ACCESSIBILITY MANAGEMENT AS A NEW RESPONSE TO TRAFFIC PROBLEMS ON URBAN ARTERIAL STREETS

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abstract: We have severe traffic problems on urban arterial streets. We have tried to increase highway facilities and decrease the number of vehicles on the highways. However, these efforts have not been successful in solving the problems. From the standpoint of transportation-land use relationship, transportation problems has their origins in the incorporated land uses. Therefore, the key to solving transportation problems is to implement transportation-land use coordination. As a function of transportation-land use coordination, access management can manage trip generations and decrease traffic conflicts, which results in the increase of safety as well as level of service.

1. INTRODUCTION

Today, we have severe traffic problems on urban arterial streets. From the standpoint of functional classification, the major role of an arterial street is movement, while providing access to abutting properties. Urban arterial streets have experienced traffic problems because of the increased direct access to and from abutting property and the failure of accommodating the movement hierarchy by suitable highway facilities (FHWA, 1982; AASHTO, 1994). Poorly located traffic signals also have created progression bottlenecks and increased traffic congestion (Demosthenes, 1993).

However, conventional geometric design or operational techniques such as computerized signal systems alone cannot eliminate the effect of poorly planned, located, or designed access to and from neighboring land and roads (Levinson and Koepke, 1993). New or reconstruction of highways requiring higher cost also cannot fully alleviate a safety problem without implementing appropriate access management (Stover et al, 1993).
From the standpoint of the design concept, a freeway has limited access by controlling direct access to abutting properties (Stover and Koepke, 1988). Full control of access on the freeways has resulted in efficient traffic operations as well as an improved level of safety (Smith and Associates, 1961; Gwynn, 1966; FHWA, 1982; AASHTO, 1994).

As a new application of the concept of access control, access management is an alternative approach to solving the traffic problems on urban highways and streets without excessive investments (Koepke and Levinson, 1992; Stover et al, 1993). In fact, access management is the single most effective element in preserving highway functions; thereby enhancing highway safety (Demosthenes, 1993).

This study investigates the causes of traffic problems on urban arterial streets from the standpoint of access management. This study addresses the principles and techniques of access management as a new alternative.

This study may contribute to finding the major causes of traffic problems on urban arterial streets from the perspective of access management. The results of this research may also contribute to the development of a comprehensive access management program on urban arterial streets.

2. THEORETICAL FRAMEWORK FOR THE PROPOSED STUDY

2.1. Traditional Transportation-Land Development Cycle

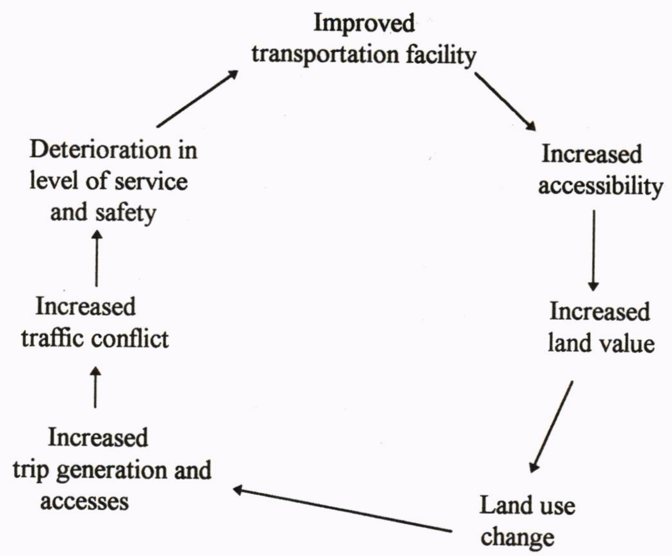
Land development needs access to transportation and transportation changes land use. The changes of land use again cause changes in transportation. Likewise, land use and transportation are closely correlated with each other.

Land development increases trip generation and accesses to and from highways which, in turn, increases traffic conflicts. The obsolescence of arterial streets caused by the increased conflict and congestion requires arterial improvements which, in turn, increases accessibility. Accessibility changes land values resulting in land use changes. New land development again increases trip generation. Traditionally, transportation-land development relationship is a continuous cycle (Stover and Koepke, 1988). The traditional model of transportation-land use relationship (Figure 1) implies that construction or improvement of highways without implementing appropriate access control measures may not obtain the functional integrity of highway facilities.

Access to and from the roadway is a crucial element for land development (HUF, 1975). Increasing the number of uncontrolled direct accesses to and from abutting properties along urban arterial streets results in inefficient traffic operations and poor traffic safety performance (FHWA, 1982). New or reconstruction of an arterial street without implementing appropriate access management fails to preserve the functional integrity of the arterial street; which in turn, requires continuous arterial street improvement (Stover and Koepke, 1988). Traffic impact assessment (TIA), transportation systems management (TSM), transportation demand management (TDM), or land use control alone cannot fully eliminate the functional deterioration of arterial streets resulting from the poorly planned, located, or designated access to abutting property (Koepke and Levinson, 1992).

2.2. Access Management and Transportation-Land Use Coordination

Access management is the planning, location, spacing, design, and operations of both public and private accesses. Access management is also called accessibility management. Traditionally, good accessibility of an arterial street has been one of the major factors attracting business activities along the arterial street which, in turn, has resulted in increased direct accesses to and from abutting properties.



Source: Adapted from *Course Note for CE 612* (Stover, 1988).
FIGURE 1: Traditional transportation-land development cycle.

Access management coordinated with land use control determines the timing, intensity, and location of roadside land development which, in turn, manages the trip generation of the roadside land development (Stover et al, 1970; Stover and Koepke, 1988). Access management also eliminates unexpected events to which the driver must respond and increases the spacing of decision points which, in turn, simplifies the driving tasks. Access management also limits the speed differential between through traffic and turning vehicles by providing appropriate turn bays at access points (Stover and Koepke, 1988).

Access management is recognized as a rational way of coordinating transportation and land development (Koepke and Levinson, 1992). As a function of transportation-land use coordination, access management improves arterial street safety (Figure 2).

Furthermore, access management preserves the capacity and functional integrity of an arterial street which, in turn, stabilizes accessibility and land values and finally, stabilizes land use along the arterial street (Stover and Koepke, 1988).

In summary, access management initiates transportation-land use coordination on urban arterial streets which, in turn, reduces traffic conflicts. Access management restores functional integrity of highway facilities which, in turn, improves efficiency and safety on urban arterial streets.

2.3. Definition of Terminology

The following terminology was defined based on the definitions and abbreviation of Colorado State Highway Access Code (Colorado DOT, 1992).

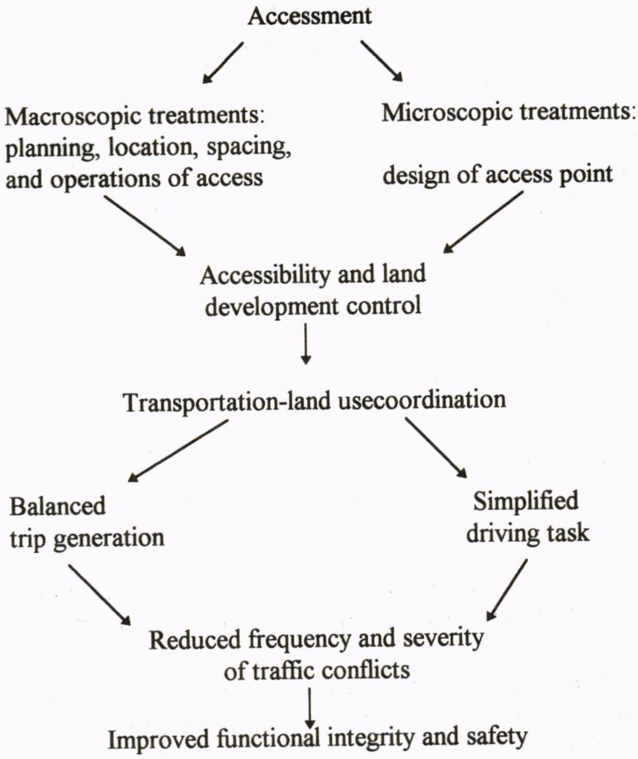


FIGURE 2: A model for safety improvement through access management.

Access: Access is any driveway or private road to a property. Access is also any public street, road, or highway connecting to a general street system. The minor road will be considered as access where two public roadways intersect.

Control or Regulation of Access: Control or regulation of access means that the right of owners or occupants of land abutting or adjacent to a roadway is regulated by the public authority such as police power.

Driveway: Driveway is an private access or any access that is not public street, road, or highway. In this study, a driveway is recognized as an unsignalized intersection.

Median: Median is a part of a highway separating traffic flows in opposite directions. In this study, a median refers to only an untraversable median having median openings for left-turn maneuvers.

Access Management: Access management can be defined as the regulation of access to and from abutting property and roads while providing access. In other words, access management is the systematic regulation of private access and public street connections. Access management is also called accessibility management. Access management can be implemented by a variety of access management treatments.

Access Management Techniques: Access management techniques can be viewed from both the macroscopic and microscopic levels. At the macroscopic level, access management treatments are related to access location, spacing, and operation. At the microscopic level, access management techniques are related to access point design such as turn bays, turning radius, angle, throat width, and throat length. Marginal and medial access techniques include access spacing as a macroscopic level and access design as a microscopic level (Stover et al, 1970).

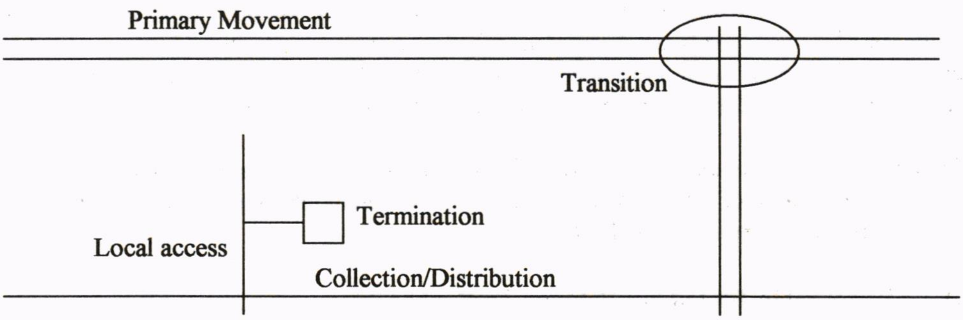
3. REVIEW OF ACCESS-RELATED PROBLEMS ON ARTERIAL SREETS

3.1. Increased Direct Accesses and Signals

From the perspectives of functional classification, the major function of an arterial street is movement while providing access to and from abutting properties. Good accessibility of an arterial street stimulates roadside development, which results in the numerous direct accesses. Increased direct access and traffic signals increases traffic conflicts which, in turn, results in the deterioration of the arterial street. Conventional geometric design and fancy signal system alone cannot solve the problems caused by poorly located accesses and signals.

3.2. Movement Hierarchy and Functional Classification System

Making a trip is composed of several distinct travel stages, which is often called the movement hierarchy (Figure 3). The movement hierarchy is classified into primary movement, distribution, collection, access, and termination based on the travel stages. Considering the total traffic volume, speed, and trip length, each movement hierarchy element needs to be accommodated by an appropriately designed facility for it. Access is accommodated by local streets, collection/distribution is accommodated by collector streets, and primary movement is accommodated by arterials (Stover and Koepke, 1988).

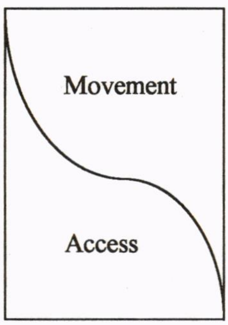


Source: Adapted from *A Policy on Geometric Design of Highways and Streets* (AASHTO, 1994).

FIGURE 3: Movement hierarchy.

Highways and streets perform two major functions: access and movement. Considering their functions, highways and streets can be classified into arterials, collectors, and local streets (Stover and Koepke, 1988). The detailed classification is an essential part of effective access management programs. The major elements that classify highway facilities include: (1) functions performed; (2) traffic characteristics such as speed and volumes; (3) linkage between activity centers; (4) system continuity; and (5) land use and area served (Koepke and Levinson, 1992).

The major function of an arterial street is movement, while the major function of a local street is access. From unrestricted access to controlled access, the classifications are a continuum according to the degree of access and movement functions (Figure 4). As the function of access increases, the function of movement decreases. Each functional class of facility has its own characteristic (Table 1). Arterial facilities accommodated almost 75 percent of trips in urban areas even though the total such mileage was only 15 percent (Khisty, 1990).



Functional Classification	Design Types
Arterial	Freeways Expressways
	Major arterials Minor Arterials
Collector	Collector streets
Local	Local streets Cul-de-sac

Source: Adapted from *Transportation and Land Developmen* (Stover and Koepke, 1988)

FIGURE 4: Functional classification of highways and streets.

Local streets serve the access function. Local streets provide for short trips, hence traffic volumes are low and speeds are slow. Generally, local streets are connected to collectors. Collectors serve both access and movement functions. The major function of the collectors is to collect and distribute trips between local streets and arterials.

The failure of accommodating movement hierarchy by suitable arterial street facilities result in the deterioration of the arterial street. Conventional techniques cannot solve the problems caused by poorly located access.

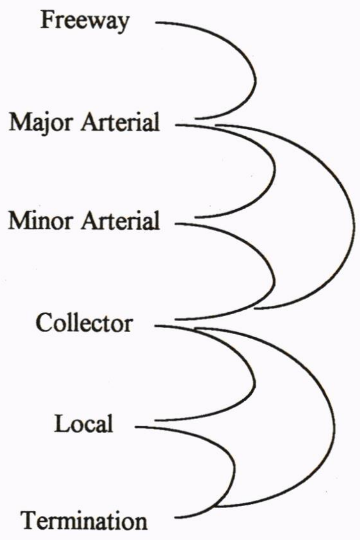
3.3. Undesirable Transitions Between Traffic Facilities

A desirable transition occurs at the intersections of the same or next classes of facilities (Figure 5). The failure of accommodating the movement hierarchy by a suitable facility or the failure to provide an appropriate transition between functional classes of facilities causes traffic conflicts and congestion. The frequent access driveways along the arterial street is a good example of not accommodating movement hierarchy by a suitable facility. Direct driveway access to arterial streets does not perform an appropriate transition function among the movement hierarchy and facilities.

TABLE 1: Characteristics of functional classification system.

Classification	Function	Continuity	Spacing miles (km)	Direct access	Mobility
Freeway & expressway	movement	Continuous	4 (6.4)	None	Provide high mobility
Major arterial	More movement; Less access	Continuous	1 (1.61) ~ 2 (3.22)	Limited	Backbone of street system
Minor arterial	More movement; Less access	Not necessary continuous	1/2 (0.8) ~1 (1.61)	Restricted	
Collector	More collection/ distribution; Less access		1/2 (0.8) or less	Safety control; limited regulation	Through traffic should be discouraged
Local	Land access		As needed	Safety control only	Through traffic should be discouraged

Source: Adapted from *Transportation and Land Development* (Stover and Koepke, 1988).



Source: Adapted from *Access Control Issues Related to Urban Arterial Intersection Design*. Transportation Research Board Paper (Stover, 1991).

FIGURE 5: Desirable transitions in the functional classification system.

3.4. Traditional Urban Street Network

The traditional gridiron street network in the pre-automobile age was finely spaced streets providing equal pedestrian movement and access to each property. The function of movement and access were uniformly provided. In the post-automobile age, the traditional gridiron street network was superimposed by a coarser grid of arterial streets.

The radial street system provided direct access to the central downtown area. Ring roads were established to provide access to property between the radial streets. In the radial and ring road system, the streets were closely spaced in the central area and became less closely spaced further from the central area (Krammes, 1995).

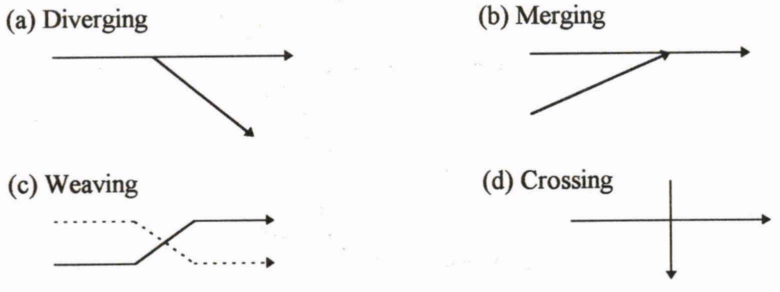
Both the gridiron and radial street system were not functionally classified to properly accommodate movement hierarchy. Densely spaced access points and signals have resulted in conflict and congestion in the post-automobile age.

Urban street networks established without access management also can be an unavoidable source of traffic conflicts and functional deterioration on the street. Traditional gridiron and radial street networks cannot accommodate the movement hierarchy by the suitable functional classification system of facilities. They also cannot maintain the functional integrity of the streets as traffic volumes increase.

4. ACCESS MANAGEMENT AS AN ALTERNATIVE

4.1. The Principles of Access Management

A traffic conflict point is where the paths of two traffic movements intersect at grade. From the most severe conflict, traffic conflicts occur in order are: crossing, weaving, merging, and diverging points (Figure 7). Because the crossing conflict has a potential for the most serious collisions such as a high speed right-angle collision, it is called a major conflict points. Minor conflicts such as merging and diverging maneuvers occur when a vehicle executes right-turn or left-turn maneuver for entering or leaving a through traffic stream



Source: Adapted from *Access Management, Location and Design Participant Notebook* (FHWA, 1991).

FIGURE 7: Traffic conflict patterns and points.

(FHWA, 1991). The conflicts between the through traffic and merging or diverging vehicles cause a traffic collision and/or congested operation.

The major principles of access management include: (1) limit the number of conflict points; (2) separate conflict points; (3) limit deceleration required; (4) remove turning vehicles from the through lanes; (5) increase spacing of major intersections; and (6) provision of adequate on-site storage. Table 3 shows a variety of access management techniques that can be used to implement these principles (FHWA, 1991; Koepke and Levinson, 1992; Stover and Koepke, 1988).

4.2. The Techniques of Access Management

Access management techniques should be provided to allow safe and efficient trips. According to the principles of access management, the related techniques should be implemented reflecting access categories (Table 2).

TABLE 2: Access management principles and relevant techniques

Principles	Techniques
Limit the number of conflict points	• Install median barrier with no left-turns at the median opening • Install raised median divider with left-turn deceleration lane • Install one-way operations on the highway • Install traffic signal at high volume driveway • Channelize median opening to restrict left-turn ingress or egress • Median closure to eliminate left-turn ingress or egress movement • Install divisional island to discourage entry into left-turn bay when weaving • Install physical barrier to prevent uncontrolled access along property frontage • Install median channelization to control merge of left-turn egress • Offset opposing driveways • Locate driveway opposite a three-leg intersection or driveway and install traffic signals where warranted • Install two one-way driveways in lieu of one two-way driveways • Install two two-way driveways with limited turns instead of one standard two-way driveway • Install two one-way driveways in lieu of two two-way driveways • Install two two-way driveways with limited turns in lieu of two standard two-way driveways • Install channelizing island to discourage left-turn maneuvers • Install driveway divisional island to prevent driveway encroachment • Install channelizing island to control the merge area of right-turn egress • Regulate the maximum width of driveways

Table 2 (Continued)

Separate conflict points	• Deny access to small frontage • Consolidate existing access whenever separate parcels are assembled under one purpose, plan, entity, and usage • Designate the number of driveways to each existing property and deny additional driveways regardless of future subdivision of that property • Require access on collector street, when available, instead of driveways on major highways
Limit deceleration	• Restrict parking on the roadway next to driveways • Install visual cues of the driveway • Improve driveway sight distance • Regulate minimum sight distance • Optimize driveway location in the permit authorization stage • Increase the effective width of the driveway • Improve the vertical geometric of the driveway • Require driveway paving • Regulate driveway construction • Install right-turn acceleration lane • Install channelizing island to prevent driveway vehicles from backing onto the highway
Remove turning vehicles from through lanes	• Install continuous two-way left-turn lane • Install alternating left-turn lane • Install isolated median and deceleration lane to store left-turn • Install left-turn deceleration lane to remove turning vehicles • Install medial storage for left-turn egress vehicles • Increase storage capacity of existing left-turn deceleration lane • Install continuous right-turn lane • Construct a bypass road • Reroute through traffic • Install supplementary one-way right-turn driveways to divided highway • Install access on collector street when available • Install right-turn deceleration lane • Install additional exit lane on driveway • Encourage connection between adjacent properties • Require adequate internal design and circulation
Space major intersection	• Set signal coordination • Optimize speed of the progression platoon • Optimize signal cycle length • Increase efficiency of progression • Increase signalized intersection spacing • Optimize signalized intersection location
On-site storage	• Provide adequate interparcel circulation to allow adequate on-site storage for both ingress and egress vehicles

Source: Adapted from *Access Management, Location and Design Participant Notebook* (FHWA, 1991). and *Access Management Guidelines for Activity Centers*. NCHRP Report 348 (Koepke and Levinson, 1992).

Marginal Access Spacing and Design

Access treatments can be viewed from macroscopic and microscopic levels. At the macroscopic level, marginal access treatment is related to driveway spacing and corner clearance. At microscopic level, access treatment is related to access point design of driveways. In this study, the driveway spacing and design are represented by the number of total driveways per mile and the percentage of driveways without right-turn bays per mile. Corner clearance is represented by the average length between the signalized intersection and the nearest unsignalized intersection.

Generally, driveway spacing is defined as the minimum distance between adjacent driveways. The minimum length between the two adjacent driveways should be large enough to provide safe sight distance and perception time. Short driveway spacing increases traffic conflict points but long spacing decreases the conflict potentials. Close driveway spacing tends to increase speed differential between the turning vehicle and through traffic which, in turn, increases traffic conflicts (FHWA, 1991; Stover and Koepke, 1988).

Driveway design also plays an important role in decreasing the frequency and severity of traffic conflicts. In this study, driveway design was represented by the right-turn bays. Right-turn bays provide storage for the right-turn maneuvers that increase sight distance and perception time which, in turn, decreases speed differential. Right-turn bays reduce the frequency and severity of traffic conflicts by removing the turning vehicles from the through lane (FHWA, 1991). Driveway design with right-turn bays may minimize the impact of close driveway spacing in relation to traffic conflicts.

Corner clearance is defined as the distance from the signalized intersection to the nearest access upstream and downstream from the intersection. The minimum corner clearance should be should be large enough to provide safe sight distance and to clear the operational area at the signalized intersection (Stover and Koepke, 1988). It is necessary to restrict access within the approach area of a signalized intersection (AASHTO, 1984). Short corner clearance increases the traffic conflicts between driveway vehicles and through traffic. Therefore, the minimum corner clearance should be large enough to minimize the frequency and severity of traffic conflicts.

Medial Access Spacing and Design

At the macroscopic level, medial access treatment is related to unsignalized median opening spacing. At the microscopic level, the treatment is related to the design of unsignalized median openings. In this study, the unsignalized median opening spacing and design are represented by the number of total unsignalized median openings per mile and the percentage of unsignalized median openings without left-turn bays per mile.

Short spacing of unsignalized median openings increases traffic conflict points and vice versa. Close median opening spacing tends to increase speed differential between the turning vehicle and through traffic which, in turn, increases traffic conflicts. The minimum spacing between adjacent median openings should be large enough to provide safe sight distance and perception time. The minimum spacing should be provided so that speed differential between a turning vehicle and through traffic should be less than 10 mph (Stover and Koepke, 1988).

The design of median opening also plays an important role in decreasing the frequency and severity of traffic conflicts. In this study, the design is represented by the left-turn bays.

Left-turn bays provide storage for left-turn maneuvers to increase the sight distance and perception time which, in turn, decrease speed differential. Left-turn bays reduce the frequency and severity of traffic conflicts by removing the left-turn vehicles from the through lane. The left-turn storage needs to be large enough to store at least 95 percent of all left-turn arrivals during the peak hour (Stover and Koepke, 1988). Medial design with left-turn bays may minimize the impact of close medial opening spacing in relation to traffic conflicts.

Signal Spacing

Long and uniform signal spacing is an essential element for efficient progression on arterial streets. To provide efficient progressive movement, the minimum signal spacing should be at least one-third mile. Long and uniform signal spacing allows flexibility in the selection of cycle length and timing plans under different traffic conditions (Stover and Koepke, 1988).

Signal spacing has been recognized as a part of signal coordination for efficient progression. Little research has focused on the safety benefits of long signal spacing yet. Squire and Parsonson (1989) found that there was a strong relationship between accident rate and signal spacing on four and six-lane divided arterial roadways.

5. THE IMPLEMENTATION OF ACCESS MANAGEMENT

5.1. Access Classification System

Access management is a new application of access control to preserve functional need, safety, and operational efficiency while simultaneously providing access to land development. Access management is a rational approach to the coordination of transportation and land development. In the long run, access management may find a balance between land development plans and transportation plans by maintaining the functional integrity of highway facilities that serve the land development and the region (Koepke and Levinson, 1992). The major tasks relating to the implementation of access management include: (1) define the access categories and access levels; (2) define the access guidelines and standards for each category; (3) establish the means of enforcing the standards.

As the basis of access management, the access classification system determines where and how access is permitted or denied. The specific access classification systems may differ from place to place. However, the access classification system should be easy to understand

and be consistent so that it can be enforceable by the court. It should be prepared to protect functional integrity of the proposed facilities in the long range transportation plan as well as the existing facilities (Koepke and Levinson, 1992).

Access management can be implemented through several steps: (1) define the access control hierarchy for the control level or categories; (2) assign access spacing and design standard to each category; (3) design access management program covering access permit application, evaluation, denial, and relocation (Demosthenes, 1993).

5.2. Access Categories and Levels

As a key initial step of access classification system, access categories are defined in association with highway facilities from access controlled freeways to local streets. Access categories are determined in relation to functional classification system (Table 3).

TABLE 3: Access Categories and Levels.

Access Category	Functional class	Access level	Direct Property access	Design feature
1	Freeway	Access at interchanges only for uninterrupted flow	Not allowed	Multi-lane; Median
2	Expressway	Access at public street intersections or interchanges for uninterrupted flow	Not allowed	Multi-lane; Median
3	Strategic arterial	Right-turn access only or access at interchange for uninterrupted flow	Restricted; right-turn only when available	Multi-lane; Median
4	Principal arterial	Right and left-turns with left-turn lane in and out required for interrupted flow in both directions	Restricted; right and left-turn entry and right-turn only when available	Multi-lane, two-lane in some rural; Median
5	Secondary arterial	Right and left-turns with left-turn lane in and out required for interrupted flow in both directions	Allowed	Multi-lane or two-lanes
6	Collector	Right and left-turn in and out with left-turn lane optional-in and out	Allowed	Two-lanes
7	Local/ frontage road	Right and left-turn in and out for safety requirement only	Allowed	Two-lanes

Source: Adapted from *Access Management Guidelines for Activity Centers*. NCHRP Report 348 (Koepke and Levinson, 1992).

Access categories are defined for highway types and functional characteristics to apply access controls in a reasonable and equitable manner. It is also because access controls should be consistent with the intended purpose of the facilities under consideration (Koepke and Levinson, 1992).

5.3. Standards and Guidelines for Access Spacing and Design

The most difficult part of implementing access management is to develop and select appropriate standards and guidelines for highway systems and access categories. Access management standards include the following major considerations: (1) the spacing and design of marginal and medial access; (2) the location and spacing of traffic signals; and (3) driveway access permit and denial.

According to the access categories, access management
guidelines should be determined considering traffic conditions and environmental characteristics (Levinson and Koepke, 1993).

Access spacing guidelines for each access category include: (1) location of interchanges or grade separations; (2) signal spacing; (3) unsignalized intersection spacing; and (4) median opening spacing (Koepke and Levinson, 1992). A driveway access point is considered as an unsignalized intersection.

Grade separations can be applied to the following cases: (1) when two expressways cross or an expressway crosses an arterial street; (2) when major arterials cross; (3) when there are no other reasonable ways to improve the existing at-grade intersection; and (4) when an at-grade intersection near an activity center interferes with traffic progression and cannot provide reasonable access to the activity center.

The signal spacing identifies the location of signals so that the progressive movement may not be impeded significantly. Uniform and longer spacing with short cycle length are desirable for traffic progression. Optimal cycle length is determined considering signal spacing and speed.

Driveway spacing may be determined based on various factors. Traffic operational factors include weaving and merging distances, safe sight distances, acceleration and deceleration rates, and storage distance. Driveway spacing for highway facilities also should consider access categories, traffic speed, and size of traffic generators.

Unsignalized median openings should be provided so that they will not impede traffic flows. It is necessary to provide adequate storage and deceleration distances. Suggested minimum spacing range from 330 ft (100.6 m) to 660 ft (201.2 m) in urban areas (Koepke and Levinson, 1992).

Access design should allow safe and efficient trips on the highway facilities. Access design should reflect access categories, traffic characteristic, and abutting environments. The elements of access design involve the geometric design of driveway, median opening, and turn bays.

5.4. Access Application, Denial, and Modification

Access application procedures include: (1) access categories of highway facilities under consideration; (2) access levels or types for the requested categories; (3) access spacing guidelines and standards; (4) access design principles and treatments; and (5) access permit, denial, and modification criteria (Koepke and Levinson, 1992).

Generally, access needs to be denied under the following conditions: (1) when a reasonable alternative access can be provided from the lower classification; (2) when the proposed access significantly compounds problems at nearby intersections; (3) when the proposed access undesirablely increases travel in residential areas; and (4) when the proposed access does not satisfy the spacing and design standards.

Access classification systems need to be regularly reviewed for reasonableness and practicality. The modification of access classification can be suggested by any individual or group. State or local agencies may change it to reflect the specific local needs (Koepke and Levinson, 1992).

5.5. Legal, Socio-Economic, and Political Aspects of Access Management

Property and land owners have a certain right of access to and from the adjacent public street system. Road users also have a certain right of safe and efficient movement. As tax payers, they can demand efficient expenditure of their public highway funds (AASHTO 1960).

An access management program should have a legal basis in order to enforce access guidelines and standards. The legal powers for implementing access management include police power and eminent domain. The legal powers provide sufficient authority and means to implement access management associated with (1) access spacing and design, (2) access permit, denial, and modification, (3) buying abutting property, (4) acquiring right-of-way, (5) taking access right, and (6) building service roads. As long as reasonable access is provided, state and local agencies may have adequate legal powers (Koepke and Levinson, 1992).

However, access management may not maintain uniformity in the interpretation, application, and enforcement of control measures. Furthermore, it is not easy to obtain interjurisdictional coordination between different levels of government levels. When access management is perceived to affect land values or business benefits, political pressures will increase (FHWA, 1991).

Politically, it is not easy for elected officials to support a retrofit of access control on existing streets and highways because of the perceived impact on businesses. Therefore, it is important to understand and document the likely impact and benefits of access management program of a retrofit. It is also important to understand the alternative cost of new construction or new right-of-way to accommodate existing and projected traffic with a safe and high level of service (Koepke and Levinson 1992).

6. CONCLUSIONS

Urban arterial streets have experienced traffic problems. Generally, the causes of the problems have been thought in two ways: one is the increased demand resulting from increased population and vehicles; the other is the insufficient supply caused by the lack of highway construction. However, it is not easy to increase highway facilities considering limited sources. As a result, traffic policy has focused on the decrease of vehicle trips by improving mass transportation system, decreasing parking spaces, introducing congestion fees, etc. However, it is not evident that travel demand management has an important role of solving traffic problems.

This study investigated the major factors of traffic problems on urban arterial streets and addressed access management as an alternative. There are a lot of access-related traffic problems on urban arterial streets which cannot be explained by traditional demand/supply perspectives. Access management is a rational way of achieving transportation-land use coordination. Considering transportation-land use relationship, access management techniques should be implemented to solve the access-related problems. Furthermore, access management techniques should be selected considering traffic conditions and roadside land use features.

Thus, it is recommended to consider the followings:

First, the concept of access management needs to be introduced in federal, state, and local plans. Access management should be included in the comprehensive planning process of local government. Second, as a complementary part of comprehensive land use plans, the access management program shows developers where and how access can be provided. In the land use plan, the access management program needs to be specified on the following items: (1) the timing and sequence of the improvements and the manner for implementation; (2) the responsibilities of each participant in the improvement process; (3) necessary requirements for temporary access; and (4) measures for nonconforming lots.

Third, coordination between local government and other agencies, including federal agencies, state governments, local bodies, special districts, and private agencies, and citizens is necessary. For this purpose, statewide transportation planning needs to be coordinated with the comprehensive plans and regional plans of local governments. Fourth, mixed land use enhances access management. Multi-use activity centers reduce vehicle trips and conflicts by integrating retail, office, residential, and recreational activities with well-designed access points.

Fifth, appropriate access management programs should be developed considering traffic conditions and environmental aspects. To do this, specific standards and guidelines of access management should be developed. Sixth, legal and institutional measures should be provided to implement access management and limit existing accesses.

Finally, it is essential to reach consensus on the necessity of access management on urban arterial streets. For this purpose, it is necessary to inform the benefits of access management.

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