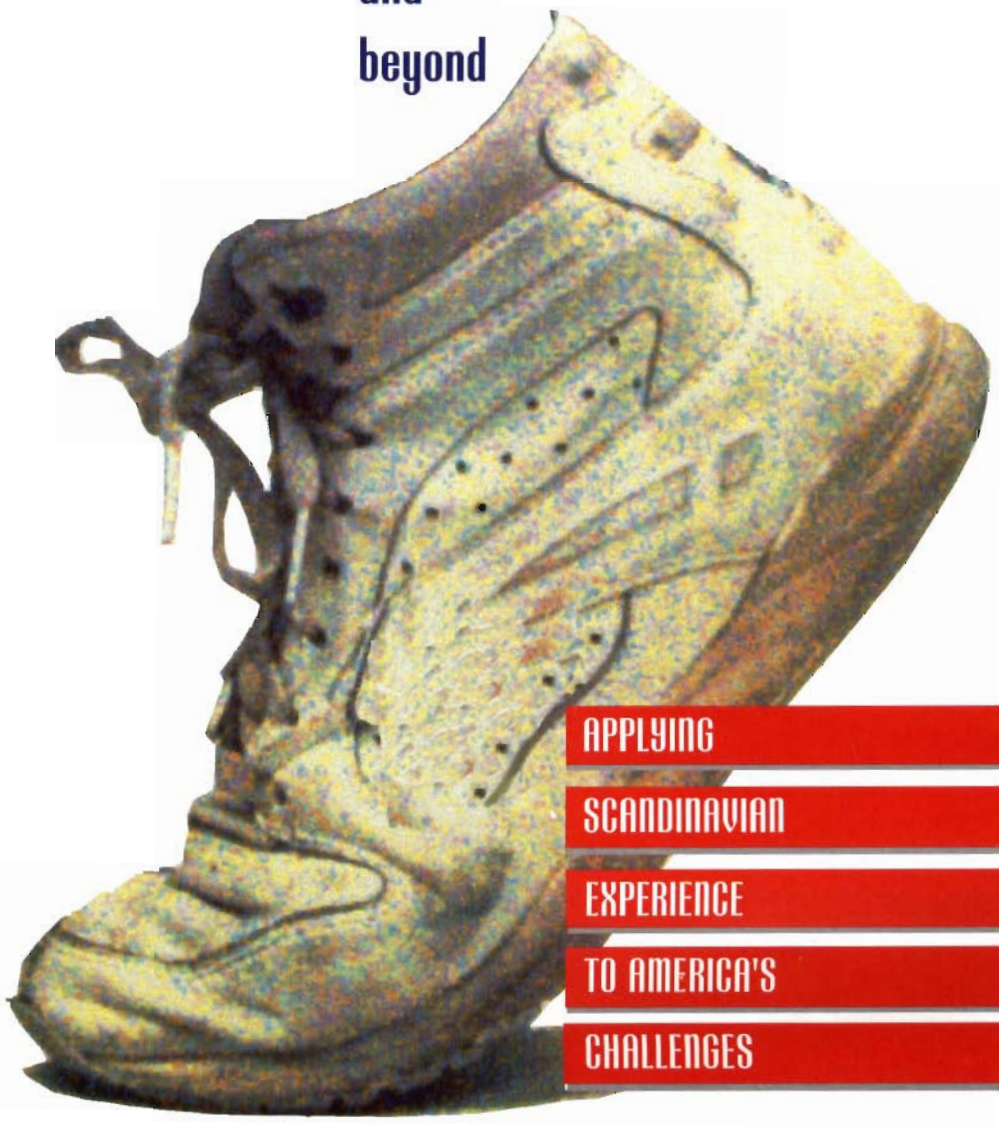
BICYCLING & WALKING in the nineties and beyond



APPLYING SCANDINAVIAN EXPERIENCE TO AMERICA'S CHALLENGES

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BICYCLING & WALKING in the nineties and beyond

APPLYING SCANDINAVIAN EXPERIENCE TO AMERICA'S CHALLENGES

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Organizations listed

DENMARK

The Danish National Road Directories
The Danish Cyclist Federation
The Danish National Railways (DSB)
Danish State Railways

NORWAY

State Railways
National Cycling Association
Public Roads Administration

SWEDEN

Swedish Cycling Federation
Swedish National Road Administration
Swedish State Railways

FINLAND

Parliamentary Traffic Committee
Ministry of Transport and Communications
Finnish National Road Administration (FinnRA)
Ministry of the Environment

Foreword

One hundred years ago, as the world prepared to enter a new century, humanity stood at the brink of a transportation revolution; bold new ideas would soon come to fruition that would change forever the way that people traveled, how they worked, even where they lived.

The creative genius of man gave birth to technologies and machines heretofore unimagined, such as faster, more efficient, and more luxurious passenger trains that could whisk people from city to city, country to country, even from one continent to another. Everyone's world seemed to be growing; trips that would previously have meant a bone-jarring week by wagon or stage now required a single overnight journey, in a comfortable seat on a train. The electric trolley car brought mobility to cities small and large, as well as feeding the growth of "streetcar suburbs" that allowed city workers to live "in the country" while commuting to work in the factories and offices within the urban center. Rural trolley lines brought commercial prosperity to small towns as well.

The greatest agent of change, however, was the automobile. First a novelty item and plaything of the wealthy, it was transformed into a possession for everyone by the advent of mass production. The country scrambled to build roads for the autos to ride upon, criss-crossing the landscape with pavement, gas stations, and shopping centers. The first seventy years of the twentieth century saw our world changed immeasurably by the automobile.

Almost forgotten in the din of internal combustion was an old friend, the bicycle. The end of the 19th century saw bicycling become a national craze as bicycle design improved; cycling clubs formed in cities and towns across the country. The popularity of cycling remained strong until mass-production made the private automobile affordable. With the arrival of the motorcar, recreational cycling was soon supplanted by leisure trips by car into the countryside. Entering the second half of the 20th century, the bicycle eventually became the transportation of school children, who put baseball cards in their spokes, and pretended to be riding a motorcycle. At the same time, the seemingly lost practice of walking as transportation faded into nothing more than the way to get from the car to the house or from the parking lot to the shopping center.

Suburban housing projects no longer provided sidewalks, and walking to the store for groceries became impossible, because the corner store was now in a mega-mall 8 miles away, out on the new bypass highway. So, we piled into the car, and drove off to join the traffic jam waiting to get on the new bypass. People stopped walking in their neighborhoods and downtowns, and we gradually withdrew into our shiny, air-conditioned cocoons.

An army, it is said, marches on its stomach; automobiles and trucks run on gasoline. It took two major disruptions in the previously plentiful supply of petroleum to make us take another look at cycling, walking, and public transit.

What we can see in these "old-but-new" modes of transportation is nothing less than a more livable environment, enhanced personal health, and a greater sense of community as we learn to get out of our single-occupant vehicles and actually start talking to each other again as we cycle to work or walk to the transit stop.

The Scandinavian countries of Denmark, Norway, Sweden, and Finland have all revived their rich cultural affinity for cycling and walking, after their own flirtation with the automobile. Cycling and walking remain a part of their lives, as indeed it will remain a part of our own. They have learned many lessons during their revival of cycling and walking, and they are more than eager to share their knowledge with the world.

The U. S. Department of Transportation has taken a leading role in the encouragement and enhancement of cycling and walking as transportation choices as we head into the nineties and beyond. In order to help address the challenges that America faces, a cooperative effort was undertaken to visit the Scandinavian countries. Their facilities, practices, and technologies in the area of non-motorized transportation were examined, as well as the interface of cycling and walking with public transit. Scandinavian officials and experts gave freely and generously of their time and talents during the visit, and without their efforts there would not have been the rich exchange that has resulted in this report, and numerous other exchanges between our peoples in the area of cycling and walking.

Now, 100 years after the start of the first revolution in transportation, we in the United States have a unique

opportunity to shape both the policies and facilities that will move us into the new century. Cycling and walking as transportation modes are growing; the time is ripe for local, State, and Federal transportation professionals and advocates to join together. The expertise contained within this report can help us to attain the vision defined in the National Bicycling and Walking Study, "a Nation of travelers with new opportunities to walk or ride a bicycle as part of their everyday life...They will like what they are doing for the community and for themselves. America will have a changed transportation system — better balanced to serve all travelers." We can work together to create a balanced transportation network that serves the needs of all Americans. This report can serve to help us get started.

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Executive Summary

The Federal Highway Administration's FHWA 2000 action plan recommended a policy of inward technology transfer in order for U. S. transportation personnel to keep abreast of new research and technologies emerging abroad. In light of the need to obtain knowledge and understanding of international transportation issues, the FHWA established an expandable program of technical visits to selected countries which had been identified as being leaders in the advancement of pedestrian and bicyclist safety.

The Minnesota Department of Transportation (Mn/DOT) has been working with the Finnish National Road Administration (FinnRA) to develop a demonstration "bicycle/pedestrian-friendly city" project in Hutchinson, Minnesota. The FHWA was invited by Mn/DOT to be a partner in the technology exchange with Finland. In order to take advantage of the work already done in Finland by Mn/DOT's representative in Finland, a representative of FHWA's Office of Highway Safety was selected to go to the Scandinavian countries (Denmark, Norway, Sweden, and Finland) with a representative of Mn/DOT. Over a 2-week period, reviews were made of innovative technologies, special physical facilities, and planning and operational practices related to bicycle and pedestrian travel. Enhancement of pedestrian and bicyclist safety was a primary focus area of the study.

The primary output of this Scandinavian activity is the expertise gained in new technologies, practices and policies and the examination of their suitability for application in Minnesota's Bike/Ped-Friendly City project, as well as in other locations within the United States. This report will serve to document the findings of the scanning effort, and describe the technologies that were acquired. Promotion of these technologies in other parts of the United States will be an ongoing Federal-State cooperative effort.

Recommendations Based Upon Study Findings

- **The construction of Cycle Centers** as observed in Copenhagen, Denmark. The provision of secure storage for bicycles is essential; ancillary services such as the sales and servicing of bicycles are also key elements in making such a Cycle Center useful to commuters as well as leisure travelers. Bicycle rental should also be made available at a Cycle Center.

- **Accommodation of cycles on public transportation** is a sure way to demonstrate a commitment to the bicycle as a partner in the overall transportation network, while at the same time encouraging cycle commuting and recreational riding. Space for bicycles should be provided on local and long-distance trains and long-distance buses

- **Functional classification and network planning of both cycle paths and pedestrian facilities** are basic planning tools for the establishment of an efficient network. The use of functional classification and network planning can ensure the orderly growth of a path system, along with providing an effective framework whereby future improvements and additions to the system may be prioritized.

- **Creation of automobile-free zones within cities and towns** in cooperation with local businesses and governments has been found to be very effective in creating vibrant commercial and cultural centers in many Scandinavian cities.

- **The Pedestrian Refuge Island** is one of the most useful features for enhancing pedestrian safety, actual and perceived, at road crossings. This low-cost item provides a protected waiting area halfway across the roadway, where walkers may wait to complete their crossing as signals, signs, markings, or traffic permit.

- **Designation and construction of "Bicycle/Pedestrian-Friendly" cities and towns** are increasingly popular facets of new towns planning and design in Scandinavia and Europe. The Hutchinson Project is an exciting opportunity to bring this idea to the United States.

- **Increase of the completeness and accuracy of accident reporting** is crucial to the reduction of bicyclist and pedestrian accidents. This is an area where immediate benefits may be reaped from any improvements gained, as the effective selection of accident reduction strategies is dependent upon accurate accident type and accident trend information

- **Utilization of Traffic Calming schemes** to reduce motor vehicle speeds within residential and commercial districts where these vehicles are still permitted. The reduction of motor vehicle speed is of prime importance in the effort to reduce accidents and to increase safety for all.


Hammerfest
Murmansk
Kiruna
Norwegian Sea
Oulu
SWEDEN
FINLAND
Trondheim
Sundsvall
Gulf of Bothnia
NORWAY
Tampere
Helsinki
Bergen
Gavle
Oslo
Tallinn
ESTONIA
Stockholm
Riga
LATVIA
Goteborg
DENMARK
Baltic Sea
LITHUANIA
Copenhagen
Vilnius
Tver
Minsk
Gdansk
Rostock
NETH
Hamburg
BYELARU

Technical Visit and Study Tour of Selected European Countries

pedestrian and bicyclist safety issues

Introduction

The Federal Highway Administration's FHWA 2000 Issue Papers identified the international trend toward globalization as a key issue affecting transportation in the next decade and beyond. The FHWA 2000 action plan recommended a policy of inward technology transfer in order for U. S. transportation personnel to keep abreast of new research and technologies emerging abroad.

The Minnesota Department of Transportation (Mn/DOT) has been working with the Finnish National Road Administration (FinnRA) to develop a demonstration "bicycle/pedestrian-friendly city" project in Hutchinson, Minnesota. This project is one example of many types of technology transfer being developed through an agreement between Mn/DOT and FinnRA.

The excellent Federal-State partnership that exists between Minnesota and FHWA is the cornerstone of the cooperative effort that has produced a joint international scanning project, using both Federal and State personnel. This joint project has been undertaken to investigate the technologies and practices in place in Scandinavia that have contributed to the extensive integration of pedestrians and bicyclists into the modal mix of their transportation systems in a safe and efficient manner. This report will present the findings of this scanning effort, together with recommendations for the applicability and implementation of successful technologies and policies.

THE HUTCHINSON PROJECT

Hutchinson • Mn/DOT • FinnRA
In cooperation with the FHWA

Bicycle & Pedestrian Friendly City

Mn/DOT and FinnRA have selected the City of Hutchinson as the demonstration city for Bike/Ped improvement technologies resulting from this scanning effort

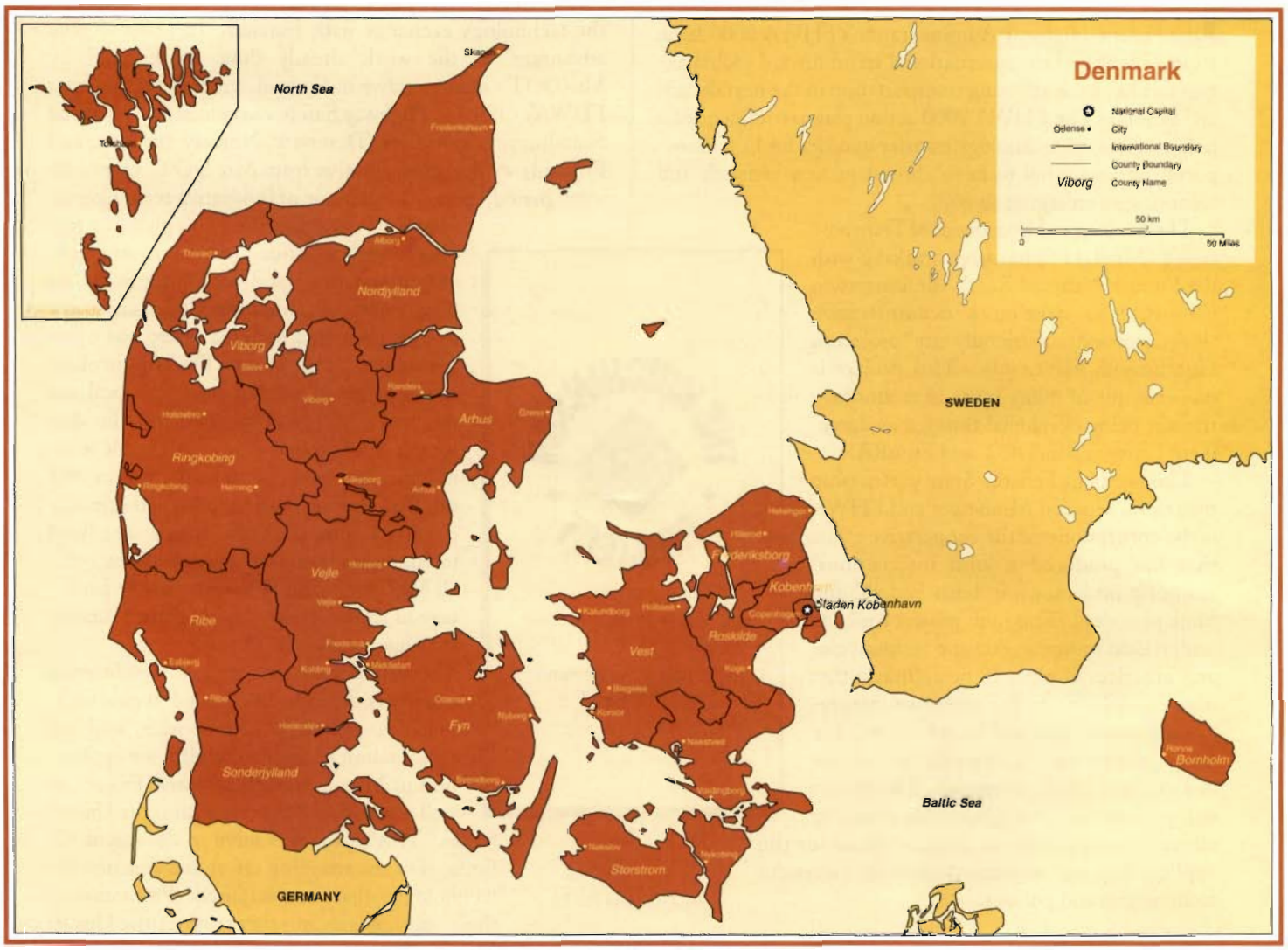
Background

In light of the need to obtain knowledge and understanding of international transportation issues, the FHWA established an expandable program of technical visits to selected countries in Scandinavia, as well as in England, Germany, and The Netherlands. These countries were identified as being leaders in the implementation of innovative technologies and practices in the advancement of pedestrian and bicyclist safety.

The FHWA was invited by Mn/DOT to be a partner in the technology exchange with Finland. In order to take advantage of the work already done in Finland by Mn/DOT's representative in Finland, a representative from FHWA's Office of Highway Safety was selected to go to the Scandinavian countries (Denmark, Norway, Sweden, and Finland) with a representative from Mn/DOT. Over a 2-week period, reviews were made of innovative technologies, special physical facilities, and planning and operational practices related to the safe accommodation and encouragement of bicycle and pedestrian travel. Enhancement of pedestrian and bicyclist safety was a primary focus of the study. The trip involved visiting selected cities to meet with local and national experts and collect data to be used for the development of implementable technologies to be used in Hutchinson, the selected demonstration bike/ped-friendly city in Minnesota. This trip was scheduled to take place in the last 2 weeks of the overall Mn/DOT-FinnRA effort to take advantage of the expertise already gained during the ongoing Mn/DOT study.

The primary output of this Scandinavian activity is the expertise gained in new technologies, practices, and policies, and the examination of their suitability for application in Minnesota's Hutchinson Project, as well as in other locations within the United States. This report will serve to document the findings of the scanning effort and describe the technologies that were acquired. Promotion of these technologies in other parts of the United States will be an ongoing Federal-State cooperative effort.

As part of the process of assimilating valuable technologies and practices from the Scandinavian experience into the United States, it is essential to examine the planning processes that brought them to fruition. This Scandinavian reconnaissance review has provided a valuable foundation for a strong Federal-State partnership in pursuit of a safer integration into the transportation system for pedestrians and bicyclists.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National Capital
Odense City
International Boundary
County Boundary
Viborg County Name
50 km
0
50 Miles
North Sea
SWEDEN
GERMANY
Baltic Sea
Nordjylland
Viborg
Arhus
Ringkobing
Vejle
Ribe
Sonderjylland
Fyn
Storstrom
Vest
Roskilde
Frederiksborg
Kobenhavn
Staden Kobenhavn
Bornholm

DENMARK

OVERVIEW

The popularity of bicycling and walking has steadily increased since 1975, when the advent of the first fuel crisis saw the re-emergence of nonmotorized modes of transportation. The initiatives advanced in Denmark as a result of the oil crisis were widely accepted at almost all levels within professional and governmental circles.

A notable example of these initiatives is the adaptation of existing railway stations to the increasing use of the bicycle which resulted from the huge disruption in the supply and cost of petroleum. These adaptations did not necessarily require major redesign or reconstruction, and often were simple "common sense" alterations. Ease of access and provision of adequate parking were two major focal points of these changes. The success of this program is well illustrated by the fine facilities in Copenhagen and Odense.

The Danish National Roads Directorate has a major 3-year traffic safety research project underway on cyclists in urban areas. New technologies involving signalized crossings, intersection priority, painted cycle lanes, and traffic circles are being investigated. The Danish Cyclist Federation (30,000 members) lobbied for improved safety and bikepath construction. Three-quarters of the Danish population own bikes—cycling is quite popular for both recreation as well as commuting.

The Danish capital city of Copenhagen (Kobenhavn in Danish) has initiated a novel program to combat the pervasive problem of bicycle theft by making unique, useful but clumsy-looking bikes available throughout the city for free. The fact that the nonstandard parts from these brightly painted and easily recognizable bikes are not interchangeable with other bikes is another discouragement to theft. Sponsors' advertisements are hung from the frame tube of these "take and ride" bikes. Eight companies put up the equivalent of $1.7 million, which was needed to get the program underway. Bicycle theft is a major problem in the city, and many people decline to purchase very expensive bicycles because of this fact. Most of the bicycles seen in the city are of a rather nondescript design, compared to the flashy "high-tech" bikes often favored by enthusiasts in the United States.

The bicycle mode share in Copenhagen is 20 percent. The bicycle mode shares in other Danish cities include 25 percent in Arhus, 22 percent in Odense, and 25 percent in Helsingor. The Danish cyclist displays excellent discipline and courtesy, as seen in the vast majority of riders who walk their bicycles when crossing the street among pedestrians or while in the many pedestrian zones in Danish cities. This cultural phenomenon is a key element to the successful integration of bicycle travel in Denmark, and it would prove very difficult to import to the United States.

Bicycle safety training in Denmark starts in the third grade, and this starts riders off on the right foot toward a lifetime of safe cycling. In a country where about 60 percent of children bike to school, the planning and implementation of safe cycle routes to schools are compulsory at the municipal level. Statistics show that most bike accidents involving children happen during leisure travel; only 10 percent of these accidents happen during travel to and from school on these planned routes.

Cycling and walking are very popular in Denmark. This view of Copenhagen shows a downtown transit station, with all kinds of people getting where they need to go—and not an auto in sight.

Current design guidelines call for a coordinated bike network with residential neighborhoods connected to the main network by local paths. Separate, adjacent bike and pedestrian paths are the rule where there is "substantial" foot and two-wheeled traffic; shared bike and pedestrian paths may be used when there are "lower" traffic volumes.

The bike and pedestrian path guidelines form 2 volumes of a 10-volume series of road standards completed in 1991. This series, *Road Standards for the Traffic Areas of Danish Towns*, was prepared by a working group composed of public- and private-sector transportation experts who were commissioned to produce a catalogue of recommended designs for the individual elements constituting the urban traffic network. The entire series emphasizes approaches that promote traffic calming and traffic safety objectives. Two volumes have been translated into English, and other volumes may be produced in English translation. The two English language publications are:

- *Road Planning in Urban Areas*
- *Speed Reducers (traffic calming)*

In the first volume, *Road Planning in Urban Areas*, Chapter 2 discusses the three main traffic networks used in the planning of the municipal traffic structure. These are the main road network of traffic roads, the public transit network, and the "main traffic network for light road users" —pedestrians and bicyclists. This light road users' traffic network, for planning purposes, has two classes—main and local paths. There are three types of facilities within these two classes, which are:

- Separate paths on separate rights-of-way,
- Cycle tracks/walking paths along roads, and
- Main routes using local roads.

Chapter 5, "Premises for Path System Planning," lays out the structure and design philosophy for the development of bicycle and pedestrian facilities. The path system is intended to serve both pedestrians and bicyclists. The guiding principles established for planning are safety and security, accessibility, directness of routes, interconnectivity, ease of navigation, pleasing aesthetics, and responsiveness to local climatic conditions such as high winds. Traffic safety is recognized as the most essential of these considerations and must prevail over any other factor when a design issue or problem arises.

It is believed that safety is best enhanced by the provision of separate paths for both foot and cycle traffic. In urban areas, however, it has been found that there may not be sufficient right-of-way to provide two separate facilities. Under this condition, the safety of light road users should be enhanced by countermeasures such as reducing adjacent motor vehicle speeds, improvements at locations where light road users cross motor vehicle traffic, as well as mitigating known conflict points, such as bus stops on roads with roadside bicycle paths.

Accessibility is the key to ensuring the usefulness of a path system. These major destinations for pedestrian traffic should be directly served by the path system:

- Schools and playgrounds,
- Shopping centers and other commercial districts,
- Transit stations, and
- Sports stadiums and other recreational facilities

An important element of accessibility is the directness of routes.

Copenhagen's Stroget is a pedestrian street where autos are excluded. It is intersected by many cross streets where cycling is permitted.

Pedestrians are extremely sensitive to being guided astray from the shortest route between two points, and paths will only be used to the extent that pedestrians feel that they represent the most efficient route available. This is most applicable to vertical movement, as stairs and long or steep ramps will discourage many pedestrians, particularly wheelchair users.

Connectivity is another central principle of effective path system planning. The individual paths that make up the larger system should be connected to each other, forming a continuous, efficient travel network for the pedestrian and the bicyclist that serves a wide range of origin and destination points. The system should also permit easy navigation by both strangers and familiar users. The structure of a path system should mirror the structure of the area it serves, thereby helping users to know intuitively where they are, based upon visible, familiar landmarks. Directional and guide signing should also be provided, as these are important for all users.

A pleasing physical appearance will increase public acceptance of the path system. Recreational users, as well as commuters, derive added benefits such as reduced stress from the regular use of an aesthetically pleasing and stimulating transportation system.

Cross streets bring bus routes and cyclists to the Straget, increasing access to the pedestrian district for everyone.

Pedestrian Accommodation in Copenhagen

The pedestrian experience in Copenhagen is rich and varied. The Stroget, a world-renowned pedestrian shopping district, runs east from Town Hall Square over a kilometer in distance to the Royal Theatre and is the world's longest continuous pedestrian precinct. Composed of five different streets, the Stroget, which first opened in 1962, is a bustling commercial and tourist center, with a lively streetlife almost 24 hours a day. This successful and vibrant "walking street" establishes walking at the center of daily activity in the life of tourists and residents alike. Bus routes intersect the Stroget at various points along its length, increasing pedestrian access and improving car-free mobility for all.

Walking is also encouraged throughout the city by an extensive transit system, which reduces the need to bring an auto into the city center. Auto traffic is nonetheless busy in this city of over one million inhabitants, and the integration of pedestrian crossin phases into the traffic signal system has been a key element in ensuring the smooth flow of both foot and wheeled traffic. The Town Hall Square, at one end of the Stroget, is a major concentration point for all traffic, with waves of pedestrians crossing H. C. Andersens Boulevard and heading for Tivoli Gardens and the commercial districts in this area.

Many of the major roads in the busy city center have multiple through and turning lanes at major intersections. An important improvement that makes pedestrian crossing safer for everyone is the pedestrian refuge island. This simple feature, largely overlooked in the United States, provides a safe haven for slower pedestrians halfway across any roadway, from wide, busy thoroughfares to quiet two-lane streets. This protected waiting area eliminates the sense of panic at not being able to get all the way across, which may cause a pedestrian to attempt a hurried and unsafe crossing. The median refuge island permits pedestrians to cross "a half at a time" during times of high traffic volumes, or in situations with short crossing phases in the traffic signal timing scheme.

A low-cost facility for use with low cycle and outo volumes is this "cycle ribbon" la painted lane adjacent to the roadway) shown in the Danish city of Odense, a favorite with cyclists.

Design of Bikeways in Denmark — Philosophy and Implementation

Within the guidelines stated above, the initiative to improve conditions for bicyclists in Denmark has centered upon the creation of coordinated and interconnected cycle tracks that serve a maximum number of common destinations. This has helped to ensure that the path system addresses the needs of the traveling public. Paths within the system may be categorized as follows:

- Cycle track and footway (separated),
- Shared path, or
- Footpath only.

One-way cycle tracks on each side of a road are the most common treatment for a facility carrying vehicular, pedestrian, and bicycle traffic. Only in situations of limited right-of-way may cycle tracks be installed at the same level as the sidewalk, separated only by a pavement marking or a contrasting texture in the pavement.

A single path for both pedestrians and bicyclists is the least desirable type of facility and should only be used when there is no alternative. The vast differential in speed and maneuverability between cycles and walkers creates a potentially hazardous situation that should be avoided if at all possible.

For cases where right-of-way is scarce, with low traffic volumes (both vehicles and cyclists), and where the vehicle speeds are low, it may be economical to use a lower-type facility such as a cycle lane separated from vehicular traffic by a pavement stripe. Another low-cost, low-volume solution used in Denmark is a called a "cycle ribbon." This is a cycle lane that has been painted a color with high contrast to the roadway pavement. Care should be taken to select a paint material that will provide sufficient skid resistance for cyclists in both wet and dry conditions.

In May of 1983, guidelines for cycle path planning were established that set forth a formula for the prioritization of new cycle path construction. Among the important considerations were accident density, as well as a concept known as system coherence, which is defined as "the opportunity represented by any project to further the overall system interconnectivity within a particular region or city."

Bicycle touring in rural Denmark is a popular pastime for city dweller and rural cyclist alike. One of the ideas behind the issuance of a national cycling map is to get the rural cyclists off trunk roadways and onto the extensive national cycle path system. This has been undertaken by making the system better known among cyclists and by creating additional access points to the system for local users.

Bikes on Transit in Copenhagen — A Success Story

Surveys in the late 1970's showed that one in 12 rail commuters in the Copenhagen area (the same ratio applied in The Netherlands) completed their commute to work by bicycle. This was accomplished either by using a second bike kept in storage at the exit rail station, or by carrying the commuter's bicycle board the train during the hours when this was permitted.

In the early 1980's the number of passengers with bicycles on the Danish National Railways (DSB) reached 700,000, which amounts to 10 percent of the population. The DSB is also currently involved in a program of building weather-protected and guarded bike storage facilities called Cykelcenters (Cycle Centers); the first two centers have gone into service at railway stations in Copenhagen. Large and plainly visible blue and white signs guide cyclists to these covered, secure centers. The Cycle Centers offer locked parking for bikes, a repair service (while the commuter is at work, the bike can be repaired during the day), and sales of accessories and new bicycles, all under one roof. The Cykelcenter at the central railway station, Kobenhavns Hovedbanegård (usually referred to as Kobenhavn H) was

observed to be quite popular and very busy.

Local trains in the Copenhagen area are called "S-trains" and their downtown stations are clearly marked at street level with a large white "S" on a distinctive red hexagonal sign. Bikes are permitted on the S-trains on any day of the week, with the exception of six hours, three in the morning and three in the evening rush hours (6:00–9:00 a.m. and 3:00 – 6:00 p.m.). These are rapid-transit type trains, with multiple doorways on both sides of each car. Inside the doors is a small, full-width standee area, just like a subway car would have. For those locations where bicycles are permitted, a large bicycle stencil is painted on both the inside and outside of those doors. Only two bicycles may occupy any such vestibule; this provided more than adequate capacity for the demand observed at both Kobenhavn H and Osterport stations.

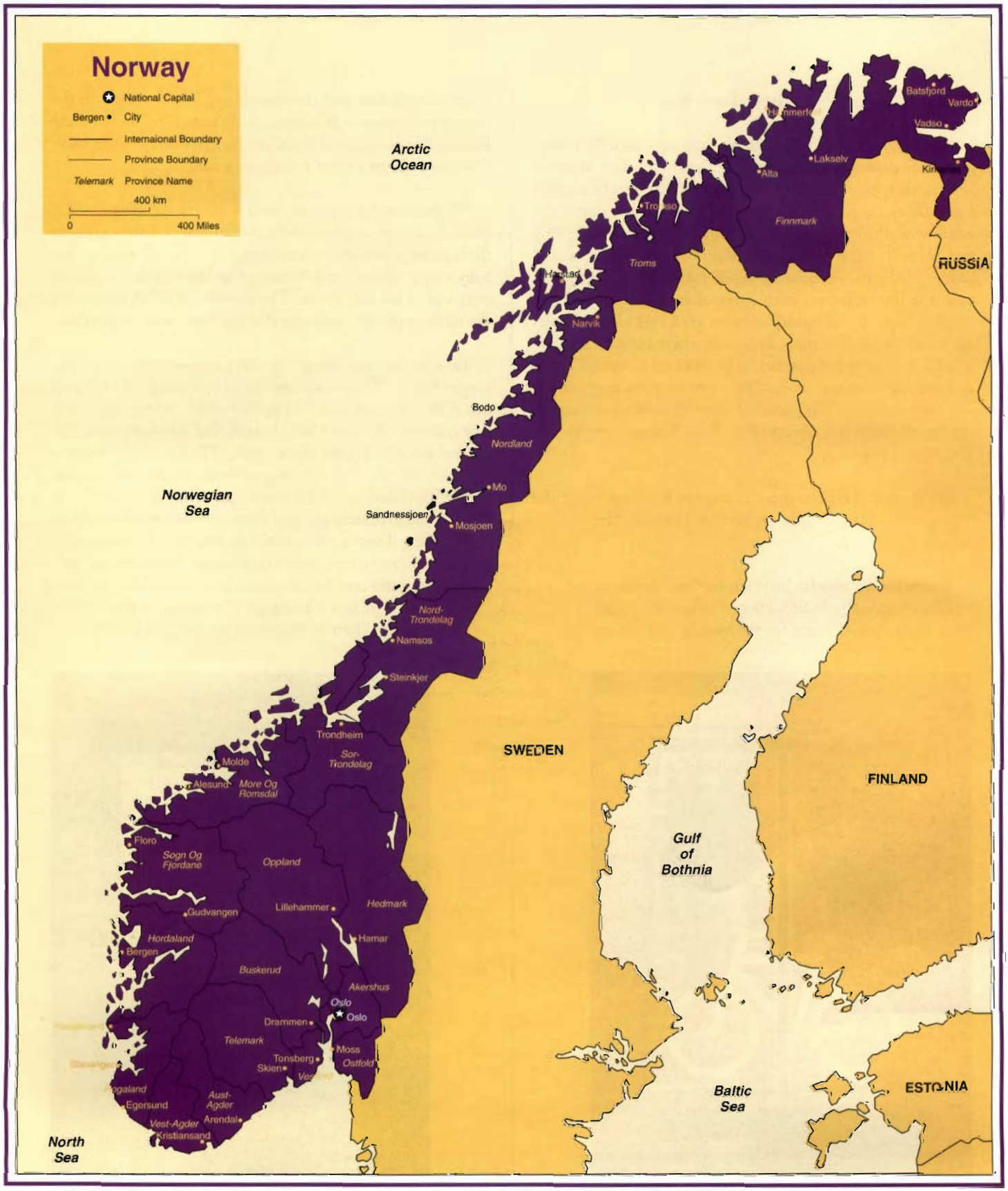
On Regional trains, there is a space for bicycles in the "flex-room," a multi-purpose section of one of the railway cars.

Trains accept regular bicycles, but not tandems, trailers, or specially-built "delivery" bikes. The rider must buy a special ticket for the bicycle in addition to the normal fare, and the rider is required to stay with the bicycle at all times. It is specifically stated in Danish State Railways' informational literature that riders take their bicycles on a train or a ferry at their own risk.

While bicycles are not carried on transit buses, these buses do accept the large perambulator-style baby carriages that are quite popular in Copenhagen. A small decal with a baby-coach symbol on it is located on the front of the bus as well next to the side doors. The number of decals represents the number of baby carriages that the bus can accommodate.

Taxicabs are also obliged to carry a passenger's bicycle in Copenhagen. This is accomplished by equipping each city cab with a bracket attached to the vehicle frame under the rear bumper. A simple bicycle rack that fits easily into this bracket is carried in the taxi's trunk. The process of mounting the bike rack and securing the bike on the rack is quite simple and takes very little extra time. Traffic is minimally inconvenienced, and bicyclists are hereby able to flag down a cab when bad weather, an equipment failure, or some other need arises. This service, with no extra cost for carrying a bike, makes cycling more attractive to a wide range of travelers and removes a potential barrier to bicycle use in this busy city.

Bicycle stencils on outside and inside doors of Danish State Railways (DSB) local "S-Tog" trains indicate those doors where bikes may be brought on board the train.


Norway
National Capital
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Alta
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Oslo
Drammen
Telemark
Moss
Ostfold
Tonsberg
Skien
Aust-Agder
Egersund
Vest-Agder
Arendal
Kristiansand

NORWAY

OVERVIEW

As was the case with many European countries that suffered physical and economic damage during World War II, Norway saw a great upswing in bicycle use after the war, and through the 1960's. Automobiles were scarce, and a special permit was required to buy a car. But as Norway entered the late 1960's, continued economic growth allowed cars to become readily available without any kind of a permit, and bicycle use declined. The private automobile became a symbol of success in Norway (as was indeed happening all over the world), and fuel was in good supply and relatively affordable. The two oil crises of the mid and late 1970's, in combination with the increased popularity of physical fitness and exercise, brought about an increase in bicycle use in the past few years as Norwegians re-evaluated their transportation priorities.

Bicycle use in today's Norway is mainly recreational in nature, and bike commuting is not as popular as in Denmark to the south. The topography in Norway is much more hilly than in Denmark, and the Norwegian climate is more severe. In Oslo, the city metro system accepts passengers with bicycles at all hours. An impressive program of recreational day trips by train to outlying cities and to the forest north of the city is also very popular. The town of Roa is a favorite destination for cyclists who take the train from Oslo and cycle back home to the city over miles of separated bikeways through the forests north of Oslo. This program is the result of negotiation by the State Railways and cycling advocates.

Two counties were visited during this review, Akershus and Oslo Counties. Akershus County is mostly rural, with a population of 421,440 (this is 9.8 percent of Norway's total). The county experienced three bicyclist and two pedestrian fatalities in 1992. With such small numbers of accidents, planning of new facilities is often affected by local pressure rather than accident analysis, with the most vocal communities often getting the attention they desire. With the expenditure of NOK 49 million out of a NOK 1.1 billion budget (NOK stands for Norwegian Kroner, the national currency), Akershus built 15 kilometers of pedestrian/bicycle paths.

Planning of new facilities occurs at the local level, based upon accident analysis. Norway has, however, found that accident frequency is often not sufficient to yield a meaningful analysis or a worthwhile prioritization of proposed improvements. The County of Akershus has responsibility for National and County roads, but not for local or private roads. Local jurisdictions purchase right-of-way and build and maintain local pedestrian/bicycle facilities. With the increase in bicycle/pedestrian accidents, the County may assume responsibility for all pedestrian/bicycle facilities, in an attempt to enhance safety.

Norway has built two "cycle towns," Sandnes and Tonsberg, and Lillehammer (host of the 1994 Winter Olympics) will be the third. These towns feature bicycle accommodations intended to maximize bicycle use for all types of trips. The success of these programs will go far to encourage more communities to undertake similar improvements. Connectivity to the national system is also essential to the success of

The Norwegian capital city of Oslo features a wide pedestrian boardwalk along the waterfront which is lined with shops, cafes and offices.

In rural Akershus county, the high-type construction and quality of materials used in this ped/bike underpass point out the importance of pedestrian and bicycle travel in Norway.

these facilities. The world attention focused upon Lillehammer during the Olympics may eventually help to further promote the "cycle town" concept, both within Norway and throughout the world.

Akershus County estimates that it would take NOK 200 million (1993 money) to fully construct a regional cycle system, which could be in place by 2005. On roads with an average annual daily traffic (AADT) of greater than 1,000, a separate facility of 3 meters in width is required; in the case of an AADT less than 1,000, a facility may be built adjacent to the travel lane, separated by a pavement stripe.

Oslo plans a system of cycle tracks leading into the downtown area, which would create a national system using local roads. This is expected to cost NOK 600 million by 2001.

Accident Experience

In 1990, Norway had 861 persons killed or injured in bicycle accidents as reported to police, while they estimate total accidents to have actually been as high as 10,000. Accidents have been shown to track bicycle sales, which have been increasing since 1990. Bicyclist accidents are felt to be more under-reported than motor vehicle accidents. An interesting facet of cycling in Norway is that while it has been found to be six times more dangerous to cycle on a sidewalk in the opposite direction to adjacent motor vehicle traffic, it is nonetheless legal to do so. Also, it should be noted that 65 percent of bicycle/car accidents were determined to be the legal fault of the motorist.

All three fatal bicycle accidents in Akershus were of the same type. Bicyclists are permitted to pass on the right in Norway; also, the painted stop bar at intersections for bicyclists is placed next to the motor vehicle stop bar. In all three cases, when a large truck attempted to make a right turn across a curbside bicycle lane, the bicyclist trying to ride straight through the intersection was struck and killed. It has been noted that the right-side mirrors of many of these large trucks are often mounted too high (relative to the height of a bicyclist) to allow the driver to see the bicyclist in his mirror. In Denmark, the bicycle stop bar is located a bit further into the intersection than the motor vehicle stop bar; in this way, the motorists can detect the presence of a bicyclist in the bike lane adjacent to them. Norway is considering adopting this practice as a mitigation to its fatal accident experience. This is a result of the Norwegian philosophy of adopting the successful and useful standards and practices of others as well as developing their own.

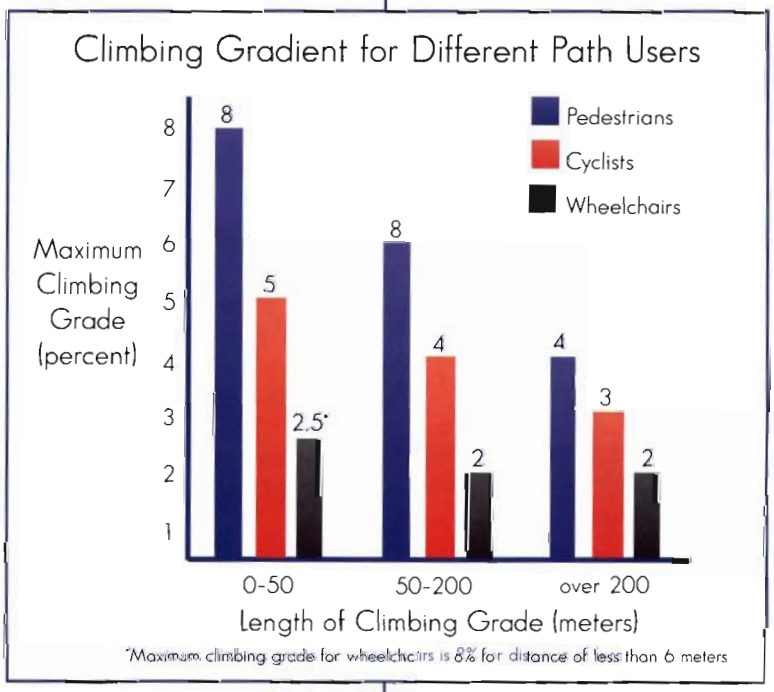
In the city of Oslo, Norway, clear pavement markings combine with a dedicated bicyclist traffic light signal to enhance safety for cyclists and motorists at on of Oslo's busy intersections

DESIGN PRINCIPLES

The publication *Road System and Road Standard*, available in English translation, outlines the design standards of the Directorate of Public Roads of the Public Roads Administration. In this publication, the Norwegian design standards classify pedestrian and bicycle facilities in three ways, as shown below. The document includes discussion of the key design elements for each classification.

- **Independent (not parallel to roadway) Ped/Bike Path in Rural Area – PB1:**

Pavement width for this high-type facility is recommended to be between 2.5 and 3 meters. Gravel shoulders of 0.25 meters in width are recommended, as are open ditches (as needed for drainage). Vertical and horizontal alignments should be kept as smooth as possible; these paths should offer efficient transportation with as little extraneous curvature and gradients as possible. The minimum radius for horizontal curvature is 15 meters, while stopping sight distances are given for flat (20 meters required) and downhill (40 meters required). Cross-slopes are to be no greater than 3 percent. Pavement width should be kept constant through underpasses, and vertical clearance at underpasses should be a minimum of 2.25 meters, with a preferred clearance of 2.75 meters. The chart on this page indicates the maximum values for climbing gradient for the different types of path users.



Requirements for sight triangles at intersections of roadways and other pedestrian/bicycle paths are discussed, along with a brief section on the use of roadway lighting on a case-by-case basis. A minimum of 0.5 meters is the recommended safety clearance (clear zone), measured from edge of pavement. Another consideration for establishment of safety clearance widths is the need to provide adequate width for maintenance vehicles and operations. The building set-back distance should be no less than 2 meters from the outer edge of shoulder (not edge of pavement).

- **Independent Ped/Bike Path in Medium Density Built-up Area:**

It is interesting to note that in some cases, in residential developments, pedestrian/bicycle paths may be used by cars solely for access to homes—with a maximum of 12 dwelling units allowed on a single ped/bike path, as long as adequate pavement width is provided. In general, for this classification, the pavement width being recommended is 3 meters, with 4 meters preferred when combined pedestrian/bicycle traffic exceeds 50 in the 15-minute peak period. A narrower pavement width may be used only where detailed analysis of traffic and maintenance aspects so indicate. The alignment standards for PB1 as outlined above also apply to PB2.

- **Pedesttian Street in Urban Area - PB3:**

This facility type generally excludes bicycle riders; cyclists must walk their bikes if a separate path or space for riders has not been provided. Adequate parking facilities for the expected volume of bicycles should be provided. The pedestrian street must be designed to allow small delivery vehicles to have access to the shops and

Oslo's ring road is complemented with a system of cyclist/pedestrian facilities, such as is shown here. Upstream of an intersection, there is a speed hump to warn cyclists of the need to slow down.

and offices that may be along the facility. This access is usually restricted to morning or off-peak hours. No further specific design criteria for this classification have been developed.

Construction of bicycle and pedestrian paths along national highways is common. Currently about 2,000 kilometers of bike paths along national highways are in place; many more facilities are in place along lesser roads. These new design guidelines separate bike/pedestrian paths from main roads; the design aim is to provide uninterrupted routes for cyclists and pedestrians that are linked to public transportation terminals, city centers, and recreational destinations in the suburbs.

Design tools for traffic calming are used in residential areas to promote cycling and walking. Roundabouts (traffic circles) are being used for traffic calming at intersections. The goal is to enhance safety for motor vehicles as well as for pedestrians and bicyclists by channelizing traffic and segregating turning movements.

Another common problem is caused by conflicts—the situation where a bus stop is on a road that has a bicycle path adjacent to the roadway. The conflict occurs when passengers are boarding or alighting from the bus. This situation places the passengers directly in the path of bicyclists, who may not be able to see them if the passengers are blocked from the cyclist's view by either the bus or the shelter. A solution that has been implemented with some success in Oslo is to route the bike path behind the bus shelter, thereby separating the passengers from the fast-moving bicyclists.

Another safety feature that helps to alert cyclists to potential hazards is the advance-marked speed hump, located just in advance of a roadway intersection. Preceded upstream of the intersection by large stenciled pavement markings saying "HUMP" (it's the same word in Norwegian), the speed hump is designed to avoid a dangerous jolt to the rider, while still being large enough to be noticed. In this way, the speed hump safely and effectively increases the alertness of bicyclists as they approach a roadway intersection.

The city of Oslo has many tunnels. A key element of new tunnel construction projects is the stipulation that improvements must be made to the surface roadway that would be bypassed by the new tunnel. The particular project that was reviewed involved extensive right-of-way acquisition as well as the construction of an elaborate cycle path facility along the surface roadway. This project featured high-quality construction, which included an elaborate granite retaining wall along the pedestrian/bicycle facility. Not only has the tunnel successfully eased congestion and rerouted through traffic out of a residential section of the city, but the improvements to the surface street have vastly improved the quality of bicycling and walking in this area.

The shared-use pedestrian/bicyclist trail that runs along

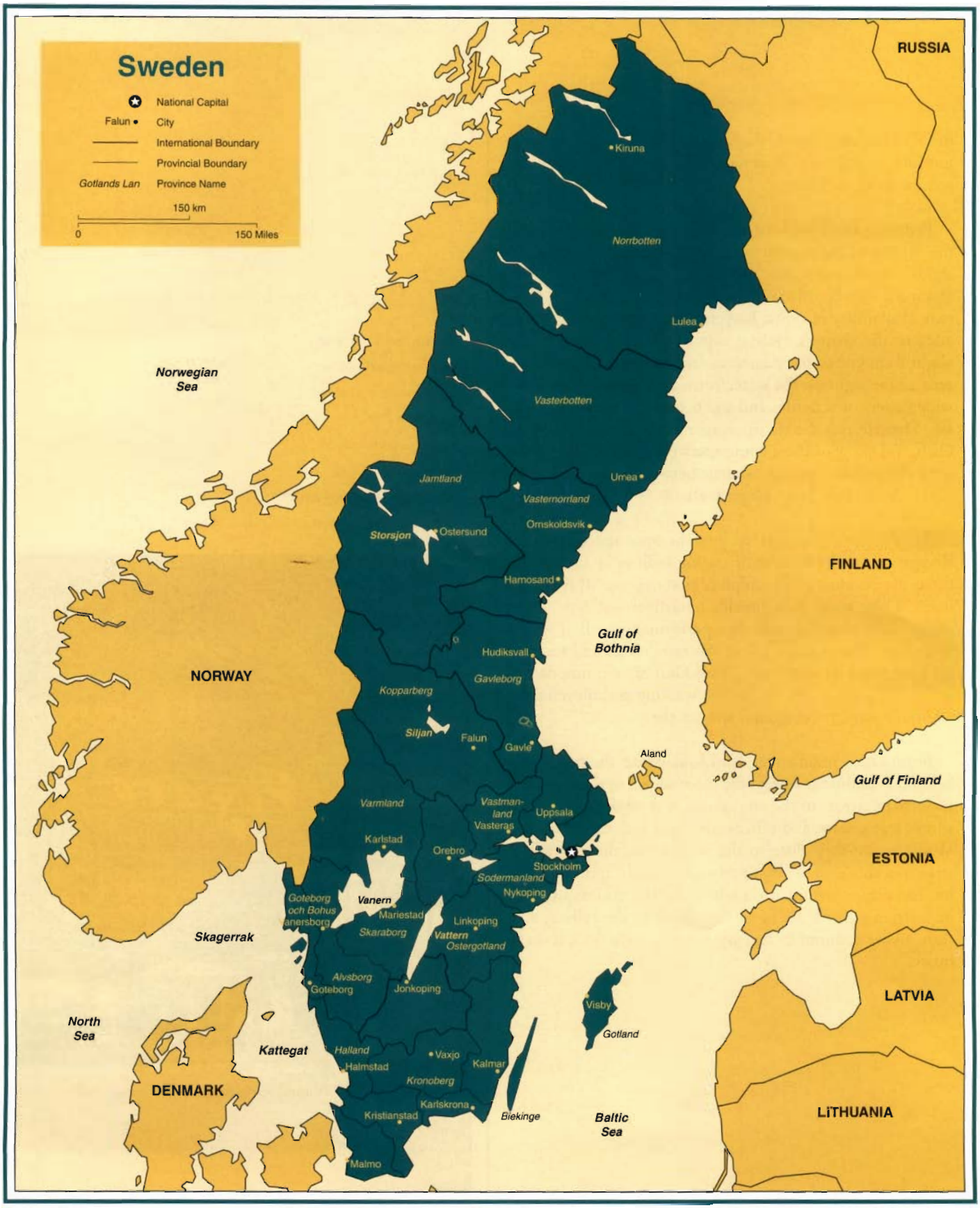
the E18 highway near Oslo carries 1,700 users in the three morning peak hours. This represents the highest measured volume in all of Norway.

Pedestrian and bicyclist accommodations are integral to the success of the waterfront Aker Brygge development of shops, offices, and restaurants. This lively center of activity features a wide boardwalk and plentiful bicycle parking. The easy availability of rental bicycles from nearby bike shops adds to the visitor's cycling experience. One may easily alight from one of the numerous ferryboats that serve Oslo, rent a bike right on the waterfront, and have access to the wide variety of activities and sights of the Norwegian capital. These ferries also transport many commuters to work in Oslo, and many of these commuters park their cycles at the ferry slip and use them to shuttle between office and ferry, never taking these bikes home at all.

Architecturally integrated into the open spaces of Aker Brygge are small plazas with seating built in by means of a three-dimensional brick sculpture that rises out of the plaza itself. These small areas provide a relatively intimate venue for outdoor concerts and other performances, all of which add to the vibrant street life of this fashionable and successful waterfront development. This kind of accommodation serves to increase and encourage walking and bicycling as enjoyable ways to get around and see the

From Oslo's main street, Karl Johansgate, the pedestrian has access to the Stortovet , the main square in the city. The pedestrian streets of the city center, with their hundreds of shops, restaurants, and offices, also feed into the Stortovet. While reasonably close to the waterfront, the pedestrian streets in this area are distinctly more urban in nature and have an active streetlife throughout the day and night. The pedestrian street leads from the square to the railway station, giving commuters an easy, relaxing walk from train to office.

Seating areas are artistically integrated into the architechture of Oslo's waterfront district. Lunchtime performances her are favorites with tourists and office workers when weather permits.


Sweden
National Capital
Falun • City
International Boundary
Provincial Boundary
Gotlands Lan Province Name
150 km
0 150 Miles
RUSSIA
Kiruna
Norrbotten
Lulea
Norwegian Sea
Vasterbotten
Jamtland
Umea
Vasternorrland
Ornskoldsvik
Storsjon
Ostersund
Hamosand
FINLAND
Gulf of Bothnia
Hudiksvall
NORWAY
Gavleborg
Kopparberg
Siljan
Falun
Gavle
Aland
Gulf of Finland
Varmland
Vastmanland
Uppsala
Vasteras
Karlstad
Orebro
Stockholm
ESTONIA
Sodermanland
Nykoping
Goteborg och Bohus lanersborg
Vanern
Mariestad
Linkoping
Skaraborg
Vattern
Ostergotland
Skagerrak
Alvsborg
Goteborg
Jonkoping
Visby
LATVIA
North Sea
Gotland
Kattegat
Halland
Vaxjo
Kalmar
Halmstad
Kronoberg
DENMARK
Karlskrona
Kristianstad
Blekinge
Baltic Sea
LITHUANIA
Malmo

Sweden

Overview

The Sverigeleden—Sweden's national bicycle route—traverses the entire country and consists of over 2,570 kilometers (1,597 miles), signed from end to end with 5,900 green signposts. Intercity bike routes cover more than 14,200 kilometers (8,823 miles). Conversion of abandoned railway lines to bicycle trails is also an indication of how popular bicycling is in Sweden. The Swedish Cycling Federation estimates that 37 percent of daily commuters use their bicycles between home and work or school in good weather. The city of Stockholm, with a regional population of 1.5 million (700,000 in the city proper), is the center of much of this activity.

In 1960, a Master Traffic Plan for the capital city of Stockholm was developed. In the 1960's, there was not much bicycle use. In fact, cycle traffic was felt to be on an irreversible decline.

From Left To Right

In 1967, a major turning point occurred in Sweden's entire transportation system when the country changed, all at once, from their former practice of driving on the left side of the road (as is still the practice in England, Scotland, and Japan), and joined the other Scandinavian countries in the more common right-hand traffic pattern. This switch was not, however, without its costs, as Stockholm was forced to abandon its tram (trolley) system in the city center, since the new traffic pattern was not thought to be compatible with established tram operation. This was combined with the attitude prevalent before the twin oil crises of the 1970's, which held that motor buses would be less expensive to operate than the electric trams. On the plus side, major extensions to Stockholm's underground T-banan subway were commenced in the late 1960's.

Around 1970, the public attitude toward the omnipresent automobile started to change; other modes of travel, including cycling and walking, became more popular. Many changes accompanied the switch from left-hand to right-hand traffic. Channelization to accommodate motor vehicle traffic was installed. Later, in the 1970's, adjustments were made to these features in order to improve bicyclist and pedestrian movement. In general, it is felt that transportation safety has been enhanced by the change from the left to the right side of the road.

Removing a Barrier

Often, in an urban setting, one of the greatest physical barriers to wider use of bicycles and other wheeled, nonmotorized vehicles is something as simple as a stairway. In Stockholm, with its many waterways, bridges, and hills, the numerous stairways have been made much more accessible to cyclists and walkers by the installation of two small ramps, as shown in the picture on the next page.

The two steel channels used to form the ramps are simply bolted to the stairs, and the wider channel is given a textured treatment to increase traction. Several landings on the stairway allow older pedestrians to use the stairway, as well as those with heavy loads such as

A simple way to remove a barrier—the narrow ramp is for bikes, bath ramps allow a baby carriage to use the stairs between a bridge and a waterfront walkway.

Experience has shown that separation of cyclist and pedestrians is essential to safety. Stockholm has provided vertical seperations between the pedestrian walk, cycle track, and the roadway

large baby carriages (very popular in Scandinavia). This provides increased direct access to much more of the city. These stairway ramps are very widely used and have proven to be an inexpensive way to remove a significant barrier to walkers and cyclists alike.

Current Accident Experience

In Stockholm, the 1980's saw an average of 25 traffic fatalities per year; in 1991, there were 1,371 injury accidents and 19 fatalities reported to police. Of the 25 fatalities per year, on average 12 were pedestrians. These reported figures are believed to be significantly lower than the actual accident experience. Transportation experts believe that 95 percent of all fatal accidents are reported to police, while 70 percent of injury accidents and only 5 to 10 percent of all "property damage only" accidents are reported. Pedestrians account for almost 45 percent of all traffic fatalities, while bicyclists are only 5 percent of the total.

Sweden as a nation averages 800 traffic fatalities per year; of these, 150 are pedestrians. Indicative of the underreporting problem discussed above is the fact that while the national total of injury accidents is 20,000, the estimated total (based partly on hospital and insurance reporting) is closer to 60,000. Accurate and complete accident data is essential to the meaningful analysis of potential hazards and the identification of accident trends and possible countermeasures.

Countermeasures In Place

With the significant representation of pedestrians in the fatality statistics as reported in Sweden, many countermeasures have been implemented to address these fatalities. Billboards carrying safety awareness messages have been erected. Acknowledged as Stockholm's most dangerous street for pedestrians, the Sveavgen has signs posted that encourage pedestrians to work together to improve safety on this busy thoroughfare. The traffic patterns on the Sveavgen have been very confusing, with numerous lane shifts that create uncertainty for motorists and pedestrians alike.

Pedestrian underpasses have not been very successful in Sweden; people seem to prefer to walk in the perceived security of the above-ground street environment. Overpasses are generally better received and are thought by the pedestrian to be safer to use. However, in Stockholm, those underpasses, which are part of T-banan subway stations, contain small shops and newsstands; the resulting commercial activity makes these underpasses seem much safer. This type of underpass, which integrates activity centers that create their own pedestrian traffic, produces a greater feeling of safety for pedestrians traveling after dark.

A major planning initiative undertaken at the local level

is to study the routes taken by children who walk or cycle to school. This includes safety analysis of sidewalks or paths as well as any road crossings used by school children. Part of the pedestrian safety program for school children utilizes 12-year-olds to assist the younger children in crossing the street. While these crossing helpers do not have the authority to stop traffic, there have been no accidents to date connected to this program.

It has been the experience in Sweden that shared-use pedestrian/bicycle paths are hazardous. In the absence of positive separation, cyclists will often ride in the pedestrian portion with potentially disastrous results.

In 1977, Stockholm enacted a new city traffic plan, which placed new restrictions on motorists, in the interest of enhancing mobility for cyclists and pedestrians. This new plan created neighborhood areas with no through vehicular traffic in an attempt to reduce vehicle speeds and increase pedestrian safety. The through traffic thereby removed from local streets has been redirected onto arterials and circumferential "ring roads" that run around city centers or districts. This combined program has accomplished a reduction in the number of accidents. In 1993, Stockholm decided to undertake another traffic plan with the intent of further enhancing pedestrian safety and increasing walking within the city

Local jurisdictions are in the practice of obtaining comments on their traffic plans from all abutting jurisdictions. This coordination function is thought to be one area where the national government may be able to give assistance and enhance safety. Local autonomy is strong in Sweden, with much authority and responsibility retained at the local level. In 1993, the Swedish National Road Administration was to assume responsibility for traffic safety; however, there is little interest in having the national government take over cycle tracks that are now kept at the local level. The dissemination of traffic safety information and educational programs will also become a national function that will support cities and towns in their safety enhancement efforts.

Design Standards and Local Autonomy in Sweden

Design standards in Sweden are far more decentralized than in the United States. Standardized designs are arrived at more by a spirit of cooperation than by coercion or pressure from a large federal government. Large cities such as Stockholm and Västerås have established their own design standards for cycle and pedestrian facilities, whereas the national government offers its assistance to small towns that might lack engineering or planning expertise at the local level.

In the example of the design of a major new bridge, engineering judgment and adjacent conditions would govern the widths of the

The railway station in Västerås is well patronized by bicycle commuters and recreational travelers, as this photo shows. The mystery is this: how do they tell their bikes apart?

This view of the Västerås station is very revealing. Notice how few cars are parked in the middle of the day. This scene is in contrast to the typical parking lot in the United States.

cycle and pedestrian facilities. The new facilities provided on this bridge would also be analyzed for their "fit" into the overall pedestrian/bicycle system plan for the city or town.

VÄSTERÅS

With over 274 kilometers (170 miles) of cycle tracks, and a 33 percent mode share for bicycles among its 120,000 inhabitants, the city of Västerås is one of the premier examples of cyclist and pedestrian accommodation in all of Sweden. As mentioned above, the decentralized nature of government's transportation planning and design means that Västerås has autonomy to plan and design its bicycle and pedestrian facilities. Freely exercising this planning autonomy, Västerås has established an extensive network of or radial main cycle paths, that are being connected by circumferential paths as indicated by data collection. Västerås' data collection is accomplished in part by means of counting loops in the pavement of the main cycle tracks.

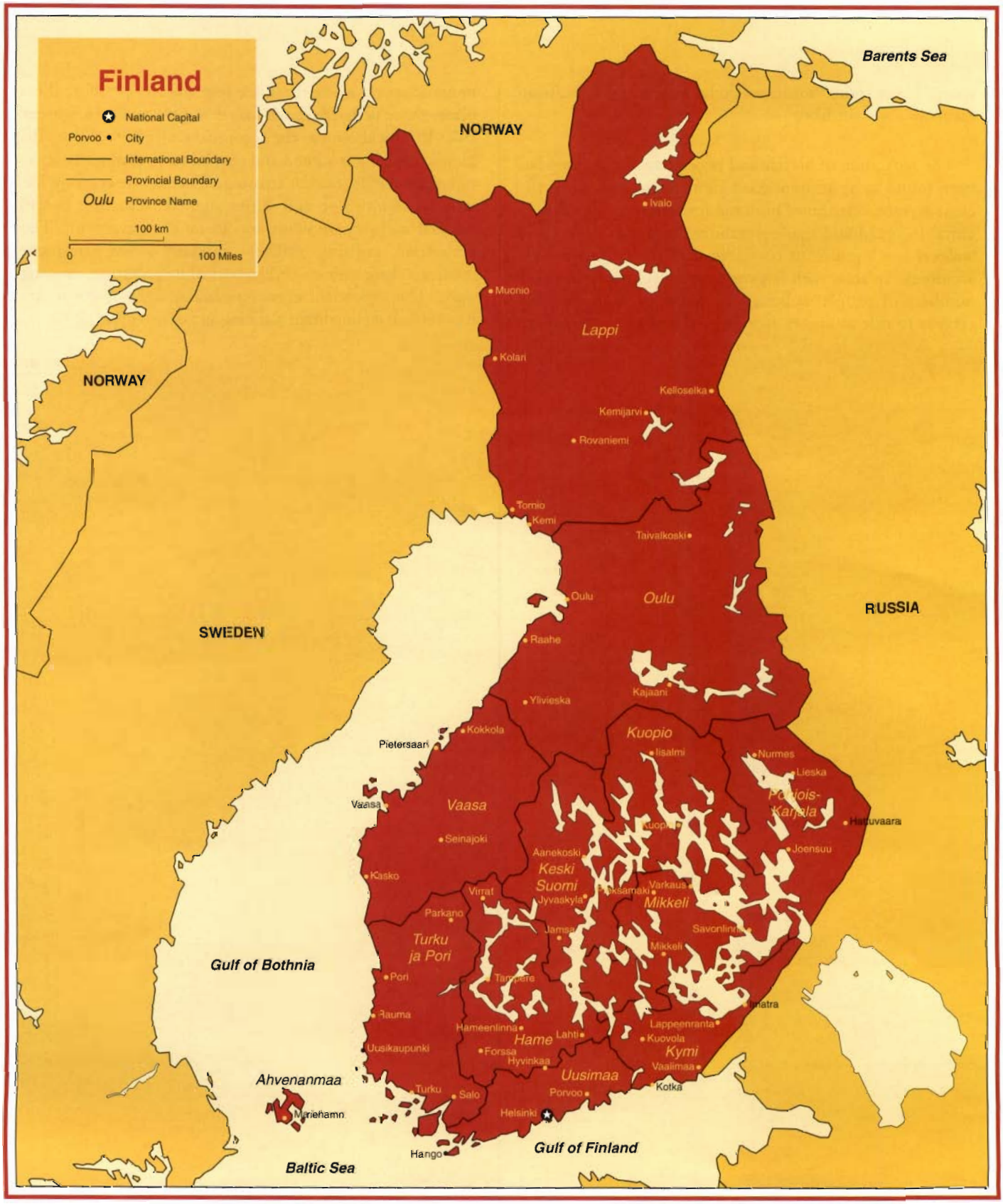
Västerås has 162 grade-separated intersections involving pedestrian/bicycle tracks and motor roads. Of these, there are 30 bridge structures and 132 tunnels or underpasses. There are also 21 signalized intersections for bicycle traffic. In fact, it has been noted by city planners that most of the motorist/cyclist collisions involve motorists from out of town; the local motorists are very aware of cyclists and are accustomed to encountering them in the transportation system. This is a good indicator of the commitment of the city and its residents to the accommodation of cyclists and pedestrians and also demonstrates the high level ofsophistication and efficiency designed into the system.

Cycle parking in the downtown area is essential to the encouragement of cycle commuting as well as leisure travel to the city's center. Between 1980 and 1990, cycle traffic into the city center doubled. Västerås has 2,000 cycle parking spaces within the ring road and anticipates adding up to 600 more in the near future.

The bicycle mode share in Uppsala (population 180,000) is 25 percent and in Malmo, Sweden's third largest city with 235,000 people, is 20 percent. Malmo has devoted considerable resources to its bicycling network and has constructed 88 underpasses and tunnels under roadways or railways for the exclusive use of bicyclists and pedestrians. The prevention of bicycle theft has also been a high priority in Malmo, with bike thefts reaching almost 25,000 per year. Lockable, circular enclosures for up to 12 bikes have been installed, which have the added benefit of sheltering bikes from rain and snow. The Swedish State Railway encourages

special "bike trains" for recreational outings, on bike/train excursions and the like.

The separation of bicycle and pedestrian traffic flows has been found to be an important element to a safe and efficient accommodation of both modes of travel. The differential in speed and maneuverability between cyclists and walkers is a significant contributor to pedestrian/bicycle accidents. In areas with large pedestrian volumes, the sheer numbers of people walking can make it impossible for cyclists to ride at higher speeds. Cyclists are more free to move at speed when there are few walkers present. This places those pedestrians who are using the facility at greater risk. In Stockholm, as the accompanying photo shows, the bicycle crossing is signed and striped to be physically separate from the pedestrian crossing. The bicycle crossing has its own round blue and white sign; the crossing is also marked with square white blocks on the pavement. The pedestrian crossing utilizes standard zebra pavement markings along with square blue and white pedestrian crossing signs. This separation, whenever available right-of-way makes it possible, is an important planning and design principle.


Finland
National Capital
Porvoo City
International Boundary
Provincial Boundary
Oulu Province Name
100 km
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Barents Sea
NORWAY
NORWAY
SWEDEN
RUSSIA
Gulf of Bothnia
Baltic Sea
Gulf of Finland
Ahvenanmaa
Ivalo
Muonio
Lappi
Kolari
Kelloselka
Kemijarvi
Rovaniemi
Tornio
Kemi
Taivalkoski
Oulu
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Vaasa
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Kasko
Aanekoski
Keski Suomi
Virrat
Jyvaskyla
Varkaus
Mikkeli
Joensuu
Hatuvaara
Parkano
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Mikkeli
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Lappeenranta
Kuovola
Kymi
Uusikaupunki
Forssa
Hyvinkaa
Vaalimaa
Uusimaa
Kotka
Turku
Salo
Porvoo
Helsinki
Mariehamn
Hango

FINLAND

The review team only spent 2 days in Finland; a more detailed report on Finnish cycle and pedestrian accommodation is being prepared by Mn/ DOT based upon its experience in Fin-land. The Parlia-mentary Traffic Committee and the Ministry of Trans-port and Com-munications have set road accident reduction objectives for Finland in the 1990's. At least one half of the targeted objectives are to be achieved through Finnish National Road Administration (FinnRA) activities. Focus areas in road safety include the improvement of safety concerning pedestrians, bicyclists, and crossing areas.

The capital city of Helsinki has an extensive network of bikeways. A report has recently been prepared that studied bike traffic in the Metropolitan Traffic System. This paper discusses possible ways to increase bike traffic in the Metropolitan area. The Ministry of Transport would like to double bike traffic by the year 2000. Railway stations should have high-quality cycle parking facilities, and the regional route network is targeted for upgrading.

ACCIDENT EXPERIENCE

Finland has experienced an increase in cycling since the 1970's, with bicycle ownership as becoming as high as 75 percent of the population. In the 1980's, cyclist accidents (1,600 per year) and fatalities (100 per year) averaged about 15 percent of all road traffic accidents and fatalities. While the number of fatalities has remained relatively constant, injury accidents have been seen to increase by 46 percent over the last decade. The prevention of these injury accidents is thought to be hampered by a lack of information on the nature and frequency of injury accidents. These accidents are often far more under-reported than are fatalities.

FinnRA is preparing city enhancement plans for Ylistaro, Rantasalmi, and Kuhmo. The plans for Rantasalmi and Kuhmo were to be implemented later. The Oulu region has recently developed a plan intended to enhance the development of its urban structure. In this plan, the city center will be developed as a pleasant urban environment. Future emphasis in the region will be on pedestrian and bicycle traffic and public transport. The light traffic network for pedestrians and bicyclists in Oulu is quite extensive; walking and bicycling accounted for 45 percent of the daily trips in Oulu in 1989.

In 1991 FinnRA, in cooperation with the MPOs, developed guidelines for light traffic along main roads in urban areas. Path networks, geometrics, crossing methods, and intersection guidelines are included in these guidelines. In 1992, the Ministry of the Environment, along with FinnRA, developed a guidebook on Traffic Safety in Land Use Planning. In addition, FinnRA is developing guidelines on Main Roads in Urban Areas (Main Roads and the Environment), and is preparing reports on transit and bike/pedestrian accommodations in large urban projects.

KERAVA

Kerava is a city of over 27,000 people located about 20 miles north of Helsinki, which has developed an enjoyable pedestrian and bicycle environment.

A noteworthy project that had only recently been opened to the public at the time of this review, was the large bicycle/pedestrian underpass constructed under the main line railroad tracks that bisect Kerava. Prior to its completion, the downtown commercial area had been separated from a significant residential section of the city. Now there is a direct link between the new Sampola business and residential area and the traditional Kauppakaari downtown that serves only pedestrians and bicyclists. Long, gently sloping approaches with attractively textured pavement lead to the underpass from both sides, creating a dramatic, public space to be enjoyed by all. Automatic doors are opened by an infrared detector when a pedestrian or bicyclist approaches the underpass. These doors remain closed at all other times, keeping wind, rain, or snow out of the

This underpass links the Västerås railway station to the city center; cyclists on the left, walkers on the right.

This bike/ped underpass connects commercial and residential areas in Kerava. This brand new facility, which runs under the railroad, is both functional and physically attractive.

underpass. Pleasingly finished with colorful surfaces on the floor as well as the walls, this facility has become very popular and has been used by between five and ten thousand cyclists and pedestrians in a single day. A central skylight, as well as ramps leading down from the center railroad platform, bring natural light to the underground space.

Traffic Calming in Kerava

Throughout Scandinavia and in many countries in Europe, the trend of traffic calming is gaining momentum. The systematic use of individual features such as speed humps, speed tables (extended speed humps), narrowings, and staggers slows motor vehicle traffic. By carefully selecting and combining these items, the planner or designer seeks to gently impede or complicate the visual and physical path of the motorist, thereby inducing a reduction in the vehicle's speed.

The speed hump is typical of a traffic calming device that is self-enforcing; that is to say, it physically prevents a vehicle from moving over it at a speed above a certain level (such as 30 kilometers per hour). Any motorist exceeding that speed over the hump will cause extreme discomfort to vehicle occupants or even damage the vehicle's suspension. The speed hump often has a contrasting surface texture or color and may be preceded by warning signs or pavement markings. The speed hump is often the only feature used in neighborhood situations where speeds are already relatively low.

Most of the speed humps in use in Kerava have been placed in areas where the prevailing speed limit is 30 kilometers per hour; separate warning signs for the humps are not used. Traffic law in Finland does not require separate warnings for humps or other traffic calming devices if the speed limit is 30 kilometers per hour or less.

Other features, such as narrowings or staggers, are not truly self-enforcing. They are usually used as speed reducers in concert with speed humps, speed tables, or even angle parking in commercial areas. Many treatments are possible; for example, plantings may be used to create an air of permanence, or simpler barricades or pavement markings may be installed in an experimental situation where relocation or total removal of the devices may be a potential outcome of the evaluation.

Traffic calming measures, such as the staggered narrowings and speed humps shown here in Kerava, Finland. These features have been effective in reducing motor vehicle speeds and enhancing safety.

Recommendations Based Upon Study Findings

pedestrian and bicyclist safety issues

The popularity of bicycling and walking as modes of transportation to and from work, shopping, and leisure activities within the Scandinavian countries has been on the increase since the oil crises of the 1970's. Prior to that time, the affection for the private automobile had grown since the end of World War II; indeed, ownership of a personal automobile was seen as a symbol of both personal and national advancement and success after the destruction and privations of the war.

The sudden, massive oil supply disruption and price increases for petroleum products in the late 1970's shook Scandinavia, and brought about a rethinking of transportation priorities and resource allocation. People rediscovered bicycling and walking, a part of their culture with which many had lost touch.

There are numerous factors that have fostered the proliferation of cycling and walking in the Scandinavian countries. Some of these, such as the greater government control of land use and development, are not readily transferrable to the United States. In addition, the extent to which cycling and walking are ingrained in the cultures of the Scandinavian countries is not possible to recreate in the car-centered, suburban sprawl of Edge Cities in the America of the Nineties.

There are, however, many reasons for optimism. The exploding popularity of recreational cycling, fueled by recent U. S. success in world cycling competition, is returning this mode of transportation to the forefront of planning and design. The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) specifically addresses the *construction of pedestrian walkways and bicycle transportation facilities (Section 1033, 1991 ISTEA),* along with the establishment of the position of State Bicycle and Pedestrian Coordinator. These landmark steps have ensured that these two important modes of transportation will become integral parts of the transportation network of the 1990's and beyond.

Numerous physical facilities observed during this Scandinavian review are recommended for consideration as part of the City of Hutchinson, Minnesota, Bicycle/Pedestrian Project, or for any other jurisdiction or organization that desires to improve its accommodation of non-motorized transportation. These recommendations are as follows:

- **Establishment of Cycle Centers** as observed in Copenhagen, Denmark, was found to enhance city cycling as an option for both locals and visitors. This type of facility should be built at a major transportation hub, such as a railway or bus station. The provision of covered, secure storage for bicycles is essential; ancillary services such as the sales and servicing of bicycles are also key elements in making such a Cycle Center useful to commuters as well as leisure travelers. Bicycle rental is also an important part of an effective Cycle Center program.

- **Accommodation of cycles on public transportation** is a sure way to demonstrate a lasting commitment to the acceptance of the bicycle as a partner in the overall transportation network, while at the same time encouraging cycle commuting and recreational riding. To the extent to which it is practical, space for bicycles should be provided on local and long-distance trains and long-distance buses. As seen in Copenhagen, the accommodation of cycles on taxicabs at the passenger's risk is

This crossing in Stockholm, Sweden, illustrates the principle of separating pedestrian and bicycle traffic wherever possible.

a relatively simple matter, given the fact that taxi service in most U. S. cities and towns is regulated by local governments. The equipment required for this service is quite simple, and its use in Copenhagen did not impede taxi service or regular traffic flow in any way.

- **Functional classification and network planning of both cycle paths and pedestrian facilities** are basic planning tools for the establishment of an efficient network. The Scandinavian countries have recognized this; the Swedish city of Västerås is an excellent example of the effectiveness of this approach. Their use of functional classification and network planning has both ensured the orderly growth of their path system, along with providing an effective framework whereby future improvements and additions to the system may be prioritized.

- **Creation of automobile-free zones within cities and towns** in cooperation with local businesses and governments has been found to be very effective in creating vibrant commercial and cultural centers in many Scandinavian cities. The best example of this was found to be Copenhagen's Stroget, a kilometer-long pedestrian street. 'This popular facility has a vibrant streetlife day and night, and is very successful commercially. The initial fears of local merchants are often quickly calmed by the increase in business after the establishment of an auto-free zone in a commercial area.

- **The Pedestrian Refuge Island** is one of the most useful features for enhancing pedestrian safety, actual and perceived, at road crossings. This low-cost item has been installed in many different forms throughout Scandinavia and Europe. It provides a protected waiting area halfway across the roadway where walkers may wait to complete their crossing as signals or traffic permit.

- **Designation and construction of "Bicycle/Pedestrian-Friendly" cities and towns** are increasingly popular in new town planning and design in Scandinavia and Europe. The Hutchinson Project is an exciting opportunity to bring this idea to the United States. All elements of land use and transportation planning and design are involved in the creation of a community in which a majority (if not all) of the local trips may be made by bicycle, walking, or on public transit (which should accommodate bicycles and complement walking trips), leaving the private automobile out of the local trip modal split as much as possible.

- **Increasing the completeness and accuracy of accident reporting** is crucial to the reduction of bicyclist and pedestrian accidents. Each of the countries visited acknowledged serious under-reporting of these accidents, particularly in the area of injury-only or property-damage-only accidents. This is an area where immediate benefits may be reaped from any improvements gained in accident reporting, as the effective selection of accident reduction strategies is dependent upon accurate data on accident types and trends.

- **Traffic Calming schemes** should be implemented to reduce motor vehicle speeds within residential and commercial districts where these vehicles are still permitted. It is widely recognized in Scandinavia and Europe that the reduction of motor vehicle speed is of prime importance in the effort to reduce accidents and to increase safety for all.

These items, as discussed in the body of this report, form a good starting point for any town, city, MPO, or State that wishes to improve its safe accommodation of pedestrian and bicycle travel, while reducing accidents and encouraging increased use of these versatile and valuable modes of transportation.

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