

# Road Projects for Barrier-Free Transportation

Fumihiko Nagai, Testuya Yokota, Kozo Takahashi, Mitsuru Sato & Masayo Kajitani  
Road Department, Public Works Bureau  
City of Osaka

As Japan's population gets older and the concept of normalization seeps in with regard to enabling the disabled and other weaker elements of society to participate in society like others do, the importance of ensuring the aged and disabled lifestyles and routines that promote their autonomy is growing. Ripe for improvement, the Law for Promoting Easily Accessible Transportation Infrastructure for the Aged and Disabled (Transportation Barrier-Free Law) was put into effect in November 2000 with the objective of promoting barrier-free access to public transportation infrastructure, roads and other routes of movement, in order to improve convenience and safety by 2010. This law calls for local governments to designate areas around railway stations for coordinated improvements and craft basic visions for such projects. Osaka City is crafting basic visions and project plans in order to create an energetic and prosperous city where anyone, including the aged and disabled, can congregate, interact and move about safely and enjoyably. This paper introduces actions taken in Osaka City with roads under the Transportation Barrier-Free Law.

Keywords barrier-free, resident participation, aged, disabled, safe access and use

## 1. Characteristics of Osaka City

In Osaka City, there are about 220 railway stations densely dispersed across a small area. Of these, about 180 stations qualify for a basic vision because they see 5,000 or more passengers a day (hereinafter referred to as "special visitor facility"). As a particular note, the average distance between stations in the heart of the city is about 1 km, which is short compared to other cities and puts most stations within walking distance of adjacent stations given that walking distance is stipulated as 500 m ~ 1 km in the Transportation Barrier-Free Law. The law sets the walking distance from special visitor facilities to government offices, welfare facilities and other infrastructure used

in daily life (hereinafter referred to as "primary facility"), as the area for coordinated improvements and identifies the routes that connect special visitor facilities with primary facilities as "special routes". Therefore, it is fair to say that these areas for coordinated improvements and special routes spread across a wide area of the city.

Given this geography and the critical state of finances today, an important topic in barrier-free efforts is to promote efficient, effective development.

## 2. Previous Barrier-Free Road Projects

Barrier-free measures for roads have been constructively undertaken mainly as a part of

traffic safety projects. Some previous barrier-free projects did the following.

1. Built sidewalks and eliminated level differences in sidewalks.
2. Installed pavement tiles for the visually impaired.
3. Dug utility trenches for sharing with power lines, etc.
4. Built garages and lots for bicycles.
5. Built bicycle paths.
6. Installed street lamps.
7. Installed guardrails.

The building of sidewalks, in particular, began around the mid 1960s from the viewpoint of road safety and efforts to eliminate differing levels in sidewalks have been aggressively undertaken since 1975 from a “barrier-free” perspective. On the other hand, the installation of pavement tiles for the visually impaired started in 1967, but, with the cooperation of the Osaka Municipal Association for the Blind (now Osaka Municipal Association for the Visually Impaired) that was created in 1975, codes were adopted for the shape and location of these tiles in the “Guidelines for Pavement Tiles for the Visually Impaired” of 1985 and installation was promoted along routes linking railway stations, bus stops and major public facilities. After that as well, “People-Friendly Urban Development” was positioned as an important municipal policy, and various measures to promote barrier-free improvements were undertaken.

It is necessary to effectively utilize the plethora of existing infrastructure in future

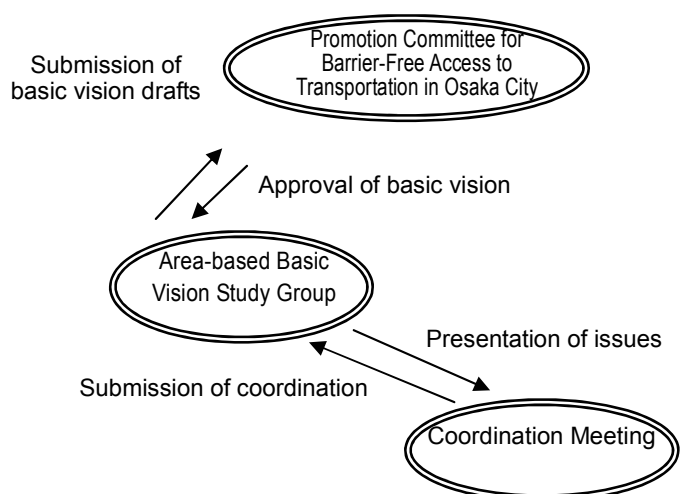
efforts to develop and manage road environments for barrier-free access and use.

### 3. Studies into Basic Visions under the Transportation Barrier-Free Law

In Osaka City, the system shown in Fig. 1 was used to craft basic visions. This approach injected the opinions of concerned persons via the participation of aged and disabled persons and local residents in order to reflect the local characteristics into each basic vision.

Also, in 2002, after studying the basic concepts of barrier-free road improvements, the “Working Group for Road Safety and Other Road Projects” consisting of experts, persons from the Public Works Bureau, Osaka Highway Office, Osaka Prefectural Police Department, underground mall operators, Osaka City Government and organizations for the aged and disabled, determined a basic policy for road development in Osaka City.

Fig. 1 Process of Crafting Basic Visions for Barrier-Free Transportation in Osaka City



### 3.1 Osaka Promotion Committee for Barrier-Free Access to Transportation

This committee selects areas for coordinated development, determines policies for adopting basic visions, etc., and approves basic vision drafts. It is made up of experts, representatives from aged and disabled organizations, concerned businesspeople, etc.

### 3.2 Area-Based Basic Vision Study Groups

These study groups are organized in each selected area to study a basic vision for the concerned area. Spearheaded by the ward offices, these groups are made of experts, residents and representatives of organizations from the local community, concerned businesspeople, etc. Basic visions gain tremendous input from residents through their participation in local groups known as “Wagamachi Watching”. The basic vision drafts are submitted to the “Osaka City Promotion committee for Barrier-Free Access to Transportation”.

### 3.3 Coordination Meetings

This meeting is for parties (public transportation operators, road authorities and the Osaka Prefectural Police Department) to examine broad issues and coordinate operations. Contractors take part in it. The meeting explains policies to the area-based Basic Vision Study Groups in their work on crafting basic visions for their areas.

## 4. Adopted Basic Visions

On March 25, 2002, the Promotional Committee for Barrier-Free Access to Transportation met for the first time and designated three large terminals (Umeda, Namba and Tennoji-Abeno) as the first areas for adopting basic visions. As shown in Table 1, basic visions were sequentially adopted.

Table 1 Adopted Basic Visions

Studies Launched	Area	Basic Vision Adopted
2002	Umeda	04/2003
	Namba	
	Tennoji-Abeno	
2003	Kyobashi	04/2004
	Tsuruhashi	
	Shinosaka	
	Yodoyabashi	
	Kitahama	
	Tenmabashi	
	Minami Morimachi-Osaka Tenmangu	
	Ebie-Noda Hanshin	
	Bentencho	
	Shinimamiya	
	Nihonbashi	
Uehonmachi-Tanimachi 9 Chome		
2004	Nishikujo	Spring 2005 (Planned)
	Sekime	
	Mitejima	
	Abikocho	
	Kireuriwari	
	Hanaten	

Also, in consideration of their proximity, geography and other factors, 12 areas that were working on basic visions in 2003 were merged into 8 areas and basic visions adopted accordingly.

## 5. Wagamachi Watching

As a preliminary process of adopting a basic vision, Wagamachi Walking activities were imparted whereby persons in each area walked the streets and train stations to identify problems to safe access from a user's perspective.

Table 2 gives the scale of those inspection activities. A diversity of the resident make-up took part including persons with physical disabilities (i.e., users of electric wheelchairs, manual wheelchairs, etc.), persons with visual impairments (partially or totally blind), persons with hearing disabilities, elderly persons and concerned local residents. Some of the persons with disabilities had multiple disabilities.

Table 2 Scale of Wagamachi Watching Inspection Activities

FY	Area	Routes Covered	Total Participants	*1
2002	Umeda	13	201	64
	Namba	10	156	60
	Tennoji-Abeno	7	178	61
2003	Kyobashi	6	118	35
	Tsuruhashi	5	99	24
	Shinosaka	7	130	46
	Yodoyabashi, Kitahama, Tenmabashi, Minami Morimachi-Osaka Tenmangu	11	154	41
	Ebie-Noda Hanshin	5	81	18
	Bentencho	4	80	18
	Shinimamiya	5	107	36
	Nihonbashi, Uehonmachi-Tani machi 9 Chome	6	100	24
2004	Nishikujo	2	63	15
	Sekime	2	86	32
	Mitejima	2	66	14
	Abikocho	2	74	24
	Kireuriwari	2	58	12
	Hanaten	3	81	24

\*1: Participating Local Residents

Inspection teams were formed of about 15 persons each, and included a leader, aged persons, persons with disabilities, care providers and persons to assist the inspection.

Inspection schedules were as follows and

required about 3 hours of time.

Assembly



Preliminary explanation and meeting



Walking inspections



Assembly, meeting and opinion exchange

In order to understand how user characteristics might weigh on opinions, inspection participants were documented in advance by gender, age, whether having a disability handbook or not, type of disability, aids used on a daily basis and whether assistance was needed for movements or not.

As the road inspection method, inspection routes were divided roughly by neighborhoods, which participants then walked. On each walk, breaks were inserted, during which the support staff that was assisting the inspection asked participants questions and filled out a survey. Surveys were not conducted while walking so that participants would feel natural about giving their opinions. However, spontaneous comments from participants were recorded while walking. Survey items (i.e., sidewalk width, pavement material, sidewalk grade, obstacles, guidance/warning tiles, etc.) were set for 2002 and 2003. The reason for setting survey items as opposed to allowing free comments was to provide a common viewpoint and criteria for participants. Free opinions were added in 2004 so that participants could comment on popular opinions collected in

previous years. Photos 1, 2 and 3 show scenes from Wagamachi Walking activities in 2002. Table 3 lists primary concerns voiced in surveys.

Photo 1 Walking Inspection in Tennoji-Abeno



Photo 2 Walking Inspection in Namba



Photo 3 Meeting in Umeda



**Table 3 Primary Concerns Excerpted from Wagamachi Walking Activities**

	Concern
Sidewalks	Narrow (Seems narrow.)
	I would like to see bicycle paths to separate pedestrians and cyclers.
	There is a level difference at the boundary between sidewalks and roads.
	I would like sidewalks and roads to be clearly defined by level differences, etc.
	Slopes at crosswalks are too steep. Longitudinal slopes are too steep.
Vision Related	It is hard to travel over pavement tiles for the visually impaired.
	There are no pavements blocks for the visually impaired or they are discontinuous.
	Aids are not provided in discernable colors.
	I have trouble finding the end of the stairs. It would be good to have not only pavement tiles for the visually impaired but also audio announcements and Braille guide plates.
Obstacles	Signs, utility poles, lampposts and other obstacles are right in the middle of sidewalks.
	Cars parked on sidewalks are nuisances.
	Abandoned bicycles and illegal postings obstruct passage.
Other	The seams between interlocking blocks cause vibrations.
	Asphalt is a good pavement.
	There is too little time to cross long crosswalks.
	There are no audio signals.

From the Wagamachi Watching activities, participants pretty much agreed about sidewalk width and slopes, but opinions clashed between the types of disabilities when it came to structural issues such as differing levels of sidewalks. For example, wheelchair users cited the difficulty of ascending to sidewalks when

there were level differences from the road, while the visually impaired commented that adding level differences would help to identify boundaries between sidewalks and streets. Wheelchair users also felt that pavement tiles for the visually impaired were hard to cross over, while the visually impaired wanted the tiles installed and made continuous.

With regard to abandoned bicycles and easy-to-understand markers, opinions were consistent indifferent of the type of disability or whether one had a disability or not.

At the post-inspection meetings, members discussed not only hardware issues such as road development but also moral issues such as abandoned bicycles and illegal postings. They also touched upon the restrictions to infrastructure development and the importance of communicating person-to-person.

With opinions divided along disability lines as aforementioned, project developers were tasked with making improvements that would facilitate use by all persons, but how to do this was a dilemma for road authorities. Moreover, road authorities were faced with enabling the effective use of pedestrian environments by taking aggressive and effective action not only with infrastructure development but also with measures against abandoned bicycles, illegal postings and parked cars as a part of road management.

## 6. Osaka City Road Policy in Basic Visions

In major urban centers like Umeda and Namba, human activity spreads across the area

because many people come to enjoy the city (meet people, shopping and entertainment). For that reason, it is necessary to create a pedestrian network that meets this diversity of needs. Accordingly, the Osaka City Government set “primary routes” as a broader definition of “special routes” that link special visitor facilities with facilities used on a daily basis in consideration of the routes between facilities.

### 6.1 Forming a Pedestrian Network

As aforementioned, many people descend upon urban centers to enjoy the city, hence the sphere of human activity spreads across the area. This fact makes it necessary to consider a barrier-free pedestrian network that meet these needs, therefore the following (1) ~ (4) were targeted.

- (1) Transfer routes (Routes between stations)
- (2) Routes to primary facilities (Routes from railway stations, etc., to facilities)
- (3) Routes for diverse needs (Routes that meet diverse needs such as going from facility to facility)
- (4) Formation of a multilevel network (Multilevel routes that cover underground, aboveground, pedestrian decks, etc.)

Considerations were also shown for the following.

- The shortest distance would be selected for transfer routes to avoid roundabout transfers as best possible.
- Effective routes would be selected based on the spatial characteristics of underground malls, the aboveground and

raised walkways. (In urban centers, underground malls were selected as primary routes because there is no cross-traffic from bicycles and cars.)

- Preferential barrier-free networks would be selected based on traffic and road usage in the overall area.

### 6.2 Setting “Primary Routes”

Routes were classified into (1) and (2) below in consideration of the aforementioned pedestrian network and the following basic concepts that were laid out for the whole city.

#### (1) Primary Routes

[1] Routes from stations to the entrances of primary facilities (Primary government offices, welfare facilities, large hospitals, placed where people gather, large commercial facilities, shopping malls, etc.)

[2] Routes between facilities in large areas that branch out or expand to commercial or business facilities, parks, etc.

[3] Routes that connect to primary routes in existing development-targeted areas (Extensions or connections to primary routes in existing development-targeted areas are also categorized as primary routes.)

#### (2) Train Station Transfer Routes

Corridors, streets, underground malls and free-access concourses in railway stations are categorized as “train station transfer routes” when a transfer route is not ensured in station buildings for transfer between multiple railways stations.

For reference purposes, maps of routes are shown for Umeda (Fig. 2) and Tennoji-Abeno (Fig. 3). As can be seen, the two areas can be distinguished by the net-like primary routes for going from facility to facility in Umeda and the more linear primary routes of Tennoji-Abeno.

Fig. 2 Map of Primary Routes in Umeda

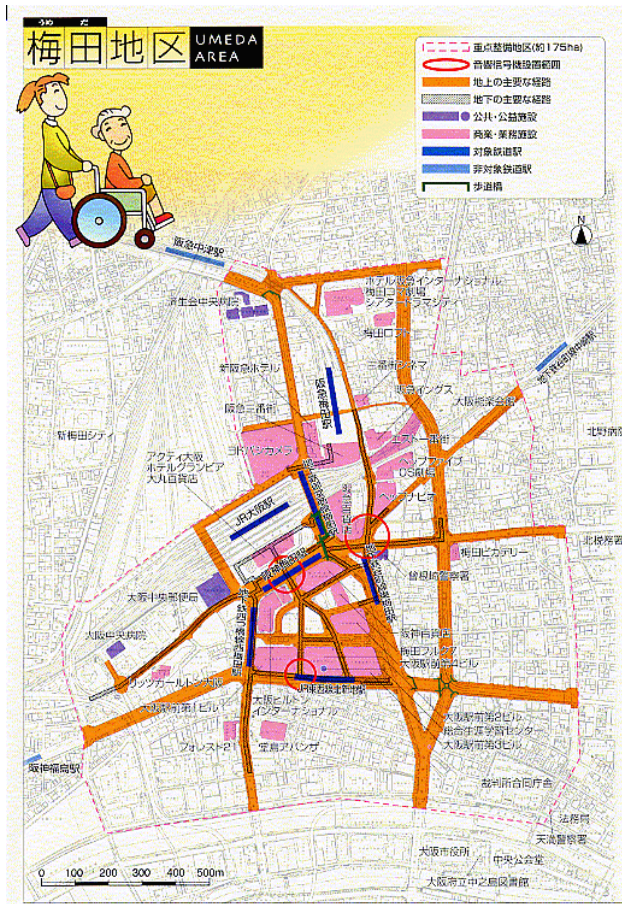
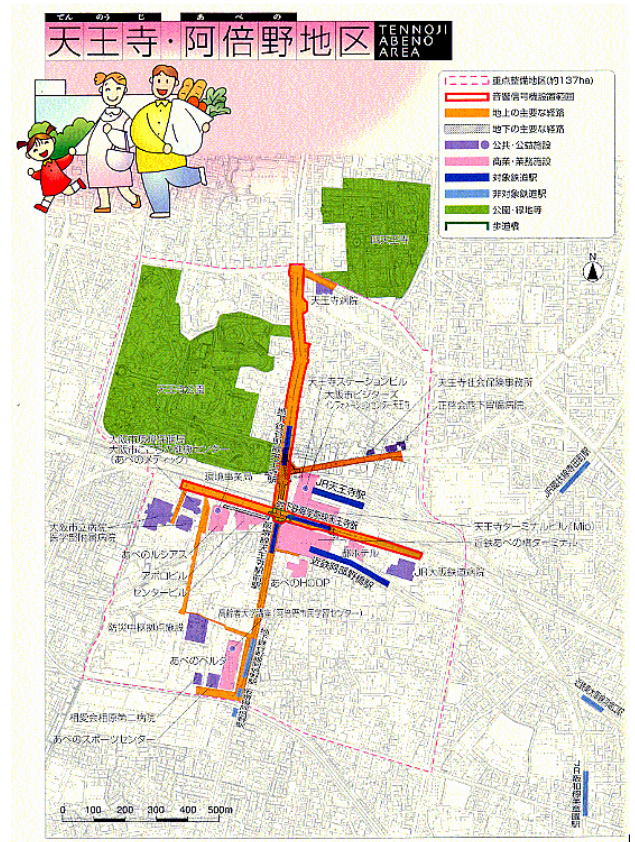


Fig. 3 Map of Primary Routes in Tennoji-Abeno



### 6.3 Basic Development Concepts for “Primary Routes”

After adopting basic visions, developers (railway operator, road authorities, Public Safety Commission, etc.) impart projects in line with the policy of the specific basic vision. Of these developers, road authorities draft and implement road development plans in line with development policy.

In Osaka City, primary road projects are classified into short-term, midterm and long-term projects as shown in Table 3. Plans are to implement projects in line with the basic concepts given in Table 4.

**Table 3 Development Concepts of Road Projects**

Short-term Projects	<ul style="list-style-type: none"> <li>○ Existing coordinated projects underway across city               <ul style="list-style-type: none"> <li>• Maintenance, management and awareness activities using daily detailed inspections</li> <li>• Installation and improvement to pavement tiles for the visually impaired</li> <li>• Eliminating level differences in sidewalks</li> <li>• Correcting slopes in sidewalks, etc.</li> </ul> </li> </ul>
Midterm Projects	<ul style="list-style-type: none"> <li>○ Project that require coordination with nearby residents, i.e., to install sidewalks, etc.</li> <li>○ Projects that require broad development and preliminary studies, i.e., installation of guide markers, etc.</li> <li>○ Projects that require cooperation from residents to enhance road management, i.e., increased removal of abandoned bicycles and illegal postings               <ul style="list-style-type: none"> <li>• Building sidewalks</li> <li>• Widening sidewalks</li> <li>• Installation of guide markers.</li> <li>• Increased measures against abandoned bicycles.</li> <li>• Increased removal of illegal postings. (Participation by residents)</li> <li>• Other</li> </ul> </li> </ul>
Long-Term Projects	<ul style="list-style-type: none"> <li>○ Projects that require investigations for security, maintenance or management reasons</li> <li>○ Projects that require investigations into cost-effectiveness because of their large size</li> <li>○ Projects that could have big social impacts, i.e., improvements to large intersections, etc.</li> <li>○ Projects that require considerable time for detailed studies and implementation, i.e., Introduction of new technologies using IT, etc.               <ul style="list-style-type: none"> <li>• Installation of elevators</li> <li>• Improvements to large intersections</li> <li>• Improvements to foot bridges</li> <li>• Providing information via IT to support pedestrian movement</li> <li>• Other</li> </ul> </li> </ul>

## 7. Other Measures for Roads

At present, the Public Works Bureau is reviewing road construction codes and is preparing a manual on installing pavement tiles for the visually impaired to accompany measures taken under the Transportation Barrier-Free Law.

These road construction codes are being revised to reflect the purport of the law and the opinions of disabled persons and others obtained through meetings, etc. Table 5 compares the new codes to other codes. Up until now, only mount-up sidewalks had been employed, but semi-flat sidewalks have now been adopted and some major changes have been instituted such as a 2 cm standard curbless height difference at crosswalks. These codes were applied not only to development areas but the entire city as well.

As a part of preparing the manual for pavement tile installation for the visually impaired, physical therapists and persons with visual disabilities are being interviewed and experiments are being conducted.

## 8. Conclusion

Osaka City has been implementing special road projects to make barrier-free improvements since 2003 and plans are to gradually expand that scope by a targeted 2010. Osaka is very mature as a city and has made considerable progress with urban infrastructure, but many issues remain to be solved from a “barrier-free” viewpoint, therefore existing road assets must be effectively utilized and the opinions obtained through the activities of

Wagamachi Watching and area-based Basic Vision Study Groups must be reflected in order to promote urban development that will make Osaka City safe, comfortable and barrier-free for everyone. We want to listen carefully to what residents and experts have to say in order to fuse urban development with barrier-free

concepts from the perspective of harmonizing the cityscape.

As a final note, the authors want to express their deep appreciation to the participants of Wagamachi Watching and study groups for their opinions, and the experts for their useful advice in crafting the basic visions.

Table 4 Basic Development Concepts for “Primary Routes”

		Basic Development Concepts
Sidewalks	New	<ul style="list-style-type: none"> <li>Show consideration for the surrounding environment and build new “barrier-free”<sup>(*)</sup> sidewalks in terms of width, grade, level differences, etc.</li> </ul>
	Improvements	<ul style="list-style-type: none"> <li>Obtain the consent of the local community as needed before eliminating level differences or improving slopes in sidewalks.</li> <li>Investigate building, widening and other sidewalk improvements with the approval of the local community if a barrier-free alternative route cannot be ensured.</li> </ul>
	Other	<ul style="list-style-type: none"> <li>Investigate the use of new technologies for road development such as permeable pavements, etc.</li> <li>Develop routes along narrow roads to ensure safe, secure passage by investigating means of passage, colored pavement for lanes, etc.</li> </ul>
	Measures against cars, etc.	<ul style="list-style-type: none"> <li>Improve parking behavior through advertisements, etc., so as to reduce street parking to a minimum.</li> </ul>
Guidance/ Information infrastructure	Pavement tiles for the visually impaired	<ul style="list-style-type: none"> <li>Install pavement tiles for the visually impaired along primary routes and other routes where guidance is deemed necessary.</li> <li>Study the installation of pavement tiles for the visually impaired on both sides of routes where installation on one side cannot ensure smooth movement so as to enable movement with the flow of people in crowded places and wide routes.</li> <li>Pavement tiles for the visually impaired should be yellow, but other easily recognizable colors may be considered based on brightness comparisons if the surrounding environment requires considerations for urban scenery, etc. Also, efforts should be made with pavement design so that pavement tiles for the visually impaired are readily distinguishable from patterns in the pavement.</li> <li>Install pavement tiles for the visually impaired in locations where deemed necessary to avoid dangers.</li> </ul>
	Other guidance /information infrastructure	<ul style="list-style-type: none"> <li>Install consistent and continuous guidance and information signs from a barrier-free viewpoint to facilitate transfer to means of public transportation, passage to nearby areas or facilities, etc.</li> <li>Provide users with easy-to-understand information on visitor facilities, governmental offices, welfare facilities, barrier-free infrastructure, etc.</li> <li>Investigate the possibilities of building information update systems.</li> </ul>
Installation and operation of means of vertical movement (elevators, etc.)	Vertical movement infrastructure	<ul style="list-style-type: none"> <li>Improve convenience by standardizing (to minimum required level) elevator operating hours in all parts of the city.</li> <li>Investigate the installation of means of vertical movement where a significant effect can be expected, to supplement and complement aboveground and underground routes in consideration of the situation of the pedestrian network<sup>(*)</sup>.</li> <li>Investigate the installation of escalators where elevators cannot be easily installed.</li> </ul>
	Other measures	<ul style="list-style-type: none"> <li>Investigate alternative barrier-free routes when means of vertical transportation cannot be installed.</li> </ul>
Improvements to intersections, etc.	Footbridges	<ul style="list-style-type: none"> <li>Make footbridges barrier-free (installation of elevators, slopes, etc.). Discuss the state of usage with related organizations if footbridges cannot be made barrier-free.</li> <li>Provide guidance to alternative routes that do not cross footbridges according to the situation of the pedestrian network.</li> </ul>
	Crosswalks	<ul style="list-style-type: none"> <li>Steadfast develop crosswalks to eliminate level differences, etc.</li> <li>Study and utilize aids developed for crosswalks (installation of lanes for the visually impaired<sup>(*)</sup>, etc.).</li> </ul>
Connections between means of transportation		<ul style="list-style-type: none"> <li>Develop infrastructure to make connections between railways, other means of transportation and roads barrier-free. Show considerations for harmonizing with amenities so that connection points, such as station-front plazas, etc., not only serve for transfer but also as places of fun and enjoyment.</li> <li>Develop bus stops and terminals for use with stepless-accessible buses<sup>(*)</sup>, one-step-accessible buses, etc.</li> <li>Effective service operation can also be considered along with infrastructure development so that stepless-accessible buses and one-step-accessible buses arrive on time.</li> </ul>
Related infrastructure	Infrastructure for rest, relaxation, etc.	<ul style="list-style-type: none"> <li>Investigate the installation and management of benches, planted tracts and other infrastructure for roads inside the pedestrian network.</li> <li>Investigate other measures to enhance convenience of the pedestrian networks.</li> </ul>
Other		<ul style="list-style-type: none"> <li>Investigate the possibilities of providing guidance and information via audio guides and IT (tests were done in the Umeda underground in 2000 and 2001) to support movement<sup>(*)</sup>. This will require further investigations into the relationships between hi-tech and users thereof, and backup measures for the hi-tech.</li> <li>Encourage development of standardized walking aids such as electric wheelchairs. Matters will need to be coordinated in order to apply uniform standards to walking aids and infrastructure development.</li> <li>Measures are needed with audio information to prevent echoes underneath elevated roads and noise in shopping malls from interfering with audio announcements. Also, studies are needed into audio plans and designs for public places.</li> </ul>
Effective use of infrastructure, etc.		<ol style="list-style-type: none"> <li>Expansion and improvements to barrier-free environments                             <ul style="list-style-type: none"> <li>Investigate alternative pedestrian routes with the approval of local residents when sidewalks cannot be built, in order to expand barrier-free environments.</li> <li>Investigate structural improvements and traffic control as needed in developing pedestrian routes.</li> <li>Investigate ways to utilize private property for sidewalks or use elevators in private buildings. Gain the cooperation of the private sector in barrier-free initiatives.</li> </ul> </li> <li>Measures for parked cars, etc.                             <ul style="list-style-type: none"> <li>Investigate measures against street parking, abandoned bicycles and illegal postings also from a barrier-free viewpoint.</li> <li>Investigate cooperation with local communities and residents as well.</li> </ul> </li> </ol>
Barrier-free traffic signals		Investigate functional enhancement (audio signals for the hearing impaired, signals for detecting the hearing impaired), improve awareness and review operation (separation of pedestrians and vehicles, longer time for pedestrians to cross, etc.).

Notes: After adopting a basic vision, developers<sup>(\*)</sup> coordinate matters and implement projects in line with the above basic development concepts.

\* Developers: Osaka City Government, road authorities, railway operators, bus operators, Public Safety Commission, underground mall managers, etc.)

Table 5 Sidewalk Structural Code Comparison

		Transportation Barrier-Free Law	Notification	Prefectural Urban Development Ordinance	Public Works Bureau (Old Code)	Public Works Bureau (New Code)	Remarks
Sidewalk Type		Semi-flat	Mount-up	Semi-flat (Mount-up possible depending on roadside situation)	Mount-up	Semi-flat Mount-up	Less than 2.5 m by rule. Use mount-up type. (Because 2 m effective width cannot be ensured with semi-flat 2.0-wide sidewalk.)
General Area	Level difference b/ sidewalk and road	15 cm or more	15 cm by code	_____	10 ~ 20 c m	15 cm by code	Sidewalks of width less than 2.5 m excluded
	Vertical grade	5% (8%) or less	5% (8%) or less	5% (8%) or less	8% or less	5% (8%) or less	Avoid composite grades at all costs.
	Horizontal grade	1% (2%) or less	2%	2% or less	2% or less	2% or less	
	Effective width	According to structural code Sidewalk 3.5 m (2 m) or more Bicycle path 4.0 m (3 m) or more	Provide continuous flat area of 1.0 or more. (Seek 2.0 m to ensure smooth 2-way traffic.)	2.0 m (1.0 m) (Provide 1.5 m or more effective width in necessary locations to ensure smooth 2-way traffic.)	_____	2.0 m (1.0 m) (Provide 1.5 m or more effective width in necessary locations to ensure smooth 2-way traffic.)	
Crosswalk (R Area of Sidewalk)	Level segment (Same as horizontal grade)	Structure that enables smooth rotation	About 1.5 m	_____	8% (Composite grade)	Provide area for waiting of about 1.5 m x 1.5 m.	
	Curbless height	2 cm by code	2 cm	2 cm by code	1 cm by code	2 cm by code	
Vehicle Loading Zone	Smooth grade	_____	15% or less (10% or less when using special border)	_____	_____	15% or less	For mount-up sidewalk. No problems with semi-flat sidewalks.
	Loading zone height	_____	5 cm or less	_____	1 ~ 5 cm	5 cm or less by code (Minimum 2 cm)	
	Effective width of flat area	_____	Requires 1.0 m or more continuous flat area.	_____	1m or more	2 m (1 m) or more	

Notes: Use values in ( ) when unavoidable.