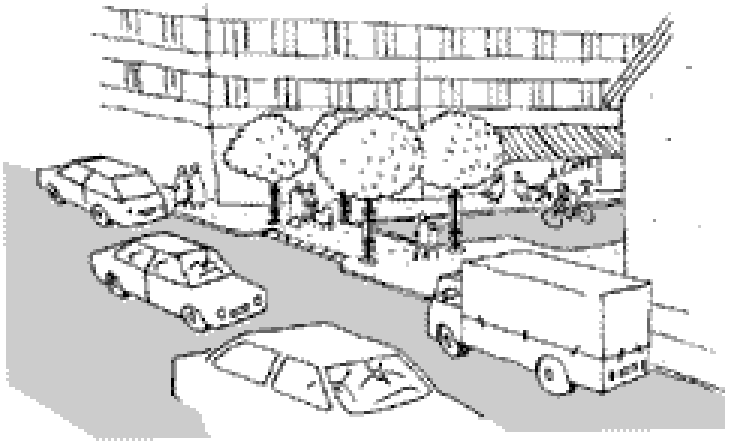
HIGHWAY DESIGN REPORT

Appendix 4

Proposed Design Principles for City Passings



June 2000

SweRoad

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1 Introduction

1.1 Purpose

The purpose of this report is to present a proposal for design principles for city passings. The objective should be to incorporate the design principles into new comprehensive Turkish design guidelines. Awaiting new guidelines, it is suggested that the proposed principles, after revision and adaptation to Turkish conditions, are used as interim guidelines for the design of city passings.

The proposal is focused on the main safety requirements. In addition, there are a number of safety details and other technical issues that must be included in the future guidelines.

1.2 Definition of city passing

City passing is a State road or provincial road passing *through or just outside* a city or a municipality in close contact with local streets and built up areas.

Roads passing outside cities or municipalities, with limited contact with local streets and built up areas, are not included in the definition of city passing in this report. Even if such roads are called city passings, they do not have the traffic and safety problems specific for roads in built-up areas. Consequently, from a safety point of view, the design conditions are more like those for normal rural roads. An example of that type of road is the bypass for road 300 at Nevşehir.

1.3 Safety Problems

The specific safety problems for city passings are mainly conflicts between through traffic and local traffic and between motor vehicles and vulnerable road users (primarily pedestrians). The demand for accessibility for the through traffic is often in opposition to accessibility and safety for local traffic and vulnerable road users. This creates conflicts mainly at intersections and pedestrian crossings. Both the number and the severity of the accidents at these locations are very much depending on the speed. The diagram below shows the risk of being killed in different types of traffic accidents depending on collision speed.

The risk of being killed in traffic accidents depending on collision speed

The graph for pedestrians is well supported by research results, while the graphs for car/car collisions are partly based on expert assessments. The diagram shows that the risk of being killed increases from about 10 percent to about 70 percent:

- for pedestrians between 30 km/h and 50 km/h,
- in side-on collisions between 50 km/h and 70 km/h,
- in head-on collisions between 70 km/h and 90 km/h.

1.4 Planning and design principles for safety

1.4.1 Basic principles

Reduction of the number of conflicts and speed
In order to reduce the risk for severe accidents, the planning and design of roads and streets in general should be made so as to minimize the number of conflicts and to make sure that the speeds do not exceed:

- 30 km/h in **pedestrian/vehicle** conflicts,
- 50 km/h in **side-on vehicle/vehicle** conflicts,
- 70 km/h in **head-on vehicle/vehicle** conflicts.

Separation of road user categories
The collision-casualty diagram shows that the risk for pedestrians to be killed is high even at speeds lower than generally accepted from an accessibility point of view. Consequently, the fundamental safety principles are that:

- vulnerable road users should be separated from motor vehicle traffic,
- at points of conflict between vulnerable road users and motor vehicle traffic, the speed should be low (preferably 30 km/h).

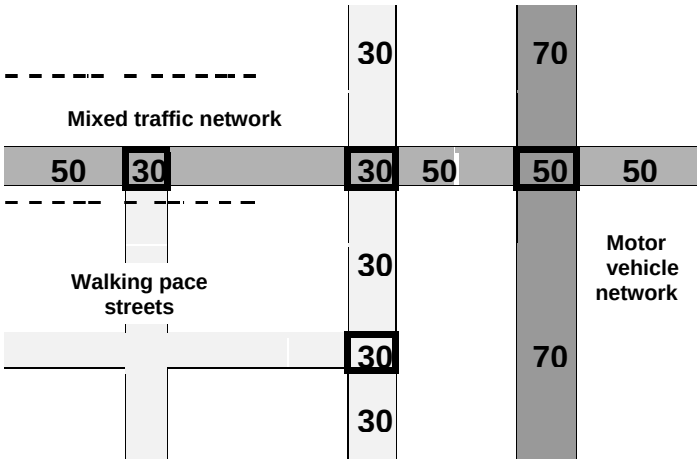
1.4.2 Planning principles

The planning and design of the urban network is a compromise between the demands of different road user categories. It is obvious that on some roads, motor vehicle traffic should be given priority, while on other roads, vulnerable road users should be given priority. For that reason the urban network should be classified into different traffic networks with separate rules for the balance between the demands of different road user categories. The following table illustrates such a classification according to Swedish planning guideline (Calm streets):

Network	Priority is given to	Design and traffic regulations adapted to	Maximum speed limit
Walking pace streets	Pedestrians	Pedestrians	30 km/h
Mixed traffic network	-"-	Pedestrians *and* motor vehicles	50 km/h
Motor vehicle network	Motor vehicles	Motor vehicles	70 km/h

Classification of urban traffic network in Swedish guidelines

The figure below gives an overview of the Swedish classification of the traffic networks.



Classification of urban traffic networks in Swedish guidelines

When there are conflicts between different demands or different road users, which is often the case in the mixed traffic network, the following priority rules should be followed:

- Safety is given priority over accessibility.
- Pedestrians are given priority over motor vehicle users.

Examples of traffic networks

Walking pace network
Amasra

Mixed traffic network
Devrek

Motor vehicle network
Mucur

1.4.3 Design principles

The control of speed is the most important design question. To ensure that the intended speed is not exceeded, the design must be based on a proper design speed and the expected traffic volume. In addition, some kind of speed control measure must often be applied. There are many different speed control measures available, such as:

- measures at intersections,
- single measures along a road section,
- general measures along a road section.

Some of the measures include extensive restrictions for the accessibility of motor vehicles and are not suitable for city passings. Measures which should be possible to use on city passings are described in chapter 2.

In addition to speed control, the design must be aimed at reducing the number and severity of conflicts. Design principles for cross-section, intersections and pedestrian crossings are presented in chapter 2.

1.5 Turkish guidelines and practices

1.5.1 Existing guidelines

The proposal is based on the following information on existing guidelines and practices concerning city passings.

There are no specific guidelines for city passings. The general design guidelines for state and provincial roads are used. Normally, city passings are designed as four lanes divided highways for 90 km/h. The traffic volume is usually not considered.

1.5.2 The need for changes

To promote safety, the following actions should be taken:

- a policy for planning and design of city passings should be established,
- design criteria for cross section, intersections, pedestrian crossings and speed control measures should be developed.

2 Proposed changes and amendments

2.1 Contents

The proposed changes and amendments include suggestions for:

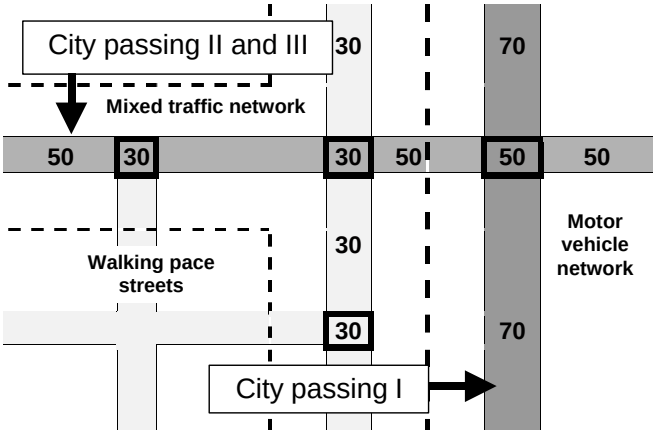
- A policy for planning and design of city passings
- Cross section
- Intersections
- Pedestrian crossings
- Speed control measures

Each suggestion is described in a separate section below.

2.2 Policy for planning and design

2.2.1 Classification of city passings

For the application of priority rules and design criteria, city passings should be classified into different groups depending on the location within the urban network. Three classes are suggested, according to the following figure:



Suggested classification of city passings

As to location and contacts with the urban network, the classes can be defined according to the following table. The difference between city passings class II and III is that in class II, but not in class III, pedestrians can be expected to use pedestrian crossings.

	City passing I	City passing II	City passing III
Network	Motor vehicle network	Mixed traffic network	
Contacts with urban streets	Only major streets	Major and minor streets	
Contacts with pedestrians	Only at intersections	At intersections and pedestrian crossings	At intersections and along sections

Suggested classes of city passings

2.2.2 Design criteria

The main design criteria are the form of separation of pedestrians from motor vehicles and the speed regulations.

City passing I

Pedestrian separation

- has separated lanes for pedestrians,
- has no at-grade pedestrian crossings between intersections.

Speed regulations
- the speed between intersections is 50 or 70 km/h,
- the speed at intersections is 50 km/h,
- physical speed control measures are not accepted.

City passing II

Pedestrian separation
- can have pedestrians close to the roadway,
- pedestrians **are expected** to use at-grade crossings between or at intersections.

Speed regulations
- the speed between intersections is 50 km/h if pedestrians are separated,
- the speed at intersections is 30 km/h,
- physical speed control measures can be accepted, but are generally not used.

City passing III

Pedestrian separation
- has always pedestrians close to the roadway,
- pedestrians **are not expected** to use at-grade crossings between or at intersections.

Speed regulations
- the speed between intersections is lower than 50 km/h, preferably 30 km/h,
- the speed at intersections is 30 km/h,
- physical speed control measures are accepted.

2.3 Cross-sections

2.3.1 General

The cross-section must be adapted to the expected traffic volume and the intended speed limit. Too wide sections will make it difficult for drivers to keep the speed limit. The need for parking/stopping and for restrictions for pedestrians must also be considered. In principle:

- the number of lanes should be decided by the traffic volume,
- the widths of lanes and shoulders etc. should be decided by the design speed.

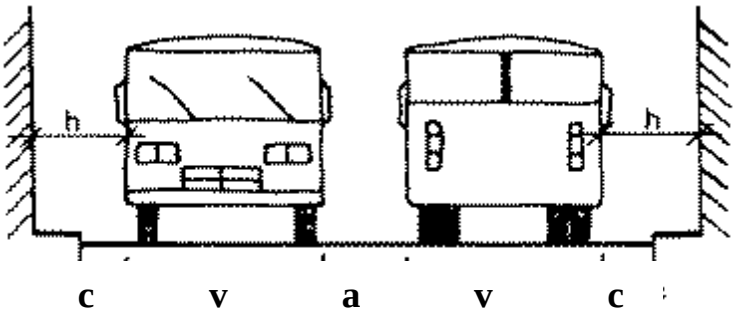
2.3.2 Needed widths

The width of traffic lanes, shoulders, pedestrian lanes, separators etc. can be determined by tables showing widths needed at different speeds. The table on the next page shows examples of values according to the Swedish guidelines.

Distances		30 km/h	50 km/h	70 km/h
h	to obstacle higher than 0,2 m	0,5	0,9	1,2
c	to curbstone	0,2	0,4	0,7
v	heavy vehicle and bus width passenger car width	2,6 1,8	2,6 1,8	2,6 1,8
a	between meeting or passing vehicles	0,7	1,0	1,3
p	between parked vehicle and curbstone	0,1	0,1	0,1

Example on vehicle widths and needed cross-section widths

For example, the width between the curbstones for a two-lane road or for one roadway of a two-lane divided road according to the figure (except for the walls) will be:

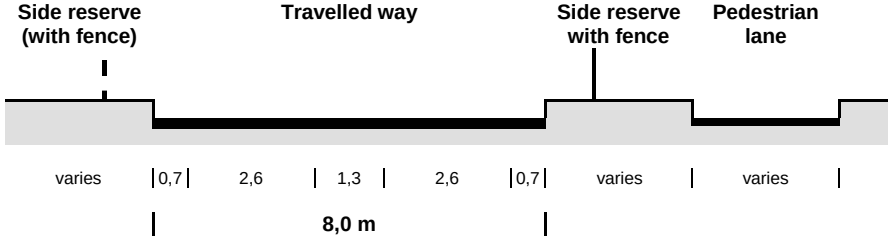


Design speed **30 km/h**: 0,2+2,6+0,7+2,6+0,2 = **6,3 m**
Design speed **50 km/h**: 0,4+2,6+1,0+2,6+0,4 = **7,0 m**
Design speed **70 km/h**: 0,7+2,6+1,3+2,6+0,7 = **7,9 m**

2.3.3 Suggested cross-sections

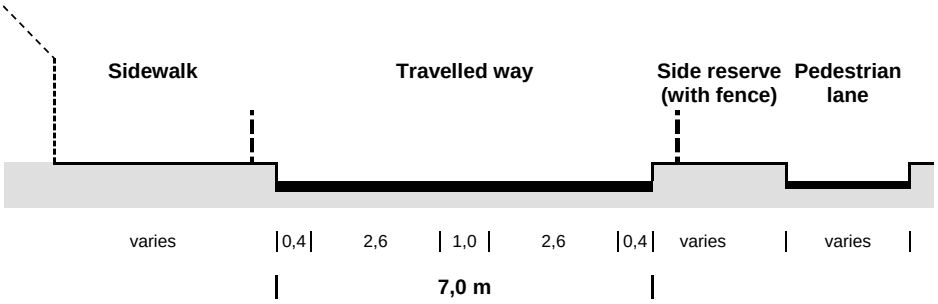
Based on the needed widths and the Swedish guidelines, the standard cross-sections below are suggested. The figures show two-lane roads, but can be applied for one direction of a four-lane divided road.

City passing I
Pedestrians are completely separated. At places where there are pedestrians close to the road, for example at houses and where there are pedestrian lanes, fences should be installed.



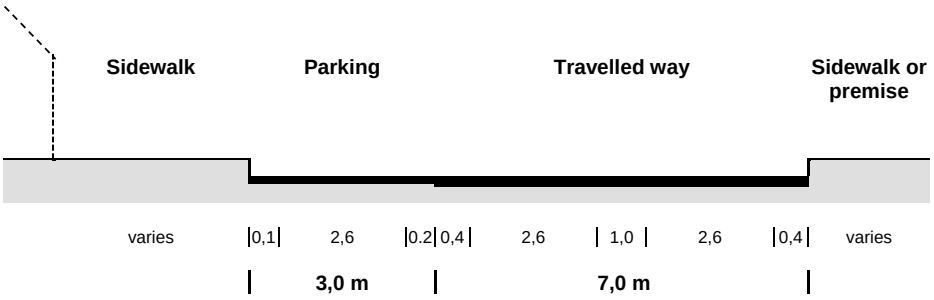
Proposed standard cross-section for city passing class I (70 km/h)

City passing II
Pedestrians are expected to use pedestrian crossings. If necessary, fences should be installed to direct the pedestrians to these crossings.



Proposed standard cross-section for city passing class II (50 km/h)

City passing III
Pedestrians can be expected to cross the road anywhere. If necessary, parking lanes can be accepted.

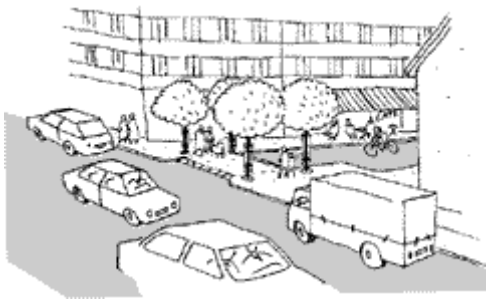


Proposed standard cross-section for city passing class III (50 km/h)

2.4 Intersections

2.4.1 Reduction of number of intersections

One way to increase the safety on city passings is to reduce the number of intersections. However, too long distances between intersections can increase the speed.



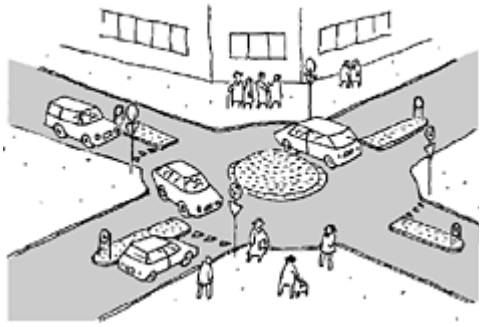
2.4.2 Replacement of 4-way intersections

Two 3-way intersections are generally safer than one 4-way intersection. Uncontrolled 4-way intersections should therefore be avoided and if possible replaced by a roundabout or split into two 3-way intersections.

2.4.3 Roundabouts

If possible, every intersection on city passings should be designed as a roundabout, because:

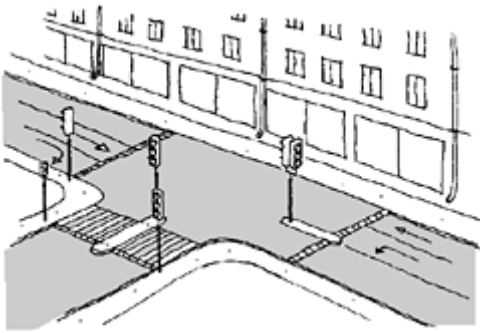
- it is the safest intersection type. Both the number and the severity of accidents are decreased.
- it reduces the speed for all traffic and allows the traffic to flow smoothly.



2.4.4 Signalized intersections

Signalized intersections can be used if:

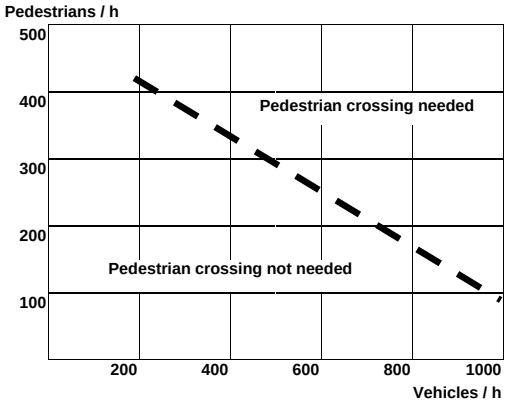
- there is a system of coordinated signalized intersections,
- the available space is too limited for a roundabout,
- the traffic volume is very high on the city passing and low on the secondary road.



2.5 Pedestrian crossings

2.5.1 Need and location

The need for pedestrian crossings is depending on the number of crossing pedestrians and the traffic volume. The following diagram shows a Swedish recommendation for when pedestrian crossings are needed.



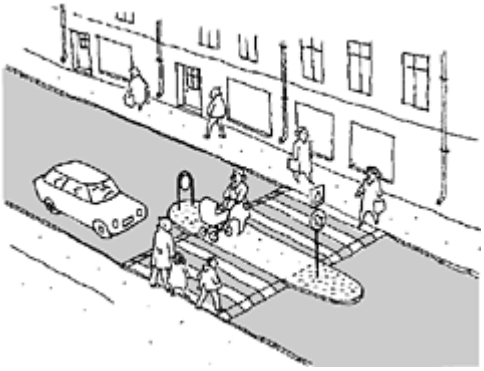
Example of a diagram to determine the need for pedestrian crossings

Pedestrian crossings should be located to places where the vehicle speed can be reduced to 30 km/h. Generally, pedestrian crossings are located at intersections.

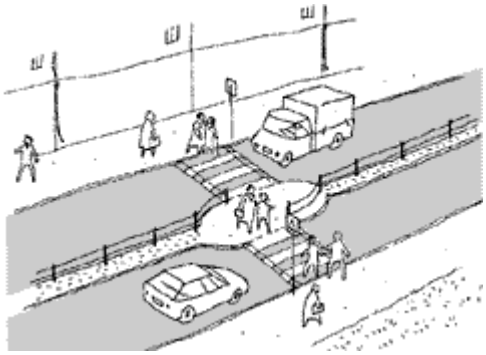
2.5.2 Design of separate pedestrian crossings

Pedestrian crossing on a 2-lane city passing
Pedestrian crossings should be constructed with a traffic island to make it possible to pass the road in stages and to make the crossing clearly visible to drivers. On roads with low traffic volumes and few heavy vehicles, the crossing can be raised over the travelled way to reduce the speed and to make it more convenient for the pedestrians.

Pedestrian crossing on a 4-lane city passing
On divided roads, pedestrian crossings can be designed with a side displacement in the median to force the pedestrians to turn and face the oncoming traffic before crossing the road.



Pedestrian crossing on a 2-lane city passing



Pedestrian crossing on a 4-lane city passing

2.5.3 Restrictions for pedestrians

On city passings class I and II, pedestrians are not expected to cross the road in other places than at intersections and special pedestrian crossings (city passing class II). To ensure this, it can be necessary to install fences or other kinds of barriers along the road or in the median on sections were pedestrians otherwise can be expected to cross the road.

2.6 Speed control

2.6.1 Preferred measures

The following measures are suggested to be regarded as preferred measures:

- Roundabouts
- Pedestrian crossings (not on city passing class I)
- Entries

Generally, the speed should be reduced at intersections and at separate pedestrian crossings. In order to make the drivers obey the local speed limit, it is important that the drivers notice that the traffic environment is changing. This can be done by marked "entries" with information signs etc. to show that the road becomes a city passing and that local traffic and pedestrians can be expected. Such entries can be combined with a roundabout or separately designed, for example, with a median traffic island and a slight side deviation of the road.

2.6.2 Possible measures

If the distance between speed reducing points with the above mentioned measures is too long, more than about 200 m at 50 km/h speed limit, speed control measures must often be applied to guarantee that speeds are not too high. Such measures should only be applied on city passings class II and III.

Reduced lane widths

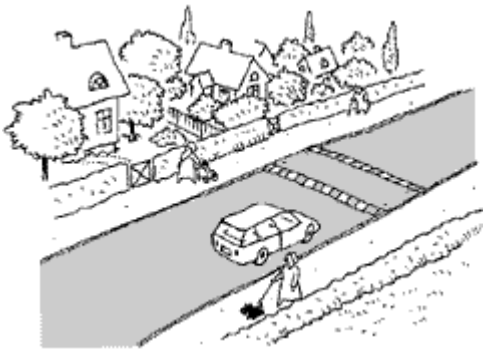
Different studies show that the average speed and the proportion of drivers exceeding the speed limit are reduced if the width of the roadway is reduced to less than 6,5 meters. However, there are also some disadvantages with narrow roads, such as decreased manoeuvre space for handling conflicts.

Speed bumps

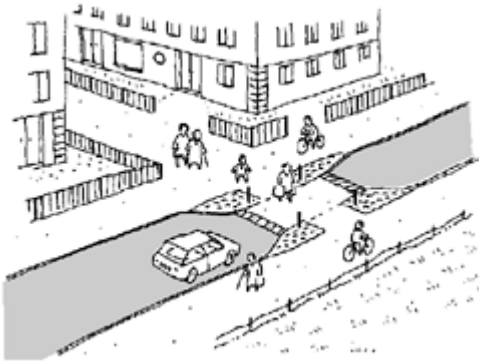
An effective way to reduce the speed along sections or at particular points is speed bumps. They can be designed to reduce the speed to 30 to 50 km/h. Speed bumps should only be used on city passings class III.

Short narrow section

On small roads with low traffic volumes (less than 5000 v/d), a narrow section along a section of 10-50 m is an effective way to slow down the traffic. The narrow section can be combined with a pedestrian passing. Short narrow sections should only be used on city passings class III.



Speed bump



Short narrow section

2.7 Parking

Generally, parking should not be allowed on city passings. If there are activities like shops at the road sides, parking can not be avoided. Parking places should be clearly marked and if possible separated from the travelled lanes. The width of the lanes should not allow "double parking".

Parking lanes should only be accepted on city passing class III.

3 Examples

3.1 Turkish examples

3.1.1 Introduction

In this chapter some examples of existing Turkish city passings are given for each of the three proposed types. The purpose is to show the differences concerning intersections and pedestrian separation even if the present design is not in accordance with the suggested design.

3.1.2 City passing I

Road 260 through Mucur and the south part of road 765 through Kırşehir are examples of city passings type I with connection only to major local streets and separated (or no) pedestrian lanes.

Road 260 through Mucur

The city passing through Mucur is about 1,5 km long and has 3 three-leg and 1 four-leg intersections.

There are no connections to minor streets and no pedestrian crossings.

Road 765 through Kırşehir, south part

The city passing through Kırşehir is totally about 10 km long and there are 9 three-leg and 2 four-leg intersections.

The south part has no connections to minor streets and no pedestrian crossings.

3.1.3 City passing II

Road 765 through Keskin and the south part of road 765 through Kırşehir are examples of city passings type II with connection to both major and local streets and pedestrians on sidewalks or shoulders.

Road 765 through Keskin

The city passing through Keskin is about 2 km long and has only 3 three-leg intersections.

There is no median separator and the road has connections to both major and minor local streets. There are no marked pedestrian crossings.

Road 765 through Kırşehir, south part

The city passing through Kırşehir is totally about 10 km long and there are 9 three-leg and 2 four-leg intersections.

The north part passes the city center. There are 4 marked at-grade pedestrian crossings, one of which in a signalized intersection, and one is a pedestrian overpass (bridge).

3.1.4 City passing III

Examples of city passings type I through city centers with parking, shops and pedestrian crossing are from Kaymaklı, Acıgöl and Göreme.

Road 765 through Kaymaklı

Road 300 through Acıgöl

Provincial road 50-08 through Göreme

Although this is a small road and a small municipality, it is a typical example of a city passing III. It passes right through the center and has the character of a “city street” with shops, parking and partly side-walks.

It is about 1,5 km long and has four lanes and street lighting. There are 2 three-leg and 2 four-leg intersections, a few small access roads and three marked pedestrian crossings.

3.2 Swedish examples

3.2.1 Introduction

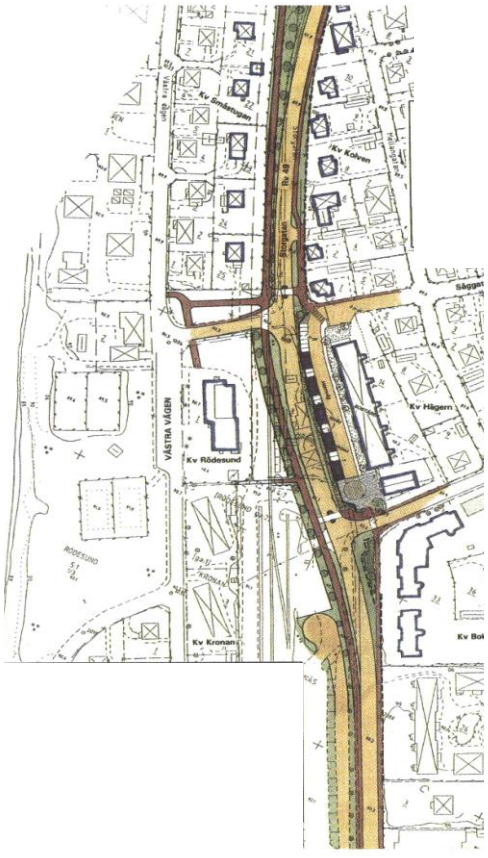
To illustrate how the proposed design of the three classes of city passings could be designed, one Swedish example of each class is briefly described.

3.2.2 City passing I

National road 49 through Karlsborg

Road 49 is a main national road with about 7 000 v/d, of which about 1 200 v/d are through traffic. The percentage of heavy vehicles is around 10 percent. The city of Karlsborg has about 5 000 inhabitants. The city is surrounded by big lakes and a bypass should be very expensive and attract only a small part of the traffic on the existing through road. Consequently, the existing road has been upgraded and traffic safety measures have been implemented.

The part through the suburbs is designed as a city passing type I.



Plan showing the connection with local roads (two three-leg intersections) and the separated pedestrian system (brown lines)

Pedestrian crossing located close to a three-leg intersection

Cross-section showing separated pedestrian lane (left) and fence between the road and a residential area (right).

3.2.3 City passing II

Regional road F131 through Tranås

Road F131 is a regional road from the countryside to Tranås, a city with about 15 000 inhabitants. The road is mainly used for traffic between the suburb it passes and the city center. The traffic volume varies from around 1 000 v/d to about 3 000 v/d with less than 5 percent heavy vehicles.

The road has been upgraded to create safe connections for pedestrians and bicycles and to improve the environment (reduce traffic noise and air pollution).

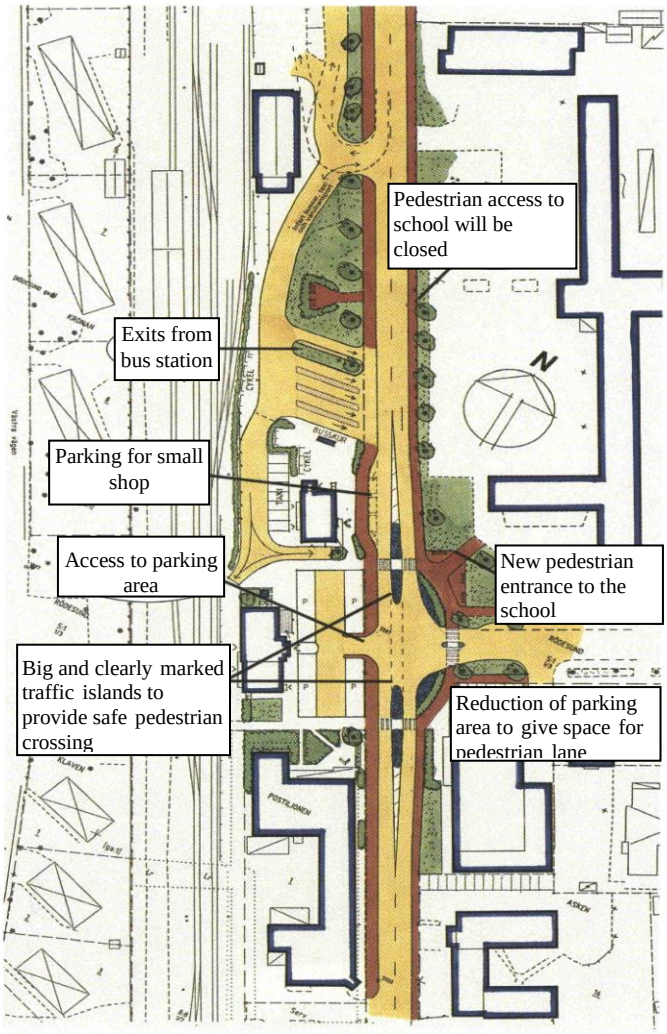
Plan showing the connection with local roads (three three-leg intersections) and the pedestrian system with sidewalks (brown lines) and two crossings (at the yellow islands)

Cross-section showing the narrow roadway and separated pedestrian/bicycle lanes

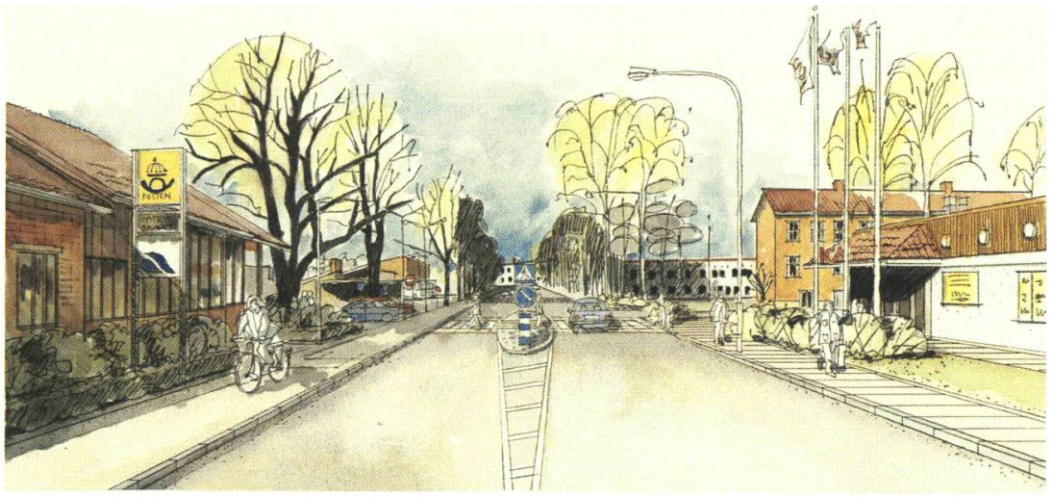
3.2.4 City passing III

National road 49 through Karlsborg

For general description see “City passing I”
The part through the city center is designed as a city passing type III.



Plan showing the coordination between through road, local streets and parking for motor vehicles and sidewalks and crossings for pedestrian



Cross-section between the post office (left) and a supermarket (right)