

Research on the Integration and Optimization of Urban Road Poles and Facilities

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Abstract

In urban roads, various traffic signs, video detection device poles, street lamp poles, old facilities poles, etc. are installed on the side of the road. This makes it appear that the roadside poles are all over, which affects the overall appearance of the city, and brings extremes to the city. This study selects the context of the guidelines for "Poles Integration" in three of Shanghai, Kunshan city and Qingdao, analyzes its advantages and disadvantages, optimizes the different classifications of the pole layout methods, and unifies the integration method of poles installed at road sections and intersections.

Keywords

Poles Integration; Integration and Optimization; Poles and Facilities.

1. Introduction

With the rapid development of traffic today, a large number of detection equipment, cameras and other facilities in the city are installed on the roadside to ensure city safety and reduce traffic problems caused by vehicles. In addition to the original traffic information signs, street light poles, and old facility poles, all the new and old facilities are laid out and the poles are spread throughout, which affects the overall city appearance and brings a huge negative impact on the urban landscape. Therefore, different cities have issued corresponding "guidelines" to regulate the surrounding facilities of roads. For example, in 2015, Kunshan City implemented the "Kunshan Urban Road Bar Integration and Pipeline Markings Setting Guideline (Pilot)" [1] to improve the road traffic environment, improve the quality of services, and enhance the quality of public spaces. The integration of the poles can make it easier for drivers to receive important information [2], have the ability to coordinate with the environment [3], and combine certain artistic design concepts to further beautify the urban environment [4]. In addition, the management of poles must have a special department for overall planning and coordinated comprehensive management by relevant departments [5].

2. Problems faced by poles

2.1 Impact on drivers and pedestrians.

The sight of drivers and pedestrians will be greatly affected by a large number of scattered poles, which poses a greater safety hazard. When the driver reads the traffic sign information during driving, it is easy to be distracted in a short time, especially in places with a large amount of information such as intersections, which easily affect the traffic capacity and passing efficiency of the road, and reduce the safety of urban road travel.

2.2 Low facility space utilization.

The land in the city is very expensive, and the intersection is even more expensive. The space utilization rate of a large number of rods in the "golden area" is extremely low, which is not conducive to the sustainable development of the transportation facility system.

2.3 The impact of facility maintenance and management.

In terms of maintenance management, the current road maintenance mainly focuses on the road surface, and less attention is paid to traffic facilities. Therefore, the renewal of transportation facilities will not keep up with the changes in roads, leading to backward facilities. Even due to improper coordination between departments, no one manages the transportation facilities after installation, and the damaged facilities will leave greater safety hazards.

3. Multi-poles requirements in China

3.1 Shanghai.

In 2018, Shanghai introduced relevant "Guidelines" to promote the intensive construction and standardization of road poles and related facilities, build a harmonious and orderly road space, and shape the urban landscape. The following requirements for pole integration[6]:

1. The content of pole integration: Road lighting poles, traffic sign poles, signal poles, monitoring poles, road name poles, public service facility indicator poles, tram poles, bus stop poles, parking guidance poles, etc;
2. For special forms of rods, the rods can be set independently, and at the same time coordinate with the surrounding environment of the road.

The Shanghai "Guidelines" did not specify detailed requirements for road name plates and traffic signs. However, road name plates are incorporated on signal light poles at intersections, and traffic signs do not provide detailed layout requirements. In addition, the appendix of the "Guidelines" gives a plan for the arrangement of poles at urban road intersections, involving the intersection of various urban road grades, but there is a certain degree of non-university in the classification of urban roads. Due to the limitation of the red line range of urban roads, different roads have different mechanical non-separation methods and central separation methods. In practice, the separation method of roads will be more complicated.

3.2 Kunshan City.

Kunshan City is located in the core area of the important Yangtze River Delta urban agglomeration. By improving the integration of urban p and other related facilities, and setting urban signage standards, we will further improve the quality of urban public services, beautify the urban environment, enhance the cultural connotation of the city, and shape the spirit of the city.

The "Guidelines" require one pole for multiple purposes in the city, leaving "two poles": on the basis of street lamp poles and traffic facilities poles, attach signs such as "speed limit" to eliminate unnecessary signs; display more than one card, reduce the number of signs[1].

The "Guidelines" have made very detailed regulations for various road name plates, guide signs and traffic signs and poles; there are no detailed classifications and regulations for the layout of signal light poles at intersections.

3.3 Qingdao.

Qingdao's "Guidelines" must be based on the surrounding landscape planning and design for newly renovated and expanded roads. In principle, the street light poles and traffic facility poles are retained, and other signs are combined on the above two types of poles. To sort out the rods on the existing roads, eliminate unnecessary rods, and integrate street light poles and traffic facilities poles on the basis of meeting industry standard conditions.

The "Guidelines" have made very detailed regulations for various road name plates, guide plates and traffic signs and poles, and made a detailed distinction between newly renovated and expanded roads and existing roads. Regarding the requirements for traffic signal light poles, the "Guidelines" propose that the left turn signal light, right turn special signal light, non-motor vehicle signal light, and pedestrian signal light should be attached to the signal light pole for newly renovated and expanded roads; integrate the signal light poles of existing roads, install pedestrian signal lights on signal light poles, monitoring poles or street light poles, and at the same time organize regular inspections and remove abandoned signal light poles in time [7].

Qingdao's "Guidelines" put forward a series of requirements for the management measures after "Poles Integration". New reconstruction and expansion of roads require relevant departments to provide guidance, supervision, and inspection while meeting basic requirements. The construction unit is responsible for the joint poles and cabinets, and organizes relevant departments to install, confirm, and verify equipment and pipelines [7].

3.4 Comparative analysis.

As for the requirements for the assembly of signal light poles at intersections, the layout requirements of the above three cities are completely different. Shanghai has adopted the method of displaying the pictures to lay out the signal light poles at intersections according to the classification of urban roads; neither Kunshan City nor Qingdao listed detailed requirements for the arrangement of signal light poles at the intersections.

Regarding the arrangement of poles on the road section, Shanghai has given detailed spacing requirements for the spacing of poles close to the intersection, using "m" and "light pole spacing" as the unit. Kunshan City listed the placement positions of the five types of poles through pictures, and did not specify the spacing requirements of poles in detail. The appendix after the "Guidelines" of Qingdao gives the integration forms of some poles, but does not give specific requirements for the spacing of the poles.

For the form of poles, Kunshan City has considered lighting equipment for slow traffic; Shanghai is only lighting for motor vehicle lanes, and the consideration is insufficient. Qingdao did not consider the street lamp poles and the traffic facility poles together, but it merged the electronic police and lane marking poles, the electronic police and the monitoring equipment poles.

In terms of management measures, the design guidelines of Shanghai and Kunshan did not include supervision and management into the text.

4. Integration and optimization of urban road poles

When integrating the poles in this study, they are classified into roads and intersections. The integration of poles on the road section will be based on street lights, and the transportation facilities will be installed according to the different needs of the road section; the type of the integration of poles at the intersections will be classified and installed in the form of urban road sections. The combination of road section traffic signs and intersection traffic signs should pay attention to the continuity, legibility, and standardization of information.

4.1 Poles installed on the roads.

4.1.1 Installation of traffic signs.

Because the speed and field of view of the car and pedestrians are different, the space experience is also different. Regarding the layout and planning of traffic signs and traffic information on road sections, pay attention to the reading of traffic sign information according to the design speed, and build road landscapes that meet psychological needs. Usually at low speeds (5~15km/h), the driver has no influence on the reading of traffic sign information. However, when the driving speed of the car continues to increase, the driver's viewing angle will gradually narrow, and the traffic sign information that can be read will be less [8]. The specific relationship between speed and visual characteristics is shown in the Table1.

Table 1. The relationship between speed and visual characteristics [8]

| Speed (km/h) | 20 | 40 | 60 |
|---|------|------|------|
| Visual angle (°) | 70 | 55 | 43 |
| Focus distance (m) | --- | 46 | 180 |
| Minimum distance of identifying roadside scenery (m) | 1.71 | 3.39 | 5.09 |
| Clearly recognizable distance in the forward field of vision (cm) | --- | 180 | 370 |
| The size of the object that can be clearly identified in the forward field of view (cm) | --- | --- | 110 |

Therefore, for roads with different design speeds, reasonable traffic facilities should be arranged, and the perspective and orientation of the driver and pedestrians should also be considered. When traffic signs are installed on road sections, they must be installed in accordance with the " Code for layout of urban road traffic signs and markings " [9], and meet the requirements of the sign layout and road clearance requirements. The requirements are as follows:

1. At the same place, there should be no more than 4 signs on a pole, and they should be arranged in the order of prohibition signs, indication signs, and warning signs, first up and down, left and right;
2. The minimum distance between signs on urban road sections should not be less than 30m; it shall not hinder traffic safety and affect the parking sight distance requirements of the road;
3. The order of setting similar signs should be arranged according to the importance of the prompt information;
4. To prevent information overload, information should be kept continuous, and important information should be set repeatedly;
5. Multiple warning signs: the most necessary ones should be set; when the number of prohibition signs is more than 2, they should be set in combination;
6. Special signs, such as stopping to yield, decelerating to yield, meeting cars to yield, lifting speed limit, lifting prohibition of overtaking, etc. should be set up separately, in accordance with the requirements of the specification;
7. Auxiliary signs should be set at the lower edge of the main signs. When auxiliary signs with more than two contents are needed to explain the main signs, they can be combined, but the combined contents should not be more than three;
8. The pitch angle of the sign installation is perpendicular to the driving direction. The installation should reduce the glare impact on the driver; it should be arranged and adjusted according to the road alignment.

The installation of traffic signs can be randomly and flexibly matched with the rods while meeting the requirements. Not only can the traffic signs be installed on the road section, but also can be combined with the signal light rods in the design of the intersection to increase the acceptance of important information [8].

4.1.2 Road section monitoring equipment, intelligent acquisition equipment.

Since each city has different financial capabilities, this article does not make detailed requirements for the deployment of smart collection equipment. The basic road monitoring equipment has the following requirements, and the pole form is shown in Fig. 1. It is recommended to set the corresponding equipment rods at a distance of about 20-30m from the intersection signal light poles.

4.1.3 Traffic guide signs, lane-dividing signs, and other large traffic signs.

The large guide signs near the intersection should not be placed together with the lane-dividing signs. This will cause the information overload of the large guide signs, allowing the driver to read more information, making the brain's reaction time longer and distracting [10].

The two types of signs can be set separately according to the Shanghai Guidelines [6]. According to the direction of travel, first set up road signs, and then set lane-dividing signs according to a certain distance (about one light pole distance), see Fig. 2. If the road space is limited and large road signs

and lane-dividing signs need to be arranged side by side, they should be arranged from left to right in the order of lane-division signs and road signs [1].

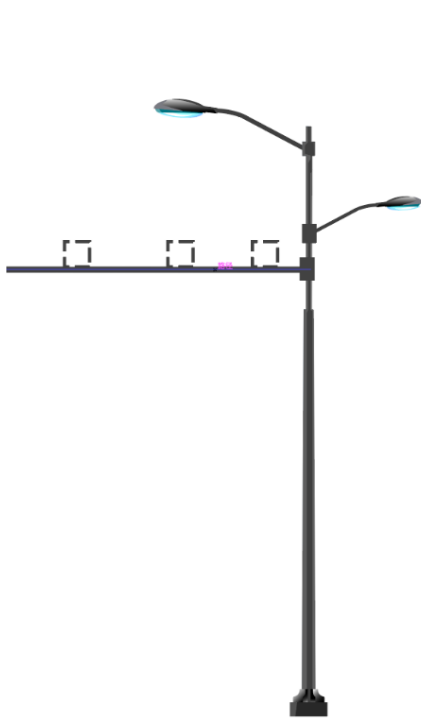


Fig. 1 Monitoring equipment poles integration



Fig. 2 Large signs poles integration

4.2 Poles installed at the intersections.

The large-scale poles at the intersection are mainly X-shaped poles, see Fig. 3, which is arranged with street light poles as the carrier and signal light layout as the main. A small guide sign that intersects the road is added in the middle of the crossbar, which echoes the content of the guide sign on the road section, so as to achieve continuous traffic information [10].

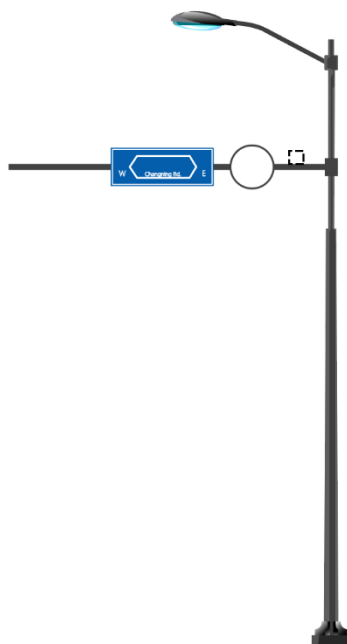


Fig. 3 X-shaped poles

4.2.1 One breadth road intersection.

Take the X-shaped rod cloth as the main, and add road name plates, pedestrian signal lights and appropriate traffic signs according to the actual road conditions, see Fig.4.

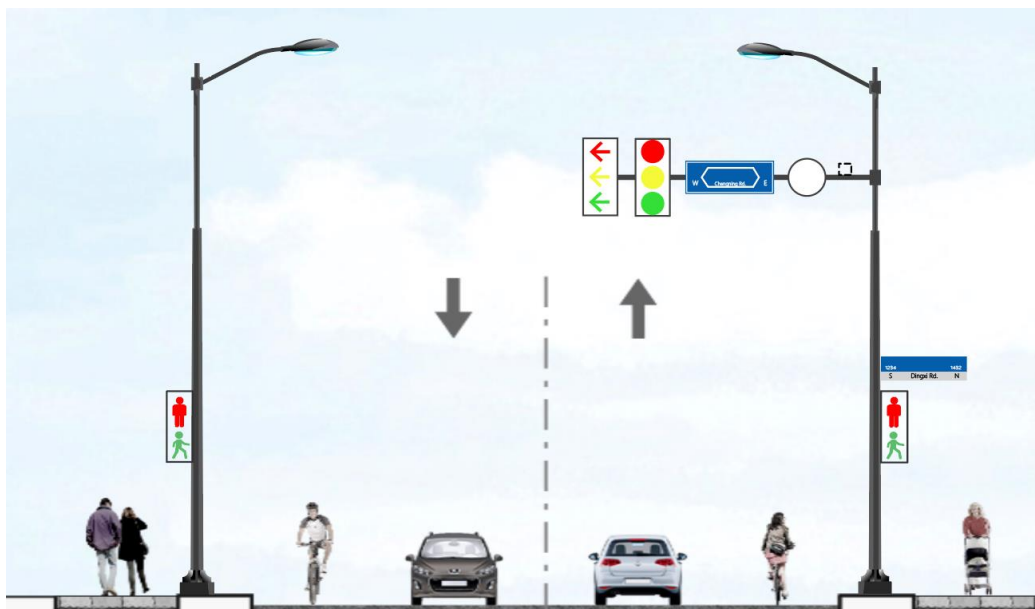


Fig. 4 Integration Poles installed at one breadth road intersection

4.2.2 Two breadth road intersection.

The number light poles are arranged on the central separation belt, with the X-shaped pole arrangement as the main, traffic signs and pedestrian signal lights are added according to the actual road conditions; the poles are arranged in the road, and two side street lights can be designed to provide two-way motor vehicle lighting. If there is a need for street light poles on the road side, large traffic signs can be added, and road name plates, pedestrian signal lights and other equipment can be added according to the actual road conditions, see Fig. 5.

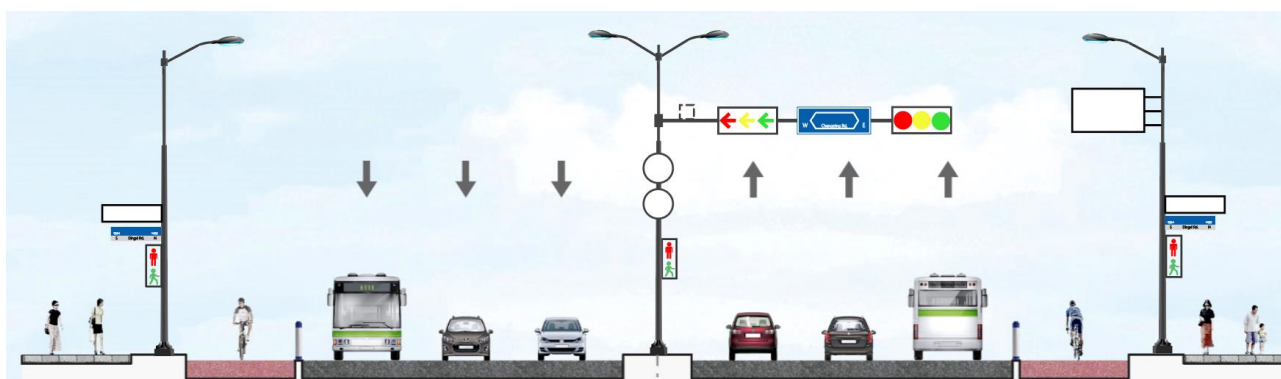


Fig. 5 Integration Poles installed at two breadth road intersection

4.2.3 Three breadth road intersection.

The number light poles are arranged on the machine non-separation belt, with the X-shaped pole cloth as the main one, and traffic signs are added according to the actual road conditions. Because they are arranged on the machine non-separation belt, street lights on both sides can be designed to provide non-motor vehicle lighting. The roadside poles are mainly small rods, which integrate pedestrian signal lights and various guide signs and road name signs, see Fig.6.

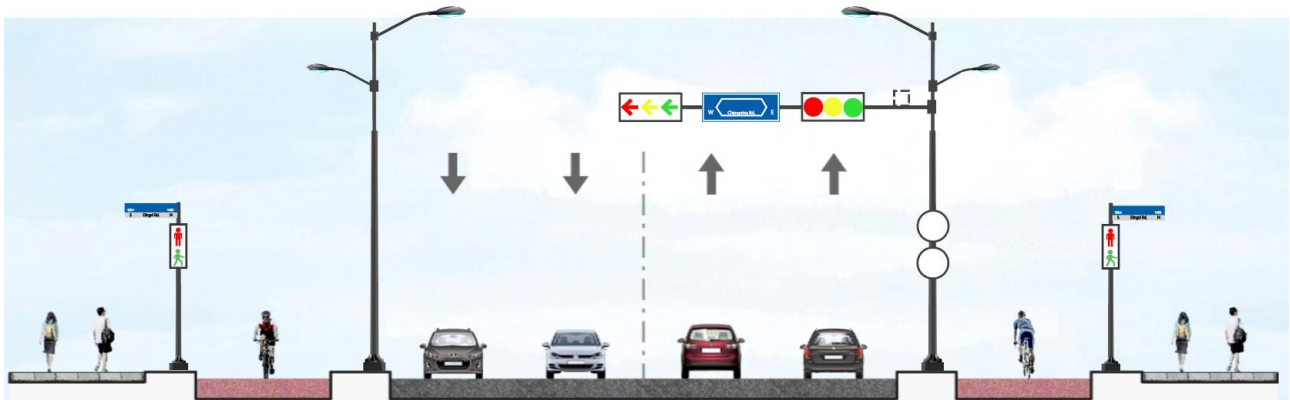


Fig. 6 Integration Poles installed at three breadth road intersection

4.2.4 Four breadth road intersection

The signal light poles are arranged on the machine non-separation belt and the central separation belt. The X-shaped pole arrangement is used as the main part. Traffic signs, pedestrian signal lights and other facilities are added according to the actual road conditions. The poles are designed to provide two-way lighting for vehicles. Roadside poles are mainly small rods, integrating pedestrian signal lights and various guide signs and road name signs, see Fig. 7.

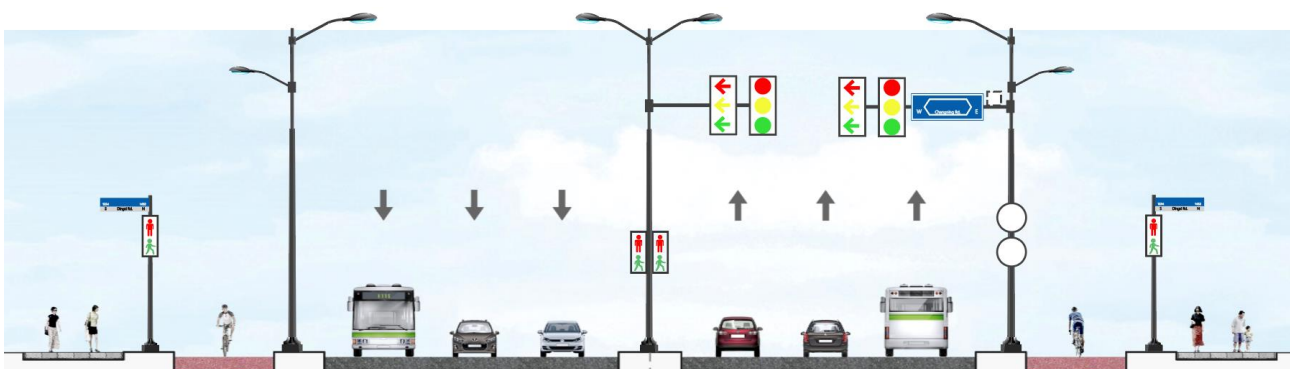


Fig. 7 Integration Poles installed at four breadth road intersection

Under special circumstances, when encountering bridges, pedestrian bridges and other facilities, signal lights, small road signs, etc. can be attached to bridges, piers, flyovers and other facilities to reduce the installation of rods, reduce the cost of rods, and make the road landscape more simple.

5. Conclusion

This study is mainly based on the guidelines of the three cities of Shanghai, Kunshan, and Qingdao to unify, select feasible parts, further standardize and modify, and propose a nationwide "multi-pole integration" standard. In the road section, the traffic signs, large-scale guide signs and lane-dividing signs, roadside guide signs and road name plates, etc. shall be unified and unified, and the rods shall be unified. Intersections are classified according to the cross-sectional form of urban roads, which is more extensive.

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