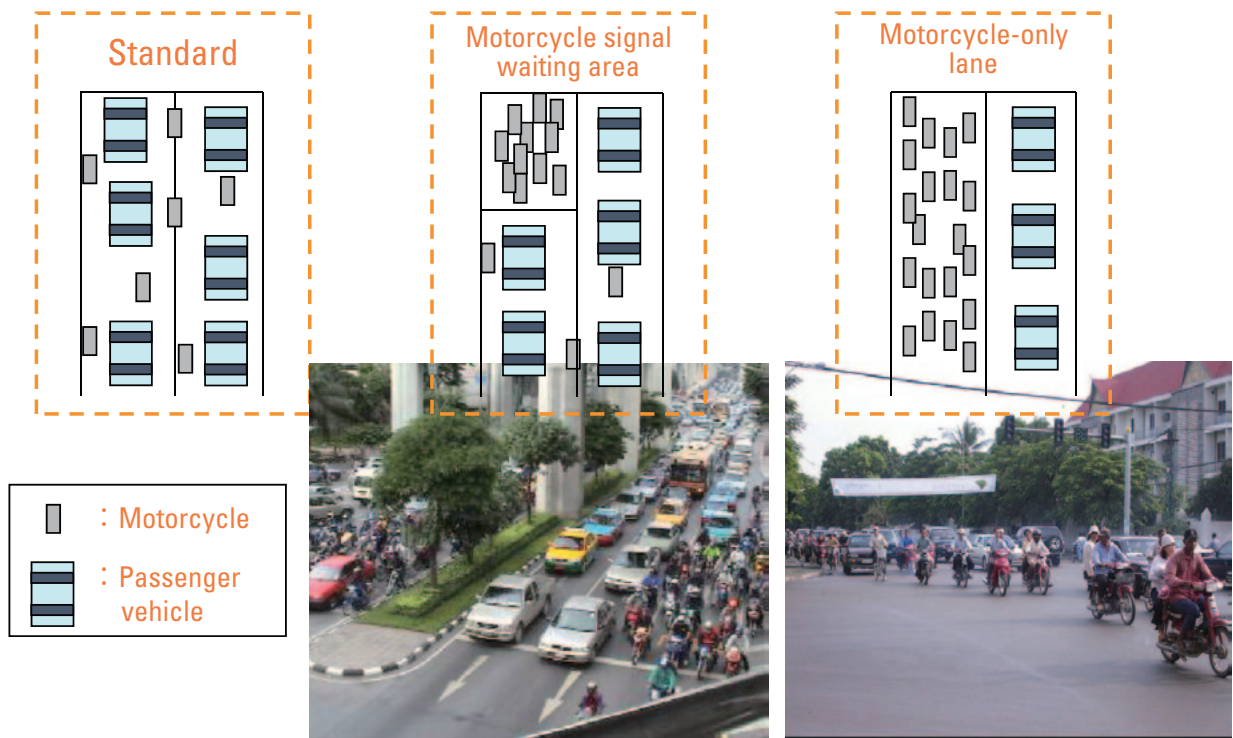
Intersections are operated in a variety of ways according to the ratio of motorcycles to overall traffic volume. We recorded videos to perform a traffic survey in Bangkok, Chiang Mai, and Phnom Penh, three cities with different motorcycle ratios and different methods for traffic operation at intersections. We performed a quantitative evaluation of each intersection's traffic capacity<sup>(1)</sup> and investigated the

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(1) Intersection traffic capacity: At a single-path portion of a road, capacity is taken to be the number of vehicles that can pass through that location in one hour. At intersections, however, traffic passes through from different directions, reducing the number of vehicles that can pass. It is therefore important to determine intersection capacities.

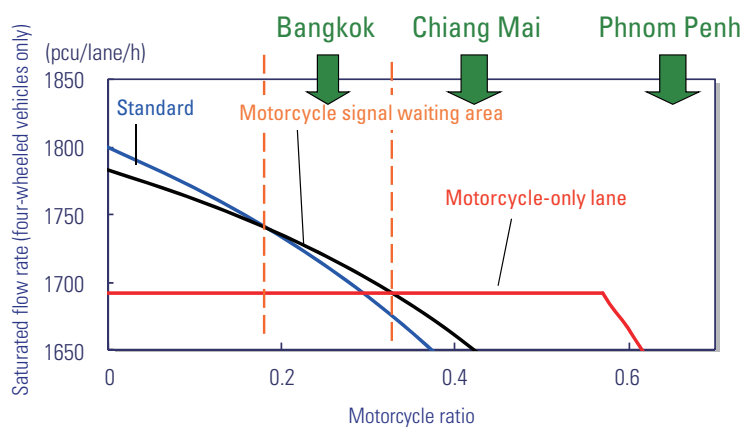


**Figure 1. Three types of intersection configurations**

intersection configurations that were most efficient for traffic flow control according to the variations in motorcycle ratio.

We found that an increased number of motorcycles traveling alongside four-wheeled vehicles at a standard intersection can impede traffic of four-wheeled vehicles. In contrast, we found that lane-splitting motorcycles did not have an effect on the operation of four-wheeled vehicles.

Therefore, comparing standard intersections with intersections that have a designated area for motorcycles to wait for traffic signal changes, the latter have the negative effect of pushing back the stop line for four-wheeled vehicles, delaying their start times. However, there was a positive effect in that allowing motorcycles to collect at the front of signal wait areas reduced the number of motorcycles running between cars. We thus found that in situations where there is a low motorcycle ratio,



There is an appropriate method according to the motorcycle ratio for traffic operation at intersections.

Saturated flow rate on the vertical axis refers to the maximum number of automobiles that can flow into an intersection without travel interruption during a green light. This is used as the base value for finding intersection capacity.

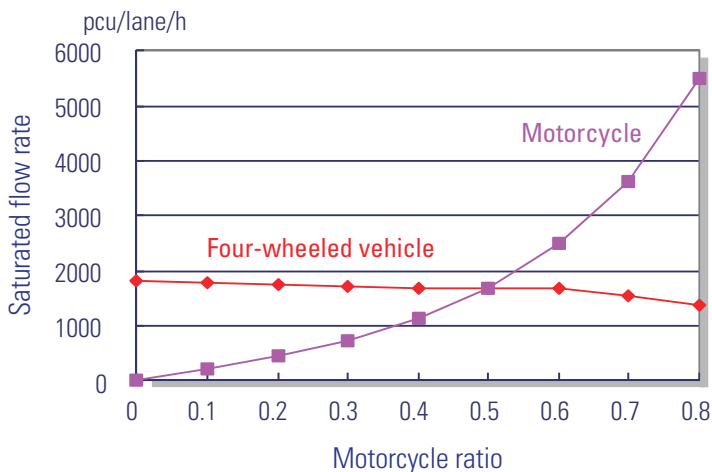
**Figure 2. Changes in intersection capacity due to motorcycle ratio**

standard intersections may allow for more efficient traffic flow, but the opposite may be the case with higher ratios. We observed an effect due to establishing motorcycle-priority lanes and to the narrowed lanes for four-wheeled vehicles. This indicates that the optimal intersection configuration may differ according to motorcycle ratios.

## 2-2. Impact on transport volumes due to conversion from motorcycles to four-wheeled vehicles

There is an assumption that increased economic development will promote four-wheeled vehicle usage, thus lowering motorcycle usage ratios in cities where these ratios are currently high. We therefore analyzed the potential effects of this conversion from the viewpoint of transport volume.

In Bangkok, each motorcycle carries on average 1.2 people, while each automobile carries on average about 1.5. Under the assumption that changes in the motorcycle ratio will not have a large impact on the average number of riders per motorcycle or four-wheeled vehicle, we calculated changes in cross-sectional throughput (the number of persons passing through an intersection lane per hour) for various motorcycle ratios. Note that when performing these calculations we assumed optimal intersection configuration for the motorcycle ratio.



**Figure 3. Changes in intersection capacity due to motorcycle ratio**

traffic operation for the utilization of motorcycles may increase transport capacity.

We could ascertain that decreased motorcycle ratios resulted in a decreased number of persons passing through intersections, and that such reductions were larger with higher motorcycle ratios. The current motorcycle ratio in Phnom Penh is approximately 0.7 and that in Bangkok is approximately 0.3. This indicates that Phnom Penh in particular will experience serious traffic congestion should four-wheeled vehicles become more popular. However, this also means that appropriate

## 3. Conclusions

The various analyses performed in this project indicate that motorcycles are a highly space-efficient means of transportation. We believe that the development of motorcycle-based taxis and messenger services in Southeast Asia is a result of motorcycles' mobility making them well suited as a supplemental means of small-scale goods distribution and trunk route transport.

Increased demands for transportation result in increased traffic volume. However, trying to accommodate for this volume by focusing on only four-wheeled vehicles will increase private marginal costs<sup>(2)</sup> and road usage costs. This translates into decreased total social benefit. In contrast, utilization of space-

efficient motorcycles can decrease private marginal costs, thereby increasing benefit and allowing more comfortable road usage.

Motorcycle ownership is currently declining in Japan, but intelligent utilization of motorcycles in Southeast Asian cities may help prevent the worsening of road conditions that accompanies development of automotive societies. However, attaining this utilization will necessitate the solving of many problems. The over-capacity motorcycle-riding that is frequently seen in Southeast Asia is dangerous, and there is a need for education to improve driving etiquette. As indicated above, there is also a need for appropriate road maintenance and traffic control better suited to motorcycle operation. Thus, implementing these changes will require not only traffic engineering and traffic planning, but also urban planning efforts.

#### 4. Future outlook

In Japan, there are numerous studies regarding the utilization of ultra-compact vehicles that are larger than motorcycles but smaller than small automobiles. How best to position the role of such personal vehicles—including motorcycles—as a part of urban transport, and how to connect them with public transportation, are important issues not only for Southeast Asian cities but also for cities throughout the world. In the future, it will be necessary to explore the roles and limitations of such vehicles from a variety of viewpoints regarding environmental and spatial efficiency and traffic safety issues, leading toward the development of an ideal traffic system.

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(2) Private marginal cost: An increased number of automobiles results in congestion and lower traveling speeds. Private marginal cost is a generalized cost referring to the amount of worsened congestion resulting from the increase of a single car (Social marginal cost: Under these conditions of increased number of automobiles, worsened congestion results in increased costs due to congestion not only to the added car, but to other cars as well. Social marginal cost refers to this amount of increase).