Handbook for
SAFE DESIGN


Ontwerp
VEILIGE OMGEVING

Handbook for

SAFE DESIGN


ontwerpen voor een
VEILIGE OMGEVING


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VEILIG ONTWERP

FOREWORD

The Safe Environment Design programme aims to invite designers and external safety experts and inspire them to collaborate with each other from an early stage in the design process. This will help make the Netherlands safer. Safe Environment Design developed seven icons with design principles that urban planners and architects can use. These cover both small and large measures in spatial design that ensure greater safety for inhabitants and users.

The icons inspired urban planners Marnix Scholman and Thomas van Wanrooij to expand upon them in word and image. Jos van Mierlo from Omgevingsdienst Midden en West Brabant (Environmental Services Central and West Brabant) and Metha de Heer from Veiligheidsregio Midden West en Brabant (Safety Region Central and West Brabant) arranged for safety experts to provide the content. The outcome is a practical handbook that complements our December 2014 publication, 'Designing for a safe environment'.

Look, read and become inspired to design a safe environment.
www.ontwerpveiligeomgeving.nl

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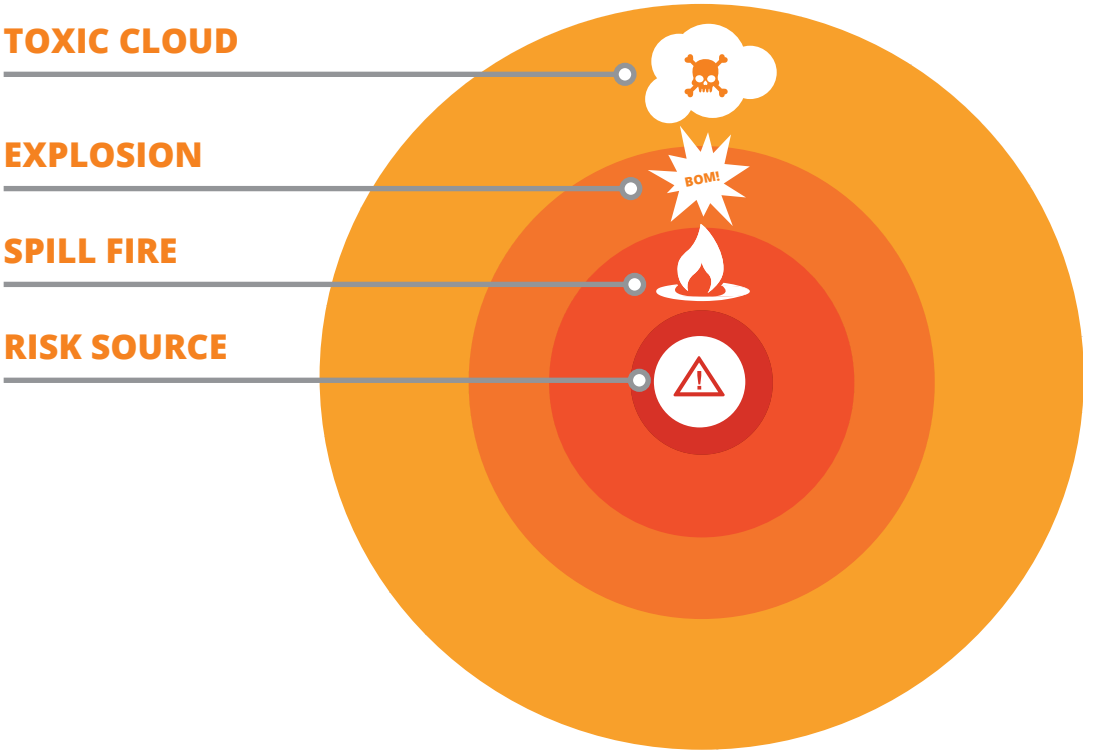

TOXIC CLOUD
EXPLOSION
SPILL FIRE
RISK SOURCE
BOM!

INTRODUCTION

Designing for a safe environment has long been one of the tasks of the Dutch urban planner. We built fortifications to defend us against enemies and dikes for the battle against water. The gunpowder disaster in Leiden in 1807 made it painfully clear that danger didn't come only from enemy armies and rising water. Dangerous materials are also an important risk source.

Designing in the vicinity of dangerous materials is a challenge. A risk source is an establishment where dangerous materials are present or the area associated with the transport of dangerous goods by road, rail, water and pipelines. Depending on the type of dangerous material, disasters can involve accident scenarios such as fire, explosion or a toxic cloud. A fire limits itself to a few dozen metres from the risk source. When an LPG tanker explodes, the impacted area can amount to hundreds of metres. A toxic cloud can extend for kilometres.

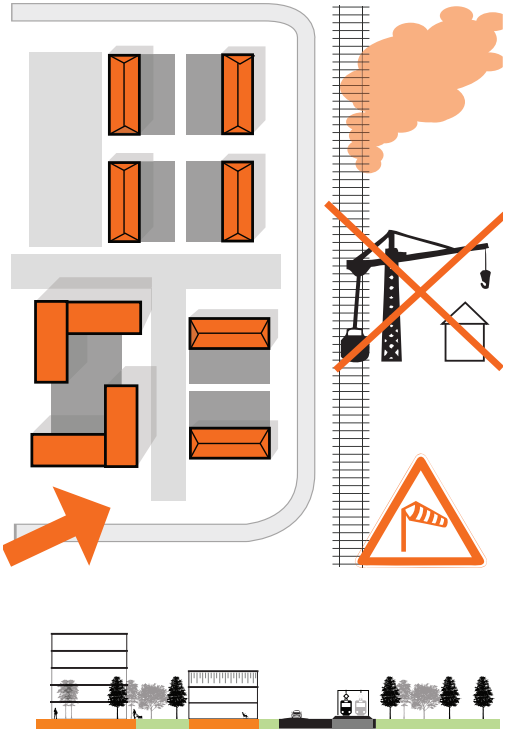
The actual effect of an accident is dependent on the layout of the area surrounding the risk source, among other things. If there are no people present within the impact zone, then there will be no casualties. If people are present, they must be able to leave or take cover safely and in time. Emergency services must be able to reach the risk source. By converting the icons from the book into urban planning principles, this handbook clarifies how to make the area surrounding the risk source as safe as possible. The risk source in this book is still a railroad transporting dangerous materials. Of course, the design principles are also valid for other risk sources, such as an establishment where dangerous materials are present.

Depending upon the incident, people may either need to escape the source (fire) or close their windows and doors and stay inside (toxic cloud). Clear information is vital.


NEPTUNA
POLITIE

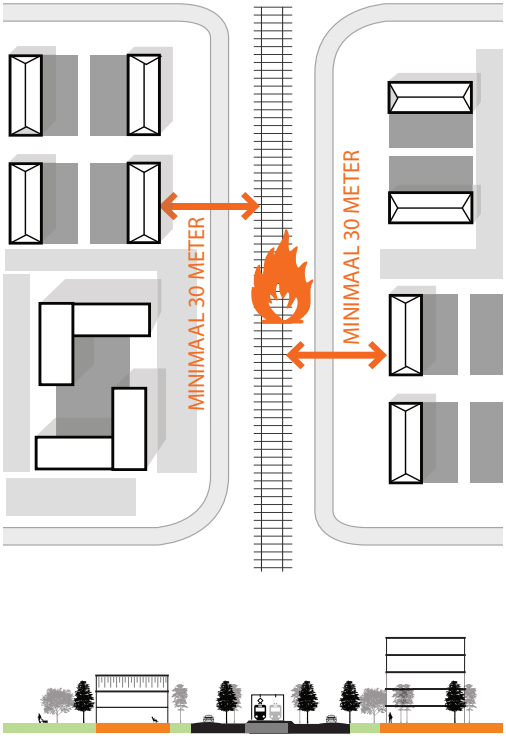
1. TAKE WIND DIRECTION INTO ACCOUNT WHEN THERE IS A TOXIC CLOUD

In the Netherlands, the prevailing wind comes from the south-west. When a toxic cloud is released during a disaster, it moves in a north-easterly direction in response to the prevailing wind. This is important for the design of buildings. This means, for example, that construction takes place mainly to the west of a risk source in order to reduce the effects of potential toxic clouds. Because a toxic cloud can travel for many kilometres, it is impossible to completely prevent their effect. However, taking the prevailing wind direction around risk sources into account can help to limit the damage.



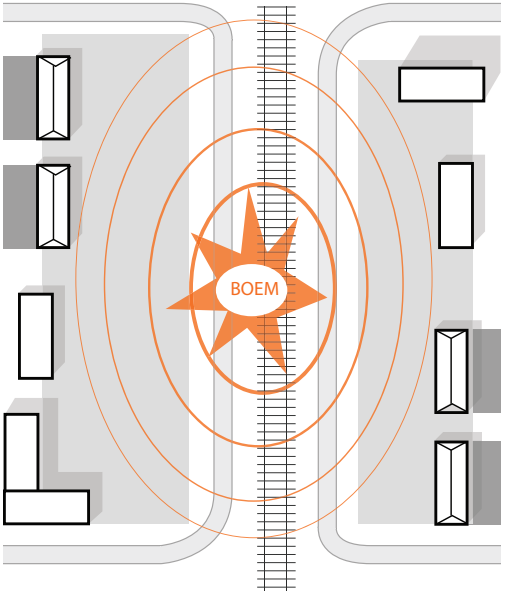
2. TAKING ACCOUNT OF FIRE

A fire limits itself to a few dozen metres from the risk source. It has therefore been noted in legislation and regulations that the effects of an accident involving flammable liquids must be taken into account along roads and railroads and other potential risk sources where flammable liquids are present. An accident might release flammable liquids from a tanker or tank wagon that then ignite and spread. This is known as a spill fire. A spill fire can claim victims in a zone up to 30 metres from the risk source. Construction within this zone is therefore not recommended, as the fire can spread to buildings. It is still possible for the zone to have a function, for example as park, recreation area or sports ground.



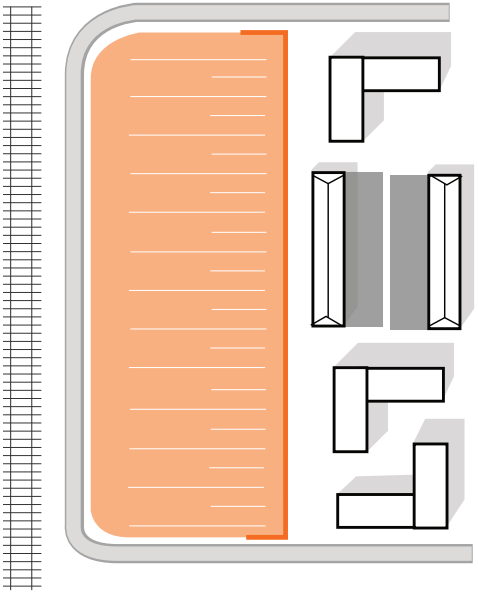
3. TAKING ACCOUNT OF AN EXPLOSION

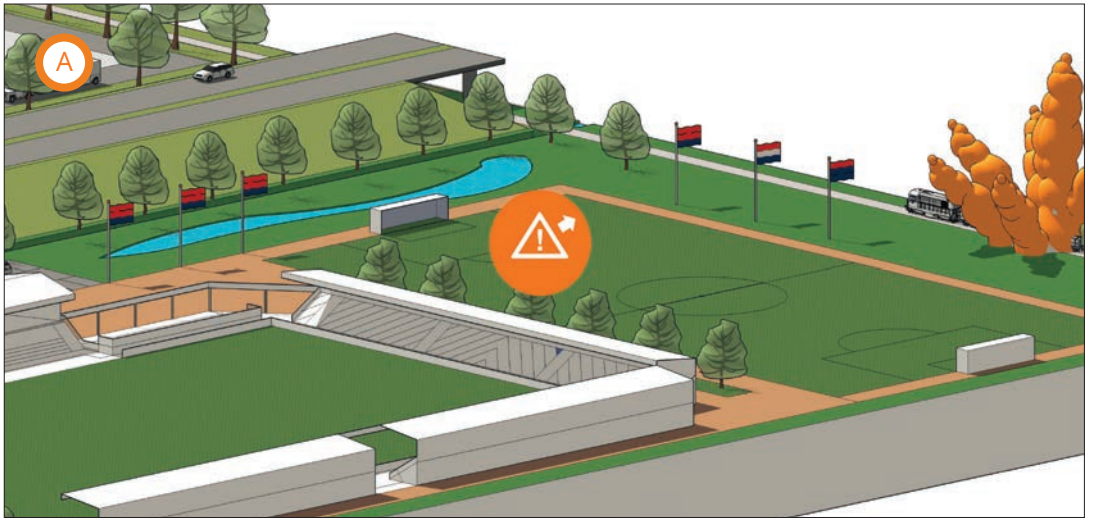
The area affected by an explosion can amount to hundreds of metres. It is therefore necessary to have sufficient space around risk sources in order to avoid serious consequences from explosions. The further buildings are from the risk source, the better. There should also be an obstacle-free area between the source and any buildings. Buildings should be a reasonable distance apart and should not form a wall. Trees planted in the explosion zone act as shock absorbers. It is preferable to plant the trees in clusters rather than rows. Naturally, they should be sturdy trees.



4. CREATE A HEIGHT DIFFERENCE AT THE SOURCE.

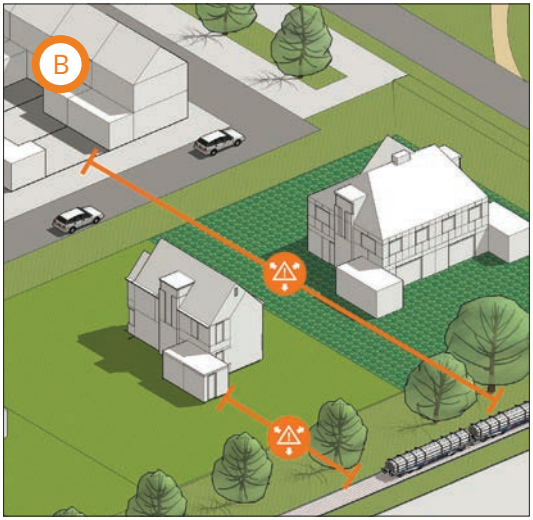
A height difference helps against the spread of a spill fire. Burning fluids seek the lowest point, so this lowest point should be at the risk source. A park that slopes downwards from a residential area can help prevent a fire spreading towards dwellings.





The schematic development of the different areas should seek to maintain sufficient distance from the risk source. The further they are from the centre, the greater the distance from the railroad and the broader the street profiles.

Open out the axonometric drawing in the back of the book.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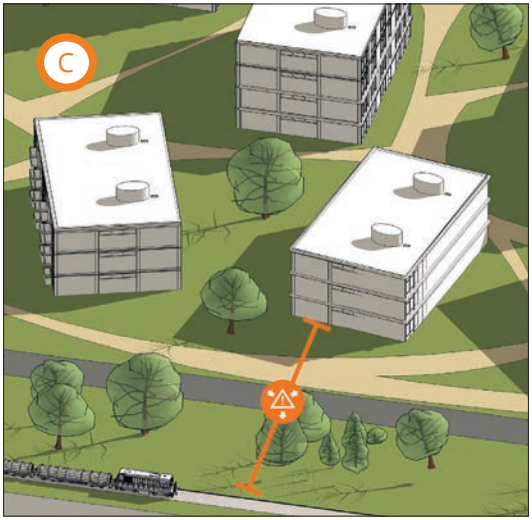
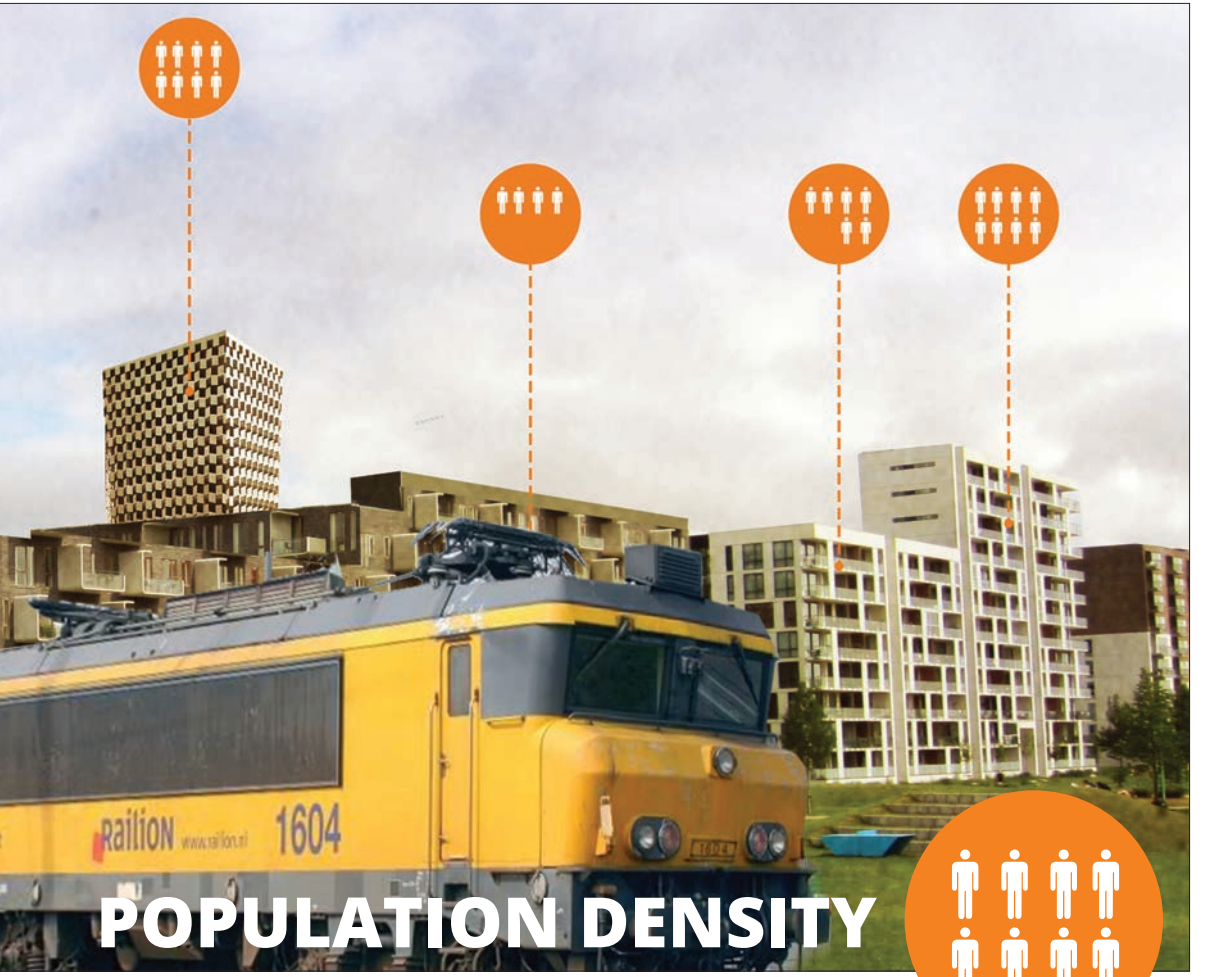

C

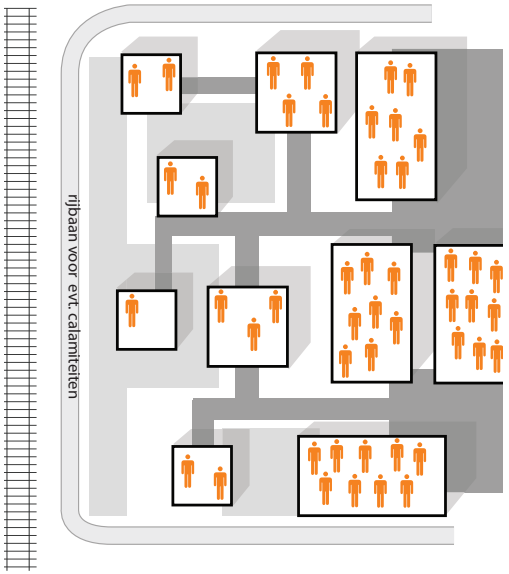
The population density decreases towards the risk source.



POPULATION DENSITY

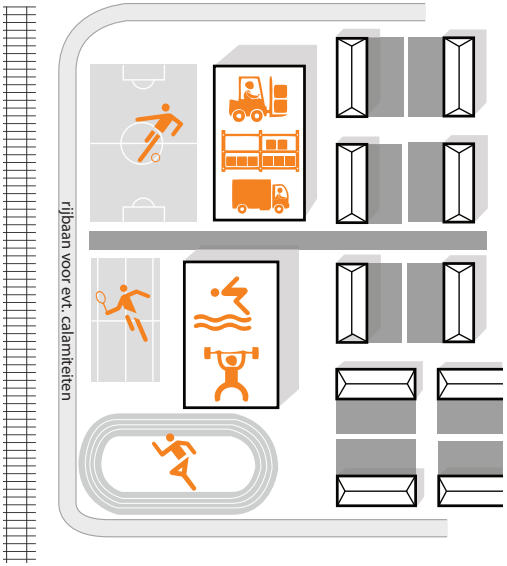
1. THE CLOSER TO THE RAILWAY LINE, THE LOWER THE POPULATION DENSITY

In order to limit the number of victims of a potential disaster, the designer can ensure that there is a lower population density close to the risk source. The fewer people there are close to the risk source, the fewer victims there will be. There are several ways of accomplishing this. This design principle assumes that there are fewer buildings close to the risk source. The greater the distance from the risk source, the greater the number of buildings and people.



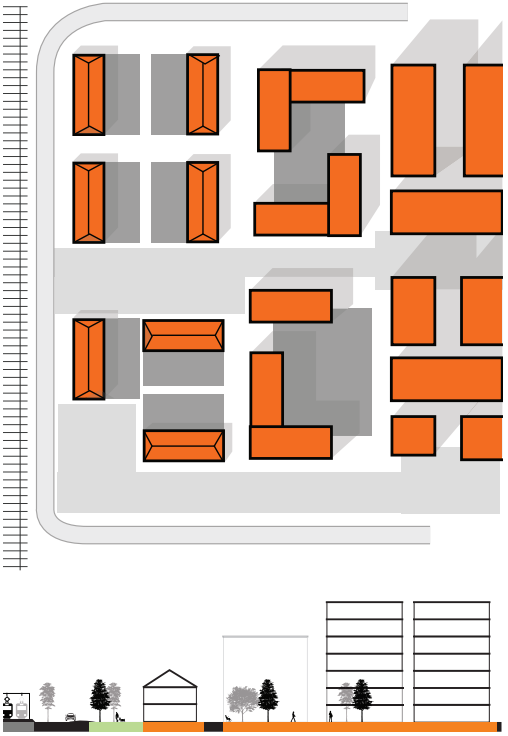
2. PLACE LONG-TERM FEATURES FURTHER FROM THE RISK SOURCE

Features that ensure people are close to a risk source less often and for shorter periods help to make a place safer. For example, a sporting facility instead of housing. At sporting facilities, the indoor sports are further removed from the risk source than the sports fields. Labour-intensive companies can also be located closer to the risk source. Housing is located further away from the risk source.



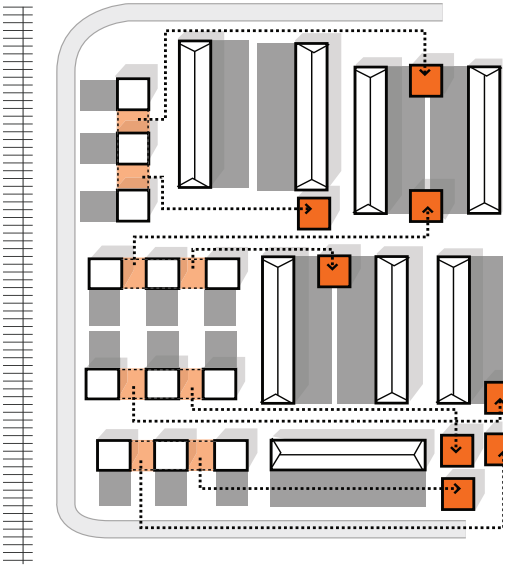
3. DISTRIBUTION OF HOUSING TYPOLOGIES

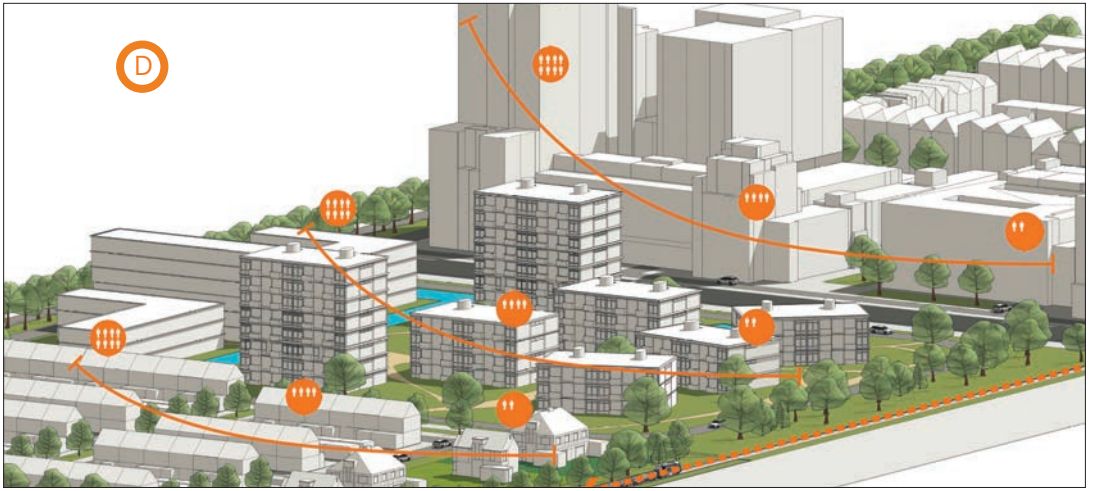
One way of limiting the number of casualties due to a disaster is to take account of the housing typology. The closer to the risk source, the fewer residents there should be. This means placing lower density residences close to the risk source, for example free-standing houses or semi-detached houses, patio homes or terrace houses. The further from the risk source housing is located, the higher the population density can be. The residential typology can therefore continue to grow accordingly. The higher the building density (Ground Space Index), the greater the distance from the risk source.



4. DEALING WITH GROWTH AND SHRINKAGE

Towns and villages grow in terms of the number of inhabitants, but can also shrink demographically. In addition, many areas in the Netherlands are experiencing a strong trend towards a greying society. If fewer dwellings are needed, then let this shrinkage take place especially in the vicinity of risk sources. This will help to improve safety.

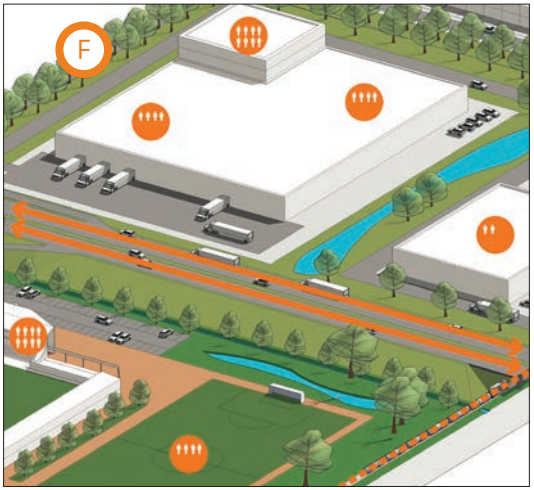




The district has located a recreation park near the risk source. This park serves as a buffer between the risk source and housing. The distance from the buildings to the risk source decreases the closer one gets to the old town centre.

Open out the axonometric drawing in the back of the book.


E

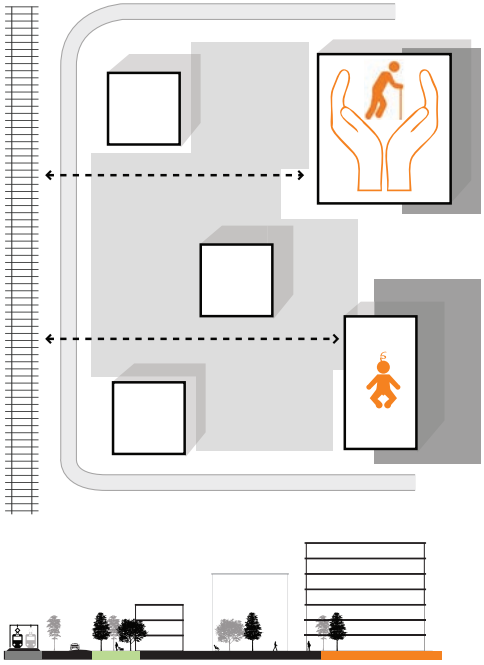

F

Facilities for vulnerable groups are located at a distance from the risk source.


VULNERABLE GROUPS
Zorgcentrum
Gevangenis

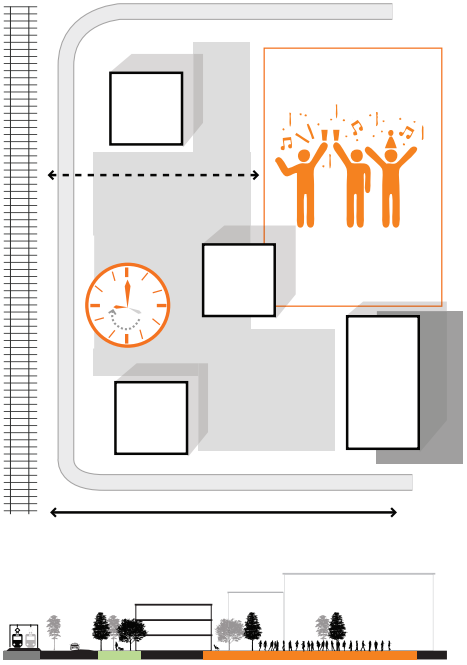
1. VULNERABLE PEOPLE AT A DISTANCE FROM THE RISK SOURCE

The elderly, young children and people who cannot independently save themselves in an emergency should always live, work or attend school at a distance from risk sources. This has consequences for the location of health care centres, child care facilities, primary schools or seniors' complexes. The aim is to observe a distance of no less than 200 metres.



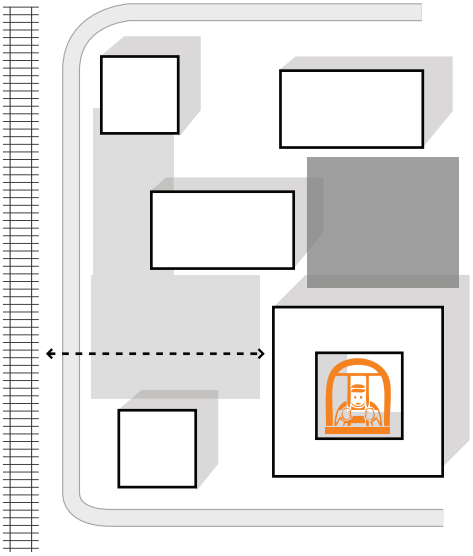
2. GATHERINGS WITH LARGE NUMBERS OF ATTENDEES AT A DISTANCE FROM THE RISK SOURCE.

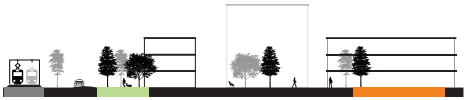
Areas for festivals, exhibitions, camping and other gatherings where large groups of people come together for longer periods of time cannot be located close to the risk source. The aim is to observe a distance of no less than 200 metres. A brief gathering, such as a demonstration, is possible near the risk source.



3. PENAL INSTITUTIONS AT A DISTANCE FROM RISK SOURCE

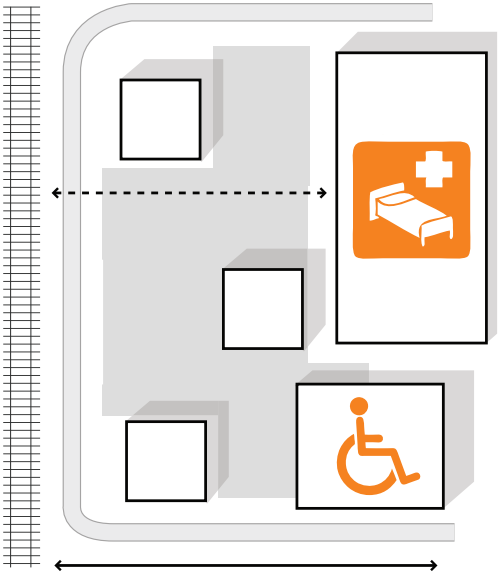
A group of vulnerable people that is sometimes forgotten are the inhabitants (and visitors and personnel) of penal institutions. This group of people should also be located away from the risk source. There should therefore also be a great distance between penal institutions and risk sources. The aim is to observe a distance of no less than 200 metres.

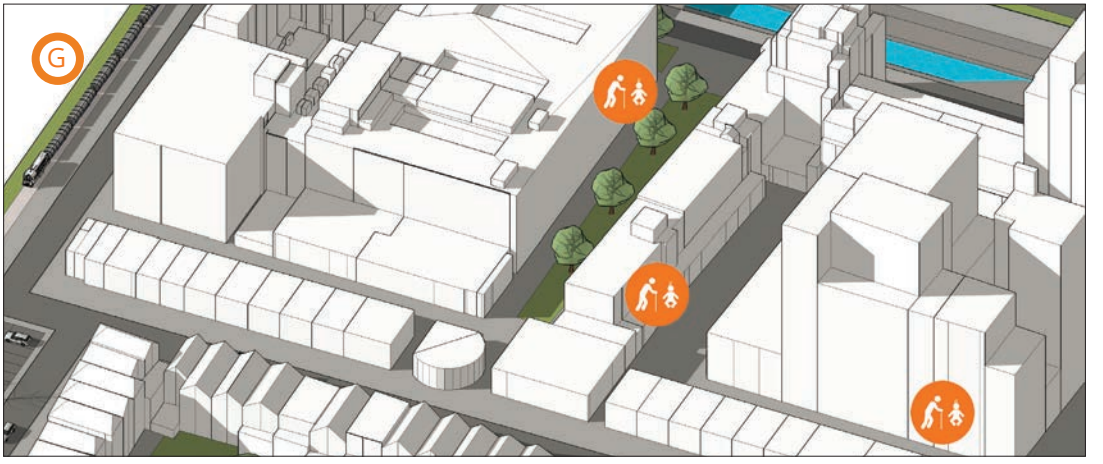




4. HOSPITALS AND FACILITIES FOR THE DISABLED AT A DISTANCE FROM RISK SOURCE

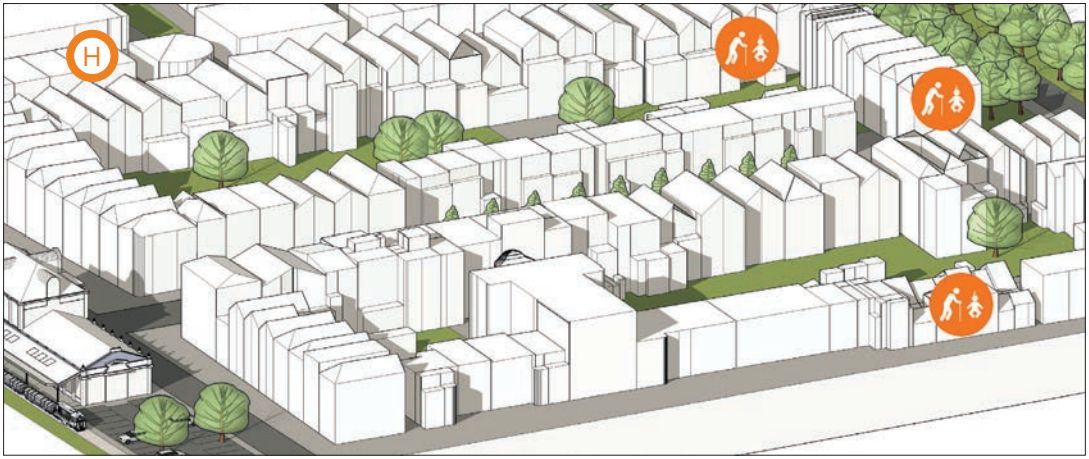
Hospitals are complexes accommodating many vulnerable people. For hospitals and other complexes housing people with a physical or mental disability, the aim is to observe a distance of no less than 200 metres.



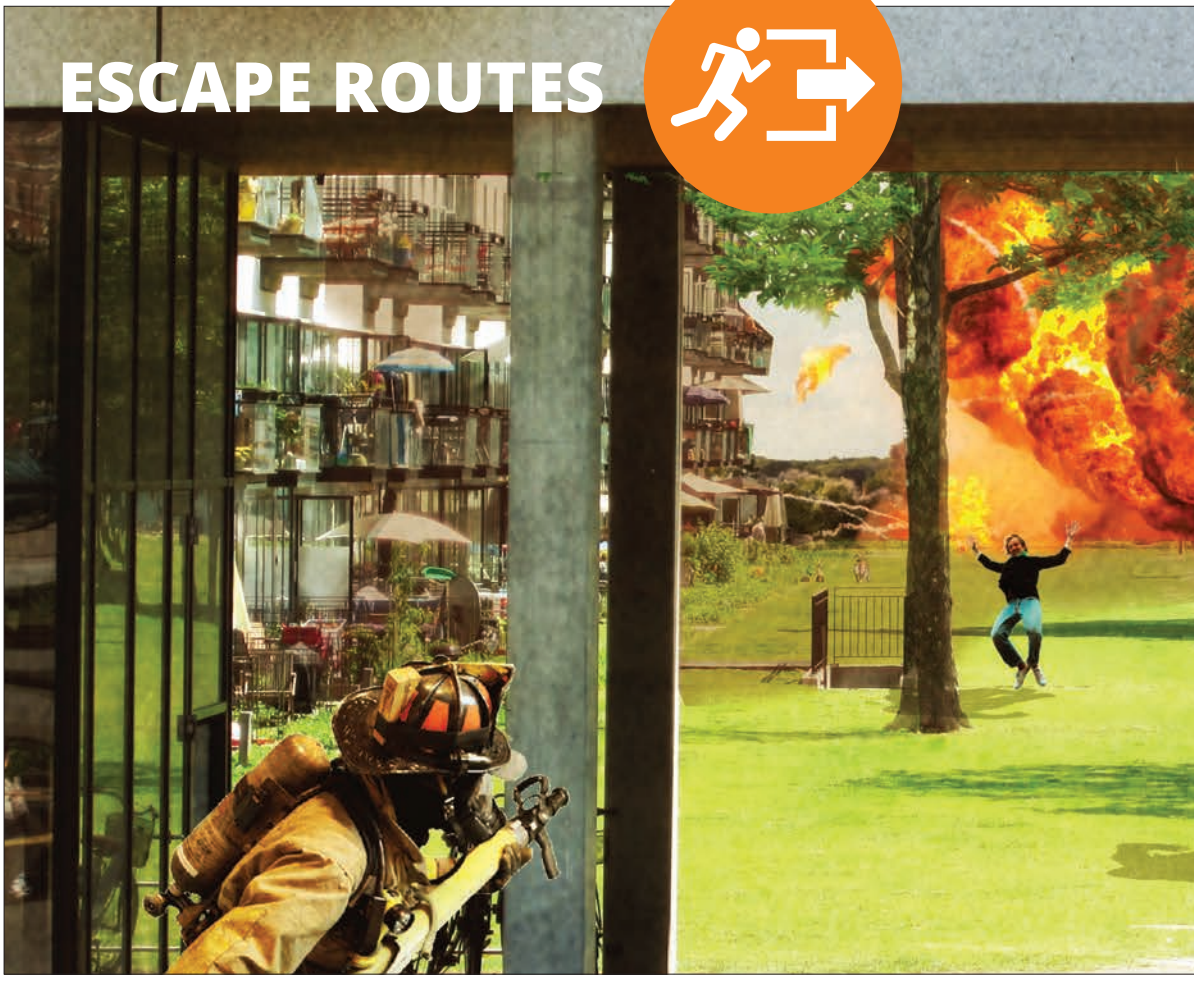


Vulnerable groups stay at a distance from the risk source with buildings as a buffer. There is also a good and fast route to a relatively safe place. These routes are always set out in such a manner that they lead away from the source of the disaster.

Open out the axonometric drawing in the back of the book.



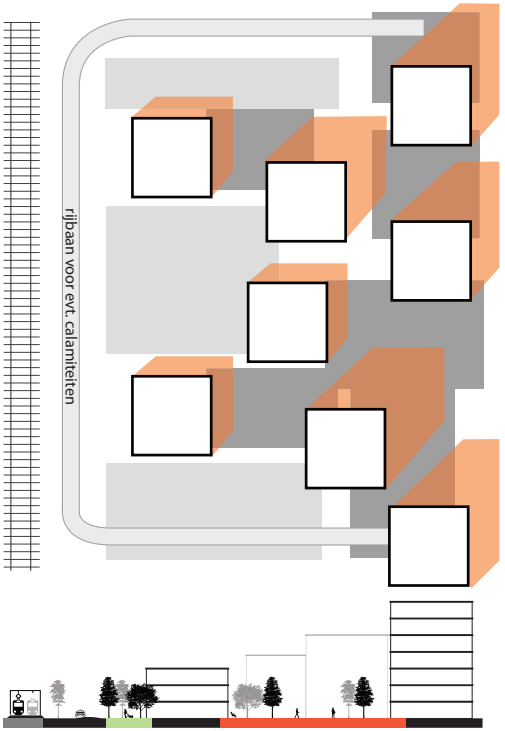
ESCAPE ROUTES



It is important to have a clear escape route.

1. LOWER DENSITIES IN THE VICINITY OF THE RISK SOURCE

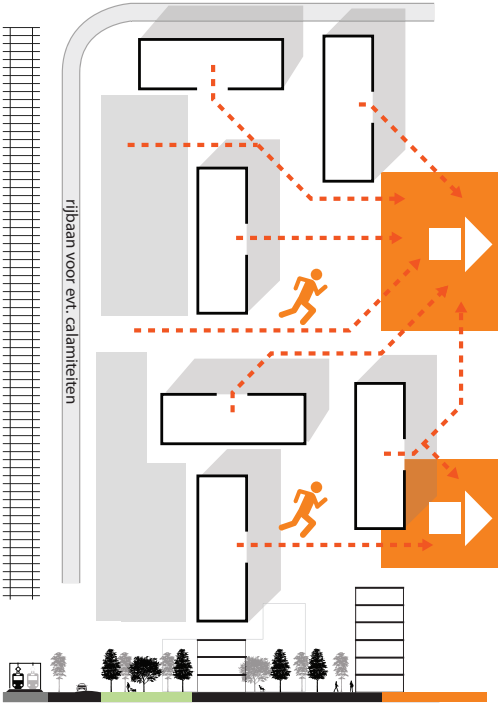
The fewer people there are who have to escape, the greater the chance of success. Having fewer and lower buildings close to the risk source helps with this. Higher density housing can be located at a greater distance from the risk source.



2. A CLEAR ESCAPE ROUTE FROM THE RISK SOURCE

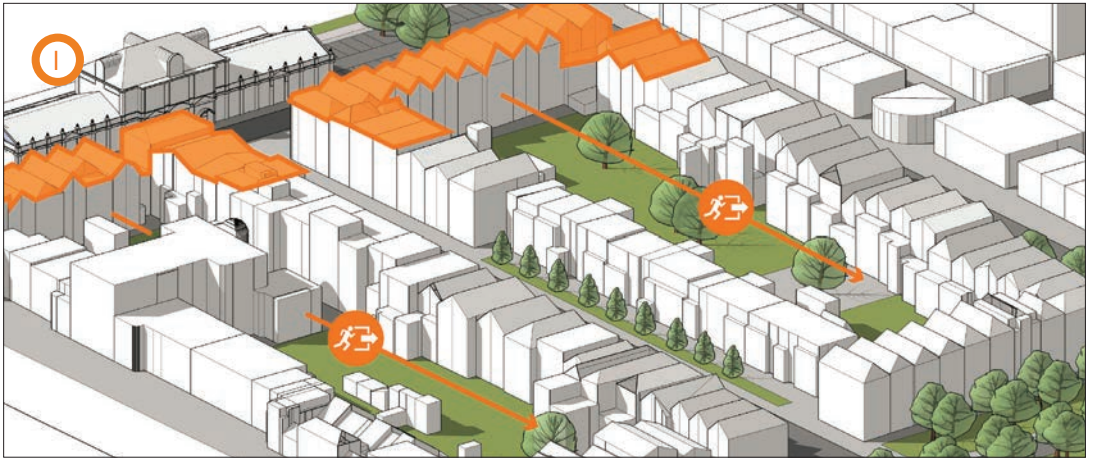
The escape route must be clearly visible and lead away from the risk source. It is the designer's responsibility to ensure this. The route should be wide enough for groups of people to escape, and should be free of obstacles.

The buildings should be positioned and composed in such a way that it is possible to see the way to the safe place. A certain degree of openness between the buildings is crucial for this. Each building must also have its own clear escape route.



3. THE BUILDING AS A SHIELD DURING A DISASTER

The effects of a disaster such as an explosion can almost never be fully absorbed by the building. However, the shape of the building can help to minimise the effect. Closed façades on the side facing the risk source can limit the effect of a disaster for the people inside the building and given them extra time to escape. The open façade with the entrance and the escape route is located on the other side, away from the risk source.



With lower densities near the risk source, fewer people will need to escape in the event of a disaster. In the different areas, the escape routes lie perpendicular to the risk source so that they provide a rapid escape route away from the source. As far as possible, the façades facing the risk source are closed and the buildings act as shields.

Open out the axonometric drawing in the back of the book.

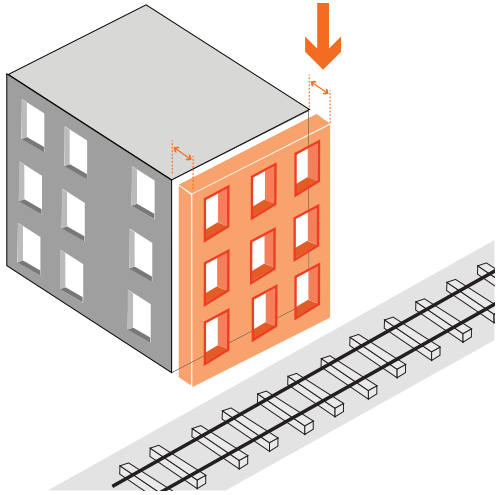

J

The closed façade of this building is on the side facing the risk source.
The exit with escape route is on the opposite side away from the source.

BUILDING-LEVEL MEASURES

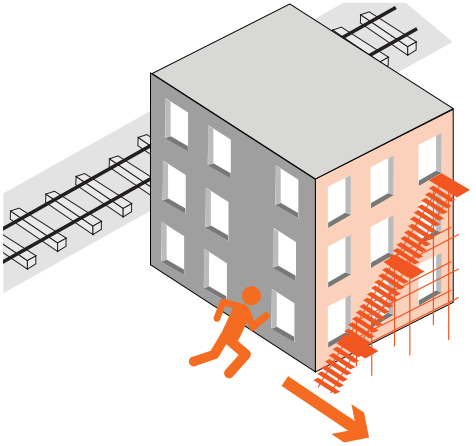
1. BUILDINGS HAVE A THICK FAÇADE ON THE SIDE FROM THE RISK SOURCE

To avoid serious consequences during disasters, buildings have thick walls on the side facing the railroad. Non-flammable insulation material and thicker walls can withstand small explosions and impede fires. This means that people can remain inside the buildings longer or that they have more time to leave the building.



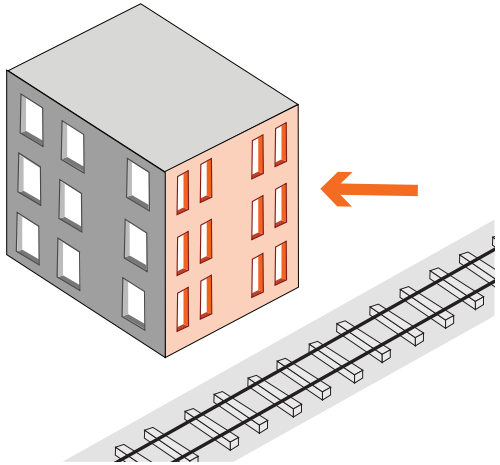
2. ESCAPE ROUTES ALWAYS LEAD AWAY FROM THE RISK SOURCE

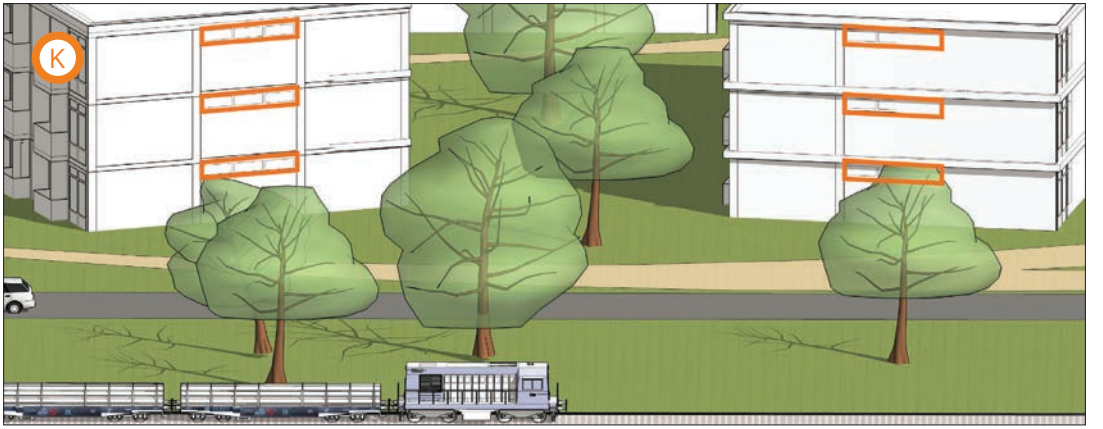
Fire escapes or other escape routes are always on the side exposed to the least effects of the disaster. This generally means the side located the furthest from the source. In this manner, people who are escaping can reach a place of safety sooner.



3. CLOSED FAÇADES ON THE SIDE FACING THE SOURCE

The façade on the side facing the risk source is as closed as possible. This means small windows, strong walls and few other openings in the façade. This limits the effect of a disaster and gives people more time to leave the building.





The apartment building has a protected façade facing the risk source. The escape routes are on the side where no direct negative consequences of a disaster are to be expected.

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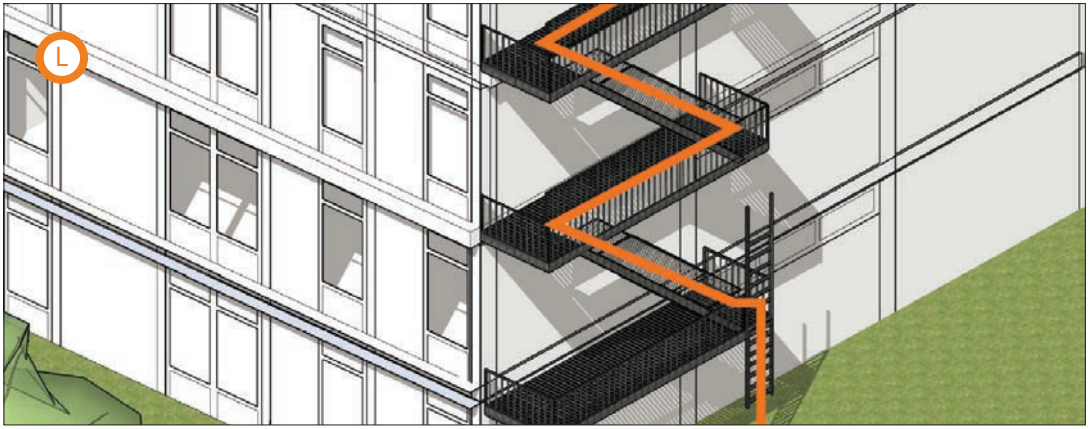

L

ACCESSIBILITY EMERGENCY SERVICES

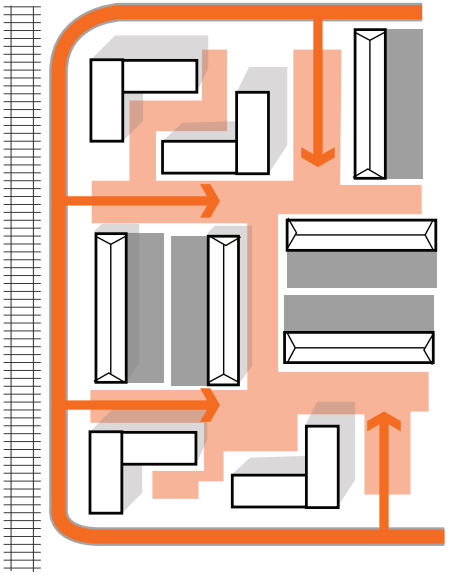
You will want to prevent this situation from occurring. It is important that the escape route be separated from the access route for emergency services.


VOLVO BRANDWEER

1. EMERGENCY SERVICES HAVE GOOD AND RAPID ACCESS TO THE NEIGHBOURHOOD

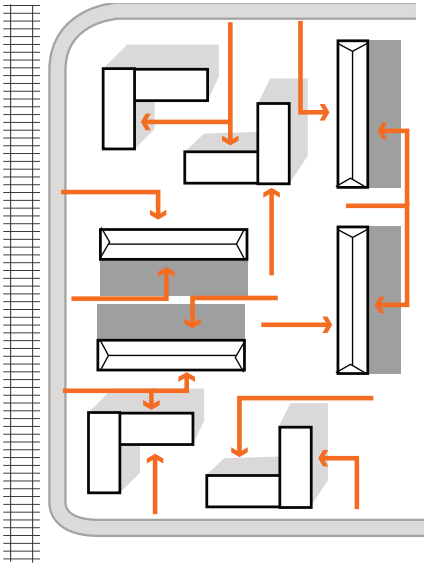
Neighbourhoods should be easily accessible via a minimum of two broad access roads. There should preferably be an access route in each wind direction, making the neighbourhood accessible from a number of different points. An access road near the risk source is naturally also necessary, in order to fight the disaster.

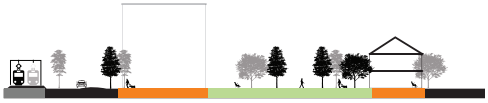
The traversability of the area is extremely important. The urban structure of an area near a risk source must be spacious enough to allow each road to be accessible from a number of different points. Several emergency vehicles must be able to pass each other easily. For this reason, streets and public spaces are broad and free of obstacles. A rapid connection to the main traffic structure is also important.



2. ALL BUILDINGS ARE ACCESSIBLE FROM A MINIMUM OF TWO SIDES

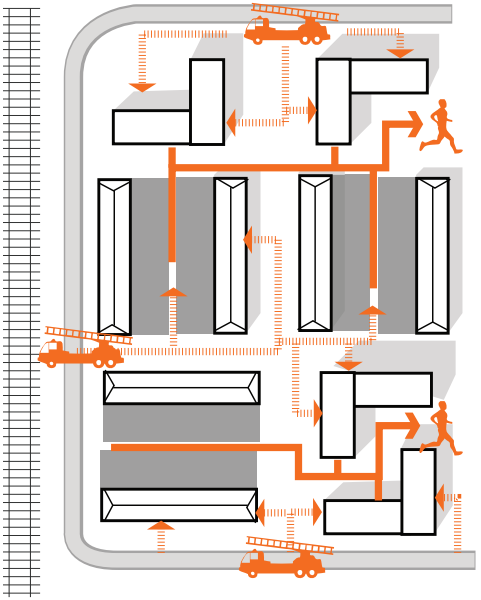
The urban structure of an area must make it possible for all buildings to be accessible from a minimum of two sides. It should always be possible to reach a fire from a safe side. The position of a building and its entrances must make this possible.





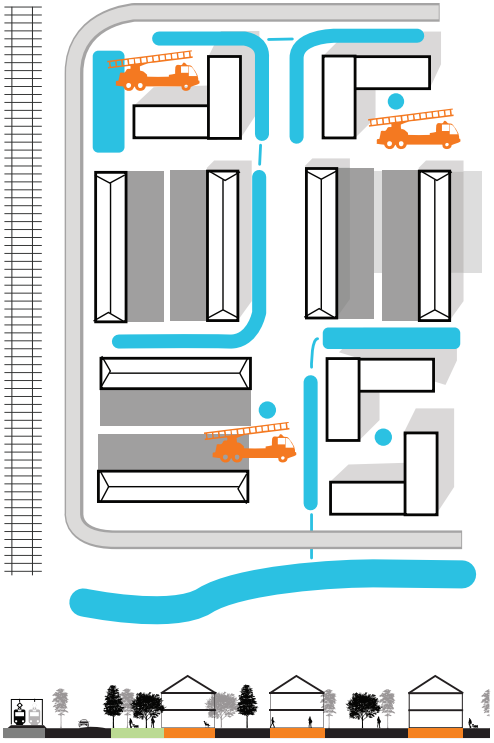
3. SEPARATE ESCAPE ROUTES FROM EMERGENCY SERVICE ACCESS ROUTES

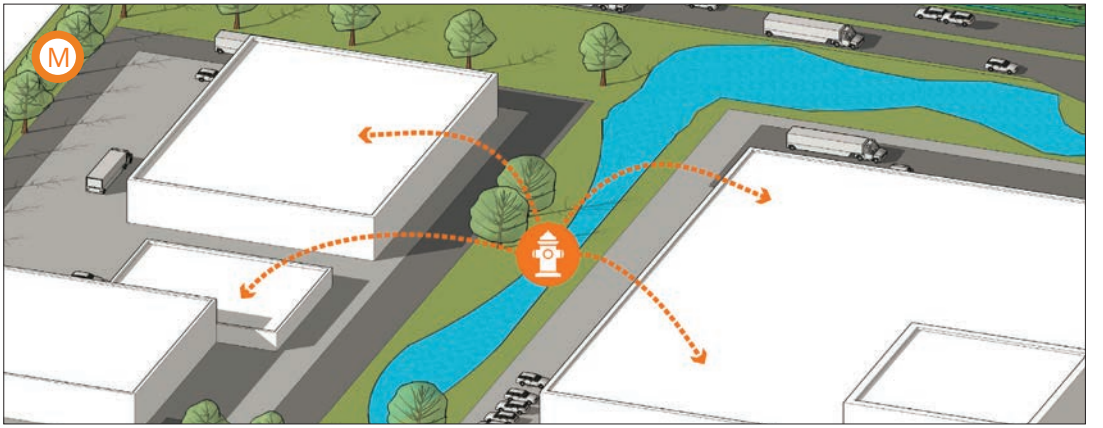
Of course, emergency services must be able to reach a disaster scene quickly. But people occupying the area concerned also need to be able to escape quickly and safely. For this reason, escape routes should be separate from the emergency services supply route where possible. The spatial structure of the area around the risk source should make this possible. Where there are very broad roads, a completely separate system is not necessary.



4. THERE IS SUFFICIENT WATER FOR FIREFIGHTING NEAR THE SOURCE

Firefighting water should always be available near the risk source in order to allow a quick approach to the source. This water can come from a recreational lake or pond. These water sources must be part of a continuous water system so that the water is constantly being replenished. The water should be no less than 80 cm deep. If the source is not accessible during a large disaster due to safety, heat or toxic fumes, water facilities should also be accessible from the surrounding area. This could include ditches or lakes. Installing these facilities underground saves space.





Emergency services can make use of water from ponds and ditches for extinguishing fires. This also has a natural and ecological function. Neighbourhoods without water features are supplied with firefighting water through fire hydrants. There are also fire hydrants in built-up city areas where efficient use of space is crucial.

Open out the axonometric drawing in the back of the book.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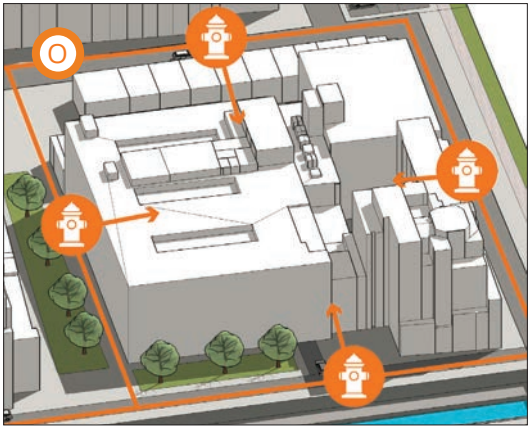
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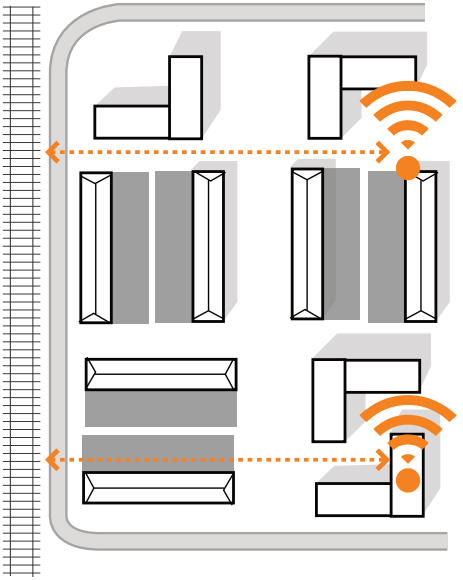
Good internet and mobile telephone services are essential for communication during an incident.

COMMUNICATION

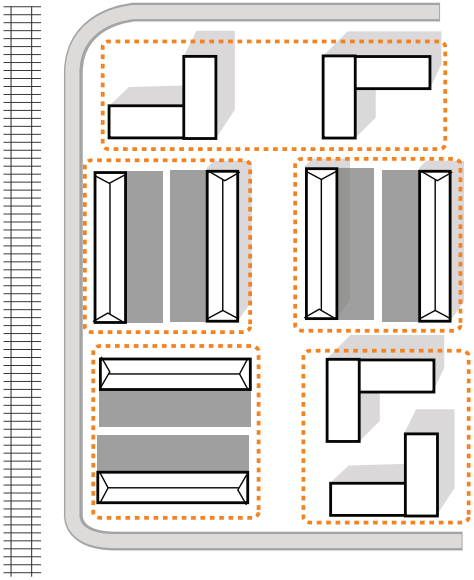
1. TRANSMISSION TOWERS AND CONTROL ROOMS AT A DISTANCE FROM THE POTENTIAL SOURCE

A great deal of important information is communicated during disasters using the internet and mobile telephones. It is therefore important that transmission towers for mobile telephony and internet are located at a distance from the risk source. This is also important with regard to control rooms for emergency workers and other vital infrastructure.



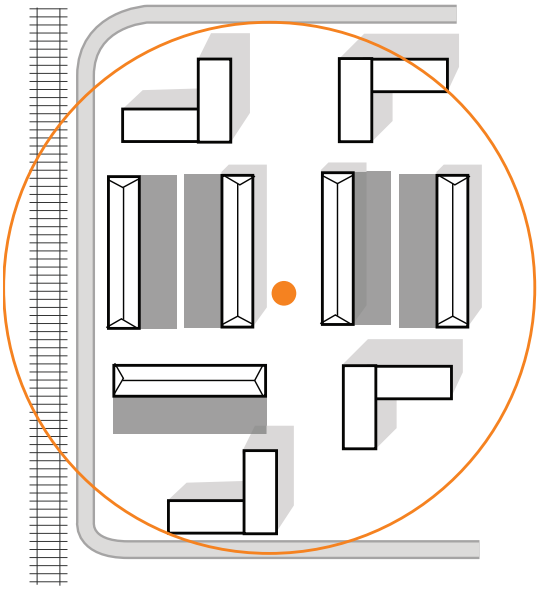
2. CREATE CLEAR NEIGHBOURHOODS THAT PROMOTE SELF-RELIANCE

During disasters, it is good if people in small, manageable neighbourhoods can help each other directly after the disaster. Spatial design can provide places within a spatial structure where small groups of people can find each other quickly to share information or help each other. This enhances inhabitants' self-reliance. There are municipalities where those living close to a risk source practice the emergency procedures together to stay prepared for a disaster. Inhabitants know where to go in the event of a disaster.



3. WARNING AND ALERT SYSTEM (WAS) COVERS THE WHOLE CITY AND VILLAGE

The Warning and Alert System masts that give warnings in the event of a disaster should be positioned so that the entire population is alerted. In the future, WAS will be replaced by NL-Alert.



4. COMMUNICATION IS CRUCIAL DURING AN INCIDENT

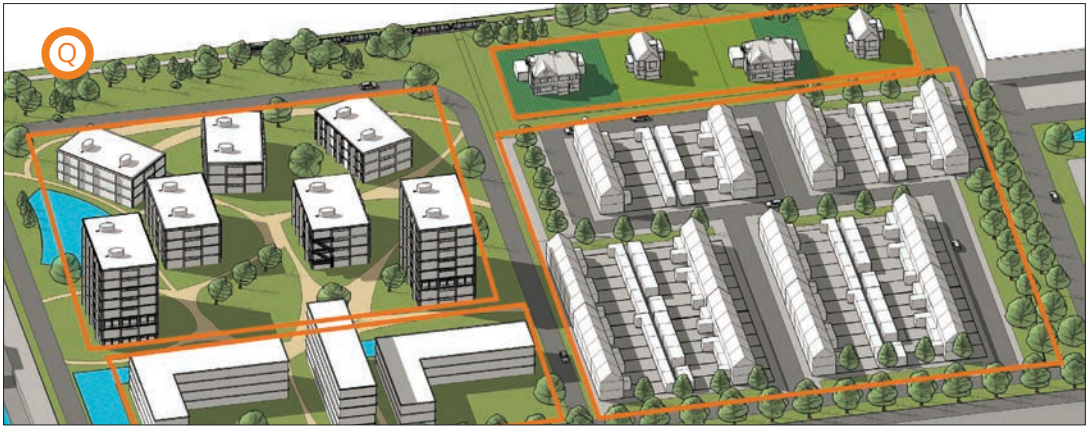
Where design measures do not eliminate risks, communication in administrative accountability can be the deciding factor in making these risks acceptable. Good communication can significantly increase safety.

If people are conscious of the potential risks and know what they have to do in the event of an incident, this contributes to safety. This requires honesty in advance from the government, and from the companies that are the source of the risk. A shared strategy and structural monitoring of the communication are essential. This risk-related communication is not intended to make people afraid of what might happen, but to make them aware of their own ability to bring themselves and their loved ones to safety.

Communication is crucial during an incident. Technology is an important tool with regard to this and should be taken into account during the design. There are areas with specially developed apps and the government uses NL-Alert. Twitter, Facebook and other social media also play an important role in people's self-reliance during an incident.

In addition to the communications via social media and the warning and alert system, communication among individuals during disasters is also extremely important. The best scenario is when the population organises itself into small, orderly groups in order to reach a place of safety. A spatial design with small, organised groups of dwellings and businesses can help in this.

Open out the axonometric drawing in the back of the book.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COLOPHON

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