Session #7

Improving Small City Highways;
New Techniques for Improving Safety and Livability Through Technology Transfer

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ABSTRACT

Highways provide needed access to destinations in small cities in addition to allowing through travel to other places. Many small city highways are very wide and traffic speeds excessively high. Extensive paved areas, narrow sidewalks, and little greenery has resulted in a dangerous, unpleasant environment for residents and visitors. Increasing traffic volumes and resulting highway reconstruction often make problems worse. City residents recognize these problems and would like to see design solutions that improve the safety and livability of their communities.

These problems are not unique to the US. Scandinavia has similar problems. Traffic in small cities accounts for a relatively small amount of total traffic, but for a large share of accidents and fatalities. This is especially true for pedestrian and bicycle traffic.

The Danish Road Directorate, Norwegian Public Roads Administration, and Finnish National Road Administration have constructed "Environmentally Adapted Throughroad" pilot projects to address these problems. They have done research, published reports, and revised their highway design guidelines as a result. Designs focus on 1) moderating traffic speeds and fitting motor traffic into city land-use; 2) increasing the safety of pedestrian and bicycle traffic; 3) supporting the cityscape and livability with highway design; and 4) taking all community impacts into account when planning and reviewing proposed design alternatives. The planning technique of "roadway segmentation" is key in addressing these areas.

Positive results have occurred. Traffic speeds and accidents are down, and small city environments have improved. Residents are satisfied with the changes.

This paper presents the history, concepts, processes, and results of the Scandinavian activities. The information comes from reports and from interviews from an FHWA Study Tour that included myself. The reports include: a) "Danish Road Standards, Part 0, Road Planning in Urban Areas" -1991, b) "Danish Road Standards, Part 7, Speed Reducers" - 1991, c) the Danish "A Catalog of Ideas" -1993, d) Miljoprioriterede gennemfarter, Effekter i 21 byer, Rapport nr. 70, Danish Road Directorate" - 1996, e) Improvement of Small City Through Roads" -Finnish National Road Administration - 1993, f) "Summary from the Norwegian Street Enhancement Program" -1996, and other reports..

The paper includes a bibliography and contacts list.

INTRODUCTION

Scandinavian Road Agencies, in cooperation with local governments, have constructed and researched "Environmentally Adapted Throughroads" in small towns. The roads are designed to balance traffic and environmental improvements. The Danes have a unique name for this process of conversions - "Traffiksanering' or "traffic made sounder."

The population of these pilot towns ranges up to 10,000 in Finland, with similar populations in Denmark and Norway. Experiences from the towns apply to stretches of highway between 470 and 2891 m long and longer in Denmark, between 400 and 750 meters long in Norway, and of similar lengths in Finland. ADTs typically range up to 16,500.

Why Throughroads?

Previous actions on residential roads along with differentiation of traffic resulted in many long and straight residential and distributor roads with excessive traffic speeds. Traffic roads, with resulting greater traffic and drivers with less respect for speed limits cause most serious safety and environmental problems.

Throughroads carry a small amount of total kilometers traveled but a significantly larger amount of personal injury or fatality accidents (PIF). In Finland in the early 1990's, throughroads accounted for about 6% of Public Roads length, 17%of overall kilometers traveled, and 27% of all PIF.

Throughroads are the "Main streets" of small towns; years of road construction for motorized traffic only (starting in 50's/60's) resulted in building removal, wide paved roads and parking, less greenery, etc. Residents of towns are unhappy with this condition.

History of Throughroad Improvements, Policy and Pilot Projects:

1960's - Traffic Differentiation created the separation of heavy, fast traffic from light (bicycle and ped) traffic, and slow traffic. Problems with inconsistent coordination of land use and traffic planning resulted in light traffic using paths and primary (arterial) and distributor (collector) roads not designed for such traffic. Residential and local distributor roads became long, with excessive speeds. Grade separations were expensive, and local road closures resulted in long detours.

<u>Denmark</u>

1970s - "Woonerven" improved residential roads and raised awareness of traffic calming. The Danish Road Traffic Act of 1976 (shared local roads), and "Silent Roads" (local), were successful in residential areas. There was reconstruction to remove black spots and other safety improvement on throughroads, but no real "traffic calming."

1980s - Danish Road Directorate (DRD) published "Highways through Towns - a Catalog of Ideas -1981" showing how car speeds could be reduced, bicycle and pedestrian service and safety improved, and environment improvement. Pilot projects constructed on arterial highways in three towns with ADTs of 3-4,000. Effects studied in the "EMIL-project" (Consequence evaluation of environmentally adapted throughroads). Most results positive: reduced speeds, improved safety, reduced environmental impacts, inhabitants and road users happy with changes. This resulted in

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more pilot projects in towns with ADT's of up to 20,000.

1990s - Road Standards for Urban Areas - 1991, published by DRD, coordinates traffic planning based on speed differentiation with the definitions of traffic and local roads in the Danish Municipal Plan Act (1984). 1992-1994 saw planning and construction of conversions of throughroads in 25 Danish towns based on 1991 Road Standards, etc. Again, largely positive results have occurred.

<u>Finland</u>
1960s/70s - Sidewalks installed along thoroughfares of most Finnish built-up areas (BUA). Typical thoroughfare had extensive paved areas, wide roads, narrow sidewalks, poor safety for bicycle and pedestrian traffic.

1980s - Throughroad design and construction based on the "Design Directive for BUA Thoroughfares"(1984) by Finnish National Road Administration (FinnRA). Goals included taking the existing environment into account and improving it, clarifying traffic arrangements and safety, and improving the level of service for bicyclists and pedestrians.

1990s - "Throughroads built in the 1980s; Villagescape and Functionality Survey, published effects. Speed constraints were not used as design features; average travel speeds were close to the speed limit but the speed limit was often greatly exceeded. The environment or "villagescape" were not sufficiently taken into account resulting in the road dominating the environment. "Improvement of Small City Throughroads" published in 1993 to address previous shortcomings. Six case study towns were chosen to apply the new design principles and concepts. RFPs and competitions for designs were held. In 1995 the first follow-up study of the case towns published for Rantasalmi. Results include improved safety (esp bicycle/ped traffic), improved environment, improved access, and residents and drivers were pleased with the results.

<u>Norway</u>
1991-1995 - Environmental Priority Thoroughfare Program established by Norwegian Public Roads Administration (NPRA)constructs trial projects in five towns to obtain more information on the effect of re-designed streets and to generate more attention and interest in environment and traffic improvements. In 1992 the "Road and Street Design" manual was published by NPRA. Re-introduced the "street" as more than just an artery; also an urban design element and commercial/social arena. In 1995 the Hearing Draft for updated "Roads and Streets" was developed to deal with traffic construction in urban areas and cities. "City life - the Street as a Social Arena" R & D project of 27 streets and town squares was also started to acquire knowledge about urban social activities as a premise for street design.
1996 - "Street Enhancement: Summary from the Street Enhancement Programme" was published by NPRA, presenting a summary of experiences from the trial projects. A comprehensive report and individual reports are to follow. Effects include reduction in traffic speed, reduction is also expected in accidents, parking is more orderly, the visual environment improved and outdoor uses increased.
1997 - Four reports on the City Life R & D programme published by the NPRA.

APPROACHES TO SOLVING THROUGHROAD PROBLEMS:
A main thoroughfare through a town must serve several functions - through-traffic, bicycle and foot traffic, local traffic, shopping, and everyday use by the townspeople. These requirements involve numerous interests and services (sometimes viewed as conflicting), which can be addressed in different ways. Strategies are often categorized as:

A: Bypass Roads

A new road is built leading through-traffic outside the town center.

B: Main Thoroughfare with through-traffic priority

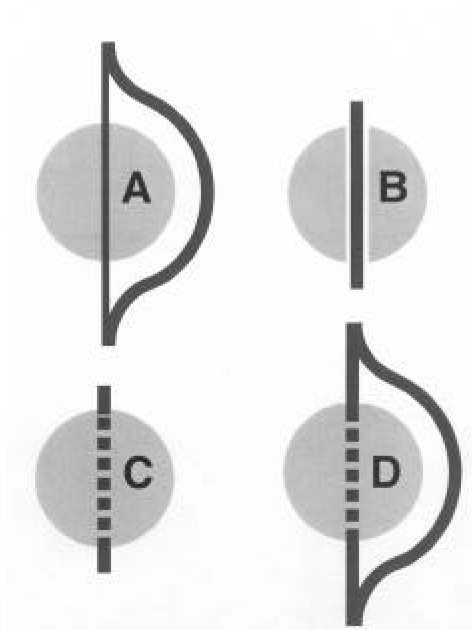
Traffic on the main thoroughfare has priority, employing e.g. medians, safety fences, guide rails, limited access, priority for through traffic and speed limits of 60 km/h (35-40 mph) or higher

C: Environmentally adapted throughroad main street

The thoroughfare gives priority to local functions and is adapted to the local environment. Bicycle and pedestrian traffic and local road traffic are provided with good accessibility, while through-traffic has somewhat lower priority.

D: Bypass and enhanced main street

A combination of Strategy A and C. This solution satisfies the requirement for environmental improvement of the old main road when a new bypass is built.



Strategy principles.

Environmentally adapted throughroads do not necessarily reduce the amount of traffic in a town. Bypasses can provide good results where there is a high volume of through traffic. However, environmentally adapted throughroads will often be quicker and cheaper to build than a bypass, conflicts arising from taking R/W for roads are avoided, and they will physically and socially improve the local environment.

THROUGHROAD DEVELOPMENT PRINCIPLES
The goals of Strategy C (and the old main road of Strategy D) are to improve traffic safety and services, and the local environment. The main development principles for traffic and land-use are very similar in all the countries and are:

A clear town plan and road network plan must be done for major investments, such as road conversion, in built-up areas.

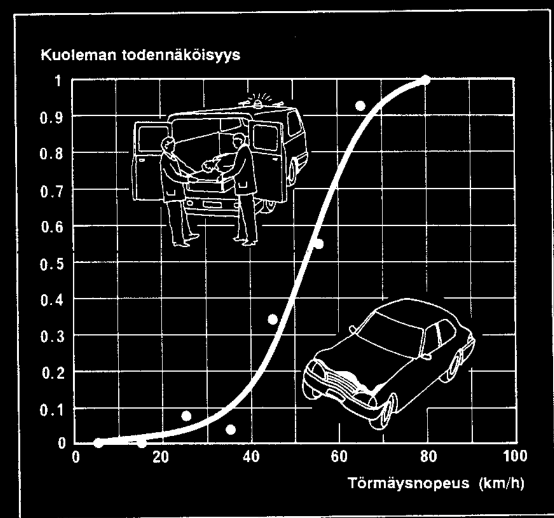
Multi-disciplinary collaboration and cooperation between planners, engineers, architects, landscape architects, residents, property owners, road users, and sometimes artists, is required.

An open planning process is needed to search for common ground in values, to acknowledge the significance of conflicting values, reach consensus about problems, environmental and traffic goals, and terms imposed by the environment.

Improving bicycle and pedestrian traffic service and safety, based on light traffic network needs and links, is of major importance.

The speed limit (and desired operating speed) on downtown roads or other sections must be reduced to 30 to 40 km/h (20-25 mph) to improve traffic safety. Research in Scandinavian (and other countries) shows that the probability of a pedestrian fatality increases exponentially when the motor vehicle impact speed is over 40 km/h (25 mph). Diagram 5/7, from Finland, illustrates this principle.

5/7. Probability (K) of a pedestrian fatality in an accident as the function of impact speed (Vt).



Throughroads should be developed as a **common space** to be used by all residents of the community, meeting the social needs of various user groups.

Changes in the community structure and environment should take into account along with construction, maintenance, and traffic costs.

Preserve or rediscover the small scale and richness of detail of the road and its environment. All existing building and trees should be preserved. Road surfacing materials, lights, street furniture, and other details should conform to the basic design and character of the area concerned.

Spatially limited and narrow road sections should be kept as is. Wide open thoroughfares can be sub-divided using parking, paths, sidewalks, green spaces, etc.

THROUGHROAD PLANNING PHASES

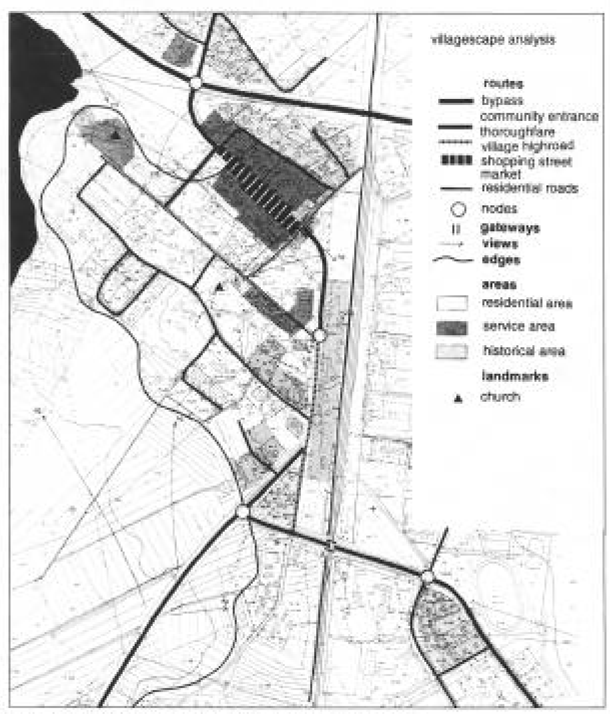
Throughroad improvement design begins with drawing up a schematic plan. In this plan, the different development alternatives are examined in parallel with land-use planning. All basic decisions on traffic arrangements, and any land-use solutions linked with them, are made in the schematic plan. Technical designs are examined only to check their feasibility and that their costs and other effects can be studied.

6/3. The phases of throughroad planning.

Throughroad design, from the "present-state analysis" to the details of individual design concepts, requires an open planning process with close cooperation between land-use, villagescape, and traffic planning expertise. Residents, road users, focus groups, businesses, landowners, and others should involved to gain their opinions, experiences, and expertise. They may be involved through questionnaires, open houses, planning workshops and design charettes, and theme days, etc.

Formalized open meetings and work seminars involving general discussions of solutions should be held up to the detailed planning/design phase. It is important to include directly involved interests and individuals in the work. In many projects, information brochures were distributed to residents and businesses, and project material was exhibited.

Throughroad Analysis
The drafting of a schematic plan begins by preparing a comprehensive analysis of the present situation. This is used as the basis of throughroad segmentation and design. The analysis studies:

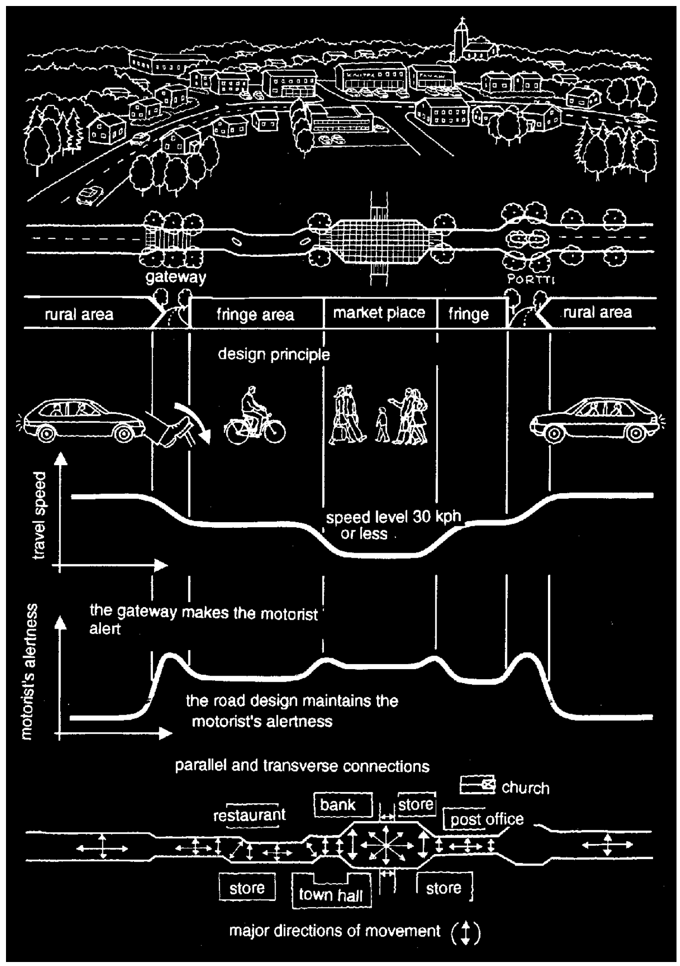


6/4. Example of a villagescape analysis in a small rural built-up area. Wharti.

- Land Use and the Functional Structure in the Built-up Area
    - -the present structure, functions, the need for links between them, and shortcomings
    - -center point of the built-up area
    - -realistic estimate of growth and the potential for change
- Villagescape
    - -originality and positive features of the environment
    - -problems requiring correction
    - -sites to be preserved, environment imposed constraints on land-use and road design
- Road Networks (including Light Traffic Networks)
    - -the status of the road in the national and area networks
    - -speed level goals in different parts of the road networks
    - -road network history and goals
- Traffic
    - -traffic function
    - -traffic safety situation
    - -functional goals

Throughroad Segmentation

A throughroad consists of separate, discrete sections. A section is a stretch of road in which problems and properties of the road and its environment are fairly constant. It begins with an approach section, often followed by a section where construction is denser before the shopping street section. The character of the traffic in each section is defined by the functions along the road and its' status in the road network.



Segmentation is used to make it easier to define the development goals for each road section and to find solutions to traffic problems while taking environmental factors into account.

Sections are defined at the goalsetting stage of design based on inventories and problem analysis. Both environmental and traffic properties are examined in a section of throughroad.

The design concepts used in a section of road should be based on its traffic goals and environmental properties. For instance, two shopping street sections in different towns, though similar in function and status, may differ greatly in spatial delimitation and scale. Particular care must be taken with historically valuable and homogeneous environments.

Changes in the road environment and the reason for various road design features must be evident to road users. At the boundaries between sections, design work should make use of environmental features and technical means of traffic guidance.

Elements used to achieve main development principles

Many different types of geometric design, material, and visual elements are used to achieve development principles and section goals and designs.

Figure 17 from the Danish Road Guidelines addresses the appropriate application of main types of speed reducers. Types 1-8 are appropriate for throughroads (traffic road, desired speed < 40-50 km/h, and both ADT ranges).

Main Type	Road Class		Desired Speed (km/h)			Annual Day Traffic (ADT)	
	Traffic Road	Local Road	≥60	50	≤40	>3000	≤3000
1 Pre-warnings	x	x	x	x	x	x	x
2 Gates	x	x	x	x	x	x	x
3 2-lane raised areas	x	x		x	x	x	x
4 2-lane humps	x	x		x	x	x	x
5 Staggerings	x	x	x	x	x	x	x
6 Staggerings with raised area	x	x		x	x	x	x
7 2-lane narrowings from road centre	x	x		x	x	x	x
8 2-lane narrowings from roadside	x	x		x	x	x	x
9 Narrowings to 1 lane	(x)	x			x		x
10 Narrowings to 1 lane with raised area	(x)	x			x		x
11 Narrowings to 1 lane with humps	(x)	x			x		x
12 Staggerings with narrowing to 1 lane	(x)	x			x		x
13 Staggerings with narrowing to 1 lane and raised area	(x)	x			x		x
14 Staggerings with narrowing to 1 lane and humps	(x)	x			x		x

(x): To be used only in special cases

Figure 17. Applications of the 14 main types

Other elements include: medians, roundabouts low speed intersections, curbside parking, lighting, planting, and street furnishings,

Standard cross-sections should not be used. The traveled-way cross-section, curb to curb, should be based on low travel speeds. Widths of 5.2-7.0 m (17-23 ft) are suitable, with 6.0-6.5 m (20-21.5 ft) widths the most commonly used. Traffic volume does not effect traveled-way width.

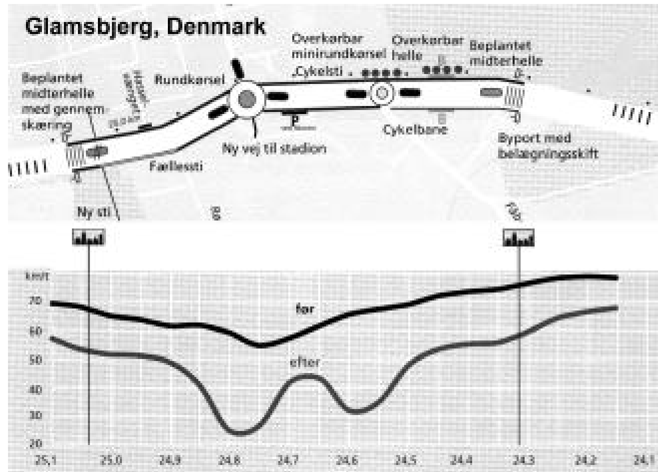
Sidewalks and bicycle lanes or tracks (one-way paths) service light traffic. Crossings between bicycle and pedestrian traffic and parking cars should be minimized.

Bus stops can be built without bays, in which case stopped buses act as constraints.

EXPERIENCES AND RESULTS

Traffic Speeds

People drive slower and at a more even speed in the majority of locations. Average speeds have been reduced from 10 to 30 percent, and the speed ranges have also been narrowed. Top speeds have been appreciably reduced. The 85th percentile speed also shows sharp reductions, for example, averagingabout a 10 km/h reduction in Norwegian trial projects. The chart illustrates the



average before and after speed levels in Glamsbjerg, Denmark. Note the significant speed reduction through the use of roundabouts.

Accidents

Earlier Danish throughroad conversions show PIF accident reductions of 1/3 average. Many of the recent projects are too new to have adequate follow-up data. Similar results are expected in the newer towns. In rare cases, accidents stayed the same or increased slightly due to some poor design details, many of which have been corrected.

In Norway, there is reason to expect future accident figures to be reduced by 20-40%. In Rantasalmi, Finland, there were 5 personal injury accidents involving light traffic in the 5 years before construction; since improvements there have been none.

Significant reductions in light traffic accidents were common in all countries.

Modal Use and Traffic Flow

In many locations foot and bicycle traffic has increased. In some locations, auto and truck traffic may be reduced slightly. Through-traffic takes longer to pass through after reconstruction. In the smallest towns the delays are insignificant, only 4-5 seconds. In other towns, the delay may be up to 40 seconds. In many locations, access to intersecting roads and adjacent properties has been improved because of less speed difference between traffic.

Traffic Noise

Measurements in most locations show that traffic noise has been reduced slightly. This is attributed to reduced traffic speeds and/or volumes.

Residents and Road Users

In opinion surveys, the majority of residents and road users respond positively to the changes to the roads and to the environment.

Pedestrians and bicyclists tend to keep to the crossings created at new refuges and raised sections. In surveys, they felt satisfied with the new facilities and felt that their safety had improved considerably. Both residents and drivers have responded positively to the decreased speeds, and they liked the fact that the speeds had been lowered.

In some towns, a decrease in the number of parking spaces and the inconvenience of using them drew criticism. However, based on videotapes, there seemed to be enough parking spaces, at least on the days when the tapes were recorded, and using curbside parking spaces did not appear difficult.

Maintenance

Maintenance costs may increase noticeably during the first summer and winter seasons after reconstruction. Winter maintenance problems include the extra care necessary to plow narrow roads, and bollards and plantings were easily damaged by plows. Curbs, raised sections, and parking bays also make plowing more difficult.

Spin-off Results

The pilot projects have contributed towards strengthening physical planning in the towns. In some locations the upgrading of the street was combined with replacement of utilities, resulting in a noticeable cost savings for municipalities.

Reports indicate that shopping has increased and there is a higher level of interest in new housing development in many locations.

CONCLUSION

The planning technique of “roadway segmentation,” and the development of environmentally adapted throughroads, has produced many positive results in Scandinavian small towns. Traffic speeds and accidents are down, bicycle and foot traffic has increased, people feel safer and small city environments have improved. Residents are satisfied with the changes.

Scandinavian research in traffic speeds, traffic network planning, and the environment over the last 25 years has produced valuable information and guidance which would be of great benefit in small towns in the United States. Technology transfer activities can bring this information to interested individuals and organizations, where it can be appropriately applied in communities throughout the country.

Many public works professionals have embraced the idea of traffic calming on residential streets. Residents of towns large and small are making us aware of their desires for improved traffic safety and the environment. Information from Scandinavia is a resource that can be immediately used in meeting these needs and desires.

IMPROVEMENT OF SMALL CITY HIGHWAYS
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Photocopies of all of the Scandinavian reports may be obtained from Greg Pates; see the first page of this paper.