Roadway Levels of Service in an Era of Growth Management

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The tendency in growth management is to focus on roadway level-of-service standards. However, the methods used to determine roadway levels of service may affect conclusions about road adequacy as much as do the standards to which they are compared. The specific method used to analyze roadway levels-of-service can make at least a two-letter grade difference in the outcome; so can the choice of analysis period or peak hour. Although harder to quantify, the effect of averaging levels-of-service across facilities could be of comparable magnitude. In determining roadway levels of service, most Florida jurisdictions go by the book. They analyze the 30 highest hourly volumes roadway by roadway, using methodology from the 1985 *Highway Capacity Manual*. A few jurisdictions have opted for innovative but unconventional approaches. Although it is tempting to reject these approaches as "not professionally accepted," the "book" was written for applications other than areawide growth management. This relatively new area of application requires fresh thinking. In the context of growth management, the use of the following is recommended: (a) simple regression models to estimate average travel speeds and, from them, arterial levels of service; (b) average levels of service to determine adequacy of facilities within travel corridors; and (c) the 100th rather than the 30th highest hourly traffic volumes as the basis for roadway level-of-service determinations.

Roadway levels of service play a central role in Florida's efforts to manage growth. The state's landmark growth management law embraced a "pay as you grow" philosophy, commonly known as concurrency. Adequate infrastructure must be available concurrent with the effects of development. Adequacy is defined by level-of-service standards, which are adopted by local governments as part of their comprehensive plans. No development order or permit may be issued if levels of service will be degraded below the adopted standards.

As one observer noted, "five of the infrastructure elements have posed few problems for local governments. But the sixth category, roads, is proving to be a nightmare" (*1*, p. 6). Roads are the infrastructure element most likely to trigger public dissatisfaction, growth moratoria, and legal challenges under the growth management law. Thus, it is crucial that roadway level-of-service determinations be accurate and results be interpreted meaningfully.

SCOPE OF INQUIRY

In determining roadway levels of service, most Florida jurisdictions go by the book. They analyze 30th highest hourly volumes roadway by roadway using methodology from the 1985 *Highway Capacity Manual* (*2*).

A few jurisdictions have opted for innovative but unconventional approaches. Although it is tempting to reject these approaches as being not professionally accepted, it must be remembered the "book" was written for applications other than areawide growth management. This relatively new area of application requires fresh thinking.

Accordingly, three old methodological issues are addressed anew in this paper:

1. What methods should be used to analyze levels of service?
2. When should levels of service be averaged or otherwise aggregated?
3. What peak period or peak hour should be analyzed?

METHODS OF ANALYSIS

Methods of analyzing roadway levels of service may be arrayed according to data and analytical requirements and corresponding precision of estimates. It is usually assumed that the simplest methods are the least precise, the most complex methods the most precise. To the author's knowledge, this assumption has never been field-tested.

Assessment of Standard Methods

To test standard methods of analysis, traffic and travel time data for three arterials were acquired from consulting firms. Two of the arterials, Kirkman Road and Turkey Lake Road, are in Orlando. The former has high traffic volumes and low signal density, and the latter has relatively low traffic volumes and higher signal density.

For each arterial, traffic counts and travel time runs were increased during the same peak hours on the same weekdays. Thus, by design, actual travel speeds (derived from travel time runs) and estimated travel speeds (dependent on traffic counts) relate to the same periods.

Data in hand, intersections were first analyzed with HCS (Highway Capacity Software). Liberal assumptions were made about

- Saturation flow rates at intersections on these arterials (1,850 vehicles per hour after adjustments),
- Amount of green time devoted to arterial through movements (the maximum possible, given the timing plans of these semiactuated traffic signals),

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- Arrival types of vehicle platoons (the best possible progression, given signal spacing and signal timing offsets), and
- The peak-hour factor (a value of 1.0 was assumed, as if flow rates were constant during the peak hour).

A peak-hour factor of 1.0 was assumed to achieve a measure of consistency between HCS results and travel time runs. If actual peak-hour factors had been used instead, HCS would have analyzed the peak 15-min period of the peak hour, whereas travel time runs were averaged over the entire peak hour.

After intersection delays were computed, they were fed into the HCS arterial analysis program. The program adds intersection delays to running times between intersections to arrive at estimates of overall travel speed.

Assumptions from HCS analyses were later carried over to ART-PLAN; ART-PLAN is a simplified version of HCS distributed by the Florida Department of Transportation (FDOT). This meant that outputs of both programs could be compared with travel time runs with some assurance that all were measuring the same conditions.

Estimated and actual average travel speeds are compared in Figures 1 and 2. Given two arterials, two peak periods, and two directions, eight comparisons can be made. It appears that actual travel speeds are significantly higher than estimated speeds in nearly all cases. They are 5 to 10 mph higher in most cases than HCS estimates and a letter grade higher in level of service.

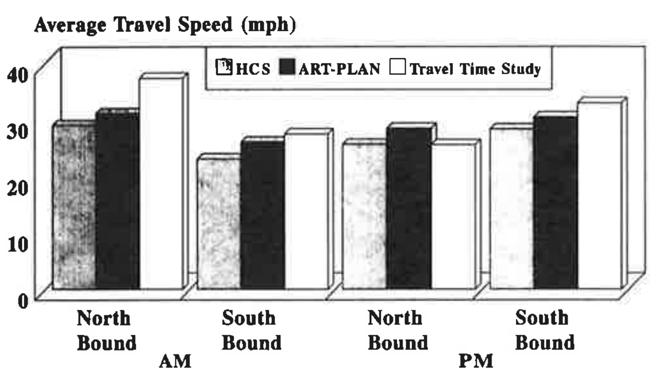

FIGURE 1 Average travel speeds, Kirkman Road.

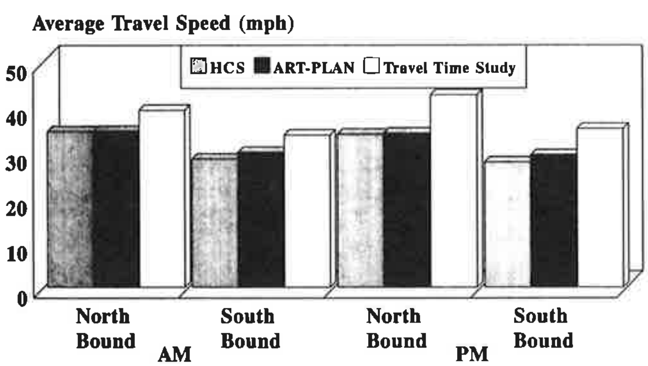

FIGURE 2 Average travel speeds, Turkey Lake Road.

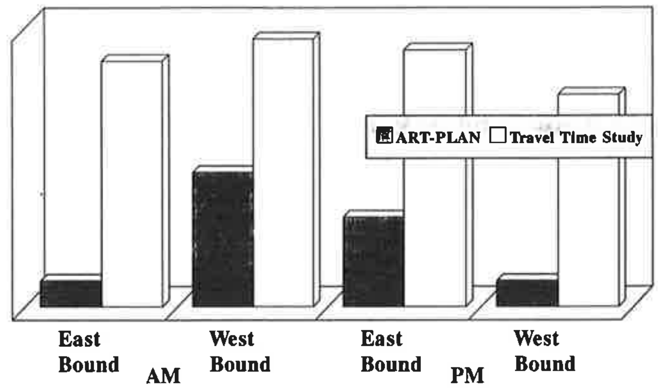

FIGURE 3 Average travel speeds, Broward Boulevard.

The other arterial analyzed was Broward Boulevard in Fort Lauderdale–Plantation. Broward Boulevard has higher traffic volumes on side streets than Kirkman Road and thus can claim a smaller portion of the signal cycle to accommodate its heavy traffic volumes.

Average travel speeds and peak-hour volumes for Broward Boulevard were gathered on comparable weekdays of the same month. Portions of the cycle devoted to through movements were observed at the same time that traffic counts were taken. Thus, although green ratios for Broward Boulevard appear very low, there is no reason to doubt the validity of the values supplied by the consulting firm.

Estimated travel speeds on Broward Boulevard are a fraction of actual speeds (see Figure 3). If results for Kirkman and Turkey Lake roads suggest that standard methods of analysis underestimate travel speeds, results for Broward Boulevard indicate that standard methods break down entirely when demands are too heavy relative to intersection capacity. Methods of analysis seem to break down before the road system does in practice.

Why Estimates Differ from Actual Travel Speeds

To help explain why actual travel speeds are higher than estimated speed, results for Kirkman and Turkey Lake roads were analyzed by roadway segment and by component of total travel time, the components being delay at intersections and running time between intersections. Typical results (for northbound a.m. movements) are presented in Tables 1 and 2. Actual stopped delays are mostly shorter than those estimated with HCS and ART-PLAN. Differences are greater for intersections with long delays. Actual running speeds are significantly higher than those estimated with either program and, as such, account for most of the difference between actual and estimated average travel speeds. Following convention, the posted speed limit was taken as the free-flow speed in HCS and ART-PLAN analyses. However, roads are often designed for higher speeds than are posted, and, as casual observation suggests, drivers tend to drive at design speeds on long, uninterrupted segments with moderate traffic volumes.

There is another reason that actual running speeds are higher than estimated speeds. HCS and ART-PLAN compute some

TABLE 1 Average Stopped Delay in Seconds: Northbound a.m. Movements

	HCS	ART-PLAN	Travel Time Study
Kirkman Road			
Carrier to International	10.0	11.4	12.15
International to Major	7.3	7.3	6.0
Major to Vineland	9.8	11.1	11.2
Vineland to Conroy	29.3	28.8	6.4
Average	14.1	14.7	9.0
Turkey Lake Road			
Sand Lake to Wallace	3.4	3.4	12.3
Wallace to Panther	2.6	2.6	2.6
Panther to Paw	1.0	1.0	0
Paw to Hollywood	1.9	1.8	0
Hollywood to Production	1.2	1.2	5.7
Production to Vineland	0.9	0.8	0
Average	1.8	1.8	3.5

TABLE 2 Average Running Speed in Miles per Hour: Northbound a.m. Movements

	HCS	ART-PLAN	Travel Time Study
Kirkman Road			
Carrier to International	32.1	31.8	29.7
International to Major	36.8	46.7	51.5
Major to Vineland	33.2	33.1	39.1
Vineland to Conroy	35.2	35.3	42.8
Average	35.2	39.6	44.6
Turkey Lake Road			
Sand Lake to Wallace	38.9	38.9	49.6
Wallace to Panther	38.2	38.2	46.2
Panther to Paw	32.4	32.4	48.4
Paw to Hollywood	29.8	29.9	30.8
Hollywood to Production	30.5	30.6	29.0
Production to Vineland	36.1	36.1	38.9
Average	36.6	36.7	44.7

stopped delay at all intersections. Hence, they assume acceleration and deceleration at all intersections. Although delay associated with deceleration is set proportional to stopped delay, and thus is small when stopped delay is small, delay associated with acceleration is a function of segment length (*2*, Table 11-4). The latter can significantly depress estimated running speeds on short segments.

In reality, no stops or delays are experienced during most travel time runs at intersections with high green ratios and good progression. Thus, contrary to HCS and ART-PLAN, vehicles travel at free-flow speeds over entire roadway segments or even sections.

Application of Travel Time Studies

Few jurisdictions conduct travel time studies as a method of determining arterial levels of service. One reason is the high cost of such studies; this factor may be rendered moot eventually by advances in automatic vehicle location technology. The more important reason is the perception that travel time study results apply only to the specific period when travel time runs are done—that they cannot be used to predict levels of service under standardized conditions, as required in growth management. This perception is incorrect.

Travel time study results can be used to calibrate HCS, ART-PLAN, and other programs. Default values assumed by these programs may not be applicable to a particular locale. Programs can be run with progressively higher saturation flow rates or free-flow speeds until estimated intersection delays, running speeds, and overall travel speeds better approximate travel time runs. The better-calibrated programs can then be used to predict levels of service under standardized conditions.

Alternatively, travel time study results can be correlated directly with traffic volumes and other variables in statistically derived models. To illustrate this approach, average peak-hour travel speeds were acquired for 17 two-lane roadways in Seminole County, Florida. With a.m. and p.m. peak hours, and northbound and southbound directions, speed data were available for a total of 68 movements.

Average peak-hour travel speeds were regressed on peak-hour traffic volumes, numbers of signalized intersections per mile, and posted speed limits. Both linear and nonlinear forms of the regression equation were tested. The best fit to the data was obtained with a linear equation in two independent variables: peak-hour traffic volume and number of signalized intersections per mile (see Figure 4). The speed-volume relationship is known to become nonlinear as road capacity is approached. Apparently, Seminole County roads operate in a flow range that is adequately represented by a linear equation.

The explanatory power of the model estimated for Seminole County is probably inadequate for use in predicting average travel speeds and levels of service. The standard error of the estimate, 5.3 mph, could result in a one- or even two-letter grade difference between estimated and actual levels of service. Nonetheless, with 55 percent of the variation in average travel speeds explained by only two independent variables, it appears likely that a good predictive model could be developed with a richer data base (including such independent variables as the green ratio, arrival type, and percentage of turns from exclusive lanes).

The regression model's simplicity should not be viewed as a shortcoming. The complicated models and multitude of parameters used in the 1985 *Highway Capacity Manual* only give the appearance of precision (*2*). In light of results for Kirkman

$$\text{Average Travel Speed} = 44.7 - \underset{(3.12)}{0.0087} \times \text{Peak Hour Traffic Volume} - \underset{(6.65)}{7.74} \times \text{Signals Per Mile}$$

R-squared	**= 0.55**
Standard Error	**= 5.3**
Number of Observations	**= 68**
Degrees of Freedom	**= 65**

t - statistics shown in parentheses

FIGURE 4 Regression equation for average travel speed: Seminole County, two-lane roads.

Road, Turkey Lake Road, and Broward Boulevard, added complexity need not translate into added precision.

AREAWIDE LEVELS OF SERVICE

The *Florida Engineering Society Journal* (*3,4*) featured a debate over the merits of averaging roadway levels of service within a corridor, district, or entire urban area. One author contended that averaging could result in a "glossing over of transportation problems" (*3*, p. 20). Another countered that requiring each roadway link to operate at a minimum acceptable level of service causes "short-term incremental improvements rather than long-term comprehensive improvements" (*4*, p. 24).

Both authors are right. The challenge is to devise level-of-service measures and standards that encourage a long-term comprehensive approach to transportation improvement programming while still addressing localized traffic problems.

Current Practice

It is routine in traffic impact studies to estimate levels of service for

- A lane group at an intersection,
- An entire intersection,
- A roadway segment from intersection to intersection, and
- A section of roadway with multiple intersections along its length.

However, we enter uncharted waters when combining levels of service of various facilities into one overall level of service. There is no standard, professionally accepted level-of-service measure for a travel corridor, a traffic district, or an entire road network.

Concepts Underlying Areawide Levels of Service

Two distinct concepts justify and guide the development of areawide level-of-service measures. The first is the concept of typical trips. Over the course of a day, or even a single trip, a person may travel on scores of roadway links and dozens of different roads. Presumably, a traveler's perception of roadway conditions is based on an entire trip or even an entire day's worth of travel, not the delay at one intersection or congestion on one roadway segment. Therefore, roadway levels of service might reasonably be combined to reflect common travel patterns and trip lengths.

Areawide levels of service may also be justified by the concept of alternative routes. Where a well-developed road network exists, an individual may have many routes available for a given trip. If any route provides an acceptable level of service, government may have met its responsibility to the individual trip maker. Hence, roadway levels of service might reasonably be combined for parallel routes within a travel corridor.

Alternative Areawide Approaches

There are at least three ways to combine the levels of service of various facilities into one overall level-of-service measure. All have precedents in Florida's local comprehensive plans.

The first approach is to sum traffic volumes and capacities for roads in a given area (where capacities are equal to maximum volumes at adopted levels of service). If the sum of traffic volumes is less than the sum of capacities, the area might be deemed to meet level-of-service standards. Lee County, Florida, sums traffic volumes and roadway capacities within traffic districts and uses any net capacity to justify degradation of already "backlogged" roads (see Figure 5).

A second approach is to average levels of service across facilities of a given type in an area. Although averaging in this context is novel, averaging travel speeds on arterials has been an accepted practice since the 1985 *Highway Capacity Manual* was released. It is not difficult conceptually or methodologically to go from averaging speeds on arterials to averaging speeds across arterials. The Brevard County Comprehensive Plan allows levels of service to be averaged in one specific travel corridor.

A third approach is to adopt a performance summary for roads in an area that specifies the percentage of roads at or above given levels of service. A standard is applied to centerline miles, lane miles, or vehicle miles collectively rather than to each road individually. An example of this approach is found in the Orlando Comprehensive Plan (see Table 3).

All three approaches—summing volumes and capacities, averaging levels of service, and adopting performance summaries—allow local governments to finance the most cost-effective system improvements rather than isolated roadway improvements dictated by minimum operating standards. How does one choose among them?

The adoption of performance summaries conforms to standard engineering practice, whereas the other two approaches extrapolate from such practice. By continuing to analyze roads individually, performance summaries avoid methodological leaps of faith.

Even so, the averaging method may be preferred for growth management purposes. Travel speeds fall precipitously as traffic volumes approach capacities. With areawide averaging, local governments, concerned about maintaining average travel speed, will have a considerable incentive to fix traffic hot spots. Less incentive is provided by the other approaches.

The fact that areawide averaging is not standard engineering practice practice represents an opportunity instead of a constraint. Standard practice could change with an update of the *Highway Capacity Manual*, as level-of-service standards are increasingly applied to growth management. Even if standard practice remains tied to individual facilities, areawide averaging will gain all the legitimacy required for growth management if it is sanctioned by regulatory agencies.

Weighting Factors

Whichever method is chosen, roadways must be assigned weights that reflect their contributions to overall levels of service. Lee County weights traffic volumes and capacities of roadway segments by their respective lengths (i.e., by cen-

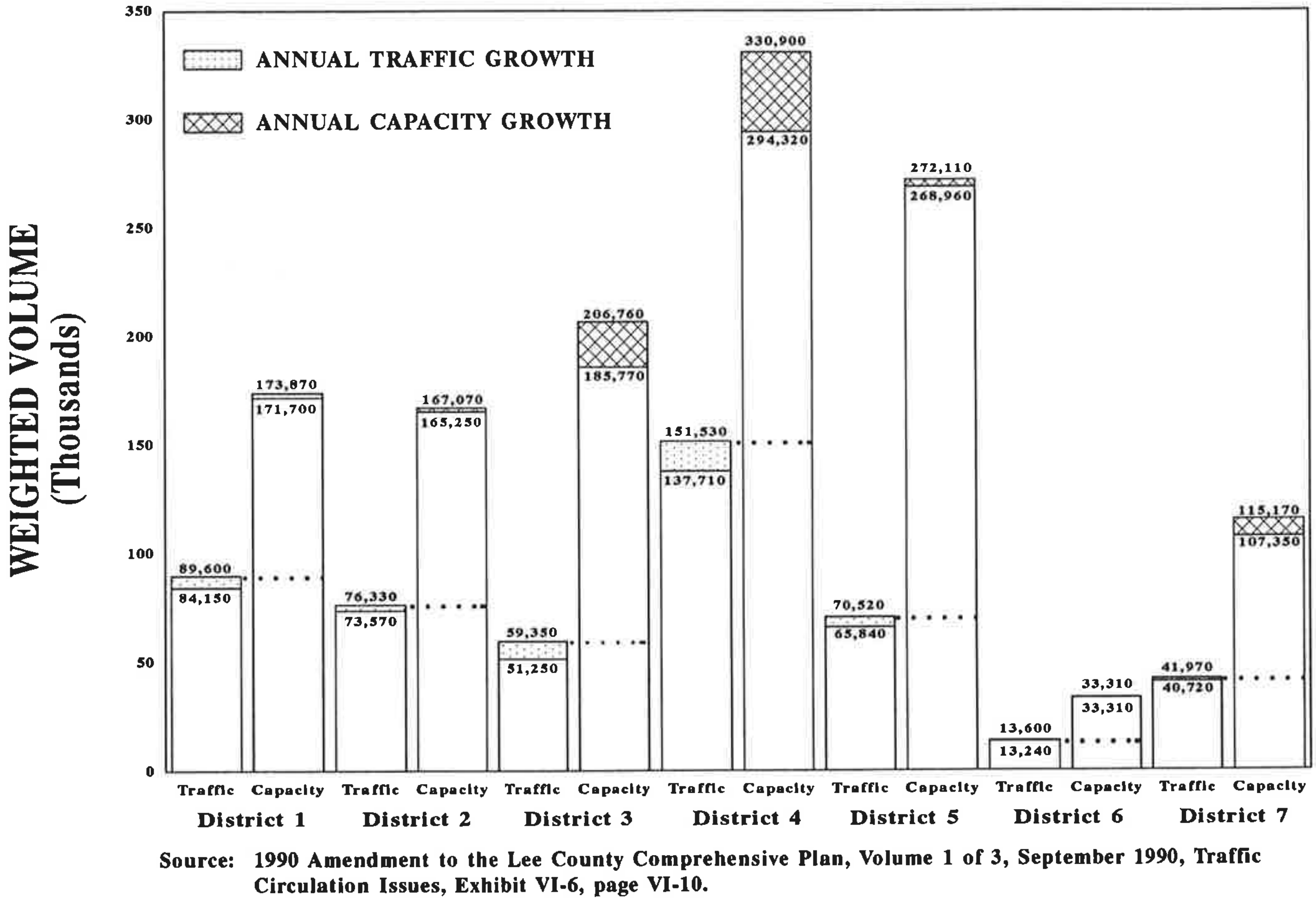

FIGURE 5 Traffic volume versus capacity by district, Lee County.

TABLE 3 District Performance Criteria, City of Orlando

Traffic Performance District	Lane Miles Operating at or Above Level of Service Standard	
	1995	2010
1	73%	75%
2	69%	73%
3	33%	52%
4	32%	34%
5	79%	88%
6	81%	84%
7	88%	88%
8	80%	95%
9	60%	66%
10	55%	50%
11	59%	62%
12	89%	97%
13	100%	100%
14	85%	91%
15	51%	58%

terline miles). Brevard County also uses segment lengths as a weighting factor. Pasco County weights its performance summary by the number of vehicle miles traveled on various roads; Orlando uses the number of lane miles; and Tampa uses centerline miles in one performance summary and vehicle miles in another.

Use of vehicle miles accounts for the volume of traffic exposed to various traffic conditions. Since it is the "average" experience of travelers we wish to capture in an overall level-of-service measure, not the average condition of roadways, vehicle miles appears to be the preferred weighting factor. Use of other weighting factors could encourage improvements to low-volume roads simply to meet regulatory requirements, whereas higher-volume roads go unattended.

Delineation of Travel Corridors

Localities will require some guidance as they delineate corridors or districts within which levels of service are averaged or otherwise combined. This discussion will refer to such areas generically as transportation concurrency management areas (TCMAs), a name coined by Florida's state planning agency.

If TCMAs are too large, traffic problems will be glossed over and development decisions will be subject to challenge. Property owners near the edges of large TCMAs might be expected to challenge project disapprovals prompted by traffic congestion at central locations or opposite edges.

If TCMAs are too small, flexibility to respond to systemwide needs will be sacrificed. In the extreme, TCMAs will cease to reflect motorists' experiences on typical trips or their choices among alternative routes and simply become surrogates for individual facilities.

For guidance in delineating TCMAs, the concepts of typical trips and alternative routes may be combined in the following general guideline: TCMAs should be drawn so as to encompass alternative routes available for common peak-hour trips. How this guideline is put into operation is best left to local planners; let it suffice to say that the guideline could be put into operation. For example, regional travel models could be used to generate tables of trip interchanges between traffic zones, and from them, common origin-destination pairs could be identified. Because level-of-service standards apply to peak hours, primary consideration might be given to work trip interchanges. Boundaries could be drawn so that traffic zones between which a majority of trip interchanges occur are part of the same TCMAs.

CHOICE OF PEAK HOUR

Florida's administrative rules require that levels of service be analyzed for peak-hour conditions. Use of peak-hour volumes is consistent with standard engineering practice in facility design, traffic operations, and traffic control.

However, as McShane and Roess note, "If peak-hour volume is to be used as a common focus of design, operations, and control analyses, it is critical to understand *which* peak hour is being used" (*5*,p.63). Among the multitude of choices are the single highest hour of the year, the 30th highest hour of the year, the average peak hour of the peak season, and the annual average peak hour.

Interplay of Peak Hour and Level-of-Service Standards

The choice of peak hour cannot be divorced from the setting of level-of-service, or LOS, standards. The effect will be the same if a lower standard is applied to a higher-volume hour, or if a higher standard is applied to a lower-volume hour. In its comprehensive plan, Lee County adopted two standards: LOS D for the annual average peak hour and LOS E for the average peak hour of the peak season. The lower standard (LOS E) applied to the peak season may be more restrictive than the higher standard (LOS D) applied to the entire year.

Does this mean that there is no preferred peak hour for growth management purposes? Hardly; it does mean that the choice of peak hour must be made on some basis other than the desire to foster or restrict growth (which can be accomplished with any peak hour by simply lowering or raising the level-of-service standard).

30th Highest Hour

Use of the 30th highest hourly volume is near universal in roadway design. The practice dates back to the 1950 *Highway Capacity Manual* (*6*). Traffic studies of that era observed extreme variations in traffic flow on facilities from hour to hour, day to day, and season to season. When hourly traffic volumes during a 1-year period were plotted in order of descending magnitude, the resulting curves often dropped sharply at first and leveled off quickly. The "knee" of the curve, where the slope changed markedly, often corresponded to the 30th highest hourly volume.

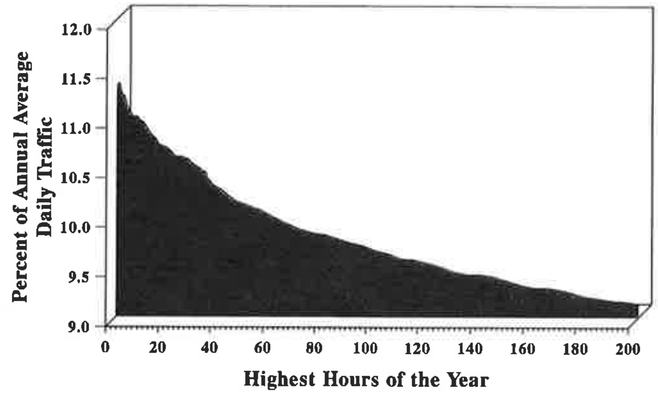

FIGURE 6 Small city route: Marianna US-90, Station 117.

Based on this early work, it has become conventional wisdom that

- The 30th highest hourly volume is the point of diminishing returns in roadway design.
- It is uneconomical to design for volumes to the left of the 30th highest hour, because a great deal of capacity is required to meet demands that occur only a few times a year.
- It is shortsighted to design for volumes to the right of the 30th highest hour, because little additional capacity is required to meet demands that occur frequently.

This need not be the case. Hourly traffic volumes in many localities do not follow the indicated pattern. Hourly volume curves tend to flatten out rather than remain static as areas become more developed; the knee of the curve becomes a moving target or disappears entirely. Even if hourly volume curves have predictable turning points, these points have no economic significance; the optimum design of a facility can be determined only by comparing the costs of alternative designs with the benefits to motorists (*7*).

Plots of hourly traffic volumes for 20 representative FDOT permanent count stations illustrate the arbitrariness of the 30th highest hour (see, for example, Figure 6). Several of the curves never level off and some have no point at which the slope changes markedly. Even where there is a discernible "knee," it seldom corresponds to the 30th highest hour.

The choice of design hour is ultimately a political rather than a technical matter. It involves balancing the public's desire to hold down road user taxes (which means more traffic congestion) against their desire to avoid traffic congestion (which means higher user taxes).

100th Highest Hour?

If statewide level-of-service standards are to have meaning, they must apply to the same peak hour everywhere. FDOT has proposed a shift from the 30th to the 100th highest hour as the basis for level-of-service determinations. Is this shift warranted and in the right direction?

Use of the 30th highest hour ties level-of-service standards to the exceptional travel experience. It could be argued that

TABLE 4 Traffic Counts at Various Peak Hours

Station	30th Highest Hour	100th Highest Hour	Average Peak Hour/Weekdays/ Peak Season
117	1890	1736	1658
87	2217	2069	2157
166	1444	1345	1145
13	2105	2049	2024
161	4905	4815	4756
96	2022	1958	2005
145	594	548	554
149	252	229	219
38	2162	2048	2130
118	1938	1748	1604
47	879	811	644
66	1913	1772	1594
94	3494	3403	3419
105	1424	1309	1326
113	4571	4425	4481
151	3494	3359	3421
159	2222	2137	2231
160	1076	989	948
164	2167	2039	1697
165	3350	3123	3320

standards should instead reflect a more typical travel experience—"typical" at least of peak periods.

Table 4 presents traffic counts at 20 permanent FDOT count stations. For some roads, the 100th highest hourly volume is lower than the average peak-hour volume on weekdays during the peak season. For others, it is somewhat higher. However, in general, the 100th highest hour is roughly equivalent to the average weekday peak hour during the peak season, except on recreational routes. (On recreational routes, weekend peaking causes the 100th highest hourly volumes to far exceed weekday peak-hour volumes. This is the case at FDOT Count Stations 66, 164, and 166.)

The 100th highest hour volume would be easy to estimate, assuming this rough equivalence is borne out. It would be necessary to take only one 24-hr count on a typical weekday during the peak season. The highest hourly count for that 24-hr period could be taken as an estimate of the 100th highest hourly volume. This would improve on the practice in many localities of applying a generalized *K*-factor to a single, seasonally adjusted 24-hr traffic count.

Additionally, the 100th highest hour volume would be relatively easy to project. Standard regional travel models forecast traffic volumes for the average weekday during the peak season. To obtain estimates of the 100th highest hourly volumes, it would be necessary only to apply a peak-to-daily ratio to model outputs. At present, modelers must first convert model outputs to annual average daily traffic volumes and then apply a generalized *K*-factor to the result.

Peak Period Instead of Peak Hour?

Daily peaks tend to spread out as urban areas grow and traffic congestion causes motorists to adjust their travel hours. Indeed, the largest cities do not have a peak hour per se but a 2- to 3-hr period in the morning and afternoon when commuting is heaviest. Roads become capacity-constrained, and *K*-factors come to be determined by supply rather than demand. We can expect even more spreading of the peak as traffic congestion worsens and communities seek to better manage travel demand.

With the state's approval, Dade County and the city of Miami based levels of service in their comprehensive plans on average hourly traffic volumes for the two highest consecutive hours of the average weekday. Although analysis of a 2-hr peak period flies in the face of time-honored design convention (which uses a single design hour), the convention may prove too limiting.

It is not the spreading of the peak that, in time, will justify a shift from peak-hour to peak-period analysis. This spreading is already reflected in hourly traffic counts and should be reflected in the *K*-factors used in traffic projections. Instead, it will be the adoption of policies that encourage commuters to adjust their times of travel.

Let us say a locality adopts a trip reduction ordinance requiring employers to institute flextime. Employees would then have the option of commuting at less congested hours. Such a policy could justify the averaging of traffic volumes over flexible starting and ending hours. As when alternative routes are made available, a case could be made that with flextime in place, government no longer has responsibility for accommodating every trip maker's choice of travel hour.

CONCLUSION

The tendency in growth management is to focus on roadway level-of-service standards. However, the methods used to determine roadway levels of service may affect conclusions about road adequacy as much as do the standards to which they are compared.

The specific method used to analyze roadway levels of service can make at least a two-letter grade difference in the outcome. So can the choice of peak hour. Although it is harder to quantify, the effect of averaging levels of service across facilities could be of comparable magnitude.

Thus, even adopting the same level-of-service standards, level-of-service determinations for, say, the city of Miami and Jefferson County, Florida, have entirely different implications for motorists. Jefferson County goes by the book, comparing the 30th highest hourly traffic volumes on individual roads to the maximum volumes at different levels of service based on *Highway Capacity Manual* methodology. In contrast, Miami has adopted an innovative but unconventional approach, comparing person-trip volumes for the two highest hours on the average weekday to the practical capacities of multimodal transportation corridors.

In the context of growth management, three innovations seem particularly promising: (a) using simple regression models to estimate average travel speeds and, from them, arterial levels of service; (b) using average levels of service to determine adequacy of facilities within travel corridors; and (c) using 100th rather than 30th highest hourly traffic volumes as the basis for roadway level-of-service determinations.

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