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Street design and community livability

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Abstract

In the USA, there is a renewed effort towards ensuring that the design of transportation facilities enhances the cultural, social, historical, and of course, the natural environment. This shift in emphasis has been promoted in part by the ISTEA and TEA-21 acts of 1991 and 1998 and is reflected at the federal level by policy initiatives such as the recently published 'Flexibility in Highway Design" from the FHWA. At the local level, an example of the new approach is seen in the increased use of traffic calming techniques as viable design solutions. Unfortunately, current design standards

1 Introduction

The design of streets and highways is suddenly a hot topic of discussion in the USA. Many people believe that the prevailing design standards facilitate vehicular flow at the expense of a livable, vibrant and attractive environment. The engineering community has moved swiftly to address this issue. For example, the Federal Highway Authority (FHWA) recently published "Flexibility in Highway Design" which provides a framework for incorporating community issues into the highway design process on a case-by-case basis (1). In addition, more and more projects are being executed in which traffic calming measures are used to restore the balance between vehicular traffic flow and neighborhood livability.

These measures represents an important first step towards correcting a problem which has contributed to sapping the vitality of our urban centers, degraded our rural villages and has facilitated the sprawl of suburbia. However, if we are to develop design standards to fully address these pressing issues, we must go one

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step further and develop a coherent system of design that treats community issues as integrals part of the design process. In this quest we can learn from countries that already have experience with a multi-objective approach to design. For example, the highway design system in Germany appears to do a good job of incorporating context sensitive considerations into the design process.

As with the US standards, the basis of the German design standards is the highway classification system. The highway classification system is sometimes overlooked, but it is fundamental to the highway design process. In essence, a highway classification system is the framework for describing the type of roadway that can be built as part of a given design code. For example, the German highway classification system explicitly identifies streets that are designed primarily as public gathering places. The prevalent highway classification system in the USA makes no mention of streets for this purpose. This does not mean that such streets cannot be built in the USA, however, it does make it harder, since such a street would be an exception to the norm. Furthermore, street types that are not explicitly discussed in the highway classification system are unlikely to become part of the lexicon of the typical transportation engineering, and as such, are not immediately considered design alternatives even in situations where they would be most suitable.

In this paper, we will evaluate the system of highway classification that is used in the USA and in Germany. Our goal is to develop guidelines concerning how the American system can be modified so that community livability issues are integrated into the overall approach to the system of highway design. As part of this evaluation, we reviewed the theoretical basis of the systems and the resulting design guidelines. We also talked to government officials and policy makers, planners and engineers at the municipal, regional and statewide levels in order to obtain insight into how the guidelines are actually implemented.

2 The basis of functional classification

Functional classification is used to categorize roadways according to their predominant role in the highway network and also on the basis of their physical setting. Different systems of functional classification employ different methodologies to achieve this goal. In this section we will give an overview of the approaches used in the USA and in Germany, respectively. Most localities in the USA base their system of functional classification on the AASHTO method.

Typically, the role of the roadway in the network is determined by the level of mobility provided to automobile traffic by that roadway. In general, the mobility function decreases as access increases. On this basis, the AASHTO functional classification differentiates between arterial, collector and local roadways. Arterials serve those corridor movements that have long trip length and great volumes. Collectors serve subordinate traffic generators, while local roads provide for access as well as for local circulation (2).
Under the German system of functional classification, the role of the roadway is defined in a very similar manner. However, in this case, six different levels of

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mobility are recognized. These six levels range from Level I - highest level of vehicular mobility to Level VI - lowest level of mobility (3). In other words, a Germany roadway in mobility levels I and II are roughly equivalent to AASHTO's arterials, while, mobility level VI is the equivalent of an AASHTO local road.

The second factor in determining the classification of the roadway is the physical setting of the roadway. For example, both systems of classification treat roadways in an urban downtown differently from highways in open rural environment. The rational for this is that since roadways in varying settings serve different functions, the functional classification (and hence, design standards) should respond to the roadway setting. Although the basic concept is similar, the criteria for defining the physical environment are perhaps the biggest differences between the AASHTO and the German approach.

In the AASHTO based system, the roadway setting is simply defined as being either urban or rural, with the distinction made on the basis of area wide population density. In other word this system classifies roadways over a fairly wide geographic area and does not respond to localized changes such as that encountered in going from open fields to small villages. As shown in Table 1, the full AASHTO classification is distinguished by its simplicity. The number of different highway types is quite small, ranging from rural arterials to urban local roads.

Conversely, the German guidelines use a complex system that distinguishes between a large number of roadway settings. Table 2 shows that there are three different criteria for determining the roadway setting. The first criterion is somewhat similar to AASHTO's rural vs. urban distinction, however, in this case the question is posed in a slightly different manner: is the road outside or within a built-up area? The second criterion considers the physical aspect of the setting: is the road framed by buildings? The final criterion is a consideration of the non-vehicular uses of the roadway: is the roadway used largely for vehicular or pedestrian access or does it serve the role as a public gathering place? This is one of the most important distinctions from the AASHTO approach, since it contains the implicit understanding that roadways serve many functions beyond that of simply carrying vehicular traffic.

Table 2 shows the final matrix of classification groups in Germany. While the American guides suggest nine different categories, the German guide defines twenty-two highway classifications. Many of the highway types in the German guide are quite similar to those in the AASHTO. For example, AI in the German guide would be equivalent to AASHTO's rural arterial. However, many of the German roadway types are not explicitly considered in AASHTO. For example, the German E VI is a roadway that is designed as a public meeting place and excludes vehicular traffic. In general, the German system includes community friendly streets as part of the regular design scheme. In the USA, such roads can only be considered as an exception to the accepted design standard.

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Level of Mobility	Roadway Setting	
	Rural	**Urban**
Mobility	Principal Arterial	Principal Arterial
	Minor Arterial	Minor Arterial
	Collector	Major Collector
		Minor Collector
Access	Local	Local

Table 1: Highway Classifications in the AASHTO System (2)

Level of Mobility	**Functional Category**				
	Outside built-up areas	Within built-up areas			
	Not surrounded by buildings	Surrounded by buildings			
	Mobility			Access	Public Realm
	A	**B**	**C**	**D**	**E**
I	**A I**	**B I**	**C I**		
II	**A II**	**B II**	**C II**	**D II**	
III	**A III**	**B III**	**C III**	**D III**	**E III**
IV	**A IV**	**B IV**	**C IV**	**D IV**	**E IV**
V	**A V**	-	-	**D V**	**E V**
VI	**A VI**	-	-	-	**E VI**

Not applicable Very problematic Problematic Not encountered in practice

Table 2: Roadway categories in the German Guidelines (3)

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3 Functional classification and context sensitive design

As discussed above, the method used in AASHTO for describing the physical setting of the roadway is quite simple: the setting is either rural or urban. This approach has led to problems in situations where functional classification does not sufficiently respond to the highway setting, thus resulting in an inappropriate design for the context. Suitable design accommodates automobile travel appropriately and creates a streetscape by arranging features such as sidewalks, street furniture and lighting in a way that responds to the function and the setting of the street. A functional classification that correctly identifies the function of a roadway in its context enhances design.

One of the issues is the recognition of small built-up areas such as village centers in a rural context. If, for example, such village centers are not recognized as built-up in the functional classification, this has important implications for the design standards applied. Generally, rural roadways are designed to provide for fast and safe automobile movement. Urban roadways provide for other modes of travel such as bicycle and pedestrian travel in addition to auto. The safety of these modes as well as the constraints imposed by the built-up roadway environment are important design considerations in the urban environment (4).

According to the AASHTO Classification, an urban area is a contiguous area, which is comprised of census block groups with a population density of more than thousand persons per square mile and encompass a population of at least 5000. All remaining areas are considered rural (1). Thus, in Connecticut, the densely developed areas in the southwestern and central areas of the state are classified as urban. The northeast and northwest of Connecticut are mostly classified as rural even thought it is really a diverse mix of small cities and towns, rural areas and some low-density sprawl (Figure 2).

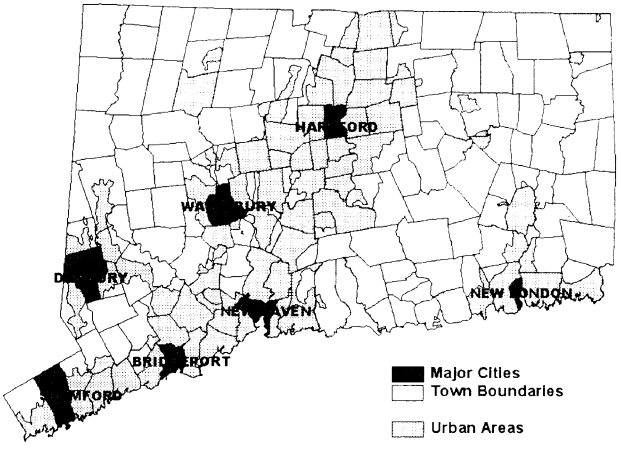

Figure 2: Areas classified as urban in Connecticut

This classification fails to recognize small clusters of development in a rural context such as village centers. These village centers, however, are certainly centers for the life in the rural communities as they encompass public facilities such as schools, churches, post offices, libraries and small commercial establishments. The classification does not differentiate between a highway penetrating such a village center and one in open field.

Existing rural highway layout in Connecticut is such that roads do not typically alter their design as they enter village centers. The roadway design does not lead the driver to adopt a driving behavior appropriate for a village center, where they might have to share the road with pedestrians and cyclists. In general, only a speed limit sign indicates the entrance to a village center. A lack of sidewalks, which are not required in rural design standards, often forces pedestrians to walk on the highway and aggravates these conditions.

Since the AASHTO classification does not sufficiently respond to the roadway setting in these cases, the present policy is to promote suitable roadway design by allowing flexibility of design standards (16). In fact, in recent years a shift in the provision of transportation infrastructure has taken place and context sensitive design has taken on new importance. Engineers, for example, have started to specify more moderate roadway and shoulder width, and to design for lower design speeds where appropriate. However, there are examples of local communities which are unwilling to simply depend on the application of flexibility of design standard. Sidewalks, for example, have still not become a standard in the highway layout in rural village centers, even in the vicinity of schools. The experiences of these communities emphasize the need to institutionalize the change.

In the German system, categorization into different roadway category groups (Figure 3) serves as a planning tool to support suitable design. Therefore, the response to the highway environment and the predominant street function is incorporated in this distinction. This categorization does not identify urban areas over a wide geographic area, but recognizes the built-up character of any development (2).

Streets do not only serve transportation related functions. They represent a major part of the developed urban area and, therefore, they shape our cities more than any other urban feature. They are a place of commercial and social encounter. People meet here, they discuss issues, children play in streets and vendors sell their goods. Streets are part of the public realm and often serve social activity just as much as they serve automobile travel. Urban planners more and more embrace a perception of streets incorporating these varied functions. Therefore, functional classification should also incorporate these non-transportation functions and facilitate suitable design.

As shown in Table 3, the German system recognizes the public realm function of streets. Moreover, the German guides suggest a procedure for assessing such

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roadway usage. Figure 3 shows a simplified matrix as an example of what is suggested in the German guidelines to assess roadway usage. In this particular case, the road is classified as a local roadway that functions largely as a public living space. The basis for this assessment includes the fact that significant social and recreational interaction was observed and that the road was also important for pedestrian access. The road was also used for automobiles, but mostly for parking and access. The designation of the road as a local roadway with a predominant public realm function means that it will be designed as a shared facility with low vehicular speeds.

Predominant Function	M: Mobility A: Access P: Public Realm	**Importance**					**Explanation**
		Very high	High	Intermediate	Low	Very low	
Mobility	M				■		Local road
Automobile Travel	M				■		Cul-de-sac, no through traffic
Parking	A		■				No driveways
Transit	M/A					■	No transit
Bicycle Travel	M/A				■		Unfavorable topography
Pedestrians	A		■				Commercial Establishments
Pedestrian Crossing	A/P		■				Commercial establishments
Social Activity	P	■					Important recreational destination
Children Play	P	■					A lot of playing activity observed
Other special usage (e.g. Greenery)		■					Important recreational destination
Evaluation: Predominant Function: Public Realm Roadway Classification: Local							This roadway is an important public realm because of the recreational significance of the surroundings

Figure 3: Simplified example for the assessment of roadway usage in the German functional classification guides

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Some municipalities in the US have gone beyond the AASHTO approach and have developed a more refined system for characterizing the physical setting of the roadway. The system of classification in Seattle, Washington, USA differentiates between residential and commercial access streets. This distinction is based on the land use of adjacent property. The city of Norwalk, Connecticut makes a similar distinction. Norwalk, which under the current classification of the Connecticut Department of Transportation is entirely urban, has defined an urban boundary area encompassing Norwalk's downtown. The surrounding areas are classified as residential. Roadway usage in those different areas varies and the local roadway design guidelines respond to this notion (6). Norwalk has defined a historic district, an extensive business area and an intensive business area too. Those classifications so far do not have implications for the roadway design.

4 Functional classification as a planning tool

The above discussion focused on the role of functional classification in determining the appropriate design details of roadways for different roadway settings. However, functional classification by its very nature also serves an important planning function, since it provides a link between transportation network planning and roadway design. In the German system this link is explicit. For example, the importance of a given highway depends not only on the size of the centers being linked, but also on the presence of other modes of transportation. In the US, this connection between transportation planning and highway design is not facilitated by the functional classification system. This inhibits the planning for multimodal transportation at the local and regional level. Also it results in inconsistencies in highway design and planning between the state and local governments.

On the local level, the focus on the automobile related function of roadways often neglects other street functions. Streets also serve pedestrian, bicycle travel as well as bus transit. These modes of travel require a contiguous transportation network. Neglecting them in functional classification results in a transportation network that does not promote those alternative modes of travel. Highway design features such as sidewalks do not only enhance pedestrian safety but also facilitate walking activity. If functional classification as the link between planning and design does not incorporate these modes, the establishment of suitable design suffers.

The AASHTO classification system, which is designed to determine funding eligibility from a federal perspective, does not sufficiently respond to the roadway setting. Therefore most municipalities in Connecticut have introduced their own functional classification systems in order to be equipped with a better design tool and to address the shortcomings of the AASHTO classification.

Currently, there are two systems of functional classification in Connecticut that run in parallel. On the local level each municipality applies its own functional

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classification system for development planning and highway design. Conversely, on the state level, the AASHTO based classification is applied for statewide and regional transportation planning. The consequence is that there is an inconsistent perception of street functions and functional classification on the regional and local level.

5 Conclusions

Functional classification serves as a tool to identify the predominant function of roadways and to classify them accordingly. Functional classification assigns different levels of mobility and differentiates between varying physical settings. The classification of a roadway is fundamental to the highway design, since it determines which design standards are applicable. Moreover, functional classification plays a significant role in determining funding responsibilities.

In this paper we took a close look at the guidelines and actual practice of functional classification. We talked to officials involved in the design and planning process and others in policy-making positions at the state and local levels. Based on this assessment, we identified shortcomings and strong points of current classification systems.

Functional classification that neglects modes of travel other than the automobile and does not consider adjacent land uses leads to unsatisfactory roadway design. Village centers in Connecticut where rural roadway standards are applied in a built-up context exemplify this problem. Inappropriate linkage of funding and design through the planning tool of functional classification can lead to instances where funding considerations govern and prevent the use of the most appropriate design for the situation. In such cases, functional classification was found to impede rather than to support suitable highway design.

We also found examples where local municipalities in the United States adopted functional classification systems that address the shortcomings of the statewide system of classification. These local systems of classifications are like the German system in that they are based on the notion that a sufficient response to the roadway setting is necessary if functional classification is to serve as a tool that enhances highway design suitability and the livability of the affected communities.

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