Advice on

Bridges, gradients and steps

The law and management of public access rights vary widely between the four countries of the United Kingdom. Practical elements of the following advice apply in all of them but the law in Scotland and Northern Ireland may differ from in England and Wales.

Riders and drivers of horses are referred to generically as equestrians.

More advice is available on www.bhs.org.uk/accessadvice.

IMPORTANT This guidance is general and does not aim to cover every variation in circumstances. Where it is being relied upon, The Society strongly recommends seeking its advice specific to the site.

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Bridges

Definition of terms in the table below:

Infill — solid panelling fixed to the parapet-rail to obscure a horse's view of traffic or turbulent water passing beneath the bridge

Kickboards — a raised edge to the deck, preventing a foot sliding laterally off the deck

Uplift — the gap between deck and kickboard or infill (to allow drainage)

For more detail on items marked *, see sections below.

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Width and sightlines

The specified widths are primarily for the comfort of users passing one another. If it is not practical to provide the recommended width, mitigation may be required such as signs at each end giving priority to horses so that passing another user

does not place a horse too close to a parapet. A bridge width of less than 2.5m may be insufficient to turn a ridden horse safely. A horse drawing a vehicle is likely to need at least 3.5m to turn, depending on the type of vehicle.

Waiting areas should be at least 3m in width and length, 4m is preferable. The area should increase with the potential waiting period as horses may become restless, particularly if the environment is threatening.

Bridges carrying roads with high volumes of traffic should have a segregated marked route for riders.

There should be no bollards, gates or other width limitations on the bridge or in the waiting area. A gate on a bridge less than 3m wide means a ridden horse will not have enough space to manoeuvre into the safest position – alongside the gate with head beyond the latch. Having to tackle a gate head-on is contrary to BHS recommended practice because it increases risk for horse and rider and, depending on the gate, may be impossible to open so a complete obstruction.

Parapet-rails

Use of the term parapet is variable: some use it only for a component essential to the structural integrity of the bridge; some use for any structure above the deck. Here the composite 'parapet-rail' applies to any superstructure.

Parapet-rails are not always required, or may be acceptable at a lower height than standard depending on the site. Influencing factors are the height of the span, width of the deck, what is being bridged and a horse's line of travel relative to the parapet-rail. A railway or fast road with a high span may need solid parapets or infill and more substantial or higher parapet-rail than a low span over a stream. Similarly, the length of the span, the width of the deck and other users, who may affect a rider's preferred line of travel, will also affect the need for parapet-rails.

Parapet-rails on bridges are usually designed to prevent a pedestrian or vehicle from leaving the bridge deck. Parapet-rails to prevent a rider falling from a horse over a parapet-rail would be over 2m high and are rarely practical or desirable therefore the height of any parapet-rail on an equestrian route is likely to be a compromise and there is no single solution for all situations.

The desirable height of a parapet-rail will be influenced by the proximity of a horse to the rail on a normal line of travel as well as the local conditions. Unless avoiding other users, an equestrian is most likely to take the centre line of a bridge.

The psychological benefit of higher parapet-rails is inestimable and can be achieved by wire mesh suspended from cables to reduce weight and wind resistance on a high span. Anecdotal evidence shows that even if a parapet would not withstand an impact, it makes an equestrian feel safer, which emotion is transmitted to the horse, so both are more confident in passing over the bridge and more likely to do so safely. A standard height parapet-rail may be below the knees of a rider on an average sized horse, which may cause a rider to feel vulnerable on a high span if their line of travel is close to the edge, and that unease will be felt by the horse.

For a bridge over a dual carriageway, the Society recommends a parapet-rail height of 1.8m if a horse's line of travel is likely to be within 2m of the parapet, and 1.5m height if more than 2m away, however, there will be sites where a lower height is acceptable, such as a single track accommodation bridge with low incidence of other users where an equestrian may take the centre line. Alternative measures on bridges carrying roads with standard low parapet-rails may include warning motorists of oncoming horses in the centre of the bridge.

Parapet-rails or infill may not be practical on low spans over watercourses where flood potential could allow waterborne debris to collect and increase stress on the bridge.

Horses might be alarmed by traffic passing beneath them, whether on a navigable river, road or railway. Solid infill of parapets to obscure their view may be desirable in some situations. However, most horses will quickly accept the conditions with sensitive handling.

Solid infill may also be desirable on ramps parallel to a railway line or motorway on the railway or the road's side of the ramp.

Bridges over bogs should be of reasonable width, with non-slip surfaces and edge boards to reduce the risk of a horse slipping off the bridge and being stuck in the bog.

Where it is not practical to meet the recommended standard on any bridge, mounting blocks at each end of a bridge would be welcomed by equestrians who prefer to dismount and lead across the bridge (see BHS Advice on Mounting Blocks), however, this must be the rider's choice, not a requirement to dismount, as some will feel safer mounted or may need assistance to dismount and mount and a bridleway or carriageway is a right of way *on horseback* so bridges should be constructed accordingly. Equestrians continually assess risk as they ride or

drive and will take all precautions to avoid distress to their horse; their actions or preference may vary depending on conditions.

Where a council is considering deviation from the specification, consultation with the BHS is recommended so that a compromise may be agreed and mitigation included as appropriate.

Structure and surface

Structures should be stable.

Deck surface should be non-slip to both shod and unshod horses. If wood is used, attaching wire mesh to the deck boards is not safe for horse use. Non-slip grit strips and fibre reinforced polymer boards have been used successfully.

Decking should be substantial; it must not flex or respond to use with loud noises.

Gaps in the decking should be small enough that the river, road or railway cannot be seen by a horse in motion.

Stone mastic asphalt or asphalt with an aggregate size of less than 14mm should be avoided as it is too likely to be slippery or become slippery to horses unless top-dressed with a high friction grit.

Wood can be slippery when wet, but a wooden deck can be made non-slip with epoxy resin and bauxite grit as a liquid application or in attached strips or sheets. An easy option on wooden decks has been a generous scattering of sand, but it will need frequent replenishing although it can be effective for months, depending on the environment and level of use. It is at least a useful quick solution while something longer term is sought.

Wooden or recycled plastic struts may be screwed to sloping decks, but water and organic material tend to collect against them causing rot. This can be reduced by angling them to shed water and recycled plastic struts have been used successfully. Struts may become loose and their edges are vulnerable to wear as struck by hooves. Struts should be frequently inspected to ensure they are secure because screws holding them could cause injury if the wood around has rotted.

Rubber compounds as a deck coating have the advantage of deadening sound as well as providing a comfortable non-slip surface. Rubber may come as a liquid, in sheets or as recycled crumbs bound with polymer which forms a pouring compound, which is spread and levelled. For a bridge surface, it need not be thick.

Grit and rubber options may be used on a central 1m strip rather than the full deck width if necessary.

Pedestrians on bridges often walk by the parapet to look over it, but equestrians and cyclists are more likely to use the centre of the deck.

Steel is increasingly popular with the decline in longevity of wood. It is noisy, which can be deafening with a couple of steel-shod horses, which is unpleasant for the horses, riders and other users, so should be avoided. Polymer bound rubber crumb (poured and levelled) and rubber compound setts, tiles or sheets have been successful in deadening sound and making the bridge seem more solid as well as providing a non-slip and comfortable surface for all users. Attention to the design of the deck's surface below the rubber is essential to prevent trapped water and rot of steel or wood.

Load

Horses vary in mass from about 200kg to a tonne. The most common range for riding and driving will be 350 to 700kg.

In walk, the peak force on a horse's foreleg is about half its bodyweight, so about 2,500N in a horse with 500kg body mass. The peak force will increase with speed to about 12,500N at full gallop. The weight and force distribution are not equal between fore and hind legs. Put another way, a trotting horse may exert 1,500lbf of pressure.[1]

Common exercise vehicles drawn by horses are between 100 and 300kg. A vehicle drawn by a pair or team of horses will not necessarily be heavier.

Vegetation

Overhanging vegetation should be clear of the bridge by 3.4m. Bridges overhung by trees may become slippery from vegetation or moss and greater attention will be needed to maintain a non-slip surface and control rot.

Vegetation to the sides and from the banks below a small bridge, culvert or causeway can obscure the edges of the crossing, in which case parapet-rails will be more important to mark the available width and add protection.

[1] Springhill Equine, Part 1: Everything You Ever Wanted To Know About Your Horse's Feet

Gates on a bridge

Bridges should be ungated unless they are at least 3m wide, to allow for a horse to be turned to stand parallel to the gate to open or close it.

Bridges less than 3m wide which need gates to exclude livestock will need the gate situated in a fenced area of 4m diameter or square to provide manoeuvring space at the end of the bridge.

All conditions as for any gate apply, see BHS Advice Note on Gates www.bhs.org.uk/accessadvice.

Fords

Fords may be cheaper than bridges and may be appropriate where the depth of water in normal conditions is less than 0.5m. They may be preferred on less used routes but whether it is the ford limiting use should be investigated.

Environmental constraints, such as the work required to build the ford, the control of pollution and the watercourse profile may mean a proposal for a ford fails the impact assessment for watercourse consent.

Where a ford is considered appropriate or has historically been the only crossing facility, the force of water flow in normal conditions should allow a horse to walk easily without being pushed off course. Watercourses change, and although a ford may have been appropriate in the past, may no longer be feasible.

For a ford to be appropriate, its base within the watercourse must be firm, level, free from holes and non-slip. Often levelled bedrock or the natural bed of the watercourse will fit these criteria with little intervention. In other locations, ridged concrete or stone setts may be required.

Entry points must be firm and able to withstand fluctuating water levels and potential damage from horse use without poaching. Protecting the surface of entry points from erosion is a challenge, particularly in watercourses where levels fluctuate frequently, or flow is strong, or creates scour. A sealed surface may be favoured to withstand erosion but can be slippery for users and could require regular intervention to be non-slip.

The gradient of the entry points should be no more than 1 in 12 although 1 in 10 may be acceptable if the rise is short (low bank). The entry points must shelve into the river.

Abrupt or steep banks are unacceptable because a horse would have to jump in or out with high potential for slipping or falling, and the pressure could increase erosion of the bank and riverbed. However, long shallow steps may be acceptable at some sites to help provide a resilient surface.

For a watercourse in a remote location, steeper entries may be acceptable if it will have negligible impact on normal use and if users are likely to have encountered equivalent terrain to reach the ford, however, such decision should only be reached after consultation with the BHS and consideration given to whether the nature of the ford is limiting use.

Poles showing the water depth should be provided if the bottom of the ford cannot be seen in normal conditions. Markers for the entry points may be required if the crossing is greater than 4m between banks or if the points are not obvious from the opposite bank.

Stepping stones or bridges for pedestrians should be on the upstream side of the equestrian crossing so a horse is not pushed towards the hazards of that structure by the flow of water.

Irish bridges or Irish fords

A low water crossing, or Irish bridge/Irish ford, provides a dry crossing at normal water level but in high water conditions, water will flow over its surface forming a ford. Low water crossings have no parapets or raised edges which would impede flow. Old ones may be constructed by large pipes (round or rectangular cross-section) laid adjacent to each other parallel to the flow with a concrete surface on top so the water flows through the pipes at normal levels and over the whole structure in high water forming a ford depth crossing. This type is now unlikely to be approved by river authorities because of potential effect on fish and scour in high water conditions, but a single wide low ‘pipe’, effectively a very low bridge, might be accepted in specific conditions.

Culverts

A culvert is usually a crossing of a ditch or small watercourse with low flood response, in a narrow, defined channel. It is constructed with one or more pipes laid parallel in line with the flow of water and filled above with concrete and/or stone and earth to a level with the ground to either side. Headwalls may be required to protect the banks either side of the culvert where the constraint of the pipe may cause turbulence in the flow.

As with a small bridge, width and whether handrails are required depends on location, character of use, height of span, width and length of the crossing, and line of travel.

Causeways and boardwalks

A causeway is a raised path across a bog or other wet area constructed from consolidated stone with an appropriate top surface. Where water flow between each side of the causeway is required, pipes are laid in line with the flow of water, across the direction of travel within the embankment.

A boardwalk fulfils the same purpose of providing a dry surfaced path over a wet area and is, in effect and construction, a long low bridge just above ground level. The same principles apply as for a bridge deck. A kickboard to prevent slipping off is required. Longevity and mitigating slip hazard are the greatest challenges. If wood is used, attaching wire mesh to the deck boards is not safe for horse use. Non-slip grit strips and fibre reinforced polymer boards have been used successfully.

Width and whether handrails are appropriate will be site-dependent, as for culverts and small bridges.

Gradients

Steep gradients are not necessarily a limiting factor for horse use but, as for pedestrians, will of course compromise accessibility of a route or site for some. and should be considered as for pedestrians where variation in experience and agility mean some people will choose to use certain steep routes or not. In natural terrain, the feasibility of any gradient is up to the judgement of the individual. Where use of a popular steep route is causing erosion which needs control, pitching and steps can be feasible on a bridleway but greater space at any level

will be required than for pedestrians. They are not feasible on a route open to horse-drawn vehicles. Polymer-bound rubbercrumb-grit compounds have been used successfully on steep slopes to reduce erosion, with cross-gullies into the substrate filled with the porous rubber mix.

Ramps

For general purposes of a built path, such as a ramp for a bridge, a gradient of 1 in 12 is the accepted maximum for people in mobility scooters, which is rightly applied across all users to ensure accessibility. However, where a ramp is recognised as unable to accommodate mobility scooters, and a compromise is necessary to facilitate access by a majority, a gradient up to 1 in 7 is feasible for horses, depending on location, but the steeper the gradient, the more the nature of the surface is crucial to provide good grip, to reduce impact on joints, and sliding on descent.[2] In exceptional circumstances, a ramp steeper than 1 in 7, with appropriate surface (bound rubber-crumb compound for safety) may be acceptable for horses if wheeled users are not a priority in that location.

Account must be taken of the topography and conditions of the area and discussion between the Society and the highway authority is essential. Compromise may be possible where there are no alternatives, particularly with close attention to an appropriate surface and adequate provision to pass other users which, as with steps, may be passing places if an overall width of at least 3m is not feasible.

Steps

Steps discriminate against many users, on foot or cycle, with child buggies or impaired balance. That includes some riders, whose horses may not have capacity for steps. Steps are not an option on byways as they cannot be used with horse-drawn vehicles.

Where evidence suggest that steps are the only option, a last resort, because of significant site constraints, the BHS *may*, in consultation with local riders, accept

[2] There are historical rights of way and roads in hilly districts at 1 in 3, which are accessible by horses, however, this cannot be considered an acceptable norm for a ramp. A new ramp greater than 1 in 7 should only be considered on a public right of way in exceptional circumstances because of its potential to limit accessibility for all or to impose a condition of one-way use only.

that steps are considered and determine an appropriate specification to be agreed. Agreement will always be site-dependent and in response to several factors.

Level of use, sightlines and space to safely pass other users if users cannot see far enough to give way is required before decisions on specification are considered.

There is a difference between one or two steps and a long flight. The BHS may agree, when consulted, a lower standard for the former if the site's conditions make steps the most appropriate option.

The BHS may also agree a lower standard where new access for ridden horses is being provided for the first time (i.e. a creation of a new bridleway), on the basis that while not all riders may be able to use the steps, for those who can, the new route is better than no route at all.

Steps should be no less than 2m wide with frequent passing or turning places, but that is dependent on the site, its level of use and locality.

- Width 2m or more, minimum 1.5m
- Sight lines of at least 15m and passing places along the flight at no more than 15m intervals. Passing places should allow a horse to be turned if necessary and their dimensions will be dictated by the immediate terrain, such as if it is steeply falling away, a greater area to turn will be needed than if it has rising banks around it.
- If it is necessary to have more than one flight with each flight turning back on the previous, the turning area should be 3m x 3m.

Treads should be no less than 1.7m long (toe to heel of tread), depending on the number of steps and the terrain of the route. At sites likely to be well used by all abilities, 2m is optimum. One or two steps in isolation are different from a longer flight and a shorter tread may be acceptable, depending on the location and use.

For a flight of three or more steps, if insufficient space is available to gain required height, then interspersing shorter tread with longer may be acceptable, if agreed with the BHS, as follows:

- Minimum 1m length treads between 1.7-2m treads
- Minimum 1.5m length each for three treads between 2m treads

Riser height maximum 150mm at sites likely to be well used by all abilities.

170mm may be acceptable in some locations, depending on use and surrounding terrain.

In exceptional circumstances, agreed with the BHS, if insufficient space is available to gain required height, then some risers may be increased up to 200mm, for no more than one-in-three risers, and should only be considered in consultation with the BHS.

Increasing riser height means greater tread length is needed so is rarely a gain, and reducing tread length is usually preferred over increasing riser height in exceptional circumstances when a compromise is required.

To increase height gain for length, treads may slope slightly towards the front.

The 'space saver' design for pedestrians does not work for horses (two adjacent parallel narrow flights which are offset vertically by half the tread height, with each foot following its own flight).

The higher the riser, the deeper its supports need to be to stay firm. This may not be possible in some locations.

Some horses can cope with shorter steps, particularly going uphill, but most cannot downhill. At a site where the guide above does not appear feasible, alternatives should be considered with the BHS. Shorter or steeper steps must only be used where there is no option but to create a potentially one way (uphill) section with an alternative descent and should be considered exceptional circumstances as they will discriminate against users.

On steeper gradients, a horse may trot or canter up steps to maintain impulsion and because the sequence in which its legs are used may make the faster pace easier than in walk, so it is a natural response of the horse. The surface of the treads must be able to withstand this use without erosion or slip hazard.

Mounting blocks will be welcome if the gradient is such that some riders may feel safer leading rather than riding their horse.

Recommendations for a common backfilled timber frame construction are:

- Use hardwood for the frame, especially the riser, e.g. railway sleepers, rather than softwood which is more likely to splinter if caught by a horse's hoof.

- Ensure the supports for the risers are deep to avoid the riser being pushed forwards – the higher the riser, the greater the load against the riser may be (depending on the area of the tread).
- Consolidate the backfill thoroughly and ensure a good layer of fines. As with steps on a footway, erosion at the point of impact coming down and going up need extra attention to ensure hollows do not form with use. Impact increases with gradient so greater attention may be needed to construction and maintenance with steeper slopes.
- Provide for drainage and run-off to the side to avoid cascading down the steps.

If a handrail is desired for pedestrians, the available width for horses should be at least 2m otherwise there is a risk of the rider's foot or leg catching the handrail, potentially with serious injury. A handrail acts like a fence alongside the bridleway and such a situation would normally require at least 3m width to allow users to pass one another in comfort and to avoid a rider being too close to the fence (handrail). For only a couple of steps, the greater width may not be necessary but a longer flight with limited width may need passing places or open ground to one side of the steps without a handrail.

Steps in upland or remote areas

On steep slopes, many horses will tend to descend partly sideways rather than straight, at an angle across the slope, and back legs may slide which can cause erosion. It may sometimes be necessary to construct steps to reduce erosion.

Steps in remote areas or a more challenging environment may be very different from in a highly used area. In remote uplands, riders and horses are more likely to be able to cope with steep gradients and higher steps, as will occur naturally in terrain down to bedrock. When improving such a route or incorporating steps to reduce erosion, it is the length of a horse which is misunderstood by those unfamiliar with horses, and the fact that it has four feet to accommodate. The following are recommended:

- Study how horses move on slopes and how much space they use.
- Aim to produce a variety of heights and lengths, as would occur naturally in a large scale version of the stone pitching that is used on some upland paths.

- Step height should not exceed 150mm. Greater than this height should be occasional, not every step.
- A riser of more than 150mm should have a long tread below it as it will be most difficult to descend and a horse may try to jump it.
- Leave an area big enough for a horse to have all four feet on one level every several steps to provide relief from the strain of having front and back legs on different levels – this usually works well as the long tread below a higher riser.

However, sometimes limitations of a site indicate higher risers or shorter treads, in which case, the BHS should be consulted on options and agreement reached with the Society.

Crossfall

A crossfall up to 1:10 is less likely to cause problems of slipping and erosion and is therefore acceptable, although this is dependent on drainage and surface type. Greater than 1:10 will need consideration of location, circumstances and use, particularly where this is a proposed diversion, or a route used with horse-drawn vehicles.

Where crossfall is greater than desirable on a new route which offers an off-road alternative, this may be accepted, however, some earthwork to reduce the crossfall would be beneficial to reduce future maintenance.

Natural surface with short grass is likely to be most acceptable. The best alternative is resin or polymer-bound rubber-crumb-grit compound. Asphalt or concrete with a crossfall greater than 1:10 is unacceptable.
