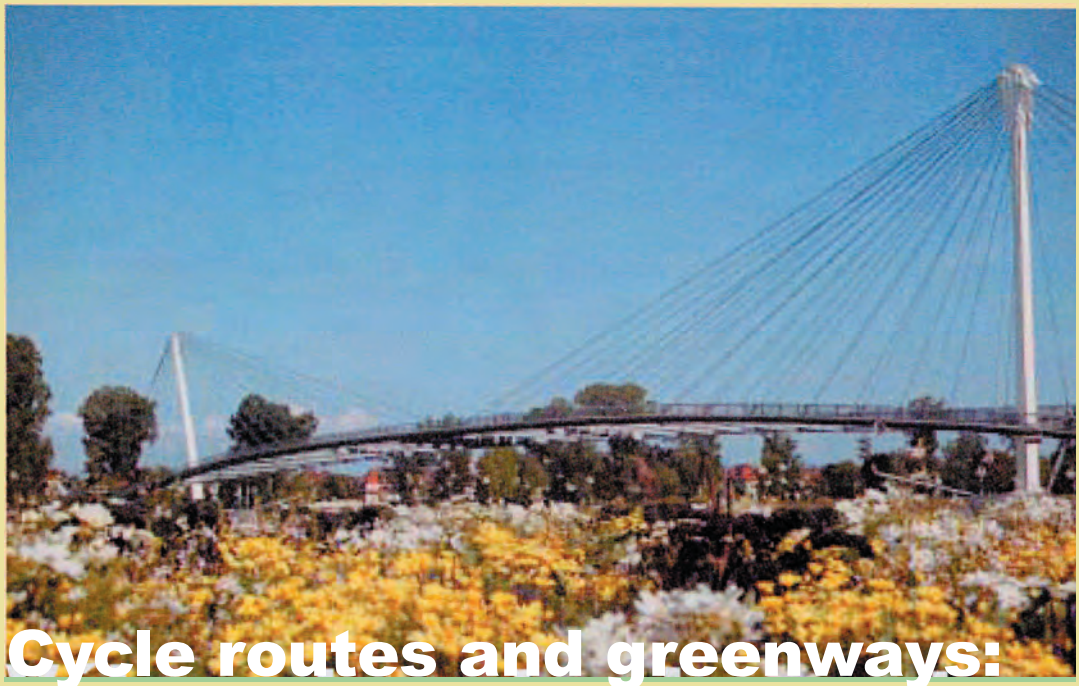

Cycle routes and greenways: engineering structures

Cycle routes and greenways may have to pass over various obstacles: waterways, railway lines, busy roads and existing engineering works, etc. To ensure that cyclists, pedestrians and other non-motorised users can travel along continuous routes and avoid lengthy detours, crossings and bypasses must be developed, improved and made safe.

Some of these routes will be entirely dedicated to alternative modes of transport; while on others, cohabitation with motorised forms of transport needs to be planned to ensure a balanced share of the space and satisfactory levels of safety for all. This sheet provides some useful reference points to help find solutions for integrating crossing situations relating to engineering works (bridges, viaducts, tunnels, underpasses and overpasses) on such routes.

Cycle routes and greenways: engineering works

Wooden footbridge for pedestrians and cyclists fixed by means of cantilevering supports along the side of the Pont des Eyzies over the River Vézère

Greenway along the River Gers in Auch, in continuation of a route designed to make it easier to cross through the town and enhance public heritage

Cover photo: Passerelle des Deux Rives (Architect: Mimram) cycle and footbridge linking Strasbourg and Kehl, 600 m upstream of the «Pont de l'Europe», with dual-lane traffic in each direction

The development of cycle routes and greenways is part of a sustainable development initiative encouraged by France's Clean Air Act (1996), the Framework Act on Town and Country Planning and Sustainable Regional Development (1999) and also the 2000 Act on Solidarity and Urban Renewal (SRU Act) which provides for non-motorised modes of transport to be taken into account in local urban planning. On routes such as these, the function of crossings and bypasses is to ensure continuous travel for cyclists, pedestrians, horse riders and other non-motorised users

User safety and the continuity of cycle routes and greenways are determining factors in route planning decisions and in developing route usage linked to daily travel, sport and leisure activities and green tourism. Nonetheless, it is also important to consider the socio-economic impact of the route, together with its impact on tourism, development in the areas it passes through, the facilities provided for users and how it fits into a national, or European network. From the moment that work begins on designing a route, it is essential to inventory every crossing situation involved.

Types of situations encountered

To cross waterways, railway lines, roads bearing heavy traffic and existing engineering works, etc., the project owner may have to deal with variety of different situations:

- the route uses an aerial structure to cross a river, a road, a railway line or a valley;
- the route uses an underground structure to avoid a road or mountain, etc.;
- the route is blocked by a structure and could either pass under it to ensure continuity or pass over the structure thanks to a slope; if this is not possible due to the layout of the site, the obstacle must be avoided (detour) or «crossed» by means of a stairway with ramps and wheeling channels.

Some general recommendations are worth highlighting before going on to deal individually with each of the above situations:

Existing structures

For every structure encountered along the route, regardless of whether it is in use or not, the project must be specified and the owners or management of the structure should be consulted, as early as possible, as they are key partners insofar as concerns the planned works.
Once ownership of the structure has been determined, a technical and economic feasibility study must be carried out. Care must be taken not to underestimate procedure or impact assessment lead times!

Technical and economic feasibility study

This study must cover the following points:

- the state of the structure,
- its size, load-carrying capacity and physical structure,
- any technical requirements that may cause problems in transforming the structure,
- the level of motorised traffic if the structure is to remain accessible to general traffic,
- potential traffic in terms of cyclists, pedestrians, rollerbladers and people with reduced mobility (PRM), etc., in other words, the demand in relation to the structure's capacity and load-carrying capacity (including maintenance vehicles suitable for the structure and other activities),
- access conditions for PRM, rollerbladers, horse riders, pedestrians with pushchairs, especially if there is any difference in elevation,
- the extra distance travelled to reach or avoid this structure.

Engineering structures to be developed

In a bid to save money, the development of new, dedicated structures on cycle routes and greenways will be kept to a minimum. This nonetheless assumes that the journeys of cyclists and other non-motorised users will be taken into account in the design of road works (roads, road crossings, motorways, interchanges, etc.). Since the 1996 Clean Air Act was passed, this has been a legal requirement in urban environments and a universal necessity, as the Government reminded its «départments» (counties) (Directiveof 31/10/02 and Circular of 9/08/04). It is obviously much cheaper to integrate facilities for environment-friendly transport on roads and engineering structures at the design stage rather than having to make changes at a later date. Before building any new structure, alternative solutions must be sought, while ensuring that they remain acceptable to users.
It is important to ensure that crossings over waterways or minor dips in the land - which implies the majority of new structures - blend harmoniously into the landscape.

Covered footbridge on cycle touring route built by the Luberon regional nature park and crossing the River Largue near Manosque

Path passing under an existing footbridge with sufficient overhead clearance for boats (Canal du Midi in Toulouse)

Modern footbridge in an industrial zone (along the bank of the River Gers)

Former railway bridge near Hyères (Var)

Wooden bridge beside an old railway bridge that follows a disused railway tunnel on a greenway in Spain

Locks and weirs: a special case

Greenways sometimes run alongside waterways that may be interspersed with operating engineering structures, such as locks and weirs. Such structures cannot be used to cross a waterway, and cannot therefore be considered as a means of crossing a waterway when designing a route. An alternative solution – for example, a bridge – must then be sought.

The route passes over an aerial structure

Bridges, viaducts and footbridges are engineering structures that the route may pass over. Depending on whether they are still in use and used by cars or pedestrians, a feasibility study must be carried out (see above) to plan how different modes will cohabit, taking account of redesign requirements and, solely as a last resort, considering the possibility of constructing an entirely new structure.

Redesigning existing bridges and footbridges

Wherever possible, priority should be given to opening up existing footbridges for use by cyclists and other non-motorised users so that they do not have to use road bridges. However, on many bridges, traffic lanes are often wide enough to allow them to be reduced. This is beneficial to both motorised and non-motorised users: reducing speed and providing space at the side of the road for drivers whose cars break down, etc.

Building an aerial structure

There are cases where it is impossible to avoid building a new structure:
- if the bridge is too narrow, too dangerous or traffic is too heavy to integrate a greenway or cycle route,
- if too long a detour must be made to reach the other side,
- if there is no other way to get across the obstacle.

A new cycle/footbridge, a footbridge alongside an existing structure, an extension fixed to the structure by means of cantilevering supports or a footbridge running under the bridge deck, must not block traffic on the route crossed: in the case of a waterway, sufficient overhead clearance must be maintained for boats to pass under the bridge, even if the waterway is no longer in use.

All cycle and footbridges must be wide enough to allow users to cross without needing to be separated: pedestrians, rollerbladers, PRM, horse riders and cyclists, together with maintenance and emergency services. The width depends on the length of the bridge: for a single-track bridge spanning a short distance, a width narrower than the standard recommendations may be allowable. Cambered subgrades and grooved surfaces, etc. should be avoided for the sake of rollerbladers.

The route uses an underground crossing

Underground crossings are generally used to allow pedestrians and cyclists to cross a dangerous road. A tunnel may also be an attractive solution, affording shelter for the users.

Underground crossings

When the construction of a short passage under a road, motorway, interchange or railway line, etc. is planned at the same time as the road to be crossed, not only is this more cost-effective than carrying out works at a later date, but the structure is usually better suited to its purpose and more convenient.

Gradients at the entrance and exit must be kept as minimal as possible, the end must be visible from the entrance and, in general, the passage should preferably be aligned with the access path.

Light-coloured facing and surfaces are recommended. Unless the passage is very short, straight and on a very gentle gradient, lighting can be used to make it safer and more attractive. Sharp corners at the entrance to an underground passage are not recommended, or should be signalled using light-reflecting materials.

In designing an underground passage, cross-sections should be adapted, as for bridges and footbridges, in light of the number and type of users (including maintenance vehicles). Thus, the minimum section recommended for cyclists alone is 2.50 m wide and 2.50 m high, with comfort criteria of 3.50 m and 2.75 m respectively. Where pedestrians will use the passage, a width of 5.00 m will prevent users from getting in each others' way.

Tunnels

Tunnels are usually found on routes that run along disused railway lines. Since they are part of France's railway heritage, they should be redesigned and their unique characteristics preserved. Before they can be used again, the stability of the structure – especially the roof – and the rock must be checked to prevent any danger of falling rocks. When shared with motorised modes of transport, certain fire protection measures are required that are unnecessary if the tunnel is only intended for non-motorised users.

The possibility of allowing non-motorised users to use the service tunnels of very long tunnels can be studied in liaison with the tunnel administrators.

Built at the end of the 19th century, and used for many years for growing mushrooms after the railway line fell into disuse, as well as a hibernation spot for various protected species of bat, the Bois Clair tunnel in Berzé-le-Châtel (Saône-et-Loire) completes the Tour de Bourgogne greenway from Charnay-les-Mâcon to Givry.

1.6 km long and featuring an ogival vault (4.5 m by 5 m), it contains a number of niches once used for safety purposes; at the bottom, it is hollowed out of the rock, with brickwork running along almost the entire length of the vault apart from a few points where it the bare rock is visible. Features:

- surfaced with polymer resin sand,
- the road surface is approximately 4.30m wide with zero-gradient longitudinal profile,
- surface water from the vaulted roof is collected by a longitudinal drain at the low point,
- the tunnel is lit by 260 x 70 W light sources: 185 overhead light fittings, 60 spotlights buried in the niches and at the entrances, 12 flashlights at the entrances; low voltage power supply; an automatic detection system with a photoelectric cell and a timer are used to turn the lights in the tunnel on and off,
- special features have been integrated to protect bats (with downlighting to avoid light on the roof); and information boards to raise public awareness.

The route is blocked by an engineering structure

The routes most likely to be blocked by an engineering structure (a bridge pier, for example) are routes running alongside canals, disused railway tracks and roads. To ensure the continuity of the route, it may pass under or over the structure in order to reach the other side; if this is not possible due to the layout of the site, the obstacle may, for example, be «crossed» via a stairway (with wheeling channel) to avoid interrupting the route; to avoid the inconvenience this involves, the only other solution is a detour around the obstacle.

Passing the obstacle

To pass over or around the structure, gently sloping ramps have to be built on either side (2 to 4% for an elevation of 5 m). In the case of gradients over 4%, the rules applicable to PRM access require the addition of horizontal landings at 10 m intervals.

A 5% slope is a threshold value, particularly with inexperienced rollerbladers in mind; in this case, a handrail should be added, at a height of 0.90 m, and the route widened by 0.20 m to 0.50 m to give cyclists and rollerbladers enough room to negotiate the curve.

To ensure safety and comfort, sharp bends should be avoided; if there is no alternative, they should be clearly signed and marked with separate lanes for travel in each direction.

If it is not possible to use a ramp to pass a structure due to the layout of the site, a stairway may be used provided that it has a handrail for rollerbladers, a wheeling channel to make it easier to carry bicycles – or even a double channel for pushchairs. These solutions do not provide access for people with reduced mobility and should only be used when the options are limited. An alternative route suitable for PRMs should be sought or information concerning the lack of access provided well in advance.

Passing under a structure

Passing underneath a structure is preferable to building a stairway, but can only be considered if the space between the base of the structure and the bank is both high enough and wide enough; it may be necessary to use ramps in such cases (cf. above) and the project must include safety railings (cf. below).

When the available space beneath the structure is neither high enough nor wide enough to allow users to pass safely, and if a stairway is not a viable alternative, they will have to make a detour to completely circumvent it.

Above: a bridge in Toulouse with a triple ramp: access to the bridge to cross to the opposite side, route passes under the bridge ensuring continuity along the bank of the Garonne and access from the road; below: the same bridge viewed from the other side, with stairs providing direct access for pedestrians, instead of the detour via the ramp (note the concrete stair «ramp» for bicycles or pushchairs; alternative solution alternative: a single wheeling channel for users carrying a bicycle or a double channel for bicycles and pushchairs)

Chambéry to Lake Bourget route passing under an existing structure by means of corbelling; a line down the middle divides the path into two, with a lane for traffic in each direction, thus ensuring safety for cyclists

Path along the banks of the Gers, with railings at certain points where it is particularly dangerous (narrow path crossing a structure)

Road bridge in Chambéry where the lanes have been narrowed – thereby reducing the speed of motorised traffic – by constructing a path for pedestrians, cyclists and PRMs, of benefit to all users; cyclists can ride either on the road or within this safety zone

Covered crossing built into an existing motorway bridge, running below the road, ensures the continuity of the Lac de Bordeaux greenway; a heavily-congested ring road with dual-lane traffic in each direction runs across the bridge itself

Safety features

When a route comes up against an engineering structure, the layout of the path implies a change of speed, or pace of which users must be informed, particularly if the space must be shared with motorised users, as is often the case. Any risk that exists requires not only improved signage, warning all users to proceed with caution, but also the introduction of measures to regulate all forms of traffic.

Shared space

When a structure remains accessible to motorised vehicle traffic, the co-existence of different modes of transport must be planned. The presence of pedestrians and cyclists, etc. must be taken into account from the point where the structure begins. If the space reserved for non-motorised users is raised above road level, the access edge should be streamlined to slope to ground level.
If slow users (pedestrians and PRM) are separated from fast users (cyclists and rollerbladers) on the route before and after the structure, then the question must be asked whether or not to maintain this separation where the route crosses the structure itself.
Cyclists will be able to choose between using the road or a safer space, suitable for families and inexperienced cyclists.
The recommended minimum space for pedestrians will be 1.80 m wide (absolute minimum: 1.40 m, clear of any obstacles) (decree of 31/08/99) and sited as far from the road as possible.

Informing and warning

In addition to marking out the route and the applicable policing rules, information to users must warn them in advance of any changes in the width of the path (wider or narrower) and any upcoming hazards. It should also inform users of the length of the structure and urge caution using road markings and vertical signs (improved where necessary), etc. In some places, exceptionally, it may be necessary to reduce the speed limit, prohibit cyclists and rollerbladers from overtaking, warn them to ride in single file or pay special attention to pedestrians, etc.

Managing stops

For users, an engineering structure may provide a good spot to stop for a break, or to read tourist information boards and maps. They may also afford a view over a valley or waterway, inviting users to stop. Since a group of people may stop and obstruct the route for other users, stopping points will be integrated by widening the path at each end, in addition to cycle stations (see Sheet No. 1) and rest areas provided along the route.
Bins must also be provided and rubbish collection arranged.

Narrower lanes

If there is little traffic using a route, and if the structure is short (5 to 20 m), narrowing a section of the cycle-route / greenway may be a valid option, providing that the narrowing of the lane is gradual at each end: 2 m is the minimum acceptable width at a given point in the case of a footbridge or a bridge at a technically-restricted site. For other kinds of structure, preference should be given to a width of 2.50 m. The choice of whether the cycle lane at such a point should be one-way or two-way depends on continuity on either side of the structure: avoid forcing users to cross each others' path as they pass a structure.

The risk of falling: parapets and safety railings

The use of parapets should be limited to danger spots: narrow river banks, sheer drops to ravines or roads with fast, heavy traffic. Elsewhere, they may be replaced by widening the lane by between 0.50 and 1.00 m, or planting a row of bushes along a steep bank, etc. to avoid creating a tunnel effect, particularly from the pedestrian's point of view.
Preference should be given to parapets or safety railings that afford suitable protection for young children. In all cases, railings should have a continuous top rail linking the posts together and no sharp edges that could be dangerous in the event of a fall.
A height of 1 m is usually sufficient, in some cases railings can be 1.20 m (maximum standard recommendation).
In areas known to be dangerous (e.g.: a narrow greenway crossing a very high structure), they may be up to a height of 1.40 m, taking care to avoid putting excessive stress on the parapet.

Intersections

Situations where a structure must be bypassed or crossed often imply having to negotiate intersections with roads used by motorised vehicles. Furthermore, it is preferable to avoid crossing over busy roads.
In any case, special care must be taken over intersections, increasing the number of warning signs for all users (see technical sheet on how to deal with intersections, to be published shortly) and taking every precaution to ensure mutual visibility.

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National cycle routes and greenways network: *definitions*

Cycle routes *are medium- to long-distance routes for cyclists, of local, region, national or European interest, which link regions together and cross through conurbations in the best possible conditions. They follow all sorts of safe routes, including greenways.*

Greenways *are facilities reserved exclusively for non-motorised means of travel. They are intended for pedestrians, cyclists, roller-bladers, people with reduced mobility and horse riders, for a variety of purposes, including tourism, leisure and daily travel by the local population.*

The routes *must be linear, continuous, safe, marked out and signposted and adapted to the needs of all levels of cyclists; with gentle gradients, usually limited to 3% although there may be some exceptions to this rule in mountainous regions. Extremely safe and well-maintained, their use should be encouraged but not compulsory, and services should be integrated for cyclists, local people and tourists, etc., in liaison with the public transport services – especially rail networks – to which the provide access.*

Ensuring safety in tunnels

In all cases, the following points should be taken into account to ensure the highest levels of physical safety for users and to offset the feeling of going down a «black hole»:

- visually prepare fast users (cyclists and roller-bladers) by giving notice of the tunnel's existence (name + length) well in advance,
- afford a clear view of access to the tunnel,
- ensure good visibility inside the tunnel with appropriate lighting (possibly using a photovoltaic system), regulate brightness to avoid dazzle upon exiting the tunnel and improve safety by installing an automatic lighting system (or manual, as appropriate), use light-colours for wall surfaces up to a height of 2 metres, and light-coloured coating either for the entire road surface or for the edges, clearly marking out the lanes.

A tunnel may be a pleasant place to find shelter from the rain or shade on hot sunny days.

Well-lit and decorated underground passage (Sweden)

Maintenance

Maintenance requirements must be factored in at the design stage and when calculating the load-bearing capacity of a structure. The structure's management should be consulted to organise maintenance.

Routine servicing for the route also applies to engineering structures: cleaning and upkeep of the surface and surrounding vegetation, etc. As for the rest of the route, the structure will be patrolled, preferably by bike, to monitor actual use conditions and the needs of different users.

Tunnels and underground passages require regular cleaning since rubbish and gravel tend to accumulate at lower points in the path. In particular, patrols should check that the lighting is working properly and that seepage and surface water is draining effectively. Structures and their safety systems, stability, load bearing and cracking, etc. should be inspected on a regular basis as decided as soon as they are opened up for use.

Sheet 4

Cycle routes and greenways: engineering structures

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