Changing the Residential Street Scene

Adapting the Shared Street (Woonerf) Concept to the Suburban Environment

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In the 1970s, the Dutch city of Delft adopted a new residential street layout. Its fundamental concept was the antithesis of the notion of segregating pedestrians and vehicles. It emphasized integration of traffic and pedestrian activity as a positive principle for street planning. The shared street approach was later systematized by local agencies and given legal status by the national government. This new concept has drawn global attention, and similar street designs are appearing not only in Europe, but also in Japan, Australia, and Israel. The shared street concept's adaptability to different countries and societies reinforces its status as a valid, flexible choice for residential street layouts. Studies and surveys of shared streets in these countries have found considerable reductions in traffic accidents, increased social interaction and play, and a high degree of satisfaction by the residents. The available data and the successful implementation of the shared street in other countries can foster its acceptance in the United States. In particular, shared streets could be a workable alternative to the prevailing street layouts in new suburban subdivisions.

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Interest in reassessing the physical form of the American subdivision has drawn attention to the physical and social ramifications of standardized street layouts. (Appleyard 1981; Moudon 1987; Homburger, Deakin, and Bosselmann 1989; Southworth and Ben-Joseph 1995). The waste of street space and the associated economic effects have long been familiar. Even in 1910, when Frederick Law Olmsted addressed the second national conference on city planning in New York, he stated: "There has been a decided tendency on the part of official street planners to insist with quite needless and undesirable rigidity upon certain fixed standards of width and arrangement in regard to purely local streets, leading inevitably in many cases to the formation of blocks and lots of a size and shape ill adapted to the local uses to which they need to be put. Another instance is that of fixing a minimum width of street and minimum requirements as to the cross section and construction there of, which make the cost needlessly high for purely local streets, and thus inflicts a wholly needless and wasteful burden of annual cost upon the people" (Proceedings of The Second National Conference on City Planning and the Problem of Congestion 1910, 22–23). Yet, since the 1930s the physical dimensions of residential street layouts have scarcely changed. Subdivisions are still dominated by residences fronting an extensive paved street. The right-of-way width for a residential subdivision street as specified by the Institute of Transportation Engineers has remained at 50 to 60 feet for the last 30 years (Institute of Transportation Engineers 1964, 1984, 1990). Constructing relatively wide cross sections in residential streets where there is little traffic (fewer than 1,000 trips per day) permits and even encourages high speeds. High speeds are also encouraged by the flat curves and good sight distance called for by street standards.

These relationships between design speed and sight distance, curve radius, and width were established for vehicular efficiency, but are incompatible with residential livability. The function of a residential area street as a facilitator of social interaction has often been diminished by the priority accorded to traffic performance (Appleyard 1981; Hass-Klau 1990). The authors of the Urban Land Institute's *Residential Streets* make that point: "It was often forgotten that residential streets become part of the neighborhood and are eventually used for a variety of purposes for which they were not designed. Residential streets do not only provide direct auto access for the occupants to their homes, but they also provide a visual setting; an entryway for each house; a pedestrian circulation system; a meeting place for residents; a play area (whether one likes it or not) for children, etc. To design and engineer residential streets solely for the convenience of easy automobile movement overlooks the many overlapping uses of residential streets" (Urban Land Institute 1990, 20). The concept of the street as a physical and social element in the residential environment is critical, both to neighborhood design and to the design and operating philosophy for the system of local residential streets. The existing conflicts between residential living and traffic (Gehl 1980; Appleyard 1981) and the growing emphasis on residential streets as multifunctional spaces (Eubank 1984; Tolley 1989) suggest that street design should encompass alternatives to design based on traffic needs. A consideration of the various possible functions of streets should help to define less rigid standards for street design and open the way to alter traditional practices.

Overseas Examples

That the street is properly a physical and social part of the living environment, and used simultaneously for vehicular movement, social contacts, and civic activities, has long been argued by many authors, including Kevin Lynch, Jane Jacobs, and J. B. Jackson. However, these characteristics of traditional European and American streets, though still found in many neighborhoods of American inner cities, have long disappeared from contemporary American suburbia. Yet in European and other foreign suburbs a major shift in residential street design has occurred. In countries such as the Netherlands, Germany, England, Australia, Japan, and Israel, the integration of traffic and residential activity in the same space is a concept that has stimulated new design configurations that increase social interaction and safety on the street, promote pedestrian movement, and please residents. Moreover, flexible implementation procedures have allowed for local initiatives and diverse design solutions, and enlisted residents' commitment (Ichikawa 1984; Polus 1985; Kraay 1986; Eubank 1987; Engle 1990; and Hass-Klau 1992).

The philosophical roots of the integration concept can be found in a report published in England in 1963 by Colin Buchanan and the "Traffic in Towns" team. In 1959 the Ministry of Transportation had commissioned Buchanan to investigate "improving urban transport." This was to be done "both in terms of reducing congestion and to come to terms with the car." Buchanan, being both a road engineer and an architect, brought to the team an innovative analysis that identified the conflict between providing for easy traffic flow and maintaining the residential and architectural fabric of the street. Under the prevailing philosophy of the late 1950s and early 1960s, this insight was unique. The team came up with a technique for evaluating and reconstructing the urban traffic system. They suggested the creation of specific street zones called environmental areas or urban rooms, which would have a character different from typical streets, with traffic levels that would vary according to their functions. Streets would be evaluated not only for their capacity to carry traffic, but also for their environmental quality as measured by noise, pollution, social activity, pedestrianization, and visual aesthetics. This second criterion, of environmental capacity, would then be used in setting standards and limitations. Thus, certain environmental areas would segregate traffic and pedestrians completely, but others would have a mixture of pedestrians and vehicles. In the latter, it was not seen as harmful to traffic flow for vehicle speed and volume to be reduced. The idea was to allow pedestrians and vehicles to mix safely in the street. Redesigning the physical aspects of the street would reclaim the social and physical public domain for pedestrians.

Unfortunately, the report's concepts of "traffic integration" and "traffic calming" in the environmental capacity zones failed to find acceptance and were misunderstood by British policy makers. The ideas ran counter to the economic and development policies of the time, which sought economic growth by building motor ways, reforming the railway system, and improving roads. Interestingly, the Traffic in Towns report had much more impact in mainland Europe. German and Dutch planners adopted its tenets to such an extent that many still refer to Buchanan as the "father of traffic calming." Niek De Boer, Professor of Urban Planning at Delft University of Technology and the University of Emmen in the Netherlands, was inspired by Buchanan's theoretical ideas in his work on the physical design of streets. Trying to overcome the contradiction between children playing and car use, De Boer turned to Buchanan's concept of coexistence; he designed cul-de-sac streets in such a form that motorists would feel as though they were driving in a "garden" setting, and so would be forced to take into consideration the other street users. De Boer renamed this type of street "Woonerf," or "residential yard." At the same time (1969), the Municipality of Delft was about to redesign and upgrade the road surfaces in inner city locations. The planners decided to implement De Boer's ideas in some lower-income neighborhoods where more child play areas were urgently needed but available sites were almost nonexistent. With resident participation, a physical design was formed that integrated sidewalks and roadways into one shared surface, creating the impression of a "yard." This was further enhanced by trees, benches, and small front gardens (Jonquiere 1978; Hass-Klau 1990)

The Delft redesign was a success. Soon afterwards, the shared street (Woonerf) concept became accepted and established through guidelines and regulations in the Netherlands (1976), and then in many other countries: Germany (1976), England (1977), Sweden and Denmark (1977), France (1979), Japan (1979), Israel (1981), and Switzerland (1982). By 1990 over 3,500 shared streets had been constructed in the Netherlands and Germany, more than 300 in Japan, and 600 in Israel (Jonquiere 1978; Toshi Jutaku 1983; Brilion and Blanke 1990; Tolley 1990; Hass-Klau 1992; Kjemtrup and Herrstedet 1992; *The Wheel Extended* 1992; and surveys by the author). The concept's popularity was such that in new residential areas it became the major type of residential street.

The Adaptation Process—The Example of Israel

The first set of minimum design standards and traffic regulation for Woonerf was adopted and legalized by the Dutch government in 1976. The following brief excerpt from the Traffic Regulations for Woonerf, translated from the Dutch, illustrates their innovative and rigorous nature.

> Article 88a RVV
> Pedestrians may use the full width of the highway within an area defined as a 'Woonerf', playing on the roadway is also permitted.
>
> Article 88b RVV
> Drivers within a 'Woonerf' may not drive faster than at a walking pace. They must make allowance for the possible presence of pedestrians, including children at play, unmarked objects and irregularities in the road surface, and the alignment of the roadway.

These regulations were the basis of the guidelines for shared streets in many other countries. In Israel, the Ministry of Construction and Housing, in 1978, commissioned a team of architects and landscape architects to design a prototype based on the Dutch guidelines for use in urban renewal projects; the Ministry's first set of guidelines, published in 1980, were almost identical to the Dutch set. The Ministries of Construction and Housing, and of Transportation formed a Technical Council Committee to review the guidelines and propose criteria for the installation of a shared street; the committee comprised government transportation agency staff, traffic engineers from academia and private practice, planners, architects, and landscape architects. The committee's revised guidelines were published in 1981 and 1982, and included these conditions for creating a shared street: (1) the area must be zoned as residential; (2) analysis of existing traffic conditions and traffic impact must be carried out; and (3) design must follow planning guidelines as well as residents' input. A research team at the Technion-Institute of Technology was then commissioned to devise revisions of built streets. This research led to the 1987 legislation adopting the shared street concept, in a specific traffic ordinance (figure 1).

Residents, developers, and manufacturers of concrete pavers were quicker off the mark than was the government in adopting the Woonerf concept. In 1981, an initiative by the residents to eliminate through traffic on a residential street led to the first shared street design in a suburb. Encouraged by the positive results (in terms of traffic performance, aes-

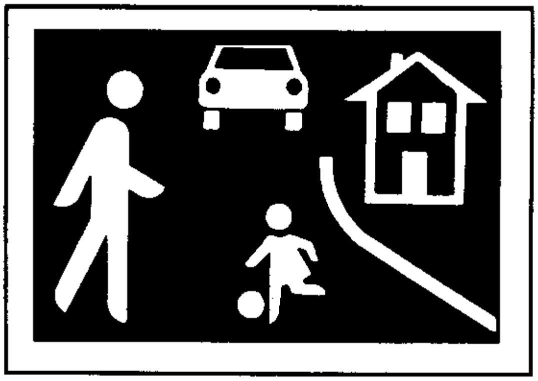


FIGURE 1. The shared street traffic sign

thetics and residents' satisfaction), the local municipality commissioned three more streets. Concrete paver manufacturers, realizing the economic potential, then lowered their prices to be competitive with bituminous paving and began an advertising campaign for shared streets. Developers adopted the concept and often used it as a sales pitch for their communities as safer, green, and more aesthetically pleasing.

Shared streets became so common that road engineers, who had controlled the planning and design of streets, felt threatened by the resulting intrusion of other professionals into their area of expertise. To please the engineers, the Ministry of Construction and Housing devised a design process and distribution of payments under which a landscape architect is in charge of the physical design of the street (including layout and final elevations), and the road engineer is in charge of subgrading and drainage. Thus both government policy and market demand established the shared street as the leading design element in subdivision layouts all over the country.

Shared Streets—Concepts and Design Characteristics

The shared streets integrate pedestrian activity and vehicular movement on one shared surface. Under this approach the street has first and foremost the functions of a residence, a playground, and a meeting area. It has the additional functions of carrying access traffic and providing parking spaces, but is not designed for intentional through traffic. The shared street can be characterized as follows:[1]

- It is a residential, public space.
- Through traffic is discouraged.
- Paved space is shared by pedestrians and cars, with pedestrians having priority over the entire street.
- Walking and playing are allowed everywhere.
- It can be a single street, a square (or other form), or a combination of connected spaces.
- Its entrances are clearly marked.
- There are no conventional, straight stretches of pavement with raised curbs, and pavement (carriage way) and sidewalk (footway) are not rigidly demarcated.
- Car speed and movement are restricted by physical barriers, and by deviations, bends, and undulations.
- Residents have auto access to dwelling fronts.
- The area has extensive landscaping.
- The area has street furnishings (figure 2).

These principles and physical characteristics can be applied to any configuration. In new housing developments the system allows for a departure from traditional linear streets to other configurations. Many new town developments in Japan and Israel use the shared streets as their basic design layout, with most residential streets being shared spaces that branch off a main collector. Both pedestrians and drivers reach the clusters of houses across a shared undemarcated surface. This arrangement freed designers to develop new spatial patterns, unconstrained by the regularity of linear streets (figure 3).

Safety and Driving Speed

High-speed driving on residential streets is usually due to the prevailing street layout, width, and pavement type, so assigned speed limits are ineffective.[2] A "restrictive" approach, on the other hand, can use any number of restrictive devices to intimidate drivers so that they are disinclined to speed. Tight curves, narrow pavements, natural obstacles (trees, rocks), visual cues (pavement color), and rough pavements give drivers turning into a residential street no chance to increase speed, and the visual impact urges them to slow down.

The most prevalent traffic accident statistics on residential streets are child-related accidents, and according to a study in England, half of all road accidents with children under five occur within 100 meters of their homes. The same survey shows that very few of such accidents occur on streets with restrictive devices and shared surfaces or cul-de-sac design (Department of the Environment 1992).

The shared street layout establishes a pedestrian orientation by giving pedestrians primary rights and making the driver feel like an intruder. Recognizing the probability of sudden conflicts, she or he exercises particular caution. This combination of an alerted driver and low vehicle speed substantially reduces the likelihood of a serious accident; the maximum speed in a shared street was recorded at 21.8 kph or 13.5 mph (Beth & Pharoah 1988, 54). The most common design feature of the shared street is unvarying pavement on both sidewalks and roadway. Elimination of curb and grade changes creates a single surface, which emphasizes the driver's arrival in a continuous space. Even if a curb is needed for drainage, the same paving material usually covers the entire space. Such features have a powerful effect; without the familiar two curb lines and asphalt runway, a driver's impulse to speed is deflected, and deceleration occurs. Drivers are inhibited further by directional changes in the route and by the placement of plantings. The driver must negotiate narrow sections of roadway, which allow passage of only one car at a time in a two-way traffic situation.

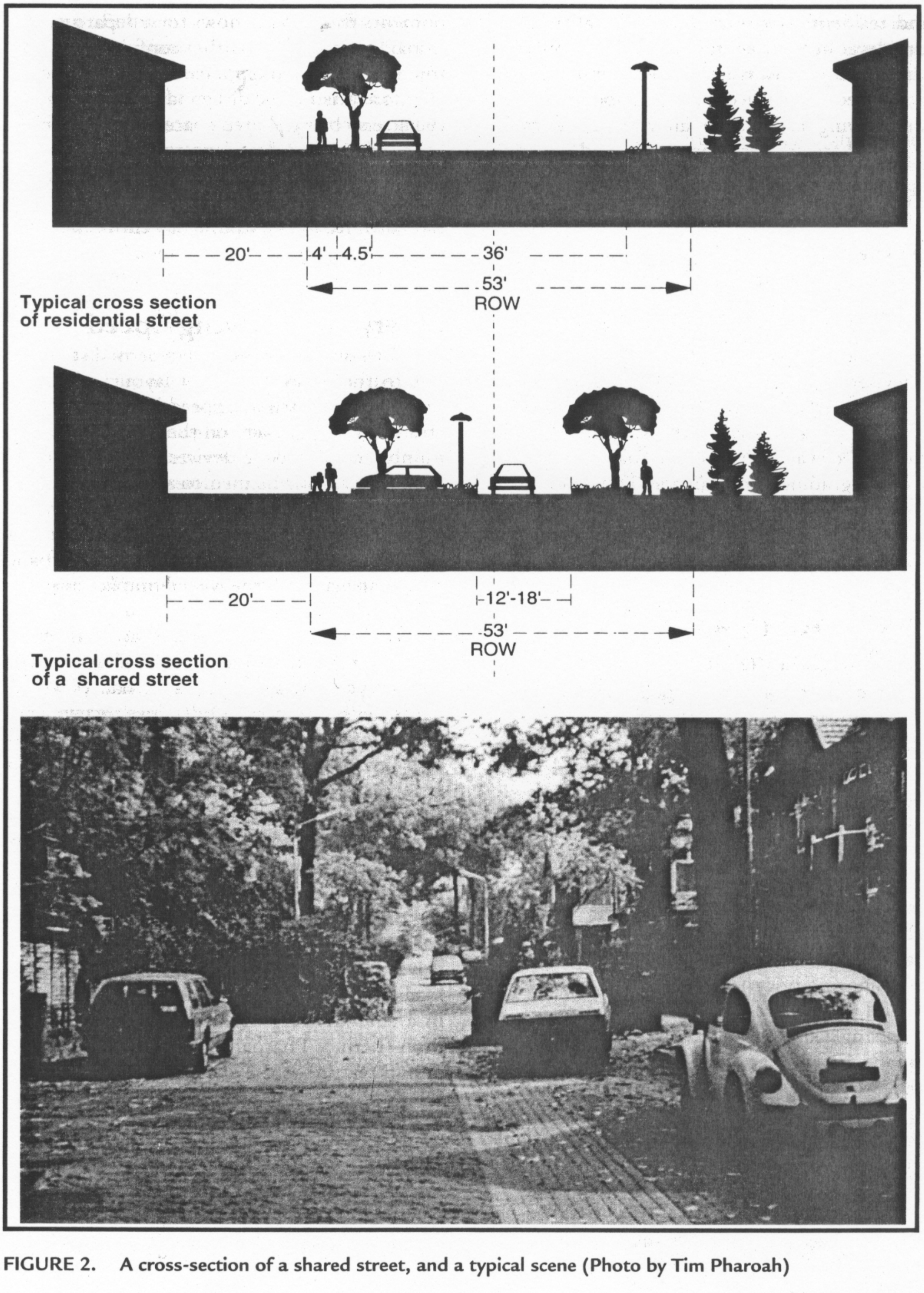
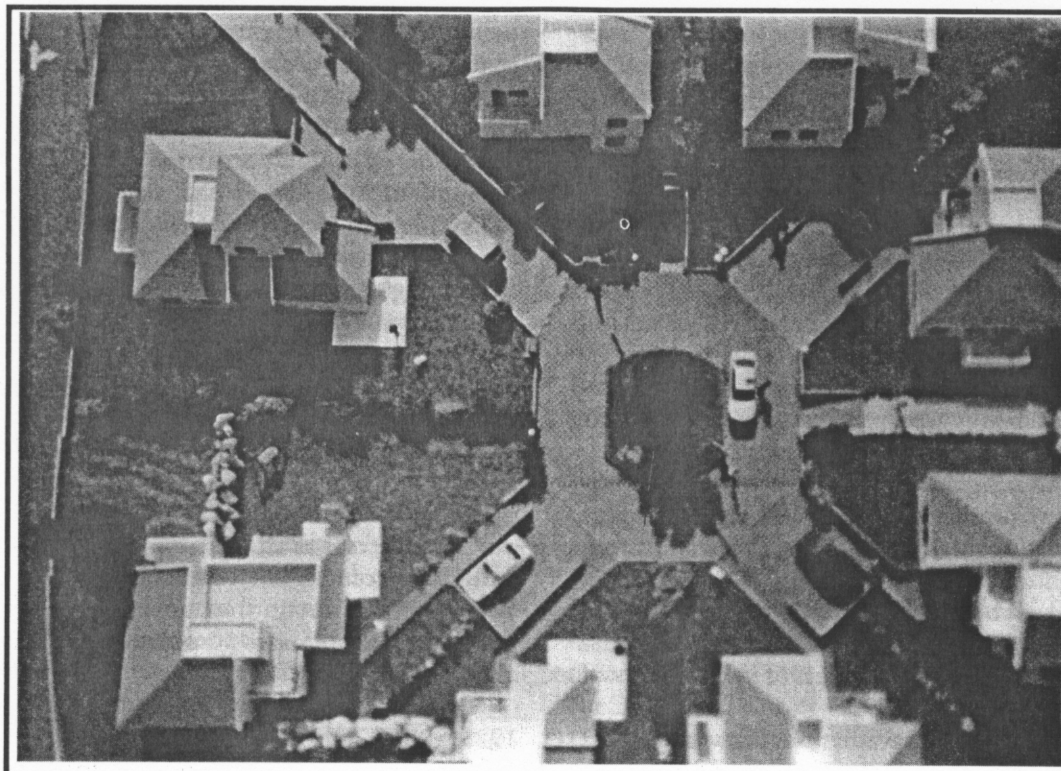
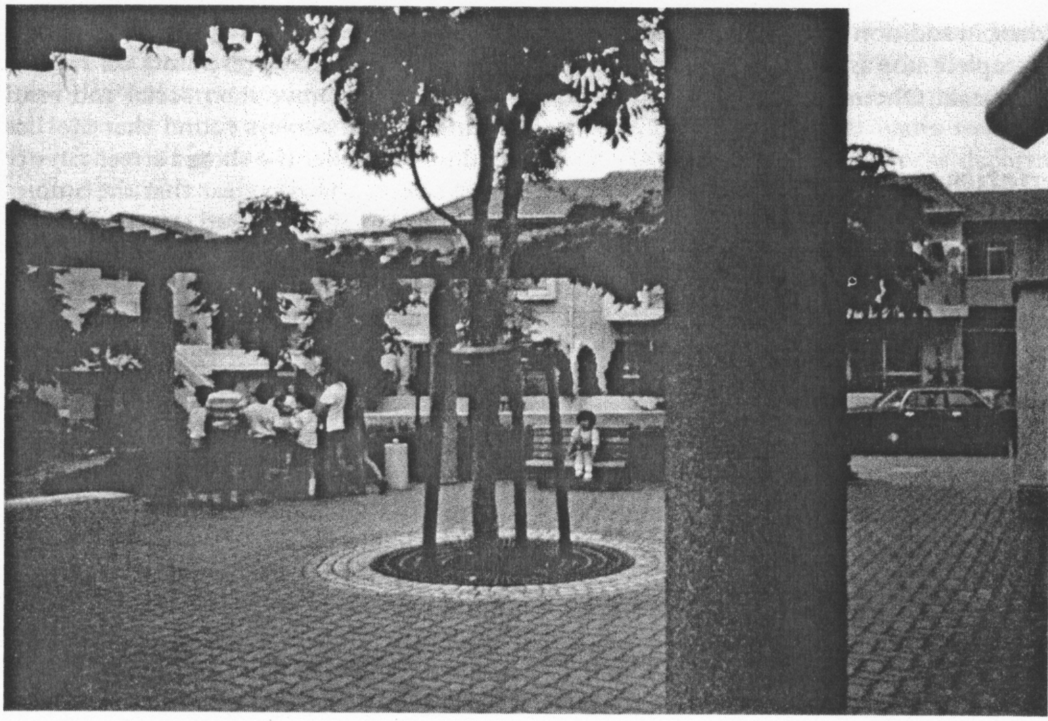


FIGURE 2. **A cross-section of a shared street, and a typical scene (Photo by Tim Pharoah)**



Ma'Cabim, Israel



Tama New Town, Japan

FIGURE 3. Shared street subdivision planning

Widths may vary to allow passage for local service vehicles.[3] Planting beds are usually low, and are made of materials that allow large vehicles, such as fire trucks, to drive over them in case of an emergency.

Even though it seems that the vehicular traffic and the pedestrians would conflict, the physical design subordinates the traffic. That situation is much safer for the pedestrian than is the usual street layout. Studies in Europe, Japan, and Israel show that on shared streets the number of accidents declines by more than 20 percent and the number of severe accidents by more than 50 percent, compared with traditional streets. (The suggestion often encountered, that safety improvements in one area increase the accidents in neighboring areas, was not proven.) Interestingly, the safety results in Europe and in Asia appear to be uniform (Toshi Jutaku 1983; Kanazaki, Ohomori, and Ishimura 1984; Polus 1985; Kraay 1986; Krause 1986; Nobel and Jenks 1989; Brilion and Blanke 1990; Engel 1990; Janssen 1991). Another promising indication is a reduction of vehicle trips of up to 14 percent (Janssen 1991).

The performance of pavement types was studied in Japan; fewer traffic accidents and safer driving were found when interlocking pavers were used. The use of different colors and the vibrations of the blocks make drivers slow down, in addition to reducing the distance required for a complete stop as compared to that on asphalt paving (Kanazaki, Ohomori, and Ishimura 1984).

Social Benefits and Residents' Satisfaction

Shared streets are more than transportation channels; they are places suited for pedestrian interaction, as people choose to pause and socialize on the street. Shared streets especially benefit children's activities. They provide play options and increase social contact within a safe home-base territory. The residents' willingness to take care of the public domain in the shared street is often observed; they view the street as an extension of their personal space and often maintain and relandscape the planting beds next to their dwellings. More time spent on the street increases the chances for social interaction, and especially so among children at play. A study in Germany found that the street redesign led to a 20 percent increase in play activity, and that play also became more complex. The use of bicycles and toy vehicles, and also of games requiring more space increased. The shift in play location from narrow sidewalks to the street's entire width including the former traffic lane was a notable change (Eubank 1987).

Similar studies in Japan report that 90 percent of those surveyed said the shared street is for people's use rather than for automobile use; 67 percent said that their children play in the street and that it is seen as a safe place to play. Other results show great satisfaction that the street space can be used for more than one purpose, and in particular that children can play throughout, not just in the play-lots. A majority of the residents (66 percent) felt that the shared street encourages social interaction and conversation between neighbors (Ichikawa 1984).

Surveys and opinion polls in Israel also show that the shared streets foster encounters and communication between neighbors. Most residents prefer a dead-end street (cul-de -sac) over a through one-way street, stating that a dead-end street improved the environment and safety of their neighborhood. The majority (81 percent) of the children were found to play every day in the street as their main play zone. Between 88 and 100 percent of the residents said they are willing and want to maintain the public planting beds within the streets, and almost 50 percent said they are actually doing so (Polus 1985, 1990).

A nationwide study in the Netherlands (Kraay 1985, 1986; Dijkstra 1990) indicates that residents' attitudes toward shared streets are influenced by the level of satisfaction from the design and social performance of the public spaces, rather than by the functioning of the traffic system. Moreover, the residents are willing to accept restraints on traffic and driving in order to improve their social and residential environment. The surveys found that mothers as well as children consider the shared street safer than an ordinary street. It is also clear that the amount of knowledge one has about shared streets directly corresponds with attitudes toward them. Thus, opposition to implementation is mainly correlated with general lack of knowledge about the shared street concept.

Cost

Shared streets can reduce expenses in new subdivisions. These savings can be seen in two major areas: efficient land use, and maintenance and replacement of materials. The conceptual framework for shared streets allows different design layouts by eliminating typical standardized features of the engineered street. Buildings can be arranged in groups around a court, or along a series of spaces connected to each other. Irregular shapes of lots can be fitted together easily. Shared driveways and the elimination of the standard cross section can reduce setbacks and increase the rear yard space. In short, more space is allocated to the units and less to roads and driveways. The flexibility of the layout permits density to increase without sacrificing visual openness and privacy. Because more units can be built without imperiling the features desired in detached suburban homes, the shared street development remains attractive to buyers, while reducing costs and using land efficiently (Bradford 1993).

The shared street is usually constructed of modular and prefabricated concrete elements, which are easily installed and long wearing. Concrete pavers are easily lifted and reset so that no trace remains of the disturbance. Unlike asphalt, concrete resists cracking and deformation. The initial cost of constructing a shared street is only slightly higher than the cost of an asphalt road. In countries where extensive use of interlocking pavers is common (Germany, the Netherlands, and Israel), and the cost of petroleum products like asphalt is high, construction with concrete pavers is cost-comparable. A 1986 study by the Israeli Ministry of Construction and Housing shows that the initial cost of installing a new shared street is only 10% more expensive than a traditional asphalt and curb layout (Ministry of Construction and Housing 1986). In the United States, the initial cost of interlocking pavers is currently 40 percent higher than that of asphalt. Yet, considering the life span of concrete pavers and their low maintenance, life cycle analysis (LCA) suggests that the design with the lowest initial cost (asphalt) may not be the best choice in the long run. With the use of pavers, street repair is simplified, as streets can be opened for utility line repair and the pavers replaced with no need for patching material. An evaluation study done in 1992 of street applications in North America shows excellent structural performance by pavers, with minimum deformation and minimum maintenance. Furthermore, interlocking concrete pavements increase in structural capacity over time and with loads. Their advantage over asphalt is that they will not deform internally, and will not crack from fatigue. Loads are spread to adjacent pavers by shear transfer through the sand in the joints (Shackel 1978, 1990; Rada, Stephanos, and Witczak 1992).

As mechanized installation becomes standard in construction, reduced installation time and labor costs should further reduce the cost of shared street surfaces in the United States. As noted above, residents of shared streets display a willingness to help care for the areas by their homes, which reduces maintenance costs (Polus 1985). Together with a pavement life expectancy of over 25 years, easy repair procedures, and lower maintenance, shared streets can be financially competitive and attractive.

Local Controls and Design Initiatives

The independence of local agencies and their ability to perform without reference to the government's yardstick form the key to changing regulations and standards. Promising venues for transportation changes have been recently established through the federal Intermodal Surface Transportation Efficiency Act of 1991. ISTEA, for the first time, authorized distribution of federal highway and transit funds at the discretion of state and local agencies. This legislation shifts to the states and cities many of the transportation decisions that have been under federal jurisdiction for more than four decades. Local agencies, free of the binding regulations usually attached to federal funding, can develop and support community programs and projects they find appropriate, on their own initiative, and with legal and financial support. For example, the city of Navato, California has recently adopted a new ordinance creating "rural street standards" (Ordinance 1313, July 12, 1994). The city uses these modified standards in workshop meetings with a neighborhood to improve design for a particular street. Other encouraging developments are TSM (Transportation System Management) programs and the increasing role of the private sector in transportation decisions (Deakin 1984, 1989; Cervero 1991). Furthermore, current literature on tort liability for local roads shows that the courts have usually ruled in favor of local jurisdictions having lower design standards for local roads, as long as the standards were set in writing (Mercier 1983, 1987). This is an important point, since in a nationwide survey conducted by the author, liability and legal issues were cited by cities' transportation and public works departments as the most important drawbacks to implementation of traffic-calming measures (Ben-Joseph 1995).

Another likely venue for implementing changes in residential street standards and regulations is the semi-private domain, which is becoming common. In many developments, a homeowners association owns and maintains the streets as private streets, and often the local planning authority allows flexibility in their design. Because the local government has no legal responsibility for these streets, different configurations and standards can be introduced. A successful example of this approach can be seen at Seaside, Florida (figure 4).

In this private development the residential streets consist of one paved surface shared by pedestrians and cars. There are no raised sidewalks or curbs, and automobile speed is controlled by the narrow driveway and the short street block. According to Andres Duany, one of the designers of Seaside, while private streets do exempt a designer from many rules, they still do not exemplify a true European Woonerf, in either their geometrical configuration or their civic characteristics. Duany's preferred method for avoiding the

FIGURE 4. Shared street in Seaside, Florida (Photo by Peter M. Owens)

limitations of street regulations is to label residential streets as parking areas, except for a few major streets designed as public. Labeling an automobile area for parking exempts it from regular street standards and put it under requirements that are usually more liberal and open to interpretation. Parking areas do not, for example, require building setbacks; their driving lanes are not controlled except for back-up space; and curb radii can be as small as 10 feet.[4]

The shared street concept also holds promise for the neo-traditional development. Advocating a highly interconnected street network (usually a grid), neo-traditional supporters claim it will reduce travel distance and time and extend accessibility by offering more route choices (Kulash 1991; McNally and Ryan 1992). Yet, increased accessibility on all the streets raises the likelihood of cut-through traffic and of speeds inappropriate to residential neighborhoods—the original impetus for abandoning grids in favor of discontinuous street systems, more than sixty years ago. Shared streets in a connected system can eliminate the deficiencies of the grid. Speed will be reduced and through traffic by nonresidents discouraged, yet connective factors such as access points and route choices will be much more numerous than in the typical hierarchical, discontinuous street system. This design would thus combine a high degree of livability and safety in the residential streets while maintaining links to the larger neighborhood.

Conclusion

There is no doubt that shared streets would be suitable for residential street layouts in the United States. This extremely adaptable concept has been synthesized and reshaped in many countries to fit local regulations and needs. Tailoring it to American standards would be a matter of innovative design and appropriate application.

Until recently, public agencies were reluctant to adopt new street designs and layouts. Engineering and public works departments, which have guided the development and management of residential streets, have often hesitated to adopt traffic management schemes for fear of lawsuits by drivers, passengers, or pedestrians. The new trend of neo-traditional design, however, by challenging established standards and regulations, has stirred an important debate about the future of residential development that extended to the transportation and civil engineering professions. In a recent nationwide survey of more than seventy cities' public works departments, more than half expressed willingness to re-examine their residential street standards and regulations. Furthermore, almost seventy percent of the cities were either taking or planning some measures of traffic control in residential neighborhoods, and about fifty percent of the surveyed engineers knew of the shared street concept and its benefit to the residential setting (Ben-Joseph 1995).

Restoring a human scale to residential streets can benefit all, from the residents, to the developer, to the local authority. The developer would find that the shared streets create an attractive public environment, thereby increasing the sales potential. Initiative by manufacturers can further reduce installation cost and prompt developers to adopt the change. The local authority will then enjoy a durable street system and residents' involvement with their streets, and will therefore have fewer maintenance problems and better traffic safety and control. Though residents have the most to gain from the shared street layout, they are probably the most ignorant of it as a workable alternative. General and public information about shared streets is nonexistent, yet the involvement of neighborhood residents in planning and implementing traffic management is crucial for acceptance. Through improved information, publications, and grassroots professional involvement, the possibility of re-design can be introduced. Such processes initiated many of the suburban shared streets in the Netherlands and in Israel.

Residential streets are the least influenced by traffic. Their domain lies more in architecture than in engineering, and so they should be under the design jurisdiction of the architect and planner. The shared street concept provides an opportunity for American planners and designers, as it did for their counterparts in Europe, to lead in achieving a deviation from the typical structured suburban design. Application of this concept in new settings opens the possibilities for a variety of site configurations. Such designs can promote a community that is safer, child-oriented, and aesthetically more pleasing. Shared streets can then become a valuable sales pitch for developments, just as they are in Europe and Japan.

The concept of the shared street and its design implementation deviate from the structured standardization of street design. The concept resulted from a more receptive and flexible design approval procedure that does not adhere to prescriptive solutions. The success of this approach to residential street design, as exemplified in shared streets, lies in creating a workable compromise between conflicting interests, both within the street's physical domain and within planning and engineering staffs.

NOTES

1. These definitions and concepts are based on the following publications:

   1. Ministry of Transport and Public Works. 1976. *Woonerven- Minimum Design Standards and Traffic Regulation (RVV) No. 179.* The Hague, The Netherlands: Ministry of Transport and Public Works.
   2. Ministry of the Environment. 1977. *Danish Road Traffic Code 40.* Copenhagen, Denmark: Ministry of the Environment.
   3. Osaka Public Works Bureau. 1984. *Area Road Network Planning and Pedestrian Roads.* Osaka, Japan: Public Works Bureau.
   4. Department of the Environment. 1992. *Residential Roads and Footpaths.* Bulletin no. 32. London, England: Department of the Environment.
   5. Ministry of Construction and Housing and Ministry of Transportation. 1981. *Guidelines for the Design of Shared Streets in Residential Areas.* Jerusalem, Israel: Ministry of Construction and Housing and Ministry of Transportation.
2. Farouki (1976) shows that the mean free speed of cars in suburban roads increases linearly with the roadway width. This linear relationship is particularly apparent for widths of between 17 and 37 feet.
3. The limited number of studies that have been conducted for residential street trip generation rates indicate a substantial range, between 5 and 20 trips per day per dwelling (Urban Land Institute 1974; Institute of Transportation Engineers, *Trip Generation,* 3rd Edition, 1982). Assuming that one trip per dwelling is made during the peak hour period, the resulting traffic volume in a street serving 30 dwellings would be 30 veh/h. The probability of two vehicles meeting under these conditions is very low. Even when two trips per dwelling occur in the peak, the probability of meeting is still low. Shared street design provisions allow for one vehicle to wait for the other, thus further reducing driving speed.
4. Interview with the architect and town planner, Andres Duany (Andres Duany and Elizabeth Plater-Zyberk Architects and Town Planners), September 19, 1994, by the author.

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