

Housing Estate Road Construction Specification January 2023

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HOUSING ESTATE ROAD CONSTRUCTION SPECIFICATION

January 2023

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INTRODUCTION

- i. Cambridgeshire County Council as Highway Authority is committed to adopting all residential estate roads under Section 38 of the Highways Act 1980 that serve a highway function, to five or more individual dwelling units and that have been constructed in accordance with this Construction Specification. Failure to comply with this construction specification will result in the road not being adopted by the Highway Authority. As part of the adoption procedure, it is incumbent on all Developers to fully co-operate with all Highway Authority staff and Representatives.
- ii. Developers shall ensure that the engineering details are approved before work starts on site. This requires sufficient time to be allowed by the Developer from the granting of planning permission to the proposed start date. This is of particular importance if third parties (i.e. the Environment Agency) approvals are required. Works undertaken by the Developer without approved drawings will be wholly at their own risk and the Highway Authority reserves the right to require suitable testing of any such works to be undertaken at the cost of the Developer. The number, location and types of tests will be decided by the Highway Authority. If any of the tests fail the Highway Authority reserves the right to require that the development be reconstructed to this specification.
- iii. All costs associated with the technical approval of the works required for the proposed development must be borne by the developer.
- iv. The Developer is required to provide specific items of information as part of the engineering detail process. The submission shall comprise:
 - a) Copy of the Full or Reserved Matters Planning Approval Decision Notice
 - b) One copy of the detailed layout approved by the Local Planning Authority
 - c) 1:2500 Site location plan
 - d) 2 x copies of the layout drawing showing the extent of the proposed adopted public highway shown in pink, proposed gully locations, connexions to the public surface water sewer and any highway drains are to be shown in blue. Any works within the existing adopted public highway shall be shown in green.
 - e) 2 x copies of the site engineering layout at 1:200 or 1:500 scale to show all dwellings, slab levels and vehicular accesses, junction and pedestrian to vehicle visibility splays and surface water drainage layout. This drawing will form the basis of the agreement dedication plan.
 - f) 2 x copies of standard construction details, cross sections, longitudinal sections, drainage details and all other supporting drawings
 - g) 2 x copies of a drawing showing the areas drained by each gully. The areas drained will be identified by varying the direction of a simple 45 degree-line hatching. The plan shall show the areas drained by each gully in numbers, high points/ low points and the direction and gradient of the fall to the gully expressed as a factor of 1 (i.e. 1:150).

- h) 1 x copy of the approval of LLFA of relevant drainage body for works to watercourse (where affected by the works)
- i) 2 x copies of the site investigation/ soils report to justify the design CBR used, based upon the plasticity index.
- j) Full set of drawings and supporting documents provided electronically.
- k) Site engineering layout showing location and nature of all utilities/ statutory undertakers' apparatus. The Highway Authority will not accept the installation of non-passive private apparatus within the adoptable highway, without the prior written consent of the Engineer.
- l) A completed street lighting brief and supporting information.
- m) Subject to the site-specific requirements to be agreed with the engineer, a condition survey existing highway/ approach road, which may comprise photographic/ video survey, and/ or cores of the existing carriageway.

If the above information is not fully provided, technical vetting process will not commence.

- n) The developer shall provide signing and road markings in accordance with the Traffic Signs Regulation & General Directions. Prior to adoption, all new housing estate roads shall be subject to a formal speed limit of 20mph (promoted with the appropriate Traffic Regulation Orders), unless otherwise agreed with the Engineer.
- v. To properly construct the new estate road, the Developer will have to work within the existing public highway. These works can form part of the Section 38 Agreement. However, if the Developer wishes to commence these works before the Section 38 Agreement is signed, they can be carried out under a Section 278 Agreement of the Highway Act 1980. Extra charges will be incurred as part of this process which must be fully borne by the Developer. No reduction in the Section 38 bond or fees will result if works relating to the Development are implemented under a Section 278 Agreement.
- vi. The Developer will ensure that a copy of this Specification is always on site and is readily available to all ground workers, engineers or any other staff involved in the management, construction, detailing or the like in relationship to the construction of the proposed adopted public highway.
- vii. In matters concerning the construction, layout, design, compliance with this specification etc., in relationship to areas of proposed adopted public highway the decision of the Engineer is final.
- viii. It is recommended that the Developer contact the Engineers representative prior to any works commencing on site to arrange a meeting to discuss general working arrangements and any issues that may be specifically linked to the proposed development. Where this has occurred in the past it has been beneficial to both parties.

- ix. In responding to the technical comments through the vetting process, the designer shall provide a commentary in relation to the points addressed, and drawings shall be updated and revised elements shall be clearly annotated.
- x. The Developer shall allow a period of 8 weeks within the work programme for receipt of comments in respect of the initial engineering submission, and in respect of any subsequent amendments as may be required. The onus is therefore upon the Developer and their agents to submit a comprehensive compliant design, to minimise the duration of the technical vetting process.
- xi. Prior to the signing of the Section 38 Agreement, the Highway Authority will require that a signed Section 104 Agreement with the respective sewerage authority is in place.

1. Street Works Licences

No work shall be carried out in the public highway without the prior approval of the Highway Authority. For any work that is carried out within the public highway, a licence must be obtained from:

Street Works and Permitting Manager
Cambridgeshire County Council, Vantage House, Washingley Rd, Huntingdon,
Cambridgeshire, PE29 6SR
Tel: 0345 045 5212 E-mail: street.works@cambridgeshire.gov.uk

The Developer is required to notify the Street Works and Permitting Manager of all works within the highway. The form for street works notification, and the traffic lights form, should temporary traffic lights be required as part of the traffic management of your works, are available via the following link:

<http://www.cambridgeshire.gov.uk/highwaylicences>

In order to ensure there is no delay to your works commencing on site, please submit the forms at least six weeks before you propose to commence on site, to the Street Works Coordinator at the above address.

All licences and permissions must be issued before any work commences, and it is the responsibility of the Developer to apply for any licences that may be required well in advance. Working within the highway without the appropriate licences is illegal and the Highway Authority will, if required, take appropriate legal action against any Developer, who is found to be in breach of the Highways Act 1980.

2. Third Party Insurance

The Highway Authority shall not be held responsible for damage to property or apparatus where such damage arises as a consequence of the work associated with the estate road or any work within the existing highway.

It is the responsibility of the Developer to ensure that they and their Contractor(s) hold adequate third-party liability insurance whilst working in the highway, any party undertaking such works must be able to demonstrate possession of valid insurance to the value of £10,000,000 for any one incident, number of incidents unlimited upon demand.

3. Inspection Regime

It will be the responsibility of the Developer to notify the Engineers representative at least five working days before any works to the proposed adopted public highway are to be undertaken, to enable a suitable level of inspection to be arranged. Works undertaken without suitable notification or technical approval will be carried out wholly at the Developers risk and may be condemned by the Engineer.

The following list is a guide to the works that will require inspection and should therefore be notified to the Engineer, the list is not exhaustive:

- a) Surface water drainage – work to start inspection of drain run and trench backfill
- b) When any soil tests are undertaken in areas that are proposed to become part of the adopted public highway
- c) Formation – level, soft spots removed, and ready to receive sub-base
- d) Sub-base – sub-base material approval required and laying to commence – compliant test data and surface stiffness must be available prior to commencement of base/binder course installation
- e) Kerblines – kerbing to start and inspection of kerb beam and kerb line
- f) Base/Binder-course – start of work, inspection of compaction
- g) Street Lighting - planting of columns
- h) Footways/Cycleways – inspection of back edgings, formation, sub-base and Binder Course
- i) Carriageway Surface course – inspection of compaction and finished surface
- j) Footway/Cycleway Surface course – inspection of compaction and finished surface
- k) Sand bed and blockwork
- l) Inspection of the completed estate road to start maintenance period
- m) End of maintenance period - Final inspection prior to adoption

Additional non-notified inspections may also occur as and when the Engineer deems necessary.

The Engineer reserves the right to request cores of all carriageways, cycleways and footways at the Developer's expense before the surface course is laid in accordance with Clause 24.01.2 of this specification. The location and number of the cores will be at the discretion of the Engineer.

4. Street Name Plates

The District Council has the responsibility for street naming and numbering. Depending on the District Authority in which your development is located, you may be required to erect the street nameplates (once the District Authority has advised you of the name(s) chosen), or you may be required to pay the District Council to undertake the task. Please ensure that you consult the relevant District Council in good time to facilitate appropriate timeliness of the process.

5. Temporary Signing of New Housing Developments

The Highway Authority may, in certain circumstances, permit developments to be temporarily signed. The proposed location of the signs must be approved by the Highway Authority prior to the installation of any such signing.

The signed route must start at the nearest Classified County Road (or Trunk Road) or other signed route which can be used to direct users of the highway to the site without the need for specific temporary signs.

The minimum size of development that the Highway Authority will allow signage on public highway for will be 10 separate dwelling units or 30 flats / apartments / maisonettes or the like.

The design of the temporary signing shall conform to Diagrams 2701 and 2701.1 Schedule 13, Part 6 of The Traffic Signs Regulations and General Directions 2016. The signs shall be manufactured using a compliant material.

The lowest edge of the signs must be set at least 2.45m above the surface of a footpath, footway or verge, at least 3.0m above the surface of a shared use path or cycleway and at least 5.4m above the surface of a carriageway over which they project.

All signs must be attached to existing street furniture. Where signs are proposed to be attached to street lighting columns the developer must contact Cambridgeshire's Street lighting. The Highway Authority will not permit the installation of new posts within the adopted public highway for temporary signing.

The signing schedule shall form part of the approved drawings for any Section 38 Agreement and the provisional certificate for the site will not be issued until all the temporary signing has been removed.

If the proposed development is not to be offered for adoption, the Highway Authority reserves the right to impose what reasonable fees, charges and deposits it feels are necessary to control the use of temporary signing within the adopted public Highway.

Please note none of the above exempts the Developer from the possibility that Planning Permission may be required for the temporary signing and the Highway Authority suggests that the advice of the Local Planning Authority is sought on this matter by the Developer.

6. Definitions

The following list of words used in this document has the meanings ascribed to them below. These meanings relate to this document only.

California Bearing Ratio (CBR) – A value for comparing strengths of soils; in this specification the design CBR value is obtained from Table 2A - Design of CBR Values

Carriageway - the surfaced part of the road primarily designed for the use of all vehicle types

CASC/ CASC+ – Cambridgeshire Asphalt Surface Course

Channel - Narrow strip, generally at the edge of the carriageway, designed to carry and lead away surface water

Cycleway – that part of the highway over which the public have a right of way by cycle

Developer - A person or group of person who are responsible for the construction, maintenance etc., of the site within which the proposed adopted public highway is to be built

Engineer – Executive Director – Place and Economy, their successor or their designated Representative

Footpath - A way over which the public have a right of way on foot only, not being a footway. A footpath will not be subjected to any possible vehicular overrun

Footway - that part of the highway, being a way over which the public have a right of way on foot only which is adjacent to a carriageway.

Formation - The level at which highway construction meets natural ground surface or the completed earthworks

Gully - a pot, generally trapped, constructed in the carriageway edge to drain water from the carriageway

HAPAS - The Highway Authorities Product Approval Scheme was set up by the Highways Agency, CSS and the British Board of Agrément, with the objective of developing national approval arrangements for innovative products, materials and systems for use in highways and related areas, removing the need for individual authorities to carry out their own assessments and tests

Highway - The highway comprises of the carriageway, cycleway and/or footway surface and any verges or visibility splays between the boundaries

Lightweight Deflectometer – test for measuring the foundation surface modulus stiffness value

Maintenance Strips – adoptable area behind kerbing required for kerb maintenance

Manhole - A chamber and shaft constructed to enable access at intervals along highway drainage and/other service

Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works (SHW) –The national specification for all construction and maintenance works on public highways. The Specification details all materials and workmanship standards that must be met. This Cambridgeshire County Council Construction Specification clarifies the local interpretation of the SHW

Section 38 Agreement (S38) – An agreement between the County Council as Local Highway Authority and the Developer under Section 38 of the Highways Act 1980

Section 278 Agreement (S278) - An agreement between the County Council as Local Highway Authority and the Developer under Section 278 of the Highways Act 1980

Subgrade - Natural ground material at and below formation

Tree Preservation Order - A TPO is made by the local planning authority to protect specific trees or particular woodland from deliberate damage and destruction

CONSTRUCTION SPECIFICATION

1.0 GENERAL REQUIREMENTS

1.01 Design Considerations

1. Where a site may be liable to flood no finished highway level shall be lower than the adjacent minimum floor level of the dwellings approved by the relevant Authority. In addition, it shall be no lower than the existing highway or otherwise from which access to the estate is gained, whichever is the lower. Finished carriageway levels/ flood flow path levels should be below the adjacent FFL's.
2. The Highway Authority will not accept water from privately owned areas being collected by highway drainage. Permeable paving is not considered an adequate intervention to prevent surface water discharging onto the adoptable highway for the lifetime of the development. Private infrastructure should therefore be designed to fall away from the highway, or positive intervention will be required.
3. Work shall not start on site until the Engineer has formally approved the Section 38 plans in writing. All Section 38 works shall be designed in accordance with this Specification. Any works commencing in advance of technical approval are undertaken entirely at the Developers liability.
4. All carriageways are to be cambered, unless expressly agreed in writing with the Engineer.
5. If the development is deemed to require an overland flood route in an exceedance event as part of its flood water mitigation strategy, then the permission to use any adoptable public highways for such a route must be gained before any submission for a Section 38 Agreement is made.
6. Where it is intended that the adoptable highway shall form part of an overland water conveyance route during an exceedance event, the roads to be used as such must be constructed to a traditional format, i.e. with carriageway and footways with full faced kerbs, except where accesses to properties are to be provided. Such roads must be cambered in accordance with Clause 1.01(4) of the Housing Estate Road Construction Specification.
7. The use of shared surfaces as part of an overland flood exceedance route will not be permitted and will preclude the adoption of the streets.
8. Where it is intended that the proposed adopted public highway shall form part of an overland water conveyance route, the roads to be used as such must have a continuous longitudinal fall of not less than 1:200 and shall contain no features such as speed tables etc., that will impede the free flow of the flood water.
9. The designer is referred to the required street gradients set out in Section 13.04; failure to achieve design compliant gradients may preclude the future adoption of the streets, and early dialogue with the Engineer is advised where it may be apparent that design compliant gradients may not be achievable.

10. During the construction phase it is the local authority's preference that all construction traffic shall use an internal separate haul road and not use the route of the estate roads. If this is not possible then the estate roads must be protected against damage, with an allowance for the additional standard axles generated from the construction HGV's which may impact upon its intended design life. Please refer to Sub-Clause 1.02 (1).
11. If the estate road is trafficked during the construction phase then the local authority will not adopt the finished carriageway until all construction movements have finished and reserve the right to reconstruct any areas that exhibit any form of defects.
12. The surface course shall only be applied after all construction work has been completed within that specific phase of the development, and all construction traffic has ceased to use the streets. If the developer chooses to install a surface course beforehand this can be undertaken on the understanding it will be a sacrificial layer and must be removed and replaced at the end of the construction phase.

1.02 Design of Construction Thickness

1. If the estate road is to accommodate site construction traffic, the following enhancements are required.
 - (i) Trafficking of the sub-base foundation only – an additional 150mm of sub-base is required as a protective layer, this will then be trimmed back to the design sub-base thickness upon completion of the construction phase.
 - (ii) Trafficking of the Binder Course – the overall finished pavement thickness must be increased to 300mm. The additional 60mm shall be incorporated into the Base layer.
2. Carriageway construction alternatives are shown in Appendices 1, 2 and 3.
3. A ground investigation for the proposed development shall be provided along the centreline of the proposed highway before any construction works to the proposed adopted public highway commence. The CBR tests the Developer shall carry out are detailed below. The minimum information for road design purposes must include soil classifications and in-situ moisture contents produced from the logs of bore holes or trial pits.
 - a) Construction thickness is dependent on the equilibrium CBR values derived from the Plasticity Values from Table 2A - Design of CBR Values, at proposed formation level on the line of the road. The Developer shall determine these values and produce the required evidence with the preliminary plans submitted for approval.
 - b) For all sites soil tests shall be carried out at a minimum of two tests per road along the centreline of the proposed adoptable public highway, the exact number and frequency to be agreed by the Engineer prior to commencement. The initial test shall be positioned at the entrance to the proposed development and the final test shall be placed at the end of the 'road' to be offered for adoption.

- c) The required tests shall be taken at a depth of 500mm below the level of the proposed finished highway surface
 - d) On all sites the lowest CBR design value will be used to determine the construction depth (see Section 2). If the CBR design values are concentrated in particular locations the Engineer may consider permitting the use of localised excavation depths in correlation to the measured values
 - e) If the Developer fails to undertake a regime of testing as detailed above the Engineer will consider any other results to be insufficient to derive a suitable CBR value and the whole site will have to be designed using a value of less than 2%
4. Where derelict sites, landfill areas, soft ground, buried structures, etc., are a feature of the development area, special design measures may be necessary and the Engineer's approval for the detailed design must be sought and obtained by the Developer prior to starting the Highway works.
5. All sampling and testing shall be performed in accordance with relevant current British Standards (or equivalent). Where appropriate, all laboratory results shall be reported on UKAS certificates.

1.03 Junction Design - Requirement for Safety Audit

1. Following the grant of planning permission and the accompanying Stage 1 Road Safety Audit, designs for new junctions on the public highway may be subject to Safety Audit at Stages 2 & 3. For continuity across the County, such Safety Audits should be carried out by Cambridgeshire County Councils Road Safety Engineering Team, on a submitted detailed design and specification in accordance with the latest DMRB document.
2. Applications for Section 38 Agreements for new roads incorporating junctions comprising right turn facilities, roundabouts or traffic signals must be accompanied by a formal request for a Stage 2 Safety Audit to be carried out by Cambridgeshire County Councils Road Safety Engineering Team, together with an undertaking by the Developer to pay the reasonable costs of the Council in executing this work. Third party Audits may be undertaken; however, such Audits will incur additional cost for internal review.
3. Any such costs are additional to the Agreement fee payable to the Council under the terms of the Section 38 Agreement and are payable within 21 days of the date of the final Safety Audit.

1.04 Mud etc., on the Highway

1. When any mud, clay or similar material has fallen or been deposited on a highway from a vehicle that has entered, left or serviced the development site it shall be removed from the highway completely, as soon as is reasonably practicable. The Developers attention is drawn to Sections 148 and 149 of the Highways Act 1980.
2. The person in charge of any vehicle shall not bring the vehicle, or cause it to be brought upon a highway, unless there has been removed from the wheels thereof as completely as is reasonably practicable all mud, clay, lime or similar material which is likely if not so removed, to cause obstruction, nuisance or danger to persons using the highway, or injury to the surface of the highway.
3. In order to achieve acceptable low levels of carriageway contamination the Developer will install suitable wheel washing or pressure washing facilities, the cost of this installing and operating the wheel washing will be borne by the Developer.
4. Suitable approved warning signs must be exhibited whilst works are in progress.
5. The Developer shall also ensure that all highway drains and ditches, roadside grips and other drainage features, are kept clear of any spoil, mud, slurry or other material likely to impede the free flow of water therein. If instructed by a representative of the Highway Authority all highway drains and ditches, roadside grips and other drainage features, shall be cleaned and made to flow freely with all due haste.

1.05 Prohibition of use of the Highway

1. The existing public highway must not be used as site roads or sites for stockpiling and storing plant, materials or equipment. The Developer shall be liable for the cost of reinstatement if any damage has been caused to the highway.

1.06 Notification of Emergency Telephone numbers

1. The Developer shall erect and maintain for the duration of the construction of the estate roads, a board or sign, within the site boundary, but clearly visible from the adopted highway, indicating the name and contact telephone number of a responsible person for the site. The named person and contact telephone number shall be available 24 hours a day, seven days a week, should the Engineer need to advise the Developer and/or Contractor of a serious or dangerous situation.

1.07 Preliminary Site Works

The developer is advised to contact Street Works Team at the earliest opportunity to discuss the booking of road space.

1. Following the issue of a Street Works licence to place apparatus in the highway, the Engineer must be given a minimum of five working days notice of the start of the highway construction works to arrange a suitable regime of inspection and must be

kept informed of the construction programme thereafter. Please note that on traffic sensitive routes at least 28 days notice is required before works may commence on site.

2. The work shall be carried out to the satisfaction of the Engineer, who shall have free access at all reasonable times to any part of the works.
3. During construction, the Developer may be required to prove the thickness and type of any material or layer if it has been covered prior to inspection - refer to Clause 24.01.2 of this specification.
4. The estate roads and visibility splays shall be laid and set out in accordance with the approved plan and maintained in this form until the relevant physical works are complete.
5. The new estate road, where it joins the existing public highway, shall have its bellmouth, footways and visibility splays constructed to finished surfacing levels prior to any other works taking place on the site. The existing carriageway surfacing shall be cut back to a clean vertical edge and the development constructed up to that edge. The surface course shall be overlapped by 300mm with the vertical joint receiving hot applied 40-60 pen bitumen, as shown on Appendix 11 – Stepped Construction Detail, unless otherwise agreed by the Engineers representative.
6. In the construction of shared surfaces, the Highway Authority encourages the Developer to use a sacrificial layer of a minimum of 80mm of bituminous base to provide a suitable running surface while permitting the installation of all connections to the public utility services that inevitably damage the bituminous construction of the highway. Such damage can lead to extensive and costly full depth reinstatements where a sacrificial layer has not been used.

1.08 Commuted Sums

1. The Highway Authority reserves the right to impose on a Developer a suitable commuted sum for extra costs associated with using materials within the adoptable public highway that do not form part of this specification, that result in a greater maintenance burden, or areas over and above those considered necessary for the effective operation of the highway.
2. Commuted sums shall be determined in accordance with the adopted County Council Policy.

1.09 General Construction Requirements

1. All materials and workmanship shall be in accordance with the appropriate British Standard/European Standard and SHW, current at the time of the appropriate S38 /S278 Agreement. All materials shall be kite-marked or produced within a defined quality assurance scheme unless otherwise approved by the Engineer.
2. The design of the works must be site specific.

3. Maintenance strips are utilised on shared surface access roads. All maintenance strips shall be a minimum of 0.48m wide and shall comprise of a paved surface. Utility easements may still be required in addition to the maintenance strips, where the maintenance strips shall not be used for the installation of services.
4. A sustainable approach to highway construction and the use of recycled products is encouraged. Such products should be utilised wherever it is possible to include them without compromising the quality of the finished works. Evidence of suitability for all recycled materials shall be provided to the Engineer prior to use. This approval process and any expansion of this specification will only be provided at the Developer's expense.

1.10 Surface Regularity and Tolerances

1. Surface Regularity - The regularity of the completed surfaces of estate road carriageways, cycleways and footways shall comply with the requirements of the following Table 1A.

Table 1A - Transverse and Longitudinal Straight Edge Measure

Highway Layer	Maximum deviation permitted under the appropriate straight edge
Surface Course Asphalt	Max 5mm under a 3m straight edge
Blockwork	Max 2mm difference in level between adjacent Blocks and max 6mm under a 3m straight edge
Footways & Cycleways	Max 3mm under a 1m straight edge

2. In addition, for estate road carriageways exceeding 40m in length and for lengths of cycleway, footway, footpath and shared surfaces exceeding 40m continuous length, without dropped kerbs intervening, then the following Table 1B shall also apply.

Table 1B - Longitudinal Rolling Straight Edge Measure

Irregularity	4mm	7mm	>10mm
Permitted max number of irregularities per 40m length	10	1	Nil
Permitted max number of irregularities per 75m length	18	2	Nil

3. At the discretion of the Engineer occasional trenches may be allowed. Cross trenches that are cut through any carriageway surface must be restored to coincide with the mean level of the immediately adjacent surface. All services must be installed prior to any asphalt being laid. Attention is drawn to the requirements of Section 5.0 - Backfilling Trenches and Appendix 11, Stepped Construction Detail.

4. The Developer shall set all fixed surface features, boxes and ironwork in the footway, cycleway or carriageway to coincide with the mean level of the immediately adjacent surface. Such fixing shall be done prior to the final wearing course.
5. Tolerances - The difference in level of a fixed surface feature and the immediately adjacent surface shall not exceed a tolerance of + or - 6mm except for those contained in Table 1C.

Table 1C – Tolerance for other fixed surface features

Kerb upstand	125mm +/- 5mm
Access way kerb upstand	25mm +/- 3mm
Vehicular crossing kerb upstand	25mm +/- 3mm
Pedestrian and Cycleway Crossing kerb upstand	6mm
Surface Adjacent to Gullies	-10mm to – 5mm
Surface Adjacent to PCC channels	+3mm to +6mm

6. For a Diagram of the Stepped Construction Detail, refer to Appendix 11.

2.0 DESIGN OF CARRIAGEWAY CONSTRUCTION

2.01 General

1. Appendices 1, 2 and 3 detail acceptable standard construction thickness for the permitted range of alternative base types and show the sub grades of various CBR's.
2. CBR values to be used for design are to be derived from plasticity index testing using samples from agreed appropriate depths and positions on site. Full test results including moisture content at test plasticity indices and materials classification must be submitted to support the claimed design CBR value, which shall be derived from Table 2A below.

Table 2A – Design of CBR Values

Soil Type	Plasticity Index from soil survey	Design CBR %
Plastic Clay	50 or greater	< 2
Silty Clay	40 - 49	2
Silty Clay	30 -39	3
Sandy Clay	20 – 29	3
Very Sandy Clay*	10 - 19	4
Very Silty Clay*	10 - 19	< 2
Silt	-	< 2
Sand (poorly Graded) (C.O.U. <10)	-	7
Sand (well graded) (C.O.U. >10)	-	10
Sandy Gravel (well graded) (C.O.U. >10)	-	15
Chalk	-	5

* Plasticity Index between 10 – 19 may require a particle size distribution test, or a CBR of < 2 will be assumed. See Clause 2.01 (8)

2. If Plasticity Index Values are not available from soil survey and test data for the proposed site, a CBR of less < 2 shall be assumed for the design.
3. A soil assessment cone penetrometer (MEXE probe) may be used for on-site checks for soft areas. Alternatively, if available vehicle mounted in-situ CBR testing equipment may be used.
4. The MEXE probe and other in-situ methods will not be acceptable for establishing the Design CBR values, only for locating areas where the in-situ values may be lower than the agreed Design CBR value.
5. The total carriageway way thickness shall be at least 490mm inclusive of sub-base.

6. Concrete block paving within the proposed adopted public highway is generally restricted to use on shared surface areas. Where used it must be installed with one of the base options and the required sub-base as detailed in Appendix 3.
7. It is noted that Plasticity Indexes between 10 and 19 can be either a Silty or Sandy Clay with considerable differing design CBR values. To clarify which category is applicable, the Particle Size Distributions shall be provided, or worst case CBR will be assumed.

3.0 CONSTRUCTION AND EARTHWORKS MATERIALS

3.01 General

1. All materials used in the works shall comply with the relevant current British Standard/EN Specification and/or the current edition of the SHW.
2. The materials shall be to the approval of the Engineer and samples shall be submitted for approval if required. Free access shall be granted to the Engineer's Representative for sampling during the works. The Engineer may require independent testing of material at the Developers cost.
3. To avoid any future consolidation and settlement within the carriageway, the Engineer requires any Clay fill must be installed in accordance with the following standard end performance method:
 - (i) The Clay Source must be tested to prove consistency by PI's and Moisture Contents and also undertake an Optimum Moisture Content / Maximum Dry Density test. This will result in a Fill Class in accordance with SHW Table 6/1. (It should be noted Site Stockpiles after a wet winter period are notoriously difficult to achieve consistent moisture levels despite being "sealed" [sealing is never totally effective] which then impacts onto the end products compliance)
 - (ii) Once Classified above – the contractor needs to propose a standard method statement in accordance with SHW Table 6/4 i.e. Roller size, number of passes and layer depth to be approved by the Engineer.
 - (iii) During installation each layer should be tested – initially by using a Hand-Held Shear Vane which should give minimum values of 50 kPa – this provides an early indication whether the material being placed is being fully compacted before placing any subsequent layers. Samples should also be taken to check the moisture content for consistency of supply.
 - (v) In order to prove 95% compaction, the insitu density of each layer should be tested with at least 1 set of cores. If a suitable density gauge is proposed this can be used but must be calibrated weekly against a pair of extracted cores. The insitu density can then be compared against the Maximum Dry Density in (i) above.

- (vi) In the case that the material has already been placed then the layers would have to retrospectively tested with using the above methods to prove that 95% compaction has been achieved.

3.02 Definition, Classification and General Use of Earthworks Materials

1. The following definitions of earthworks materials shall apply to this and other Clauses of the Specification in which reference is made to defined materials.
 - a) 'topsoil' at the discretion of the Engineer the first 100mm of any grassed area may be considered topsoil otherwise all material from grassed areas and the like shall be deemed to be unacceptable material, this must conform to BS 3882:2015
 - b) 'suitable material' shall comprise all that which is acceptable in accordance with the Specification for use in the works
 - c) 'unsuitable material' shall mean other than suitable material
2. For the purpose of Table 3A - Earthworks Compaction as below, materials are grouped as follows
 - a) 'cohesive soil' includes clays and marls with up to 20% of gravel or rock and having moisture content not less than the level of the plastic limit (determined in accordance with BS 1377 Part 2:1990) -4; chalk having saturation moisture content of 20% or greater
 - b) 'well graded granular and dry cohesive soils' includes clays and marls with up to 20% of gravel or rock and having a moisture content not less than the level of the plastic limit (determined in accordance with BS 1377 Part 2:1990) -4, well graded sands and gravels with a uniformity coefficient exceeding 10 and chalk having a saturation moisture content of 15-20%
 - c) 'uniformly graded material' includes sand and gravels with a uniformity coefficient of 10 or less and all silts and pulverised fuel ashes. Any soil containing 80% or more of material in the particle size range 0.06mm – 0.002mm will be regarded as silt for this purpose

Table 3A – Earthworks Compaction

Type of Compaction Plant	Category	Cohesive Soils		Well Graded Granular and Dry Cohesive Soils		Uniformly Graded Material	
		D	N	D	N	D	N
Smooth wheeled Roller	Mass per meter width of roll Kg/m						
	Over 2100kg up to 2700kg	125	8	125	10	125	10
	Over 2700kg up to 5400kg	125	6	125	8	125	8
	Over 5400kg	150	4	150	8	Unsuitable	

Vibrating Roller	Mass per metre width of roll on a vibrating roller Kg/m	D	N	D	N	D	N
				*		*	
	Over 270kg up to 450kg	Unsuitable		75	16	150	16
	Over 450kg up to 700kg	Unsuitable		75	12	150	12
	Over 700kg up to 1300kg	100	12	125	10	150	6
	Over 1300kg up to 1800kg	125	8	150	8	200	10
	Over 1800kg up to 2300kg	150	4	150	4	225	12
	Over 2300kg up to 2900kg	175	4	175	4	250	10
	Over 2900kg up to 3600kg	200	4	200	4	275	8
	Over 3600kg up to 4300kg	225	4	225	4	300	8
	Over 4300kg up to 5000kg	250	4	250	4	300	6
	Over 5000kg	275	4	275	4	300	4
Vibrating Plate compactor	Mass per unit area of base plate Kg/sqm	D	N	D	N	D	N
				Unsuitable		Unsuitable	
	Over 880kg up to 1100kg	Unsuitable		75	10	100	6
	Over 1100kg up to 1200kg	Unsuitable		75	6	150	6
	Over 1200kg up to 1400kg	100	6	125	6	150	4
	Over 1400kg up to 1800kg	150	6	150	5	200	4
	Over 1800kg up to 2100kg	200	6	200	5	250	4
	Over 2100kg						
Vibro-Tamper	Mass	D	N	D	N	D	N
				100	3	100	3
	Over 50kg up to 65kg	125	3	125	3	200	3
	Over 65kg up to 75kg	150	3	150	3	225	3
	Over 75kg up to 100kg	225	3	200	3	225	3
	Over 100kg						

D = Maximum depth of compacted layer N = Minimum number of passes

*** For twin-drum machines with both drums vibrating, halve the number of passes. If in doubt concerning machine-rating contact the Engineer**

3. The majority of small vibrating plate compactors do not comply with the minimum requirements of this table and are therefore not suitable of sub-base compaction.
4. Manufactures plant should be checked against the Type and Category columns to determine their suitability and performance and layer thickness.
5. The Developer shall only employ that plant which is suitable to the soils that are to be handled. The Developer shall take care to maintain the nature of the suitable material so that when it is placed and compacted it remains suitable in accordance with the Specification.
6. Any fill material used within 500mm of concrete structures or cement bound materials shall have a soluble sulphate content not exceeding 1.9g/lte when tested in accordance with clause 5 of BS1377-3:2018, unless special precautions to the approval of the Engineer are taken to protect the concrete or cement bound materials.
7. Where the excavation reveals a combination of suitable and unsuitable materials the Developer is advised to carry out the excavation in such a manner that the suitable materials are excavated separately for use in the Works without contamination by the unsuitable materials.

3.03 Definition, Classification and General Use of Sub-base Materials

1. Materials for use as sub-base shall comply with the requirements of Section 9.0 of this Specification.
2. The compaction of sub-base materials shall meet the requirements of Table 3B - Sub-base Compaction, below.

Table 3B – Sub-base Compaction

Type of Compaction Plant	Category	Number of passes for layers not greater than:	
		110mm	150mm
Smooth wheeled Roller	Mass per meter width of roll Kg/m		
	Over 2700kg up to 5400kg Over 5400kg	16 8	Unsuitable 16
Vibrating Roller	Mass per metre width of roll on a vibrating roller Kg/m	*	*
	Over 700kg up to 1300kg	18	Unsuitable
	Over 1300kg up to 1800kg	6	16
	Over 1800kg up to 2300kg	4	6
	Over 2300kg up to 2900kg	3	5
	Over 2900kg up to 3600kg	3	5
	Over 3600kg up to 4300kg	2	4
	Over 4300kg up to 5000kg Over 5000kg	2 2	4 3
Vibrating Plate compactor	Mass per unit area of base plate Kg/sqm		
	Over 1400kg up to 1800kg	8	Unsuitable
	Over 1800kg up to 2100kg	5	8
	Over 2100kg	3	8
Vibro-Tamper	Mass kg		
	Over 50kg up to 65kg	4	8
	Over 65kg up to 75g	3	6
	Over 75g	2	4

*** For twin-drum machines with both drums vibrating, halve the number of passes. If in doubt concerning machine-rating contact the Engineer**

3. The majority of small vibrating plate compactors do not comply with the minimum requirements of this table and are therefore not suitable of sub-base compaction.
4. Manufactures plant should be checked against the Type and Category columns to determine their suitability and performance and layer thickness.

3.04 Definition, Classification and General Use of Trench Reinstatement Materials

1. For the purposes of Table 3C below – Trench Reinstatement Compaction, materials are grouped as follows
 - a) Granular materials
 - b) Bituminous materials

These materials shall be strictly to the specification and overall thickness stated in this Specification.

2. The compaction of the trench reinstatement materials shall meet the requirements of Table 3C - Trench Reinstatement Compaction Table, as below

3.05 Concrete Specifications

1. The requirements for the concrete grades shown in the Specification are for Class DS-1 conditions in accord with Table 2 of the BRE Special Digest 363 (2001). Where other than Class DS-1 conditions are encountered then the mix shall reflect the requirements of Table 2 of the above Digest. All concrete references relate to BS 8500:2015 +A2:2019.
2. Aggregates shall comply with BS EN 12620:2002+A1:2008 including the option to utilise all-in aggregates. The stated size shall be 20mm unless otherwise stated.
3. The ratio of the combined or all-in aggregate to the cement for the most basic mixes shall be not more than 1:8 by volume or 1:10 by mass. No account needs to be taken of bulking of materials.
4. The concrete shall be batched mixed to meet the requirements of the crushing strengths as detailed within this specification. The use of hand mixes will not be permitted in any works offered to the Highway Authority for adoption.
5. The as placed concrete shall be compacted by hand or mechanical vibration means.
6. The surface finish of the installed material shall comply with Clause 2602 S9 of the SHW.
7. The Engineer may require the Developer to undertake compressive strength testing of Standard and Prescribed mixes. When testing is required, the strength target shall be as signified by the grade of concrete being assessed. In such circumstances all testing shall be in accordance with the relevant sections of BS1881.

Table 3C - Trench Reinstatement Compaction

Compaction Plant and Weight Category	Cohesive Materials (Less than 20% granular content)			Granular Materials (Greater than 20% granular content)			Bituminous Materials (All bituminous materials and asphalt)			
	Compaction passes required/Layers of compacted thickness up to:			Compaction passes required /Layers of compacted thickness up to:			Compaction passes required /Layers of compacted thickness up to:			
	100mm	150mm	200mm	100mm	150mm	200mm	40mm	60mm	80mm	100mm
Vibro Tamper 50kg minimum	4	8*	Unsuitable	4	8*	Unsuitable	5**	7**	Unsuitable	Unsuitable
Vibrating Roller	Unsuitable	Unsuitable	Unsuitable	6	Unsuitable	Unsuitable	5	7	Unsuitable	Unsuitable
600-1000 kg/m twin drum	8	Unsuitable	Unsuitable	6	Unsuitable	Unsuitable	6	Unsuitable	Unsuitable	Unsuitable
1000-2000 kg/m twin drum	4	8	Unsuitable	3	6	Unsuitable	4	5	6	8
2000-3500 kg/m single drum	3	6	Unsuitable	3	5	7	5	7	8	Unsuitable
2000-3500 kg/m single drum	2	3	5*	2	3	4	3	4	4	6
Over 2000 kg/m twin drum	2	2	6*	3	4	6	4	6	7	Unsuitable
Vibrating Plates	Unsuitable	Unsuitable	Unsuitable	5	Unsuitable	Unsuitable	6	Unsuitable	Unsuitable	Unsuitable
140-1800 kg/sq m	3	6	Unsuitable	3	5	7	4	5	6	8
Over 1800 kg/sq m	Minimum layer thickness 75mm			Minimum layer thickness 75mm			Compaction should be discontinued if any distress to the material is noticed.			
Notes: Single drum indicates vibration on one drum only. Twin drum requires vibration on both drums Twin drum rollers are preferred for bituminous materials.	* These options are not allowed for use on wholly cohesive materials, i.e. pure clay and/or silt containing no particle greater than 75 microns			Minimum layer thickness 75mm			** A Vibro-tamper shall not be permitted for the compaction of the permanent surface course applied to trenches of greater than 500mm width			
Alternative plant for trenches less than 200mm width, small excavation and other areas of restricted access.										
Vibro-tamper 25 kg minimum	6 passes minimum			6 passes minimum			6 passes minimum			
Percussive Rammer 10 kg minimum	Maximum layer thickness 100mm			Maximum layer thickness 100mm			Maximum layer thickness 75mm			

3.06 Mortar Specifications

1. Mortar used in below ground applications shall be composed of Sulphate Resisting Portland Cement or an equivalent sulphate resisting blend as defined within BS8500:2015+A2:2019, and naturally occurring sand complying with the requirements of BS EN 13139:2002.
2. The ratio of cement to sand shall be 1:3 by volume. The incorporation of lime to form a mix 1:3:0.25 is optional (cement: sand: lime). Allowance shall be made for bulking of the sand in mortars, where Class M12 is acceptable.
3. The mortar shall be mixed by machine to a uniform colour and consistency, with the constituent materials being accurately gauged.
4. Mortar shall be made in small quantities only as and when required. Mortar that has begun to set or which has been mixed for more than two hours shall be discarded. No addition of water is permitted for any material after discharge from the mixer.
5. When gullies, manholes and the like are to be trafficked within a period of less than seven working days, then rapid set additives must be used to achieve a rapid set suitable for the work to be progressed.

4.0 EXCAVATION AND FILLING

4.01 Soil and over burden Strip

1. All turf, topsoil and other organic and unsuitable material shall be stripped from the site of all carriageways, cycleways footways and below embankments or where directed to a minimum depth of 150mm and a maximum depth as required.
2. If required as part of the Section 38 or Section 278 works the topsoil material shall be stacked to a maximum height of 2m and kept separately from other excavated or imported materials.
3. No material shall be deposited within 5m of any tree or as directed if a Tree Preservation Order (TPO) is in place.

4.02 Excavation to Formation

1. The area of the proposed works shall be excavated to formation level and any unsuitable material exposed shall be removed and replaced with approved suitable granular material to Clause 4.06.
2. Where an existing ditch falls below the proposed works it shall be thoroughly cleared of all vegetable matter, topsoil and other unsuitable material. The treatment of such a ditch will be considered on a site-by-site basis but refer to clause 4.03.2 below.
3. Drainage of the sub-grade needs to be considered for all estate road designs – refer to Section 8.0.

4.03 Areas Below Formation

1. Areas below formation level after removal of turf and topsoil and other organic and unsuitable materials shall be made up with approved suitable fill material that must be of a consistent type (refer to Section 2.0), subject to clause 4.03.4.
2. Any filling of any ditch, dyke or the like, that is to form part of the works to create an adopted public highway shall be approved by the appropriate District Council, Internal Drainage Board or the Environment Agency. Before any works commence the Developer will provide written approval for such filling to the Engineer.
3. Either material to clause 4.06 or Type 1 or Type 2 material shall be used to backfill and for infill of isolated deep pockets such as old sumps, basement voids, etc., unless an alternative method is agreed in writing by the Engineer. Any vertical walls shall be broken out to below formation level and disposed of outside the limits of the adoptable Highway, subject to clause 4.03.4.
4. Where filling of areas liable to flooding is required, the Developer will need to provide a full method statement and detailed specification of such works to the Engineer for approval. The submission must also contain all the necessary approvals from the relevant bodies agreeing that these works can be undertaken.

4.04 Forming Areas of Fill

1. All materials for replacement or making up to formation level in accordance with the above requirements shall be deposited in layers and each layer thoroughly compacted in accordance with Table 3A – Earthworks Compaction.
2. Where the formation of, or extension to an existing embankment is required as part of the works the Developer will need to provide a detailed specification of such works to the Engineer for approval. The submission must also contain all the necessary approvals from the relevant bodies agreeing that these works can be undertaken.
3. Where the widening to existing carriageways on embankments is required as part of the works the Developer will need to provide a detailed specification of such works to the Engineer for approval. The submission must also contain all the necessary approvals from the relevant bodies agreeing that these works can be undertaken.

4.05 Areas Liable to Flooding and Suitable Granular Material

1. Where filling of areas liable to flooding is required, the developer will need to provide a detailed specification of such works to the Engineer for approval. The submission must also contain all the necessary approvals from the relevant bodies agreeing that these works can be undertaken.

4.06 Granular Material Backfill

1. Approved suitable granular backfill material shall include the following characteristics:
 - a) 10% fines value must exceed 40kN tested on a soaked basis in accordance with BS812-111:1990
 - b) Maximum particle size not to exceed 63mm
 - c) Generally well-graded (coefficient of uniformity >10) and with not more than 10% passing 63um sieve
 - d) The material shall not contain any clay lumps or any other foreign matter
2. Alternatively Type 1 or Type 2 sub-base may be used.

4.07 Geotextiles

1. Where fill is placed in areas below formation a suitable geotextile will be incorporated between any Clay formation and Fill material to facilitate construction but note the requirements in clause 1.02.3.
2. The cutting of the geotextile after placement shall be kept to a minimum. If cutting is unavoidable all the underlying sub-formation must be fully covered with any joints being overlapped by at least 300mm.

3. The use of geotextile membranes must comply with clause 7.03 and shall apply to all adoptable works including footways/ footpaths, cycle ways and cycle paths (excluding adoptable grass in visibility splays).

5.0 BACKFILLING TRENCHES

5.01 Backfill Materials

1. All trenches under the proposed adopted public highway shall be backfilled with a suitably compacted material that shall include the following characteristics:
 - a) 10% fines value must exceed 40kN tested on a soaked basis in accordance with BS812-111:1990
 - b) Maximum particle size not to exceed 63mm
 - c) Generally well-graded (coefficient of uniformity >10) and with not more than 10% passing 63um sieve
 - d) The material shall not contain any clay lumps or any other foreign matter
2. Alternatively Type 1 or Type 2 sub-base may be used.
3. Where the crown of any pipe or duct is with 1.2m of the proposed surface of the adopted public highway the pipe or duct shall be protected with a concrete pipe surround constructed in accordance with clause 16.03.

6.0 WEATHER CONDITIONS

6.01 Earthworks Operations

1. Subgrade drainage shall be incorporated as required in Section 8.0.
2. Continued working in wet conditions will adversely affect the subgrade and sub-base. If these materials have deteriorated due to trafficking or to ingress of water or the like, they shall be removed and replaced as necessary with new Type 1 sub-base material to clause 9.02.
3. No material in a frozen condition shall be incorporated in the works.

6.02 Construction

1. Material for use in construction shall not be laid on any surface, which is frozen or covered with snow, ice or frost.

2. **Table 6A - Adverse Weather Requirements for Bituminous Materials**

Material	Commence Working Air Temp	Additional Requirements	Cease Working Air Temp
Asphaltic Concrete to BS EN 13108-1	-1°C & rising	Ground unfrozen and free from ice	0°C & falling
Base and Binder course to BS EN 13108-4	-1°C & rising	Ground unfrozen and free from ice	0°C & falling
All surface courses	-1°C & rising	Ground unfrozen and free from ice	0°C & falling

3. Still air shall be defined as that moving at less than 10Km/h when measured with an anemometer located 2m above the surface of the area to be surfaced. All laying shall cease when the wind speed reaches 40Km/h and above.
4. No bituminous material shall be laid during periods of rain, that are predicted to last more than two hours or when more than 1mm/hr falls.
5. Minimum rolling temperatures are set out in the following Tables:

Table 6B– Asphalt BS EN 13108-4 & 5 (also SMA/CASC)

	Type	Temperature (Centigrade)
Maximum at any stage	40-60 pen bitumen Surface Course/Binder/Base	190
	CASC PMB	185
Minimum Delivery * **	40-60 pen bitumen Surface Course	140
	Binder/Base	120
	CASC PMB	150
Minimum Rolling# **	40-60 pen bitumen all courses	85
	CASC PMB	100
	#Temperatures by which all compaction shall be substantially completed	

* At or near these temperatures the supplier should be requested to increase the delivery temperature in accordance with BS 594987: 2015.+ A1:2017

** If warm mix asphalt is to be used please see Table 6D

Table 6C – Dense / Close Graded asphaltic concretes BS EN 13108-1

	Type	Temperature (Centigrade)
Maximum at any stage	40-60 pen bitumen Macadam	190
Minimum Delivery * ***	40-60 pen bitumen Macadam	120
Minimum Rolling ***	40-60 pen bitumen Macadam **	105
	Temperatures immediately prior to rolling	

** This temperature is dependent on adoption of minimum layer thickness in accordance with table 6A BS 594987, 2015 + A1:2017.

*** If warm mix asphalt is to be used please see Table 6D

Table 6D - Warm Mix asphalt specification (WMA).

Guidance Table for production and laying WMA temperatures

Material Type	Binder Grade (Pen)	WMA Temperature Ranges (°c)				
		Target	Minimum	Maximum	Minimum on arrival	Minimum prior to rolling
Asphalt Concrete	40 / 60 100 / 150 <i>PMB (see **)</i>	140 - 150	120	160	100	80
SMA S/C	40 / 60 100 / 150	140 - 150	120	160	105	90
CASC plus *(see Note 1)	PMB	145 - 160	130	170	120	115
Any Proprietary Mixes	PMB	To be advised by the supplier - See Note 2 Below				

Notes

Note 1 * - CASC plus (+) shall only be laid within these ranges when the ambient temperature is 5°C or above and the wind speed is below 40 km/h (at 2m height). If either of these parameters are exceeded, then the supply temperature shall default back to conventional Hot supplied levels.

Note 2 ** – Any other materials containing a PMB binder shall be subjected to the same parameters as those set out within CASC + above. For PMB HRA or AC Binder Course or Base materials to be agreed with supplier.

6.03 Specification

1. The reduction of asphalt temperatures is the preferred method of manufacture all asphalt mixes unless otherwise agreed with Cambridgeshire County Council or recommended otherwise by the asphalt supplier, (please see note about the use of Polymer Modified asphalt mixes in winter or colder periods).
2. The asphalt mixes themselves will remain the same in respect of their constituents and any end performance requirements, but the temperature shall be reduced by using either an agreed foaming process, or a proven chemically modified binder.
3. Please note that Table 6D is purely for guideline purposes with the final decision on the day for end mixing, delivery, and compaction temperatures being solely with the asphalt manufacturer and material supplier.

6.04 Warm Mix Asphalt Overview

1. Traditionally asphalt materials have been mixed and supplied at temperature ranges typically between 170°C and 190°C. At these maximum mixing temperatures, it was felt that materials could be mixed, transported and laid on site whilst containing adequate mobility in order for full compaction to take place.
2. It was also felt that by keeping temperatures under 200°C this would stop the binder becoming “coked” or “burnt” and as such not becoming brittle.
3. It is also accepted that most of the “oxidation” process of the asphalt mixes, which also hardens the bitumen, takes place during the mixing, transporting and laying processes when the asphalt is exposed to oxygen at these elevated temperatures.
4. In order to reduce the oxidation process, over the recent decade’s various attempts have been made to reduce the temperature of asphalt mixes using differing types of foaming processes and more recently with the advent of chemically modified bitumen’s. Having now obtained significant experience nationally within the developments in manufacturing technologies there is a high level of confidence that asphalts can be produced at lower temperatures whilst still maintaining a compliant end product. By producing asphalt in a reduced temperature mode there are benefits to be gained which are outlined below.
5. Benefits of Reducing Asphalt Temperatures:
 - Significant reduction of carbon emissions both at the supplier’s plant and during the laying process. These also have the benefit to the supplier of lower energy consumption (fuel) at the plant.
 - Reduction in oxidation process resulting in the bitumen retaining its original penetration and not suffering from the initial hardening process which causes a loss of some of the asphalts volatiles.
 - Improved durability and potential design life of Asphalts due to the reduction in hardening / oxidation.
 - Reduction in the amount of smoke / fumes generated by hot asphalts – benefits to both the workforce in general and pedestrians in urban locations.
 - Earlier trafficking of laid materials due to lower temperatures.
 - The ability to lay 2 layers in one shift in order to speed up programmes and reduce disruption to local traffic / residents. This would also reduce the environmental impact of queuing traffic where traffic signals are used or unnecessary mileage where traffic is diverted.
 - Extended shift patterns due to improved cooling times which permits a greater tonnage to be laid.

6. Roadworks materials containing cement shall not be laid when the air temperature in the shade is below 3°C on a rising thermometer.
7. Where fresh concrete or mortar containing Portland cement CEM 1, has been placed in the works and the temperature falls or is likely to fall below freezing within a period of up to 48 hours after placing, suitable insulation blankets shall be employed and held in place for at least three days and until the air temperature is above 1°C and rising. Insulation blankets shall be closed cell polyethylene foam sheets minimum 10mm thick with a 'U' value of 4 watts/mC or suitable material with an equivalent or better thermal capacity. The Developer must be aware that the incorporation of additives or cement replacements may retard early strength development. Where this is the case care must be taken to ensure damage does not occur after the initial 48hr period.

7.0 PREPARATION OF FORMATION

7.01 Shaping and Compaction

1. After reinstatement of any defective areas, the formation shall be cleansed of mud, slurry and any detritus prior to being compacted as per Table 3A – Earthworks Compaction. The resulting profile shall be properly shaped, even and uniform surface to a level appropriate to the approved design thicknesses in accordance with Section 2.0 and Appendices 1, 2 and 3.
2. Any depressions that occur during compaction shall be filled with a suitably compacted material that shall include the following characteristics:
 - a) 10% fines value must exceed 40kN tested on a soaked basis in accordance with BS812-111:1990
 - b) Maximum particle size not to exceed 63mm
 - c) Generally well-graded (coefficient of uniformity >10) and with not more than 10% passing 63um sieve
 - d) The material shall not contain any clay lumps or any other foreign matter
3. Alternatively Type 1 or Type 2 sub-base may be used.

7.02 Weather Protection

1. The formation shall be adequately protected from the weather and shall not be used by construction traffic. It shall be covered as quickly as possible with sub-base.
2. The subgrade shall be drained as necessary in accordance with Section 8.0.

7.03 Geotextiles Requirement

1. If the equilibrium CBR of the formation is less than 5% or the formation is formed within a cohesive material, a separating membrane with the properties set out below shall be laid on the prepared formation in accordance with the manufacturers' instructions.

2. The separating membrane shall extend 300mm further than the limits of the kerb beam and comply with SHW specification Clause 609 subject to:
 - a) The 090 shall be greater than 50 and less than 200 (BS EN IOS 12956: 2020)
 - b) The minimum tensile strength in each direction shall be 6kN/m (BS EN ISO 10319: 2015)

8.0 DRAINAGE OF SUBGRADE

8.01 General

1. On all site's measures must be installed that will maintain ground water at more than 300mm below formation level. The requirement for subgrade drainage may only be waived after ground investigations have been undertaken which can prove to the Engineer that it is not necessary. The subgrade drain-pipes must be run to an approved outfall. Refer also to Section 1.01.

8.02 Alternative Provision

1. Where sub-grade drainage has been found to be necessary, but a practical design is not possible then, separating membranes shall be placed above and below an additional 150mm of Type 1 that is to be installed below and extra to the depth of construction required by the Plasticity Index.

9.0 CARRIAGEWAY FOUNDATION

9.01 General

1. Refer to Section 2.0 and Appendices 1, 2 and 3 for design depths of construction.
2. Sub-base materials shall be spread evenly on the formation in layers of a depth of not more than 150mm compacted thickness and compacted in accordance with the requirements of Table 3B – Sub-base Compaction, at a moisture content in the range optimum - 2% or + 1% and without drying out or segregation.
3. The full thickness of the sub-base shall be continued for a distance of 300mm beyond the limits of any kerb beam.
4. The Environment Agency shall be consulted over the use of any material that may contain contaminants and which could generate an unacceptable leachate.

9.02 Sub-Base Materials

1. SHW Clause 803 Granular Sub-base Material Type 1 shall be used for Distributor Roads/ bus routes, and housing estate roads at the Developers discretion. The material shall comply with the full requirements of SHW Clause 803 Granular Sub-base Material Type 1 including acceptable secondary and recycled aggregates, only with the Engineer's approval.
2. For housing estate roads only, Housing Estate Road Sub-base (HER) may be used as an alternative. See table 9A below.

Table 9A - Housing Estate Road Sub-base (HER)

BS sieve size	Range of grading % by mass passing
63mm	100
31.5mm	74 - 100
16mm	44 - 80
8mm	30 - 65
4mm	18 - 42
2mm	13 - 35
1mm	8 - 28
0.250mm	0 - 18
0.063mm	0 - 9

3. The material shall be crushed rock, slag, crushed concrete or other approved material. It shall be well graded and lie within the grading envelope in Table 9A.

- a) In the above table the particle size shall be determined by the washing and sieving method of BS EN 933: Part 1: 2012
 - b) The material passing the 425um BS sieve when tested in accordance with BS 1377-2:1990 shall be non-plastic
 - c) The material shall have a soaked 10% fines value of 40kN or more when tested in accordance with BS 812-111:1990.
4. Copies of compliant test data in accordance with clause 9.02 undertaken by a UKAS accredited laboratory must be submitted to the Engineer prior to material being delivered to site. All test data must have been undertaken within the prior 12 weeks.
 5. Acceptance of the foundation layer (sub-base) will be based upon an end product performance testing regime. The Developer is required to undertake lightweight deflectometer testing (LWD) to ensure a minimum foundation surface modulus stiffness value is achieved prior to the placement of any subsequent asphalt layers.
 6. The LWD to be used must comply fully with BS 1924:2018 Part 2 Clause 9.2. It should also be pointed out that is a requirement of Clause 9.2.7 (within BS 1924:2018 Part 2) that correlation testing for all LWD's must be undertaken in accordance with one of the 2 options listed within the British Standard.
 7. It should be noted that the Highway Authority still reserves the right to use the surface modulus stiffness values in conjunction with their own engineering experience in order to make a final decision on acceptability of the foundation layer.
 8. In order to achieve these minimum surface modulus stiffness values the sub-base material will have to be supplied, installed and compacted at somewhere near the optimum moisture content value in accordance with clause 9.02 above. It is also worth noting that any segregation may result in failures. Please note that once the sub-base has been delivered to site the control of the moisture content becomes the responsibility of the Developer.
 9. Foundation Layers: Dynamic Plate Testing Methodology
 - a) The main function of the foundation layers within a highway design is to distribute applied vehicle loads to the underlying sub-grade, without causing distress in the foundation layers or in the overlying layers. This function is required for the full life of the pavement.
 - b) In order to demonstrate that the foundation layer have been correctly installed as per this specification, the Highway Authority will require that prior to the laying of any bound materials that a series of Dynamic Plate Tests be undertaken, to ascertain the Foundation Surface Modulus. The Testing protocol shall conform to the requirements of BS 1924:2018 Part 2 Clause 9.2. In order to maintain comparative continuity of testing and ensure a standardised approach throughout all developments, the LWD shall have a standard 300mm plate diameter, standard drop weight of 10kg and standard target stress of 100 kPa.

- c) The tests must be carried out using the following procedure:
- i. The testing must be undertaken a maximum of 5 working days before the laying of the bound layers. If adverse weather conditions prevail, the sub-grade is trafficked or other actions that may affect the performance of the material occur between the taking of the tests and the laying of the bound layers the Highway Authority reserves the right to instruct that the tests be carried out again. In order to give the Developer the maximum amount of time available to remediate any potential defects, the LWD test house must indicate to the Developer and the Engineer any potential failures whilst on site. The test house is not required to offer any contractual remediation advice to the Developer or their sub-contractors.
 - ii. The spacing of the tests shall be as follows:
 - a. On lengths of less than 100m tests shall be taken every 5m
 - b. On lengths of 100m and above tests shall be taken every 10m
 - c. Tests shall be taken between these lengths when reasonably requested by the Highway Authority's representative
 - iii. Testing shall take the form of three test points, one 1m from the kerb face, one at the centreline of the carriageway and one at 1m from the opposite kerb face, (see Appendix 24).
 - iv. The contractor must carefully record the location of all plastic ducts etc., as these may adversely affect the testing regime.
- d) In order to comply with the requirements of the Highway Authority the test results shall be for a for the Foundation Surface Stiffness Modulus and shall be the rolling mean of six results which must be greater than 80MPa. For the avoidance of doubt: 80MPa is the lowest limit that the Highway Authority will accept and any measurement below this figure will have failed the test. No individual result is to be less than 50MPa.
- e) On all LWD test results a copy of the latest calibration certificate including reference to an annual calibration exercise noted within sub-clause 9.02 (6) must be attached. These must be within 1 year of the machine being used on site used otherwise the test results will be deemed non-compliant.
- f) All test results must have a test location, the recorded force (or pressure), and the deflection as a minimum for each of the 3 readings used at each test location.
- g) The same LWD one of the approved test houses must be used for each section of sub-base to be tested with their results being definitive and cannot be challenged by the Developer. The contractor is not permitted to utilise differing LWD's on the same section as there is a possibility of result variations depending upon variations within locations, material properties and moisture contents, hence the local authority requires numerous readings and will take a compliance view on overall trends.

Table 9B: Compliance Table

Machine Type	Minimum Individual Readings (MPa)	Minimum Rolling mean of 5 results (MPa)
BS 1924:2018 Part 2 compliant	50	80

- h) Testing will also be required in accordance with 8 c) iii above, where trenches are retrospectively constructed for services across the carriageway.
- i) For ease of reference a list of companies that are able to undertake the Dynamic Plate Tests can be provided by the Engineer upon request.

10.0 CARRIAGEWAY BASE LAYERS

10.01 General

1. Refer to Section 2.0 and Appendices 1, 2 and 3 for design depths of construction.
2. Consideration must be given for all Bituminous Base materials to be supplied in Warm Mix mode as this is now the preferred method specified by Cambridgeshire County Council. Please refer to Clause 6.02 and Table 6D for further information.
3. Bituminous materials shall be machine laid. Where agreed with the Engineer, hand laid materials may be used but shall be restricted to small areas. It should be noted that the use of tack coat (conventional bitumen emulsion) is no longer permitted as it is no longer considered best practice. Bond Coats should now be used and must be applied in accordance with BS 594987:2015+A1:2017 or the rate set out in the BBA/HAPAS certificate for proprietary materials. The application requirements of Clause 920, Volume 1 of SHW must also be applied. Bond coats shall have a suitable BBA/ HAPAS certificate detailing the performance claims made for them. For certificates see the BBA website: www.bbacerts.co.uk
4. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS 594987: 2015 + A1:2017.
5. Any bituminous layer shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. All bituminous layers to be surfaced over, once cleansed appropriately must be sprayed with a suitable bituminous bond coat. This will be completed immediately prior to the laying of additional Base layers. For continuous laying works a bond coat shall be applied by the use of metered mechanical spraying equipment. Hand held sprayers shall only be used for very small scale works and in accessible areas and with the approval of the Engineer. Should the layer become contaminated, the Developer shall make good by thoroughly cleaning it to the satisfaction of the Engineer or, if this proves impracticable, the Developer will replace it with material to the appropriate Specification. Should the layer be damaged it shall be removed and replaced with material to the appropriate specification. See section 24.01 for further guidance.
6. The combined thickness of base and binder material shall be no less than 190mm. A maximum thickness at which any material shall be laid shall not exceed 100mm.
7. No laying of bituminous materials shall commence prior to any service installation being completed within the carriageway.

10.02 Material - Dense Asphaltic Concrete

1. The base layer materials shall be Dense Asphaltic Concrete. The materials formulation and compaction standards shall be such as to ensure individual in situ air voids are more than 2% but less than 7%.

2. Consideration will be given to Developers wishing to use material containing recycled products subject to the approval of the Engineer.
3. The material shall be AC 20 dense bit to BS EN 13108-1 and PD 6691. It shall be thoroughly compacted all in accordance with BS 594987: 2015 + A1:2017. Binder to be 40 - 60 pen. AC 20 dense bit can be placed in one layer of 100mm when a roller of at least 8 tonne dead weight or vibratory roller of equivalent mass is available. The supplied material must be compacted in accordance with BS54987: 2015 + A1:2017. Refer to clause 11.01.7.
4. Where a gravel aggregate is proposed a suitable design confirming the proposed adhesion additives shall be submitted. Proof shall be provided to show that the proposed mixture has been successfully laid and trafficked elsewhere.
5. If Gravel is to be used proof shall be provided to show that the mixture has been subject to the SHW Clause 929 design process and that it has been successfully laid and trafficked elsewhere.
6. Guidelines for delivery and rolling temperatures for Dense Asphaltic Concrete base layer are given in Section 6.0.

11.0 CARRIAGEWAY BINDER COURSE LAYER

11.01 General

1. Refer to Section 2.0 and Appendices 1, 2 and 3 for design depths of construction. Where the Binder course layer is to be trafficked, the binder content shall be enhanced.
2. Consideration must be given for all Bituminous Binder Course materials to be supplied in Warm Mix mode as this is now the preferred method specified by Cambridgeshire County Council. Please refer to Clause 6.02 and Table 6D for further information.
3. Permitted materials on housing estate and distributor roads are as specified in clause 11.02.
4. Bituminous materials shall be machine laid. Where agreed with the Engineer, hand laid materials may be used but shall be restricted to small areas. All materials to be supplied laid and compacted in accordance with BS594987:2015+A1:2017. It should be noted that the use of tack coat (conventional bitumen emulsion) is no longer permitted as it is no longer considered best practice. Bond Coats should now be used and must be applied in accordance with BS 594987:2015+A1:2017 or the rate set out in the BBA/HAPAS certificate for proprietary materials. The application requirements of Clause 920, Volume 1 of SHW must also be applied. Bond coats shall have a suitable BBA/HAPAS certificate detailing the performance claims made for them. For certificates see the BBA website: www.bbacerts.co.uk
5. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS 594987:2015+A1:2017
6. Any bituminous layer shall be kept clean and uncontaminated for so long as it remains uncovered by succeeding layers or surface treatment. All bituminous layers to be surfaced over, must be sprayed with a suitable bituminous bond coat. This will be completed immediately prior to the laying of the Binder Course materials. For continuous laying works a bond coat shall be applied by the use of metered mechanical spraying equipment. Hand held sprayers shall only be used for very small scale works and in accessible areas and with the approval of the Engineer. Should the layer become contaminated, the Developer shall make good by thoroughly cleaning it to the satisfaction of the Engineer or, if this proves impracticable, the Developer will replace it with material to the appropriate Specification. Should the layer be damaged it shall be removed and replaced with material to the appropriate specification. See also 24.01 for further guidance.
7. No laying of bituminous materials shall commence prior to any service installation being completed within the carriageway.
8. The combined thickness of base and binder material shall be no less than 190mm. A maximum thickness at which any material shall be laid shall not exceed 100mm.

11.02 Material – Dense Asphaltic concrete

1. The material shall be AC 20 dense bit to BS 13108-1 and PD6691 and laid 65mm thick. It shall be laid and thoroughly compacted all in accordance with BS 594987: 2015+A1:2017. Binder to be 40 - 60 pen. The materials formulation and compaction standards shall be such as to ensure individual in situ air voids are more than 2% but less than 7%
2. Where a gravel aggregate is proposed a suitable design confirming the proposed adhesion additives shall be submitted. Proof shall be provided to show that the proposed mixture has been successfully laid and trafficked elsewhere.
3. If gravel is to be used proof shall be provided to show that the mixture has been subject to the SHW Clause 929 design process and that it has been successfully laid and trafficked elsewhere.
4. Guidelines for delivery and rolling temperatures for Dense Asphaltic concrete Binder Course layer are given in Section 6.0.

12.0 CARRIAGEWAY SURFACE COURSE

12.01 General

1. Consideration must be given for all Bituminous Surface Course materials to be supplied in Warm Mix mode as this is now the preferred method specified by Cambridgeshire County Council. Please refer to Clause 6.02 and Table 6D for further information.
2. Bituminous materials shall be machine laid. Hand laid materials may only be used where restricted to small areas and when agreed with the Engineer. All materials to be supplied laid and compacted in accordance with BS 594987:2015+A1:2017. It should be noted that the use of tack coat (conventional bitumen emulsion) is no longer permitted as it is no longer considered best practice. Bond Coats should now be used and must be applied in accordance with BS 594987:2015+A1:2017 or the rate set out in the BBA/HAPAS certificate for proprietary materials. The application requirements of Clause 920, Volume 1 of SHW must also be applied. Bond coats shall have a suitable BBA/HAPAS certificate detailing the performance claims made for them. For certificates see the BBA website: www.bbacerts.co.uk
3. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS594987:2015+A1:2017. All surface course layers to be surfaced over must be sprayed with a suitable bituminous bond coat. For continuous laying works a bond coat shall be applied using metered mechanical spraying equipment. Hand-held sprayers shall only be used for very small scale works and in accessible areas and with the approval of the Engineer
4. No laying of bituminous materials shall commence prior to any service installation being completed within the carriageway.
5. The combined thickness of bound material shall be as shown in Appendices 1, 2 & 3
6. The following material and depth options for carriageway surface course construction are permitted.

Appendix 1 - the material shall be: 50mm Cambridgeshire Asphalt Surface Course Plus (CASC+), clause 12.02 refers

Appendix 2 - the material shall be: 40mm Stone Mastic Asphalt (SMA) 6mm surf to BSEN13108-5, clause 12.03 or 12.04 refers.

Appendix 3 – the material shall be: Concrete Block Paving, clause 12.05 refers.

7. On roundabouts and within 60m of junction areas or abutting existing highways, then the material is to be individually agreed with the Engineer
8. Surfacing courses shall have the following minimum PSV's:
 - a) For Housing Estate and Distributor Roads - PSV 50

b) On or within 60m of junctions of Principle, Non-principle, Classified (Class A, B & C) roads - PSV 60

c) On or within 60m of roundabouts - PSV 65

9. Guidelines for delivery and rolling temperatures are given in Section 6.0.
10. Alternative materials may be considered where the Developer can produce proof of its successful use elsewhere. Producer's technical information shall be provided and prior written approval for its use shall be obtained from the Engineer.
11. Crossfalls to carriageway shall be 1 in 36.

12.02 Cambridgeshire Asphalt Surface Course Plus (CASC+)

1. The aim is to provide a dense, impermeable, and durable surface course which contains a negative texture depth generally compliant to the requirements of a 10mm Thin Surface Course within IAN 154/12 amended. See Table 12C below. It should be noted to avoid any confusion, that the CASC+ variant must contain a polymer modified binder compliant with sub-clause 11.
2. Cambridgeshire Asphalt Surface Course Plus (CASC+) whilst being a proprietary material shall generally comply with the requirements of BS EN 13108 Bituminous mixtures - Material specifications Part 5, and PD 6691 Guidance on the use of BS EN 13108. CASC+ shall be transported handled and laid in accordance with the requirements of BS 594987:2015 + A1:2017
3. Polished Stone Value – Coarse aggregates shall have a minimum PSV of 53 unless otherwise specified by the Engineer after reference to CD236 table 3.3a. Minimum PSV for all footway surface course material shall be 45.
4. Resistance to Fragmentation – Category LA₃₀, or as otherwise agreed by the Engineer.
5. Aggregate abrasion Value – for carriageway material, not more than 12, or as otherwise agreed by the Engineer, after reference to HD36/06 table 3.2
6. Durability (Water Absorption) – Category WA₂₄ or as otherwise agreed by the Engineer.
7. When tested in accordance with the procedures in BSEN 13043, the fine aggregate shall comprise crushed rock, crushed slag fines or natural sand.
8. The use of limestone and any other material that does not comply with the minimum PSV requirements specified shall not be permitted as coarse and fine aggregates in CASC+ surface courses.
9. Particle shape – The flakiness category for the coarse aggregate shall be FL₂₅.
10. Added filler shall only be crushed limestone or other approved material in accordance with the requirements of BS EN 13043, 5.2.1.

11. The standard binder grade shall be a Polymer Modified Bitumen complying with the following requirements as specified within BS EN 14023:2010:

Penetration Class: 6 (65 – 105mm)
 Softening Point Class: Minimum 6 ($\geq 60^{\circ}\text{C}$)
 Force Ductility Class: 3

Upon agreement with the Engineer, the use of paving grade 40/60 and may be used especially for areas of hand lay work or on lightly trafficked roads.

12. The guideline target grading for the mixture shall be as shown in Table 12A below, unless agreed otherwise by the Engineer.

Table 12A – Target Grading

Sieve Size	Target % Passing	Tolerance	Overall Limits
20mm	100		100
14mm	95-100		95 - 100
10mm	66	+/- 7%	59 - 73
6.3mm	39	+/- 7%	32 - 46
2mm	30	+/- 6%	24 - 36
0.5mm	16	+/- 4%	12 - 20
0.25mm	To be recorded	only	
0.063mm	6	+/- 2%	4 - 8

13. Target binder contents shall be:

CASC 5.5%
 B_{\min} 5.0

14. Performance testing: resistance to wheel track permanent deformation to be measured in accordance with BS EN 12697-22:2003 – Small device, Procedure B when tested at 60°C

Classification: Class 2

Wheel Track Slope (WTS)_{AIR} (mm/1000 cycles): Maximum 1.0

Rut Depth (RD_{AIR}) mm: To be recorded only

15. CASC+ shall be compacted to practical refusal following the general requirements of BS 594987; 2015 + A1:2017 clause 9. The primary roller shall be a minimum 6t deadweight with a smaller vibrating roller as the finishing roller.

16. The Engineer may require his own verification checks on air void contents by taking at least a pair of cores during routine works. Alternatively, to avoid core holes in the finished mat it would be advisable to take cores adjacent to the “ramped down” area at the end of a day’s laying operation (0.5m from ramp edge) which can be milled out the following day.

17. The level of Air Voids shall be tested in accordance with the Test Method: BS EN 12697-8 Using bulk density to BS EN 12697-6:2003, Procedure B Saturated Surface Dry Condition. Maximum density to BS EN 12697- 5:2009, Procedure A in water.
18. Air Void Compliance shall be in accordance with Table 12B below. All testing to be undertaken by an approved UKAS accredited laboratory.

Table 12B – Air Void Compliance

Compliant Air Void Contents		
Material	Mean of Any Pair	
	Min %	Max %
CASC	2	6*
* An additional 1% void content is permitted for hand lay work		
Note: In order to achieve compliant compaction air void contents, it is recommended that: CASC Plus - Rolling must be substantially completed before the material drops below 115°C. (See further guidance if material is supplied in Warm Mix mode.		

19. Requirements of initial Texture depth (Revised version of Clause 942 – Table 9/3)

Table 12C – Texture depth

Road Type	Surfacing Type	Average per lane km (mm)		Average for a set of 10 measurements (mm)
		Minimum	Maximum	
All Site Locations	CASC	1.0	1.4	0.9

20. Texture depth measurement shall be carried out in accordance with BS594987:2015 + A1: 2017 Clause 8.2. Whilst the Volumetric method to BS EN 13036-1 is the preferred method, the local authority will accept either the Sand Patch or vehicle mounted Laser methods. In cases of dispute the volumetric method will be definitive
21. Unless otherwise specified by the Engineer, the nominal compacted layer thickness shall be a minimum of 40mm and a maximum of 60mm.
22. Unless otherwise agreed by the Engineer, reclaimed asphalt shall be permitted for use in CASC+ up to a maximum of 10%
23. All CASC shall be laid onto a tanker applied bond coat in accordance with BS594987:2015 + A1: 2017 Clause 5.5

24. All joints (both longitudinal and transverse) within the CASC+ shall be cut in accordance with BS594987:2015 + A1: 2017 Clause 6.8.2. The only exception to these is by the use of echelon paving or the use of an edge compactor.
25. Due to potential issues with polymers in asphalt mixes “balling up” after a period of time, the maximum time CASC+ must be laid and compacted is 3 hours after mixing. If this timeline exceeds 3 hour then any CASC+ on site must be inspected and deemed acceptable to be laid. Otherwise the material should not be used.
26. All potential suppliers of CASC+ must supply proposed mix design data showing compliance to the enclosed specification to the Engineer. (This will cover all plants they propose to supply CASC+ from).
27. Upon receipt of compliant test data the suppliers will be added to an approval list for the supply of CASC+ into Cambridgeshire. It should be noted that additional guarantees or warranties such as BBA HAPAS or CE marking is not an essential requirement.

12.03 Stone Mastic Surface Course

1. The material shall be Stone Mastic Asphalt (SMA) SMA 6mm surf to BS EN 13108-5 and PD6691 designation for use on Housing Estate Roads to Appendix 2 – Estate Road only.
2. For SMA surface course material as above the binder shall be 40-60 pen and the coarse aggregate to be of crushed rock excluding limestone with a minimum PSV of 50.
3. SMA shall be laid to a compacted thickness of 40mm as shown in Appendix 2. SMA is not a permitted material for Appendix 1 applications.
4. The material shall be laid and thoroughly compacted all in accordance with BS 594987: 2015 + A1:2017, with care taken to achieve a consistent even-textured finish particularly in areas of hand-lay.
5. The minimum texture depth required for SMA 6mm surf material shall be at least 0.5mm at time of laying (sand patch).

12.04 Heritage Surface Course

1. Stone mastic Asphalt (SMA) 6mm surf to BSEN13108-5 40 – 60 pen but containing local ‘golden’ gravel’ coarse aggregate, to be approved by the engineer. This material shall only be laid in footways, cycleways and trafficked areas of 20mph or less.
2. Heritage surface course shall be laid to a 40mm thickness, untrafficked texture depth of a minimum of 0.5mm.
3. Information is required that shows appropriate adhesion agents are to be added to ensure good adhesion between the gravel and the bitumen.

12.05 Concrete Block Paving

1. Concrete block paving may be used in respect of shared surfaces and may be permitted as an alternative to asphalt surfacing for roads other than Local Distributor Roads and Major Access Roads.
2. Clay block paving shall not be permitted.
3. All block work shall be protected from site traffic to the satisfaction of the Engineer.
4. Block paving in the form of precast concrete rectangular blocks of dimensions 200mm x 100mm x 80mm laid on a laying course may be considered as a substitute for the normal surface course layer only as clause 12.06.8 below.
5. Blocks shall comply with BS EN 1338:2003 (in accordance with Table 7) and the permitted colours are;
 - a) medium/red/buff
 - b) dark grey/dark brown
 - c) natural/brindle
6. Blocks shall be laid on a 30mm compacted thickness of category II laying course sand in accordance with the requirements in BS7533 Part 3, 2005 + A1:2009. The method detailed in 4.3.3.a) of that document shall be adopted for installing the laying course.
7. Surface regularity for Blockwork is defined in clause 1.10.
8. Blocks shall be laid in a 90° herringbone pattern unless otherwise agreed in writing by the Engineer. Where herringbone pattern at 45 degrees is permitted, laying should be to the requirements of BS 7533 Part 3 2005 + A1:2009 utilising “mitre head” starter units and inboard cutting techniques as appropriate. Blocks to be cut using approved block cutting guillotine to no less than $\frac{1}{4}$ (one quarter) of the original plan size.
9. A carriageway Base layer 190mm thick placed in accordance with the requirements of Section 10.0 over a sub-base to Section 9.0 is required below the block paving. The Developer should refer to Appendix 3 for construction thicknesses for the sub-base layer. The base layers shall not be punctured as a drainage provision prior to installing the laying sand.
10. Gaps between kerb face and blocks and between ironwork and blocks must be kept to a minimum and sealed with a well-rammed mixture of 3:1 dry sand to Ordinary Portland Cement or propriety sealing system.
11. The Developer shall use specifically designed ironwork which permits the blockwork and its laying course to be laid up to the frame of the gully grate or manhole cover. No trimming of blocks shall be permitted other than those vertical cuts necessary to achieve the laying pattern shown in Appendix 7 – Blockwork-details around ironwork, and to accommodate the horizontal alignment of the road.
12. Proprietary blocks and systems shall only be used with the prior written authorisation from the Engineer.

13. Tegula paving shall be 80mm thick, rolled pre-cast concrete paving blocks with at least three different longitudinal sizes laid to create a random pattern using a suitable mix of the block sizes available. The blocks shall be manufactured to the requirements of BS EN 1338:2003.

13.0 KERBS AND CHANNELS

13.01 Kerb Beams and Backing

1. Kerb beams and channel beams shall be installed prior to laying Base materials.
2. Kerb beams shall be constructed of ST1 concrete to SHW Clause 2602 not less than 150mm thick and 425mm wide at the profile shown in Appendix 4 – kerb and edging details. The profile shall be formed by either using shuttering both sides of the kerb beam or by using an extruded kerb beams as shown in Appendix 23. The kerbs shall be backed with ST1 concrete as shown in Appendix 4. For channel blocks, the kerb beam width shall be increased to 680mm at the profile shown in Appendix 4.
3. Kerb beams around the inside of speed control bends and for 5m beyond the tangent points of such bends shall be increased in depth to 250mm. In some additional locations these dimensions may be required at the Engineers discretion.
4. The laying of kerbs or channel to a plastic bed and haunch is not permitted.
5. Temporary kerbing, blocks and channels shall be laid on beams prior to laying base and binder materials.
6. Adoptable kerbs and channels should not be installed until housing is completed. This will normally be carried out when all wet trades and garden areas have been completed. Any kerbing installed prior to the Engineers agreement will be considered as temporary.

13.02 Kerbs - General Requirements

1. Kerbs shall be laid to general regularity and upstands shown in Table 1C - Tolerance for other fixed surface features, of this Specification and otherwise to the construction requirements of BS7533, Part 6, 1999. Special provisions for kerbs at vehicular, cycle and pedestrian footway crossings are detailed in Section 19.0 of this Specification. All kerbs shall be laid to line and level.
2. Where asphalt surface course is employed, precast concrete kerbs shall be used unless agreed with the Engineer. Such kerbs shall be 125mm x 255mm hydraulically pressed, granite aggregate Type HB2, half batter or Type BN Bullnosed to BS EN 1340:2003 and laid upright showing a 125mm kerb face. Kerbs are to be bedded on a 25mm class 1 mortar bed within 50mm of the face of the concrete beam, laid with dry joints and backed with ST1 concrete to a minimum thickness of 150mm, to within 50mm of the top of the kerb.
3. Where block paving is employed, precast concrete kerbs shall be 125mm x 255mm Type BN, kerbs showing a 25mm face. The upstand must be of uniform height subject to the tolerances in clause 1.10.5, Table 1C - Tolerance for other fixed surface features.
4. No cut kerb shall be less than 300mm in length; kerbs cut in a splay to form an external corner will not be permitted and cut quadrant kerbs shall be used.

5. Any kerbs that require replacement prior to the laying of the Surface Course may expose a void between the kerb face and the adjacent Base/Binder Course layers. This void shall be filled with a flexible/modified bituminous joint sealant that complies with either type N1 or N2.

13.03 Radius Kerb Lines

1. For curves of radius 12.5m or tighter, the appropriate radius kerb shall be used.
2. The permission of the Engineer shall be sought in all cases where it is proposed to use cut kerbs to achieve a smooth line on curves. Cut kerbs shall be of equal lengths between 450mm and 600mm and shall have suitably tapered cuts free of spalling to achieve a smooth front face to the kerb line.

13.04 Channel Lines & Design Gradients

1. Carriageway channel lines shall be laid to gradients no flatter than 1 in 150, and no steeper than 1 in 20. The use of summated channel lines shall be permitted to achieve this. Blockwork areas shall be laid to gradients no flatter than 1 in 80.
2. The maximum length over which a longitudinal fall of between 1:40 and 1:20 can be used shall be 20m. A longitudinal fall of between 1:40 and 1:20 shall be used no more than once for every 100m length of the proposed adopted public highway.
3. The above gradient regime is required to perform two key functions:
 - (i) To ensure that adoptable estate roads are accessible to all user groups, including vulnerable road users and the mobility impaired.
 - (ii) To ensure the satisfactory drainage of new infrastructure.

The designer is advised to seek the early advice of the of the Engineer if a specification compliant submission cannot be achieved; the failure to achieve such a compliant design may preclude the future adoption of the streets.

14.0 GULLY GRATES AND FRAMES

14.01 General Requirements

1. Gully gratings and frames shall be Kite-marked to BS EN 124:2015. Either Cast Steel or Ductile Iron may be used. The frame shall be bedded on a gauged Designation (i) Mortar from SHW Clause 2404 Table 24/1 (the ratio of cement to sand shall be 1:3 by volume) with at least two but no more than four courses of Engineering Brickwork Class 'B' to BS EN 771-1:2011 + A1:2015. The use of proprietary concrete collars can be used in place of the brickwork.
2. Units complying with BS EN 124:2015 Class D400 shall be used for all estate roads. These shall be hinged and must be of the "captive" type, non-rock design. Pedestrian/cyclist safe mesh grating design on shared surface streets, where cyclists may be required by physical measures to pass over the gully. Gullies shall be installed on the side facing oncoming traffic, with a minimum waterway area 990cm² and with frame at least 150mm deep.
3. Gully covers and any other carriageway and footway or cycleway ironwork shall not be installed until the carriageway binder course layer is laid. During the construction process protection shall be given to all gullies and chambers from the ingress of debris.
4. Each gully shall have its own lateral connection to the surface water sewer system; the use of Y connections or similar shall not be permitted.
5. Gullies shall be linked to the surface water sewer with at 45-degree pipe run, unless otherwise agreed with the Engineer's representative to overcome site specific circumstances.

14.02 Spacing of Gullies

1. The area of hardened surface including footways and cycleways, etc., draining into each gully will vary in proportion to the longitudinal gradient of the carriageway as indicated in the following table:

Table 14A - Maximum Drained Areas

Longitudinal Gradient	Maximum Drained Area
From 1 in 120 to steeper than 1 in 150	140 sq.m
From 1 in 80 to steeper than 1 in 120	160 sq.m
From 1 in 40 to steeper than 1 in 80	145 sq.m
From 1 in 40 to maximum 1 in 20	115 sq.m

2. Gullies shall be spaced to ensure that the drained areas do not exceed the maximum values given in the Table above. At the bottom of sag curves double gullies may be required and shall be installed at the discretion of the Engineer.
3. The maximum length for any gully connection shall be 20m.

14.03 Ironwork Surrounds in Block Paving

1. The Developer shall use specifically designed ironwork which permits blockwork and its laying course to be laid up to the frame of the gully grate or manhole cover. No trimming of blocks shall be permitted other than those vertical cuts necessary to achieve the laying pattern shown in Appendix 7 and to accommodate the horizontal alignment of the road.
2. Blockwork around carriageway ironwork shall be laid in accordance with the requirements and details shown in Appendix 7.
3. Where dished channels are used in block paved roads dished gully gratings of a compatible profile and to BS EN 124:2015 shall also be used.

14.04 Ironworks within Cycleways /Footways /Shared surfaces

1. All gully gratings situated within cycleways/ footways/ shared surfaces shall be of a suitable type approved by the Engineer, as specified in 14.01.

15.0 GULLY POTS

15.01 General Requirements - Type and Size

1. Gully pots used for carriageway gullies shall be of precast concrete using Sulphate Resisting Cement (SRC) or an equivalent sulphate resistant blend as defined within BS8500:2015 +A2:2019 in accordance with BS 5911-6:2021
2. Gully pots shall have internal dimensions 450mm diameter by 1050mm deep and shall be of the trapped type.

15.02 Bedding and Surround

1. Concrete gully pots shall be installed in accordance with BBA approval requirements. The Engineer would expect the pots to be set on and surrounded by 150mm of ST2 concrete sulphate resistant cement to SHW Clause 2602.

16.0 ESTATE ROAD HIGHWAY SURFACE WATER DRAINAGE

16.01 General Requirements

1. The highway surface water drainage layout shall be designed to cater for a 1 in a 100-year storm plus 40% climate change. The design shall ensure that the velocity of water flowing in the pipes falls within the self-cleansing range. The Crimp and Bruges method will be used to check the capacity of the system and the flow velocity.
2. A Nomograph to assist with the design of surface water drainage is provided in Appendix 12. Guidance for using the Nomograph are as follows:
 - a) Join the diameter of the pipe on scale D and the gradient (lim S) on scale S by a straight line
 - b) The intersection of this straight line with the scale Q gives the discharge for the pipe when flowing full
 - c) The intersection of this same line at scale V gives the velocity of flow for the pipe when flowing full
 - d) Equation $Q = 2.78 \times A \times 0.9 \times 25.4$

Where A = the impermeable area in hectares and Q is expressed in Litres/second (1 hectare = 10,000m²)

3. An adequate piped highway surface water drainage system, of approved pipe sizes, gradients and materials or a sustainable drainage system to clause 16.01.11 below shall be provided to an outfall.
4. Highway surface water drains shall be laid in straight lines at uniform gradients between manholes. Sight rails shall be erected at intervals of not more than 45 m and at changes of gradient.
5. Where an outfall drain or pipe unavoidably passes under land which will ultimately be conveyed to house purchase, or which will otherwise remain undedicated as highway, an Easement will be required always giving the Highway Authority right of access for repair and maintenance purposes. Acknowledgement of the presence of such a drain under each affected property must be safeguarded by the incorporation of a suitable Easement within the Conveyance of that property by the Developer. The Developer is required to submit a draft of any such conveyance to the Engineer for approval prior to the sale of any affected property.
6. Where an outfall, drain ditch or pipe will discharge into an existing drain or pipe or watercourse not maintainable by the Local Highway Authority, written evidence of the consent of the authority or owner responsible for the existing drain etc., to such discharge shall be provided to the Engineer.
7. Provision may be required to filter any drainage water prior to discharge into an existing drain, pipe or watercourse where pollution of the drain, pipe or watercourse may occur, or at those sites deemed especially sensitive by the Engineer.

8. No surface water outfall drain shall pass below any building.
9. Backfill to pipe runs shall be in accordance with Section 5.0.
10. All adoptable highway surface water drainage systems, including gully laterals shall be surveyed using closed circuit television with viewing and video recording facilities, subject to the discretion of the Engineer. The Developer shall provide suitable carriage equipment for the video camera such that the camera may be propelled or drawn from one end of a drain, duct or culvert, whilst the camera is in operation, without damage to the drainage system.

16.02 Surface Water Pipes

1. The following types of pipe from approved manufacturers may be used for highway surface water drains:
 - a) Concrete pipes made with sulphate resisting cement to BS 5911-1: 2021
 - b) "plastic" pipes (PVCu) twin wall with a smooth internal and ribbed external wall, with current BBA Certification;
 - c) other types approved by the Engineer.
2. Jointing and installation shall be to the manufacturers' specification.

16.03 Concrete Surround to Pipes and Ducts

1. Where the depth of cover to top of pipe below carriageway is 1.2m or less, all pipes and ducts, including plastic, shall have a bed and surround of 150mm ST1 concrete with sulphate resistant cement to SHW Clause 2602. The level of the upper surface of which shall in no case be less than 350mm below finished carriageway level.
2. In the case of plastic pipes measures must be taken to ensure that they do not float when the concrete is poured.
3. To maintain a degree of flexibility, 13mm thick fibreboard shall be inserted at the pipe joints to the full width of the concrete surround.
4. For porous pipes the surround shall comprise of at least 200mm of no fines concrete to SHW Clause 2603 or as agreed with the Engineer.

16.04 Soakaways

1. Principle – Soakaways will be regarded as the last engineering solution after all other interventions have been exhausted.

2. The use of soakaways is to be at the discretion of the Engineer and is dependent on the proven existence of continuous highly permeable strata below the surface. It is also a requirement of Building Regulations 2010 – Part H3 –Soakaways and other infiltration drainage systems - 3.25a Infiltration devices should not be built within 5m of a building or road or in areas of unstable land, or within 10m when used in areas of chalk.
3. For single soakaways to be given consideration, the minimum coefficient of permeability of the strata is 5×10^{-5} m/s. See clause 16.04.13 for the test method to be used. In the event of the above coefficient of permeability not being achieved consideration may be given to additional soakaways being “linked in” up to a maximum of 3 in total – See Appendix 16 – Linked Soakaways diagrammatic layout. The Developer is required to advise the Engineer of in-situ permeability testing with sufficient time to allow for witnessing of the testing.
4. Soil survey data must be submitted, the minimum information to be provided shall be full site records to include bore hole or trial pit logs, descriptions and depths of strata, classification of strata, by laboratory tests for soils contamination, and identification of water table depth. Any supporting evidence of seasonal variations of the water table depth must also be supplied.
5. Any necessary approvals from the local Water Authorities and/or Environment Agency must be obtained by the Developer and evidence of these approvals submitted to the Engineer before the proposal can be considered.
6. Soakaway chambers shall extend down to the proved continuous permeable stratum as approved by the Engineer. Chamber rings in permeable strata must be perforated and the lower ring must be founded on an in-situ concrete beam.
7. The maximum depth of the soakaway chamber shall be 1m above the standing water table to a maximum depth of 3m below finished ground level. A typical cross section is shown in Appendix 15 – Soakaway chamber details.
8. Soakaway volumes shall be such that they can accommodate at least the whole of a 1 in a 100-year storm (1%AEP), in the volume available above the base of the chamber and below the drain inverts (effective volume) – the diameter and the number of chambers to be adjusted accordingly. Storage may be reduced to take into account of proven percolation results, adjusted as clause 16.04.8. All percolation results must be submitted to the Engineer. A full set of supporting calculations such as “micro-drainage” or equivalent must be supplied to the Engineer for checking. Upon checking these calculations, the Engineer may require additional soakaways and/or revised positioning of the soakaway chambers.
9. Allowance should be made for the in-service effects of siltation and swelling, 33% for gravel/sands and “stone” layers in chalk and 50% for chalk and others. The Developer is advised to contact the Engineer to arrange for attendance on site to witness the soakage testing when it is carried out.
10. Soakaways shall be linked by overflow pipes as required by the Engineer.

11. Soakaway chambers shall not be sited under the carriageway or footway/cycleway or footpath, areas of verge must be set aside for this purpose, see also 16.04.01 above.
12. BRE Digest 365 (soakaways) is not applicable to Cambridgeshire Highway Drainage. Cambridgeshire County Council has avoided BRE drainage methods because of the difficulties inherent in the long-term maintenance of this type of soakaway.
13. Cambridgeshire's currently adopted test method is a practical and simple hybrid of BS5930 and BRE365 related methods as detailed in 16.05 below. The trial pit excavated for testing is more representative of a working soakaway chamber, in terms of size and the volume of water used, than a lined borehole, and tends to relate more to a practical methodology than to strict BS5930:2015 + A1:2020. The falling head process reduces the quantity of water required for the site, but this can still be substantial.
14. The permeability coefficient is calculated in general accordance with BS5930:2015 + A1:2020, and as the Basic Time Lag is derived graphically there is no need to repeat the test (as required by BRE 365). The only interpretive element relates to which Intake Factor is applicable from the options shown in BS 5930:2015 + A1:2020 figure 6.
15. For further details regarding the calculations contact the Engineer.

16.05 Guidance notes for undertaking drainage soakaway testing on estate roads

1. Local Authorities within Cambridgeshire have avoided BRE drainage methods due to concerns over long term difficulties of this type of soakaway. Once the soakaway has been installed all the long-term maintenance risks fall back onto the local adopting authority and as such a tried and trusted working method together with an acceptable compliant specification has to be implemented.
2. The test procedure is based around a hybrid method derived from BRE 365 and BS 5930. The reason for this was to create a practical test that will be representative of a working soakaway chamber on each specific site (the method in resume uses a trial pit as per BRE 365 but utilises the calculations within BS 5930 – Variable or Falling Head method to be used).
3. Method
 1. At the location of the proposed Soakaway Chamber excavate a trial pit for testing and take initial measurements of the length, width and depth (m) of the trial pit – try and excavate as close to possible a square section, i.e. 2 x 2 x 2m.
 2. Fill up the trial pit to the top of the sub soil strata to be tested with water and measure the start point level (L) (Nb. If topsoil exists the water level start point should not be in this layer.
 3. At one minute time intervals note the reduced water level depths. Check water level for at least one hour or until the head remains constant for a period of 10 minutes or the trial pit has drained of water.

4. At the termination of the test carry out a further smaller excavation adjacent to the test trial pit. In order to prove continuity of layer and check on water table level (this may need leaving overnight in a safe state).
5. From the data obtained at minute intervals divide this by the depth of the head at commencement and plot on logarithmic graph paper as per Figure 8 of BS 5930:2015 + A1:2020: – Calculate the Basic Time Lag (T).
6. Calculate the intake factor (F) from 'Case d', Figure 6, BS 5930:2015 + A1:2020:.. Where 'L' is the total depth of water at the start of test (as 2 above) and 'D' is the width of the trial pit (see 1 above – if there is variance between the measurements then take the smaller dimension).
7. Calculate Permeability (k) - $k = \frac{A}{FT}$ where 'A' is the cross-sectional area
8. Check for compliance against minimum requirement of: 5×10^{-5} m/s.

16.06 Surface Water Catchpit Manholes

1. Catchpit Manholes shall be provided at the head of drains, at changes of direction, pipe size or gradient and at the junction of main drains. Spacing shall not exceed 50m.
2. Upstream of the manhole at the head of a highway drain run each gully must be connected directly into the manhole and the length of gully connection must not exceed 20m.
3. Manholes shall conform in all respects with the requirements below and the Appendix 13 – Catchpit manhole details-brick type or Appendix 14 – Manhole details-precast concrete type:
 - a) Precast Concrete - Rings complying with BS 5911-3:2010 + A1: 2014 / BS EN 5911-1:2021. The concrete cover slab must be Heavy Duty Reinforced Concrete to BS 5911-3:2010 + A1:2014 / BS EN 5911-1:2021 - see Appendix 14.
 - b) Engineering Brickwork - 225mm thick class B. Dimensions all as Appendix 14. The concrete cover slab shall be separately cast to the dimensions and with reinforcement all as shown in Appendix 13 / 14.

17.0 MANHOLE COVERS / FRAMES AND HEADWALLS

17.01 General Requirements

1. All manhole covers and frames intended for incorporation within the highway shall be kite-marked products to BS EN 124: 2015 and badged S.W (surface water) and F.W (foul water).
2. They shall be Heavy Duty: BS EN 124: 2015 reference D400 with a clear opening of 600mm and minimum frame depth of 150mm.
3. Manhole covers and any other carriageway and footway or cycleway ironwork shall not be installed until the binder course layer is laid. During the construction process protection should be given to all gullies and chambers from the ingress of debris.

17.02 Bedding

1. The frames shall be bedded on a gauged designation (1) sand/cement mortar to SHW Clause 2404, Table 24/1 (the ratio of cement to sand shall be 1:3 by volume) and BS EN 1996: 2006 above two to four courses of Engineering brickwork Class B to BS EN 771-1:2011 + A1:2015. The use of accelerating admixtures to be agreed with the Engineer prior to use.

17.03 Manhole Surrounds in Block Paving

1. The Developer shall use specifically designed ironwork which permits the blockwork and its laying course to be laid up to the frame of the gully grate or manhole cover. No trimming of blocks shall be permitted other than those vertical cuts necessary to achieve the laying pattern shown in Appendix 7 and to accommodate the horizontal alignment of the road.
2. Blockwork around carriageway ironwork shall be laid in accordance with the requirements and details shown in Appendix 7.

17.04 Headwalls

1. The design for any headwall shall be submitted to the Engineer for approval prior to any construction works associated with the same commencing on site.

18.0 FOOTWAYS AND CYCLEWAYS

18.01 General

1. Footways /cycle ways adjacent areas which may be subject to vehicular over-run shall be constructed to carriageway specification, in accordance with details to be agreed with the Engineer.

18.02 Preparation

1. The formation of the footway/footpath/cycleway shall be levelled and compacted with a vibrating roller or other approved plant of suitable type to a properly shaped, even and uniform surface. Reference should be made to Section 3.0 and Table 3A – Earthworks Compaction for detailed information.
2. The formation shall be treated with an approved residual weedkiller, before construction commences. A non-woven separation membrane within the construction to limit weed intrusion prior to the installation of the base material shall be installed below the sub-base layer.
3. Bituminous materials shall be machine–laid. Where agreed with the Engineer, hand laid materials may be used but shall be restricted to small areas. All materials to be supplied, laid and compacted in accordance with BS594987:2015+A1:2017. Consideration must be given for all Bituminous materials to be supplied in Warm Mix mode as this is now the preferred method specified by Cambridgeshire County Council. Please refer to Clause 6.02 and Table 6D for further information. All bituminous layers to be surfaced over must be sprayed with a suitable bituminous bond coat to promote adhesion and improve impermeability.
4. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS 549987: 2015+A1:2017
5. No laying of bituminous materials shall commence prior to any service installation being completed within the footway.
6. Where footpaths or cycleways pass between walls, private land or other features that prevent the run-off of highway surface water, then positive drainage will be required.

18.03 Sub-Base

1. The material used shall be SHW Clause 803, Type 1, HER Sub-base or SHW Clause 804, or compliant recycled material, compacted to Table 3B – Sub-base Compaction to a finished thickness shown in the following table.
2. All footways, cycleways and cycle paths, including those separate from the carriageway network shall have a sub-base of 365mm, extending 300mm beyond the back edge of the respective kerb.

3. Special provisions for vehicular, cycle and pedestrian footway crossings are detailed in Section 19.0 of this Specification.
4. Footways/ cycleways on the inside of speed control bends shall be increased in strength by increasing the base thickness to a minimum 365mm of sub-base. This strengthening shall extend 5m beyond the tangent points of the bend.

18.04 Binder Course

1. The binder course shall be 60mm compacted thickness of AC 14 close surf Dense Asphalt Concrete to BS EN 13108-1 and PD6691 with 40-60 pen binder. Consideration will be given to Developers/Contractors wishing to use material containing recycled products subject to the conditions of Clause 1.09.4.
2. The binder course for vehicle crossings shall be designed in accordance with Appendix 10. Consideration will be given to Developers/Contractors wishing to use material containing recycled products subject to the conditions of Clause 1.09.4.
3. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS 549987: 2015+A1:2017

18.05 Surface Course

1. The surface course shall comprise 25mm compacted thickness of AC 6 dense surf in accordance with BS EN 13108-1 and PD6691 with 40-60 pen binder. The coarse aggregate shall be either crushed rock or gravel. The course aggregate shall be thoroughly compacted as per Section 3.0 and Table 3C – Trench Reinstatement Compaction. It is recommended that care be taken with the installation of this type of surfacing particularly where it is envisaged that the surface will be subject to turning traffic stresses. In such circumstances it is recommended that the alternative recommended in clause 18.04.2 is used.
2. Proprietary 6mm SMA with 40-60 pen binder mixtures formulated to be suitable for driveways and footways laid 25mm thick may be used. The material producer's installation recommendations shall be carefully followed to achieve thorough compaction. In the event of a non-proprietary generic SMA being proposed, the material shall satisfy the technical requirements of SHW reference Clause 937.
3. All vertical edges including kerbs, ironwork and joints shall be painted with cold applied thixotropic bitumen emulsion or hot applied bitumen immediately prior to the laying of any bituminous layer in accordance with BS 549987: 2015 + A1:2017.
4. A thorough examination will be undertaken prior to adoption and any areas that show sign of any damage or deterioration shall be replaced to the full width and to the total satisfaction of the Engineer.
5. Guidelines for delivery and rolling temperatures for surface course Layers are given in Section 6.0.

6. Consideration will be given to Developers/ Contractors wishing to use material containing recycled products subject to the conditions of clause 1.09.4.

18.06 Cycleway Surface Course

1. Specifically designated cycleways shall be coloured red. The aggregate shall be crushed granite and have a colour conforming to HUE 7.5R/3/4 and HUE 7.5R/3/8 as defined by the Munsell Chart. The binder shall be coloured using iron oxide to the approval of the Engineer.
2. The surface colour of shared use footway/ cycleways shall be at the discretion of the Engineer, depending upon the context and nature of the infrastructure.

18.07 Heritage Surface Course (context dependent)

1. Stone mastic Asphalt (SMA) 6mm surf to BSEN13108-5 with 40-60 pen binder but containing local 'golden' gravel' coarse aggregate.
2. Heritage surface course shall be laid to a 25mm thickness.
3. Information is required that shows appropriate adhesion agents are to be added to ensure good adhesion between the gravel and the bitumen.

18.08 Concrete Block Paving

1. Block paving in the form of precast concrete rectangular blocks of dimensions 200mm x 100mm x 80mm laid on a laying course may be considered as clause 18.07.7 below.
2. Clay block paving shall not be permitted.
3. All block work shall be protected from site traffic to the satisfaction of the Engineer.
4. Blocks shall comply with BS EN 1338:2003 (in accordance with Table 7) and the permitted colours are;
 - a) medium/red/buff
 - b) dark grey/dark brown
 - c) natural/brindle
5. Blocks shall be laid on a 30mm compacted thickness of category II laying course sand in accordance with the requirements in BS7533 Part 3, 2005 + A1:2009. The method detailed in 4.3.3.a) of that document shall be adopted for installing the laying course.
6. Surface regularity for blockwork is defined in clause 1.10.

7. Blocks shall be laid in a 90° herringbone pattern unless otherwise agreed in writing by the Engineer. Where herringbone pattern at 45 degrees is permitted, laying should be to the requirements of BS 7533 Part 3 2005 + A1:2009 utilising “mitre head” starter units and inboard cutting techniques as appropriate. Blocks to be cut using approved block cutting guillotine to no less than $\frac{1}{4}$ (one quarter) of the original plan size.
8. A binder course layer 60mm thick placed in accordance with the requirements of clause 18.03 over a sub-base to clause 18.02. The Developer should refer to Appendix 10 for construction thicknesses.
9. Gaps between kerb face and blocks and between ironwork and blocks must be kept to a minimum and sealed with a well-rammed mixture of 3:1 dry sand to Ordinary Portland Cement or propriety sealing system.
10. The Developer shall use specifically designed ironwork which permits the blockwork and its laying course to be laid up to the frame of the ironwork. No trimming of blocks shall be permitted other than those vertical cuts necessary to achieve the laying pattern shown in Appendix 7 and to accommodate the horizontal alignment.
11. Proprietary blocks and systems shall only be used with the prior written authorisation from the Engineer.
12. Tegula paving shall be 80mm thick, rolled pre-cast concrete paving blocks with at least three different longitudinal sizes laid to create a random pattern using a suitable mix of the block sizes available. The blocks shall be manufactured to the requirements of BS EN 1338:2003.

18.09 Footway and Cycleway Construction

1. Typical construction details are shown in Appendix 10.

18.10 Crossfall

1. The final footway/cycleway surface shall have a crossfall of 1 in 40 towards the carriageway.

18.11 Edge Supports

1. Where a footway does not abut a kerb or boundary wall a 50mm x 150mm hydraulically-pressed, precast, flat-topped, concrete edging to BS EN 1340:2003 Type EF shall be provided.
2. The precast edging must be securely bedded on a foundation of ST1 concrete to SHW Clause 2602 100mm deep and 200mm wide. It shall be backed with ST1 concrete from the back of the bedding to within a minimum of 40mm from the top of the edging.

18.12 Footpaths

1. The construction of footpaths, which are remote from carriageways, shall comply with the requirements of the footway and cycleway specification. In addition, footpaths shall be constructed with edge supports on both sides, as detailed on Appendix 4 – Kerb and edging details.

19.0 VEHICULAR, PEDESTRIAN AND CYCLE CROSSINGS

19.01 Vehicular Crossings

1. Vehicular crossings shall be provided at the entrance to all, garages and residential properties with accesses of sufficient width to accommodate a vehicle.
2. A minimum of four precast concrete kerbs 125mm x 150mm to BS EN 1340:2003 Type BN shall be installed to provide a vehicular crossing with a minimum width of 3.6m. These dropped kerbs shall be set to show an upstand of 25mm with tolerances as given in, Table 1C - Tolerance for other fixed surface features.
3. The use of 125mm x 255mm Type HB2 kerbs laid flat will not be permitted and purpose made dropper kerbs shall be used to join the low kerbs to the standard upstand kerbing.

19.02 Pedestrian Crossings

1. Where pedestrian routes cross carriageways and on footways at junctions, two dropped kerbs with tapers shall be provided on each side of the carriageway or junction. Any Tactile Paving shall be agreed with the Engineer prior to installation in accordance with Appendix 8 – Uncontrolled Pedestrian Crossing. The underlying construction specification for Tactile Paving must at least comply with the requirements of clause 18. The tactile paving thickness should be at least 65mm.
2. The dropped kerbs shall be set with the carriageway channel level to the tolerances given in Table 1C - Tolerance for other fixed surface features.

19.03 Cycle Crossings

1. Where a cycleway adjacent to the carriageway is interrupted by pedestrian or vehicular crossings, the change in level shall be achieved over at least two kerbs, using standard precast concrete kerbs and laid to suit in place of the standard one taper kerb.
2. The dropped kerbs shall be set to the tolerances given in Table 1C - Tolerance for other fixed surface features.

19.04 Dropped Kerbs and Alignment

1. Dropped kerbs and tapers shall comply with the requirements of BS EN 1340:2003.
2. Kerbs shall be laid to a flowing alignment and to the construction requirements of Section 13.0 of this Specification.
3. Where the interval between adjoining vehicular crossings is such that less than three kerbs show the full face of 125mm, the intervening kerbs between these crossings shall also be 125mm x 150mm laid to show an upstand of 25mm.

4. The concrete edging at the rear of the path shall to be lowered by 100mm to match the profile of the kerbline and maintain the cross fall of 1 in 40 towards the carriageway, as shown in Appendix 5 – Typical layout for vehicular accesses.

20.0 VERGES WITHIN VISIBILITY SPLAYS

20.01 Grassed Areas

1. Grass areas within highway limits shall have the following treatment during construction:
 - a) A layer of topsoil fully compliant with BS 3882:2015 100mm thick, free from weeds, coarse grass and stones, shall be placed, levelled and raked smooth
 - b) Before sowing grass seed, all weeds and coarse grass shall be eradicated by use of a non-residual weedkiller, used strictly in accordance with the manufacturers' instructions and a pre-seeding fertiliser shall be applied
 - c) Selected tested grass seed complying with the requirement of the low-growth clause 20.02 below shall be sown at the rate of 30g/sqm and hand raked over
2. In the case of germination failure, sowing shall be repeated until a good growth is obtained.
3. All adoptable verges and visibility splays shall have a permanent delineation in accordance with clause 20.04 below and Appendix 29. Any alternative delineation shall be agreed with the Engineer.

20.02 Low-Growth Grass Mixture

1. A variety of mixtures are available from seed houses to suit the range of topsoil/subsoil pH encountered in Cambridgeshire. Wherever possible, preference shall be given to using suitable native grass species of local provenance, providing they comply with low growth characteristics. The mixture, British Seed Houses – Mix A22, is suggested as being suitable for general low maintenance/low growth characteristics and shall be used unless an alternative more specific to a particular soil type is available and submitted to and approved by the Engineer.

20.03 Street Trees

1. The planting of any trees within the proposed adoptable public highway must be agreed by the Engineer at design stage.
2. The Highway Authority will only adopt grass verges that are required as part of the inter vehicle visibility splays at junctions or part of forward visibility. No other planting will be permitted within the grass verge that is to become adopted public highway. Outside the required inter vehicle visibility splays grass verges and any associated planting will remain private.
3. Tree pits shall be excavated to a depth of 1.4m and the base shall be broken up to a depth of not less than 150mm to assure that the pit will drain. A minimum of 150mm of 20mm gravel shall be laid at the base of the pit, this shall be covered with a water permeable geo-textile. The topsoil to the tree pit shall conform to BS 3882:2015 and shall be placed in layers of not more than 200mm and lightly compacted. The topsoil to tree pits in hard paved areas shall be set 100mm below the surface of the footway.

4. In verges each tree pit shall have a minimum area of 8sq.m per tree. In areas of hard paving the area of the tree pit shall be at least 4sq.m in area.
5. To protect the carriageway and footway sub-grades a suitable root barrier must be provided to encase in accordance with Appendices 25 and 26.
6. Tree pits in hard paved areas shall be protected by a cast iron tree grille as shown in Appendix 27. The grille shall comply with the loading BS EN 124. The 100mm gap between the tree grille and the topsoil shall be filled with a manufactured air permeable material.
7. Where new trees, shrubs or hedges are planted on private ground within 5m of the highway boundary or where any private front gardens abutting the adopted public highway are provided, a root barrier of 1.5m in depth shall be provided at the highway boundary, but not within the highway. The barrier shall extend for not less than 3m beyond the edge of any planting, gardens and the like, to prevent any roots from uncontrolled private planting from penetrating the adopted public highway. The barrier used must be proven to be able to contain aggressive species such as bamboos and the like.

20.04 Highway Boundary Markers in Verges

1. Where the highway boundary is to be marked in areas of grass verge or other planting the boundary marker must conform to the design in Appendix 29 or similar approved by the Engineer.
2. Boundary markers shall be set into the ground in accordance with Appendix 29. They shall be set so that 20mm of the chamfered top projects beyond the soil level. The tops of the markers shall be level and true.
3. The boundary markers shall be manufactured in sulphate resisting concrete with a minimum strength of ST3.
4. The font used for the lettering shall be Ariel, the x height shall be 20mm and the depth of the letters shall be 5mm.
5. Boundary makers shall be set at 10m intervals along straight sections of the development and at 1m centres though a radius, or as agreed with the Engineer.

21.0 COVERS FOR ACCESS TO UTILITY PLANT

1. All covers shall comply with the requirements of clause 17.01 or be certified capable of standing appropriate Heavy Duty loading.
2. All covers for access to utility plant shall be kept clear of cycleways unless agreed by the Engineer prior to installation. Any cover installed within a cycleway must have an antiskid surfacing applied as agreed by the Engineer.
3. In areas of block work in either the footway or carriageway infill covers stamped with the relevant utility badges will be required. In the carriageway covers shall be capable of standing appropriate grade A loading.
4. The Developer will ensure that utility covers are located so they are square with the carriageway, cycleway or footway, align with the general pattern within areas of blockwork and are not placed with the construction area of any form of crossing point.
5. Private utility meters shall be situated clear of the proposed adoptable highway, unless otherwise agreed by the Engineers representative. In the instance where such installation are permitted, meters shall be sited clear of vehicular accesses, and constructed in a concrete chamber with a D400 cover.

22.0 STREET FURNITURE

22.01 Timber bollards

1. Timber used for bollards shall be from a renewable European source and unless otherwise specified shall be oak with a minimum equivalent strength to SC5 strength class to BS EN 1995-1-1:2004 +A2:2014. All timber is to be good quality, straight, sound, free from sap, shakes, loose knots or other defects.
2. Dimensions are shown in Appendix 21. Preservation of timber shall achieve a resistance to all forms of fungal, bacterial, and invertebrate act for a period of not less than fifteen years. All faces of the bollard shall be clean planed, bollards shall be stained with 'Palisander' from Salodin or similar approved.
3. All foundation concrete shall be ST3 and shall be compacted whilst the bollard, is held in a vertical position at the level and location required. The depth of the excavation shall be at least one third the depth of the bollard with 150mm extra below the base and 100mm clearance to all sides. Timber bollards shall be erected to a true vertical line and if in line to a true level to within ± 5 mm.
4. If a bollard is or bollards are to be erected within the grass verge a "sterile" strip of granite setts is to be laid around the bollard so that a strip no less than 100mm wide is presented to all faces of the bollard, to allow ease of grass cutting. The granite setts shall be 100mm, cubed and shall be set in ST4 concrete and pointed with Class 1 mortar.
5. All bollards shall be provided with suitable reflectorised plates measuring 125mm x 200mm to BS EN 12899-2: 2007 the plates shall be aluminium and not less than 3mm thick, they shall conform to BS EN 485 - 2:2016 + A1:2018 , BS EN 573-3:2019 & BS EN515:2017, with traffic grey to the rear. The plates shall be attached to the bollards with four number 25mm screws and the heads of the same shall be 'written off' to prevent ease of removal. The colours of the finished plates shall be red facing the flow of traffic and white on the opposite side of the road the colours shall remain stable and true for a minimum period of seven years.

22.02 Traffic Sign Posts

1. Posts shall be either: plain tubular steel and finished PVC dip coated, colour grey complying with BS EN 10305-1:2016 or galvanised to BS EN ISO 1461:2009 and be manufactured from steel complying with the requirements of BS 7668:2016 Welded Steels.
2. All posts shall be set into the ground at a minimum depth of 400mm with a minimum bed of 250mm of ST2 concrete and a surround of 100mm of ST2 concrete.
3. All excavations shall be dug by hand. The excavation for the post shall be backfilled with ST2 concrete to the formation of the reinstatement.

4. If a post is or posts are to be erected within the grass verge a "sterile" strip of granite setts is to be laid around the base of the post so that a strip no less than 100mm. wide is presented to all faces of the bollard, to allow ease of grass cutting. The granite setts shall be 10 mm. cubed and shall be set in ST4 concrete and pointed with Class designated (i) mortar in accordance with SHW Clause 2404, Table 24/1 (the ratio of cement to sand shall be 1:3 by volume)
5. All bollards shall be provided with suitable reflectorised plates measuring 125mm x 200mm to BS EN 12899-2:2007 the plates shall be aluminium and not less than 3mm thick, they shall conform to BS EN485 – 2:2016 + A1:2018, BS EN 573-3:2019 & BS EN515:2017, with traffic grey to the rear. The plates shall be attached to the bollards with four number 25mm screws and the heads of the same shall be 'written off' to prevent ease of removal. The colours of the finished plates shall be red facing the flow of traffic and white on the opposite side of the road, the colours shall remain stable and true for a minimum period of seven years.

23.0 COMPLETION OF WORKS

23.01 General Requirements

1. Once the Developer has completed their works to the site and no further building works are to be undertaken, a joint inspection will be performed, and the Engineers will supply or certify a list of any defects. Any defects found shall be rectified to the total satisfaction of the Engineer.
2. If the binder course has been trafficked by site vehicles for the duration of the construction period, any surface imperfections must be rectified prior to the placement of the surface course. If the damage to the binder course exceeds 30% of the surfaced area, the complete binder course layer shall be removed and re-laid, on larger multi routed developments the 30% standard will be applied to each individual road, path, footway or cycleway and not to the site as a whole.
3. The Highway Authority will not accept any scarring of any form within the surface course to any highway surface. In the event that such scarring does occur the Engineer reserves the right to have the faulty surface type within the whole development resurfaced. If the scarring has occurred on a 'side road' from a main route within a larger development, the Engineer may at his/her discretion allow the resurfacing to stop at the next original joint in the surface course. If the scarring is limited, then the Engineer may at their discretion allow the developer to patch the surface course as required.
4. Damaged kerbs, channels and edgings shall be removed and replaced. If this results in damage to the footway, footpath or cycleway then a patch as required by the Engineer shall be provided.
5. The Engineer may at his/her discretion allow the Developer to patch damaged kerbs, channel blocks, edging kerbs with a suitable epoxy mortar.
6. All gully pots shall be suction cleansed, disinfected, all detritus shall be removed there from and trapped pots resealed with clean water taken from the local domestic supply.
7. The Contractor shall provide one copy of a closed-circuit television video recording of each highway drainage run, including gully laterals, accompanied by a detailed report showing the location, chainage, prevailing weather conditions, date and time of survey.
8. A complete set of as built drawings in both electronic and paper format shall be provided to the Engineer prior to the date of issue of the Maintenance Certificate.

23.02 Sweeping and herbicide application

1. Channels to the carriageway shall be swept in accordance with the following schedule
 - a) Before the maintenance period - full mechanical sweep
 - b) During the maintenance period - regular mechanical sweeping every three months

- c) At proposed adoption date - full mechanical sweep
- 2. Sweeping shall be carried out using a mechanical sweeper to remove detritus, grass and other materials to the satisfaction of the Engineer.
- 3. An approved residual herbicide shall be applied to all, channel lines, cover edges and the back of the footway, footpath or cycleway prior to adoption.

23.03 Grass Maintenance

- 1. Grassed areas provided under Section 20.0 of this Specification shall be fully maintained during the construction maintenance period and shall include all necessary treatment with weedkillers, fertilisers, etc.
- 2. Grass cutting shall be carried out in accordance with the following schedule
 - a) Before the maintenance period - full cut
 - b) During the maintenance period - cutting to 25mm maximum
 - c) At proposed adoption date - full cut
- 3. Grass shall be cut to achieve a finished maximum height of 25mm before adoption. All weeds and other detritus shall be removed from grassed areas to the satisfaction of the Engineer. Any areas of verge that show grow of perennial weeds shall be excavated by hand all roots etc. of the weeds etc., are to be removed and disposed of. The area will then be reseeded with an appropriate seed mix.

24.0 SAMPIING OF MATERIALS

24.01 General

1. Sampling and testing of mixtures and materials shall be carried out in full compliance with the appropriate British/European Standards. Testing and samples shall be provided as frequently as the Engineer may deem necessary to satisfy himself that the mixtures and materials comply with the appropriate specification. Results of all testing associated with the highway works shall be available, whenever required for the Engineer to inspect.
2. The Engineer reserves the right to instruct the Developer, to drill up to 200mm diameter cores through the highway construction before the surface course is applied to determine the layer thickness, materials used, construction type and standard of installation. These tests shall be undertaken at the expense of the Developer. Alternatively, the Developer may be required to excavate and reinstate trial trenches at his own expense in the presence of the Engineer. Where layers are not correct in thickness or material, the road will not be adopted until the works have been corrected.
3. Where material or structural thickness are found to be out of specifications, the adoption will not take place before the defective layer(s) or material(s) have been replaced. The cost of such testing and coring shall be met in full by the Developer.

25.0 LIST OF CONTACTS FOR FURTHER INFORMATION

1. For advice or information regarding the design of electrical installations, bridges, culverts and structures and for requests for AutoCAD copies of the Appendices follow the link below.

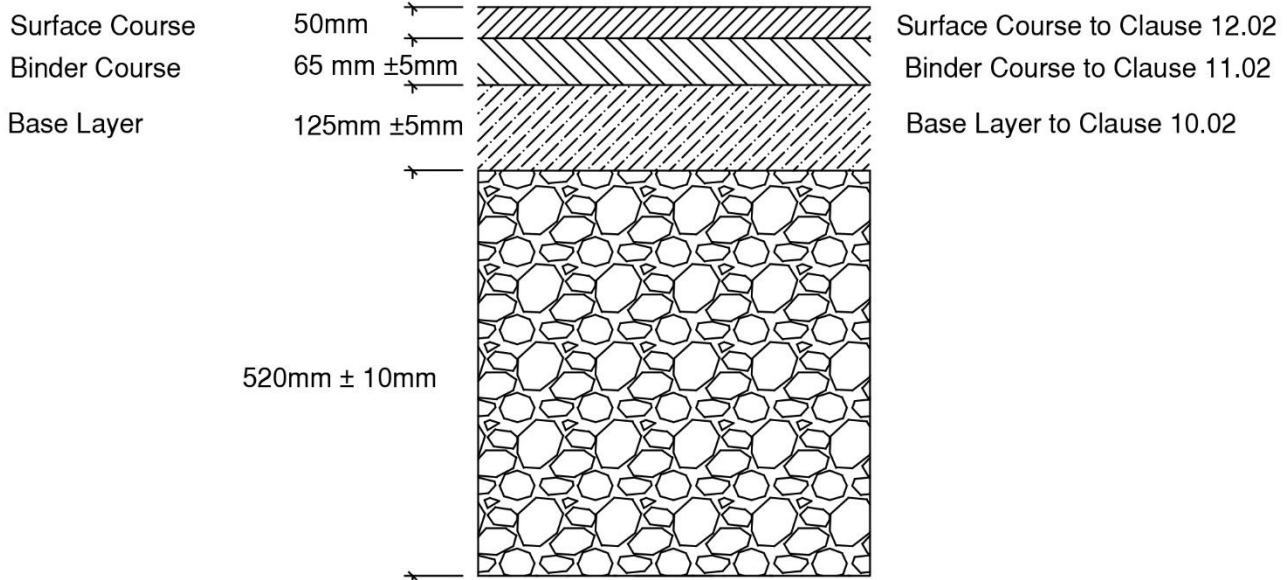
<https://www.cambridgeshire.gov.uk/residents/travel-roads-and-parking/roads-and-pathways/highways-development>

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Appendix 29	Highway Boundary Marker (in soft)
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Job Title: **Distributor Road**



Appendix 1 - notes

1. Unless *in situ* testing has been agreed by the Engineer the CBR for the site will be assumed to be < 2% the depth of the Type 1 (Clause 9.02). Sub-base may be reduced in line with the following if suitable test results are provided.

Measured CBR values	Required depth of Type 1 or HER sub-base
CBR > 5%	260mm± 10mm (minimum thickness)
CBR 5%	280mm± 10mm
CBR 4%	315mm± 10mm
CBR 3%	375mm± 10mm
CBR 2%	450mm± 10mm
CBR less than 2%	520mm± 10mm

2. If Plasticity Index values are not available from the soil survey and test data for the proposed site, a CBR of less than 2 (<2) must be assumed for the design. A separating membrane will be required where the design CBR is less than 5% (Clause 7.03).

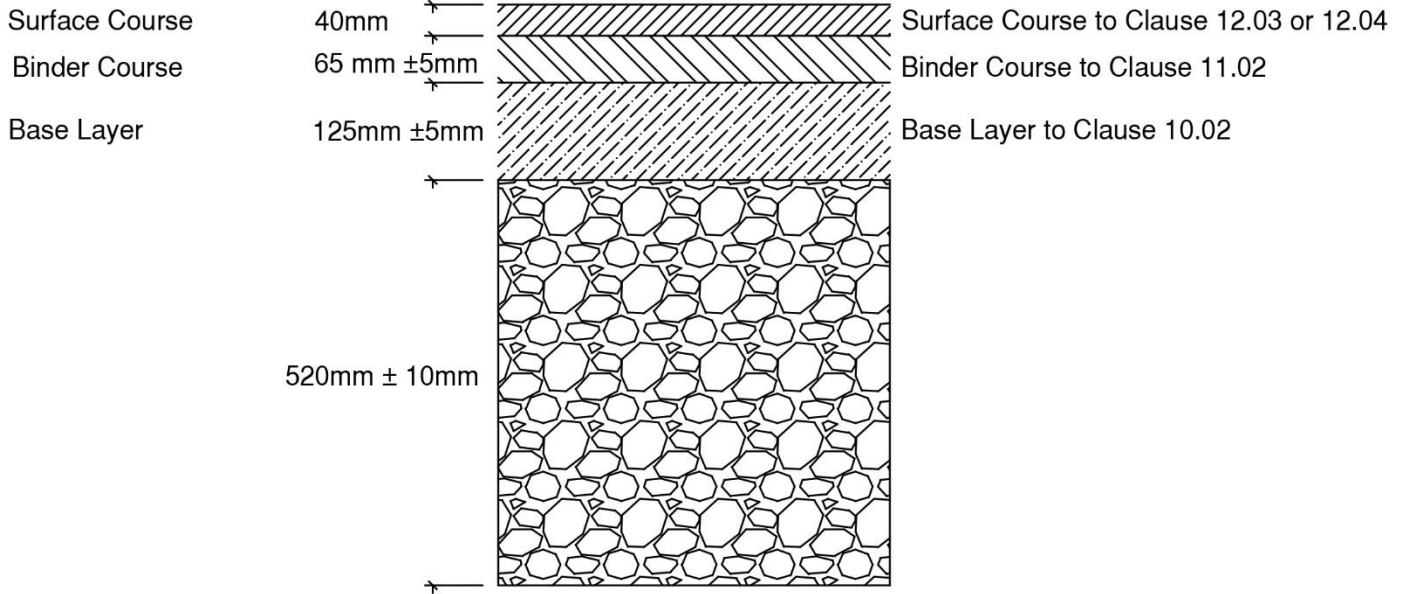
3. The total carriageway thickness must be at least 490mm (inclusive of sub-base).

4. The combined thickness of the bound layers as shown above shall be regarded as the minimum overall thickness for the bound materials.

5. If the 40 years life design traffic exceeds 1.0 msa a special design shall be submitted for the Engineer's approval



Job Title: **Estate Road**



Appendix 2 - notes

1. Unless *in situ* testing has been agreed by the Engineer the CBR for the site will be assumed to be < 2% the depth of the Type 1 or Cambs. HER (Clause 9.02) Sub-base may be reduced in line with the following if suitable test results are provided.

Measured CBR values	Required depth of Type 1 or HER sub-base
CBR > 5%	260mm± 10mm (minimum thickness)
CBR 5%	280mm± 10mm
CBR 4%	315mm± 10mm
CBR 3%	375mm± 10mm
CBR 2%	450mm± 10mm
CBR less than 2%	520mm± 10mm

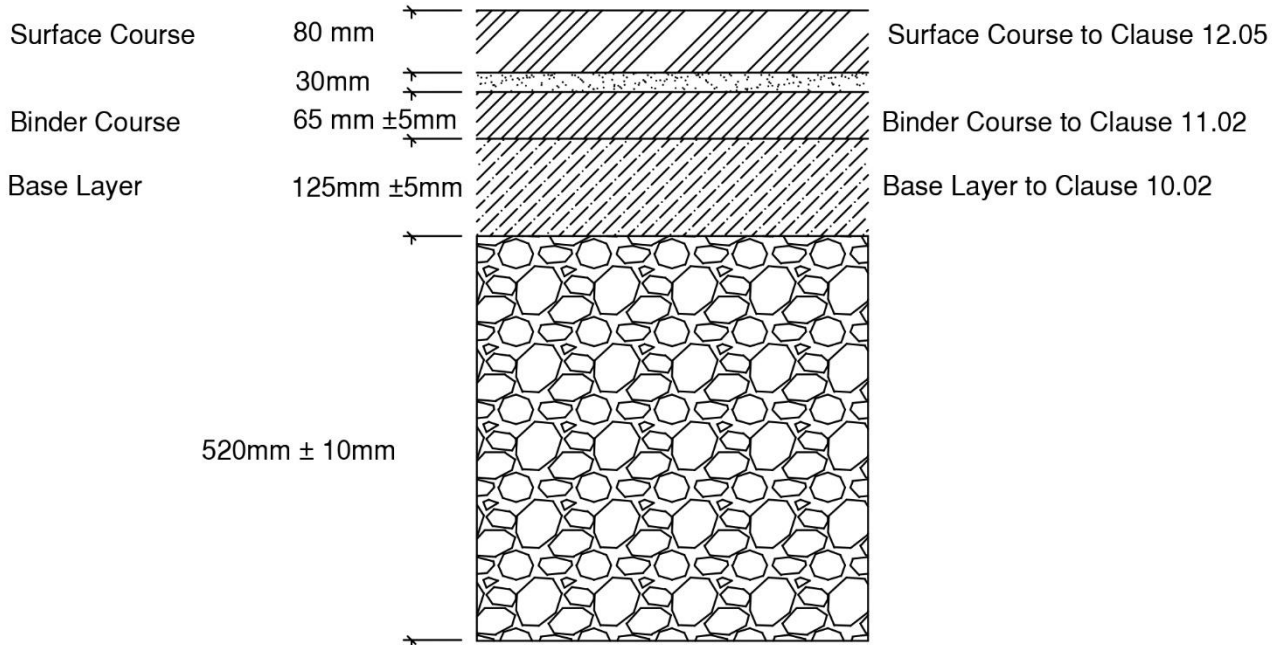
2. If Plasticity Index values are not available from the soil survey and test data for the proposed site, a CBR of less than 2 (<2) must be assumed for the design. A separating membrane will be required where the design CBR is less than 5% (Clause 7.03).

3. The total carriageway thickness must be at least 490mm (inclusive of sub-base).

4. The combined thickness of the bound layers as shown above shall be regarded as the minimum overall thickness for the bound materials.



Job Title: **Shared Use Area: pre-cast concrete blocks**



Appendix 3 - notes

1. Unless *in situ* testing has been agreed by the Engineer the CBR for the site will be assumed to be < 2% the depth of the Type 1 or Cambs. HER (Clause 9.02) Sub-base may be reduced in line with the following if suitable test results are provided.

Measured CBR values	Required depth of Type 1 or HER sub-base
CBR > 5%	260mm± 10mm (minimum thickness)
CBR 5%	280mm± 10mm
CBR 4%	315mm± 10mm
CBR 3%	375mm± 10mm
CBR 2%	450mm± 10mm
CBR less than 2%	520mm± 10mm

2. If Plasticity Index values are not available from the soil survey and test data for the proposed site, a CBR of less than 2 (<2) must be assumed for the design. A separating membrane will be required where the design CBR is less than 5% (Clause 7.03).

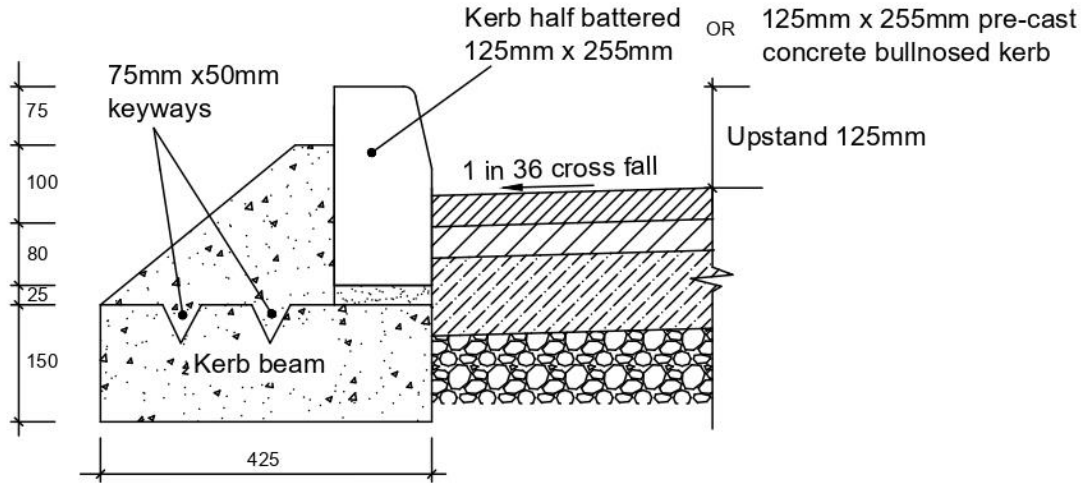
3. The total carriageway thickness must be at least 560mm (inclusive of sub-base).

4. Concrete Block Paving in adoptable roads is restricted to shared use areas, unless otherwise specifically agreed with the scheme approval engineer. Where Concrete Block Paving is used it must be installed over one of the road base layer options complete with sub-base as shown above.

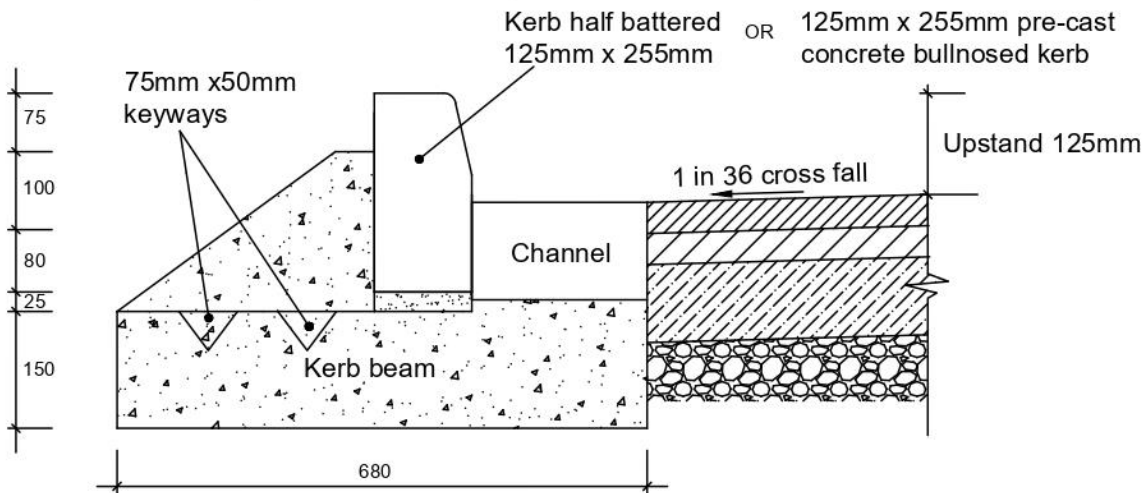
5. The combined thickness of the bound layers as shown above shall be regarded as the minimum overall thickness for the bound materials.



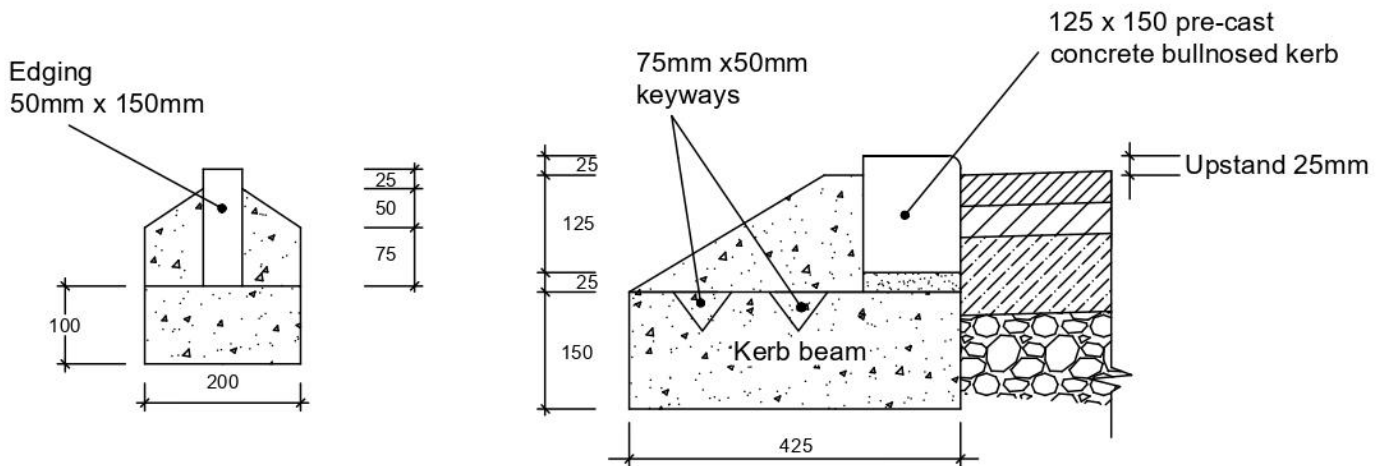
Job Title: Kerb and edging details



KERB DETAIL



CHANNEL DETAIL

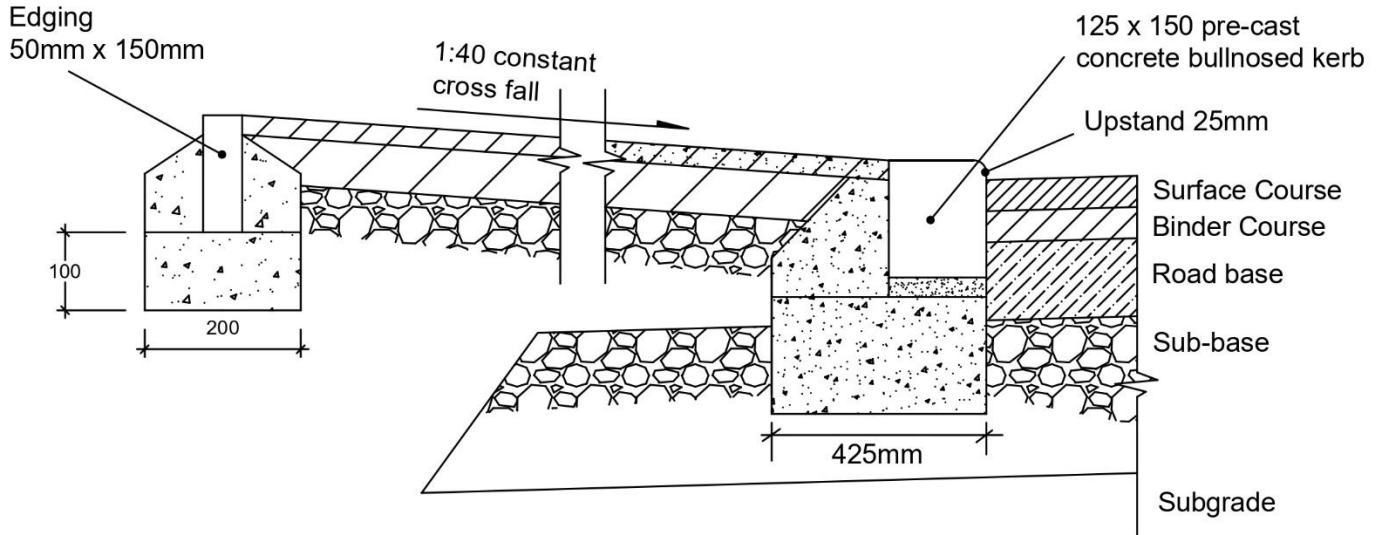


EDGING DETAIL

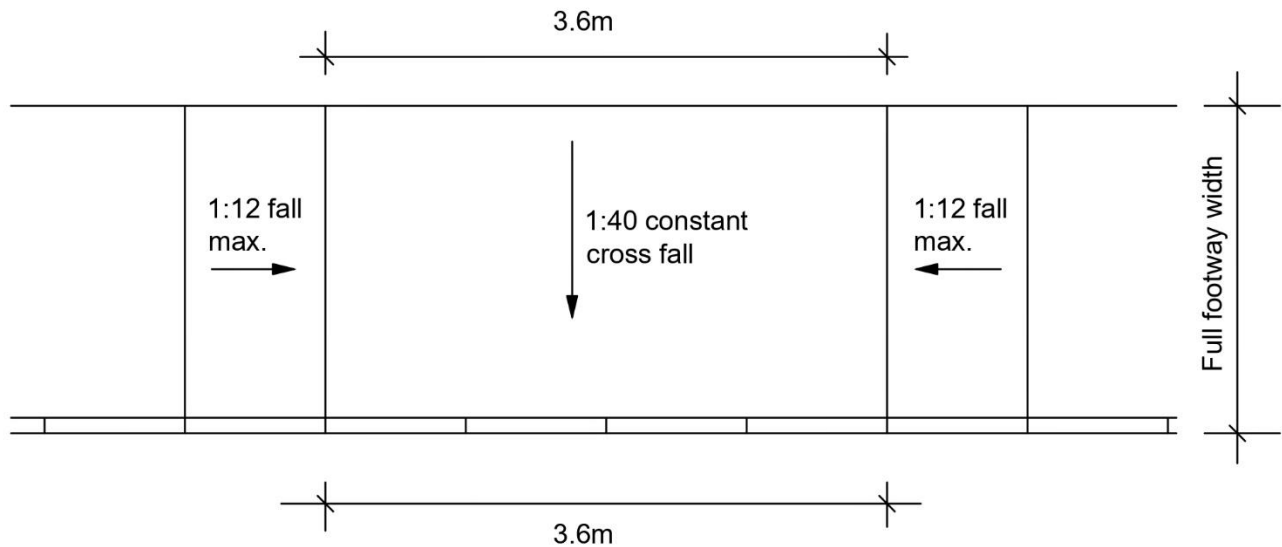
DROPPED KERB DETAIL



Job Title: **Typical layout for vehicular accesses**



TYPICAL SECTION



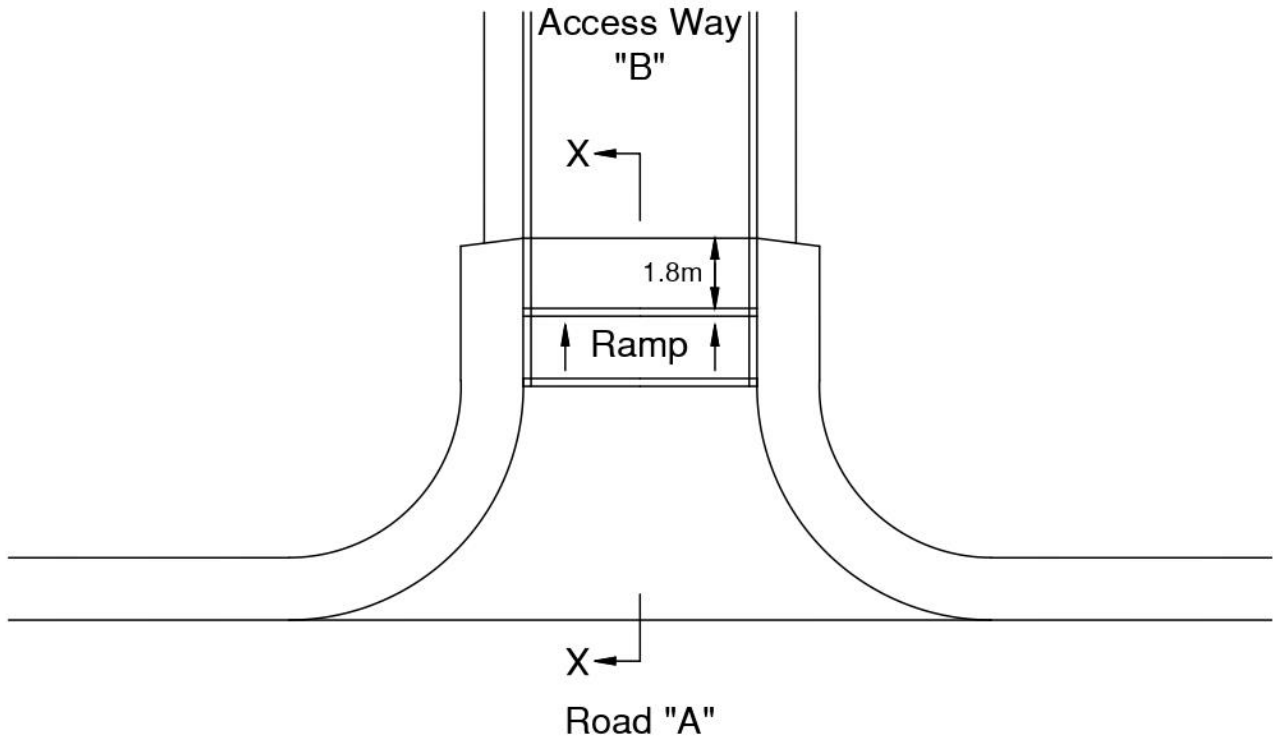
TYPICAL PLAN

NOTES

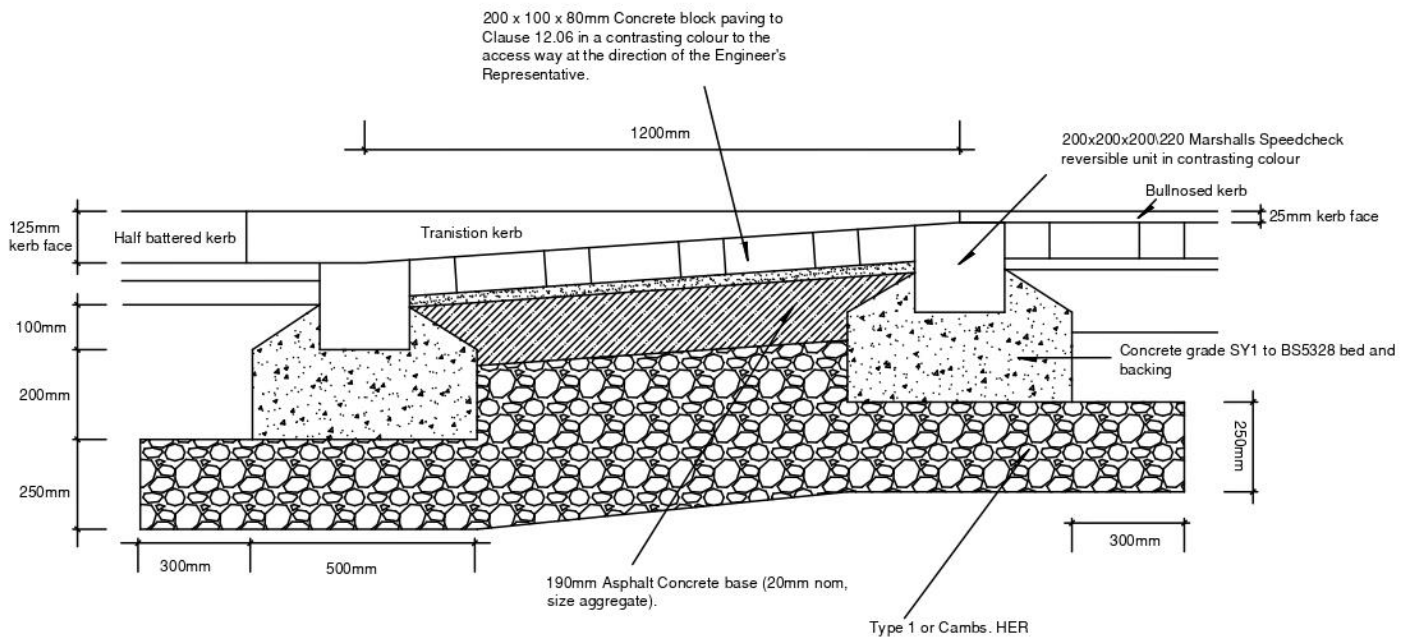
1. Depths of granular base are to be found in Appendix 10
2. Construction details for kerbs, edgings etc., are to be found in Appendix 4
3. Construction details for surface courses, binder courses and road base are to be found in Appendix 10
4. The back edge of the footway is to follow the kerb line to maintain a constant crossfall of 1:40. The longitudinal fall to the crossing across the length of the transition kerbs shall not exceed 1:12



Job Title: **Typical detail for access way ramp**



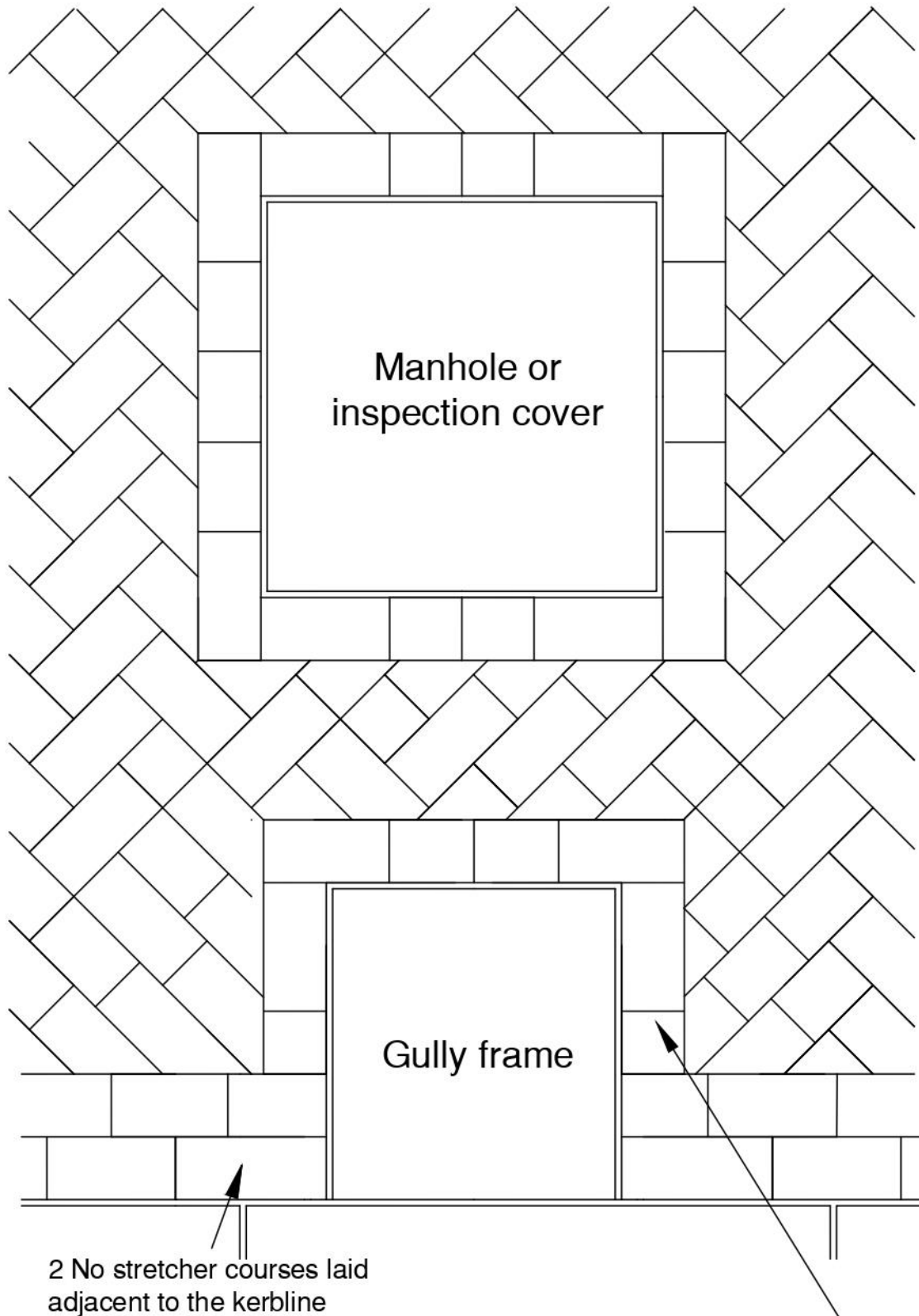
Plan of Junction Layout



Section Through Junction X - X



Job Title: **Blockwork - Details around ironworks**



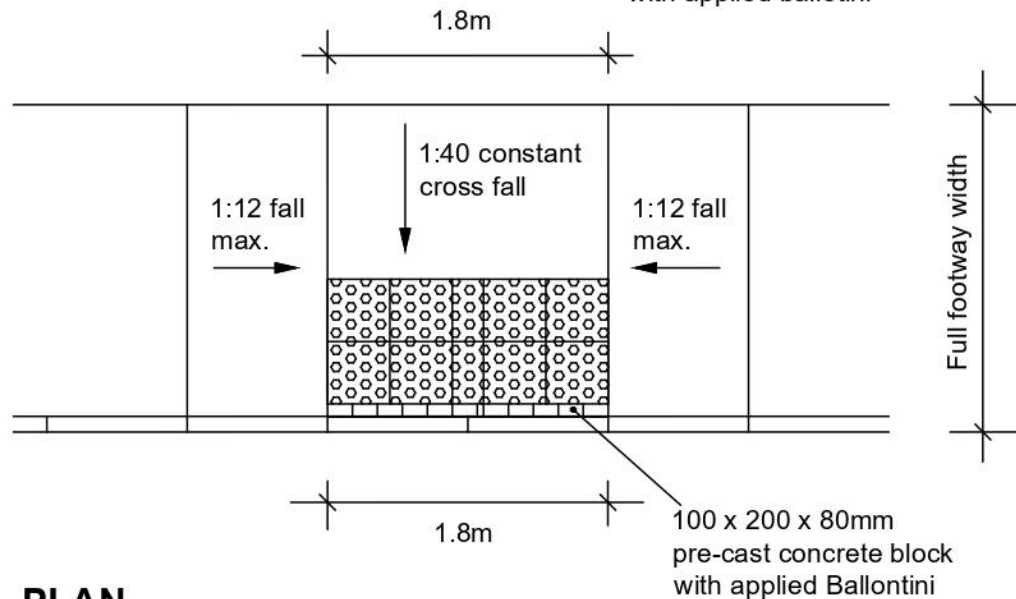
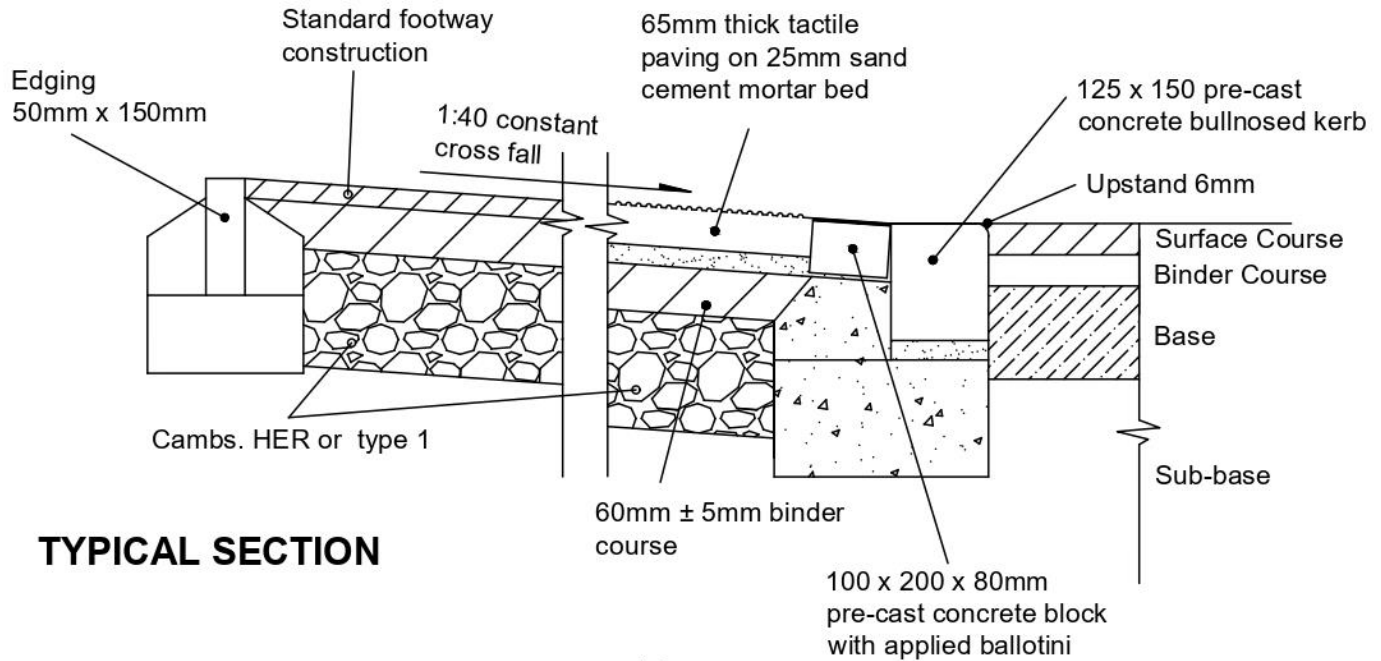
Note

The minimum allowable block size is a quarter block, i.e. not less than 50mm in length.

Concrete blocks cut to form surround



Job Title: **Uncontrolled pedestrian crossing**

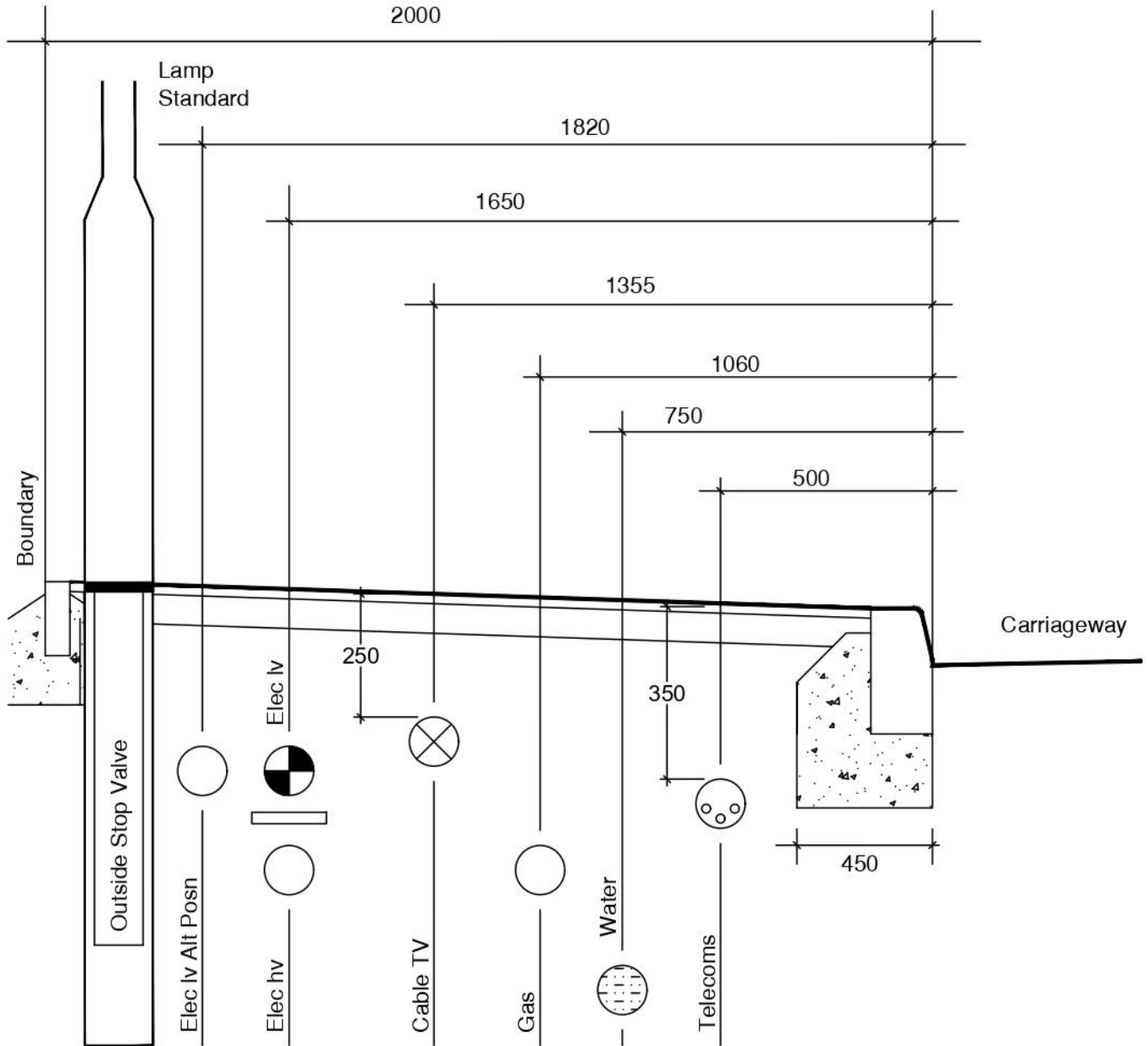


NOTES

1. Depths of granular base are to be found in Appendix 10
2. Construction details for kerbs, edgings etc., are to be found in Appendix 4
3. Binder course to base of mortar bed to slabs be to Clause 18
4. Construction details for surface courses, binder courses and road base are to be found in Appendix 10
5. The back edge of the footway is to follow the kerb line to maintain a constant crossfall of 1:40. The longitudinal fall to the crossing across the length of the transition kerbs shall not exceed 1:12



Job Title: **Public Utilities - Preferred layout in footways**

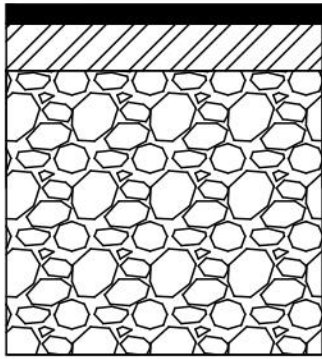


Notes

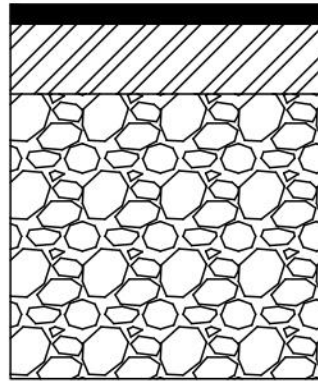
1. Preferred layout for mains in an 2000mm minimum width footway for new works, (where this width is to be provided as part of the approved layout).
2. The Developer's attention is drawn to the economic advantages of utilising "common-trenching" techniques for installation of services in footways wherever practicable.
3. The minimum depth of any service under the location of a proposed new access shall be 850mm to the crown of the duct/pipe
4. The developer will ensure that the service boxes to the Public Utilities plant are orientated so that they are in line with any blockwork areas, avoid dropped kerbs (of any type) and are in general straight to the kerb line.



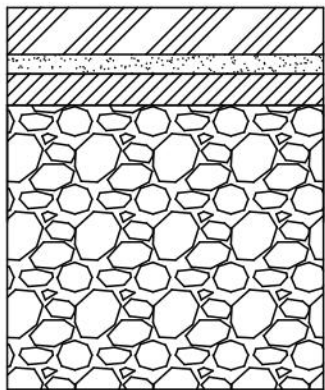
Job Title: Footway / cycleway construction alternatives



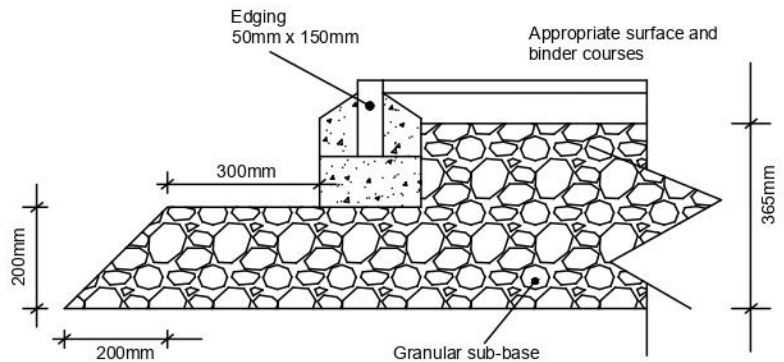
**Type A: Footway,
cycleway and Footpath**



**Type B: motor vehicle
crossing footway/
cycleway**



Type C: Footway



**Layout of granular material
below PCC edging**

NOTES

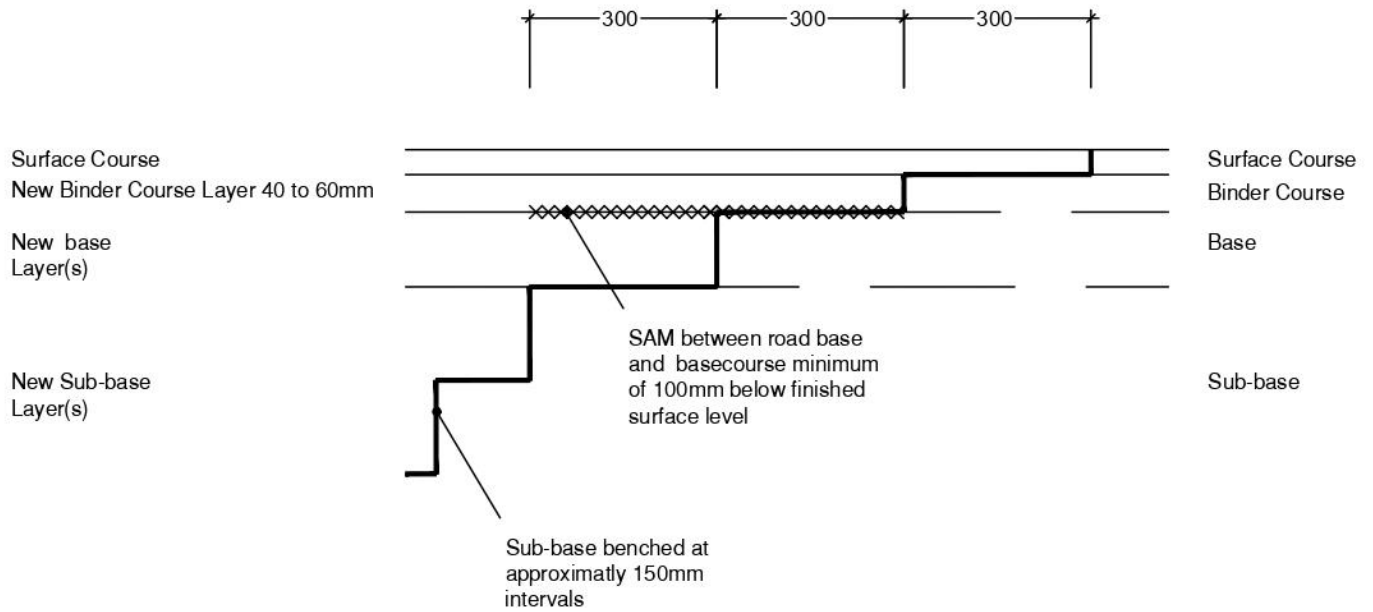
1. Surface course to be in accordance with Part 18
2. Binder course to be in accordance with Part 19
3. Sub-base to be Specification for Highway Works Clause 803 Type 1 or Housing Estate Road Sub-base or compliant recycled material.
4. Bituminous materials shall be machine laid in accordance with Part 19
5. The formation shall be treated with and approved herbicide before construction commences.
6. The sub-base shall be laid on a 'needle punched' non-woven geofabric membrane
7. Blocks will be laid to a herringbone pattern and cut into boxes etc.





Job Title: **Stepped construction detail (diagrammatic)**

New Construction

Existing
Construction



Key

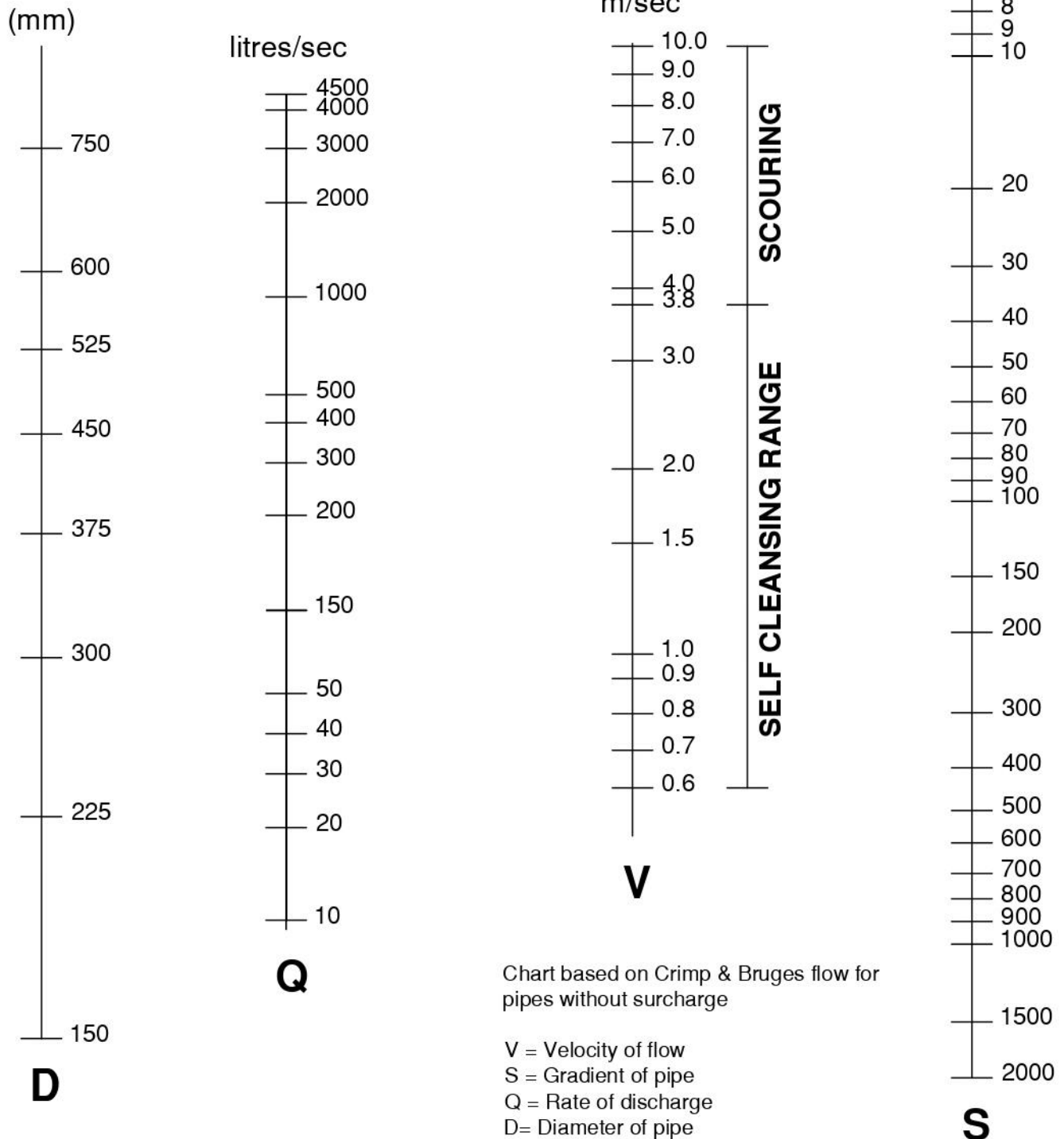
-  SAM (Stress Absorbing Membrane) to be either :
 Glasgrid Mesh or Colas preformed SAM or TOK Paving Tape.
-  Boundary between New and Existing Construction



Job Title: **Drainage - Nomograph for design**

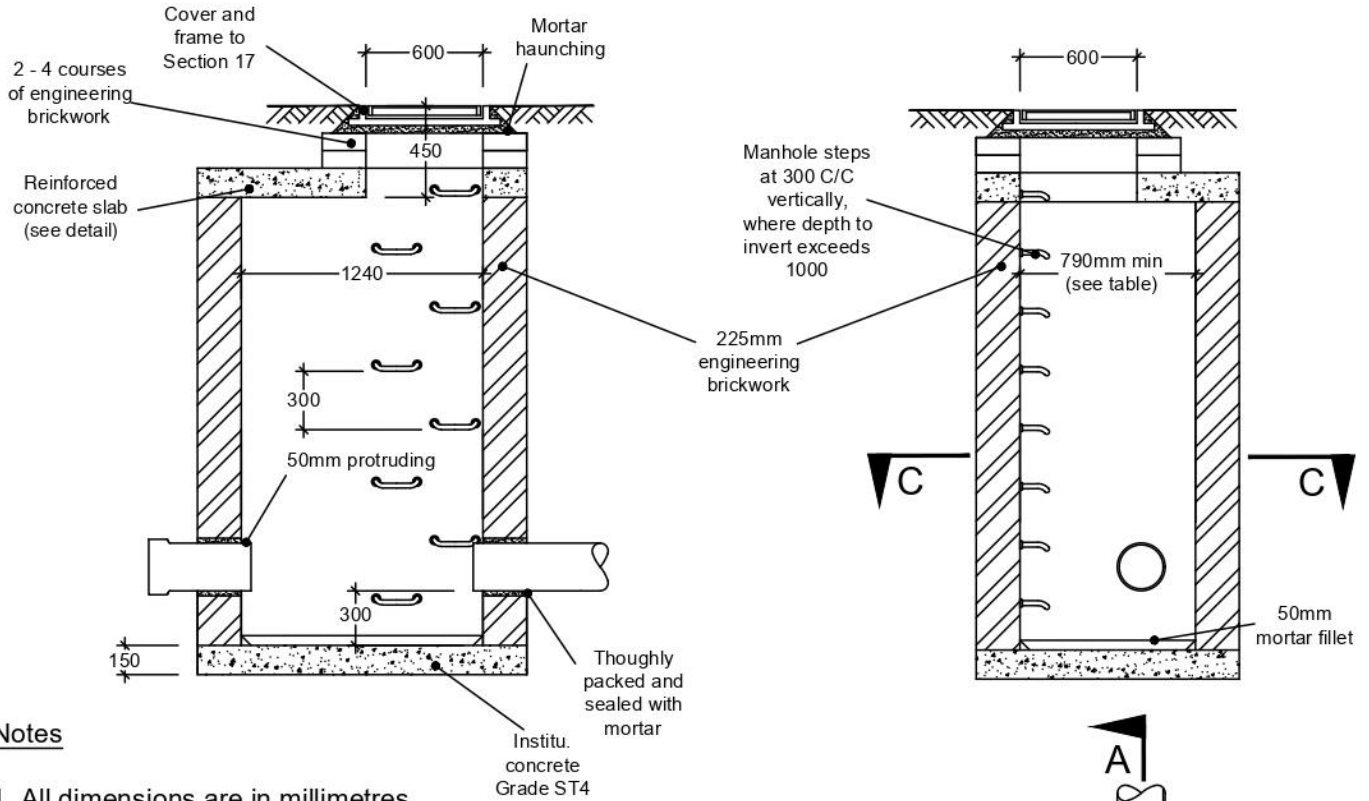
Discharge and Velocity Flow for Round Pipes

Gradient -1 in S





Job Title: Drainage - Catchpit manhole detail - brick type



Notes

1. All dimensions are in millimetres.
2. Excess excavation backfill to be C7.5.

MANHOLE COVER SLAB

Concrete Grade -class 40/20 cover to reinforcement 50mm surface finish Class F2
 w- T12-02-125B y- T16-04-125B
 x- T16-03-125B z- T12-01-125B

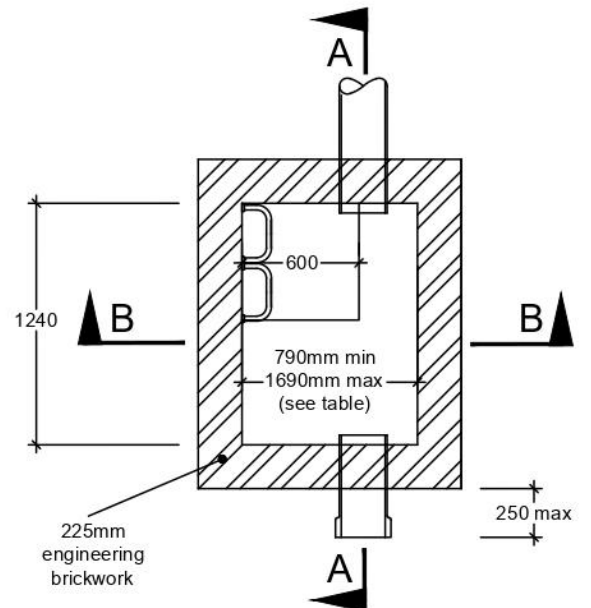
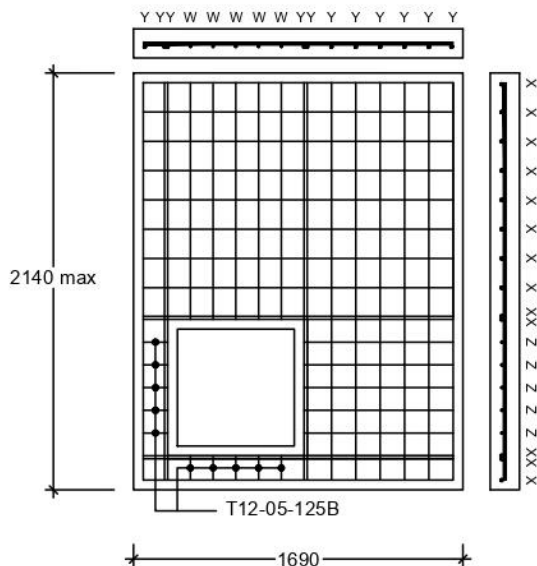
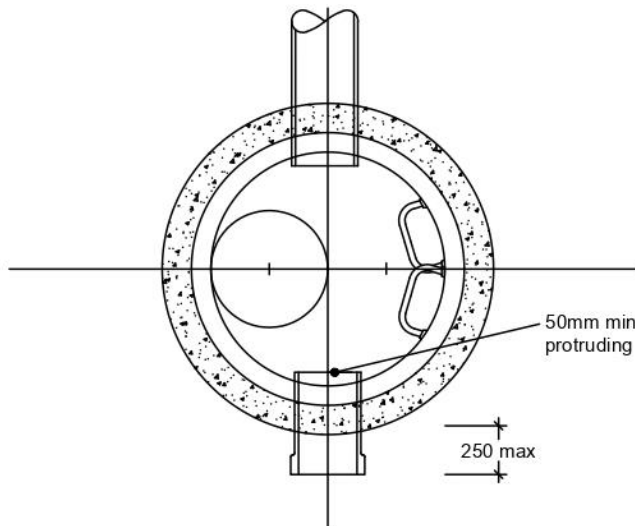
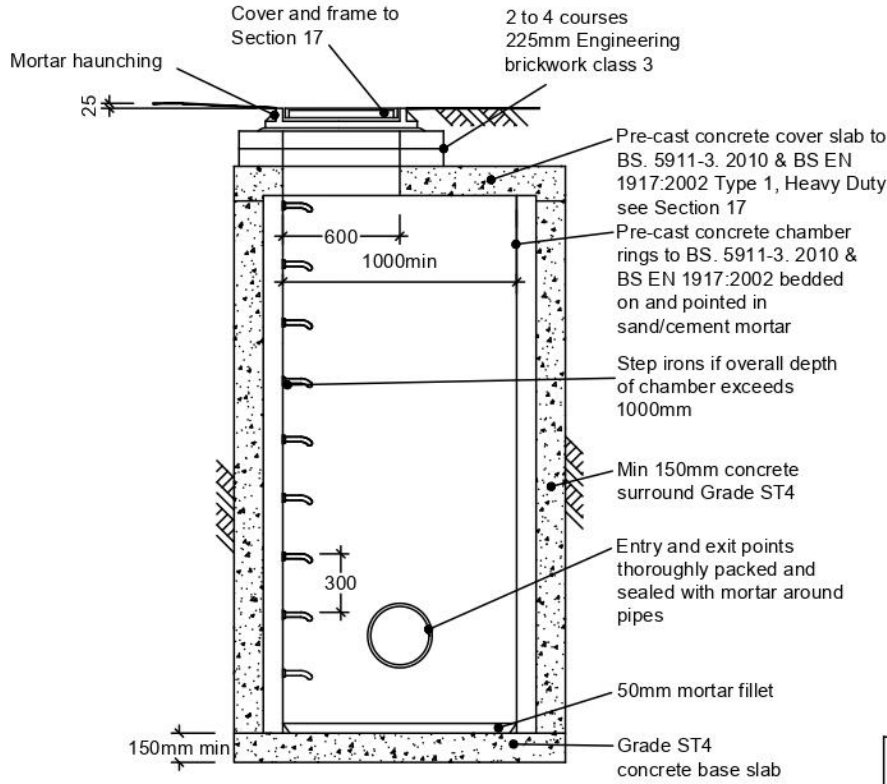


Table of dimensions

Internal dia. of outlet pipe (mm)	Min Internal width of brick manhole (mm)
150	790
225	900
300	900
375	1010
450	1125
525	1125
600	1240
675	1350
750	1350
825	1450
900	1575
975	1575
1050	1690



Job Title: Drainage - Catchpit manhole details - precast concrete type



Internal dia. of outlet pipe (mm)	Internal dia. precast concrete ring (mm)
150	1200
225	1200
300	1200
375	1200
450	1200
525	1350
600	1350
675	1350
750	1350
825	1500
900	1500
975	1800
1050	1800

Table of dimensions

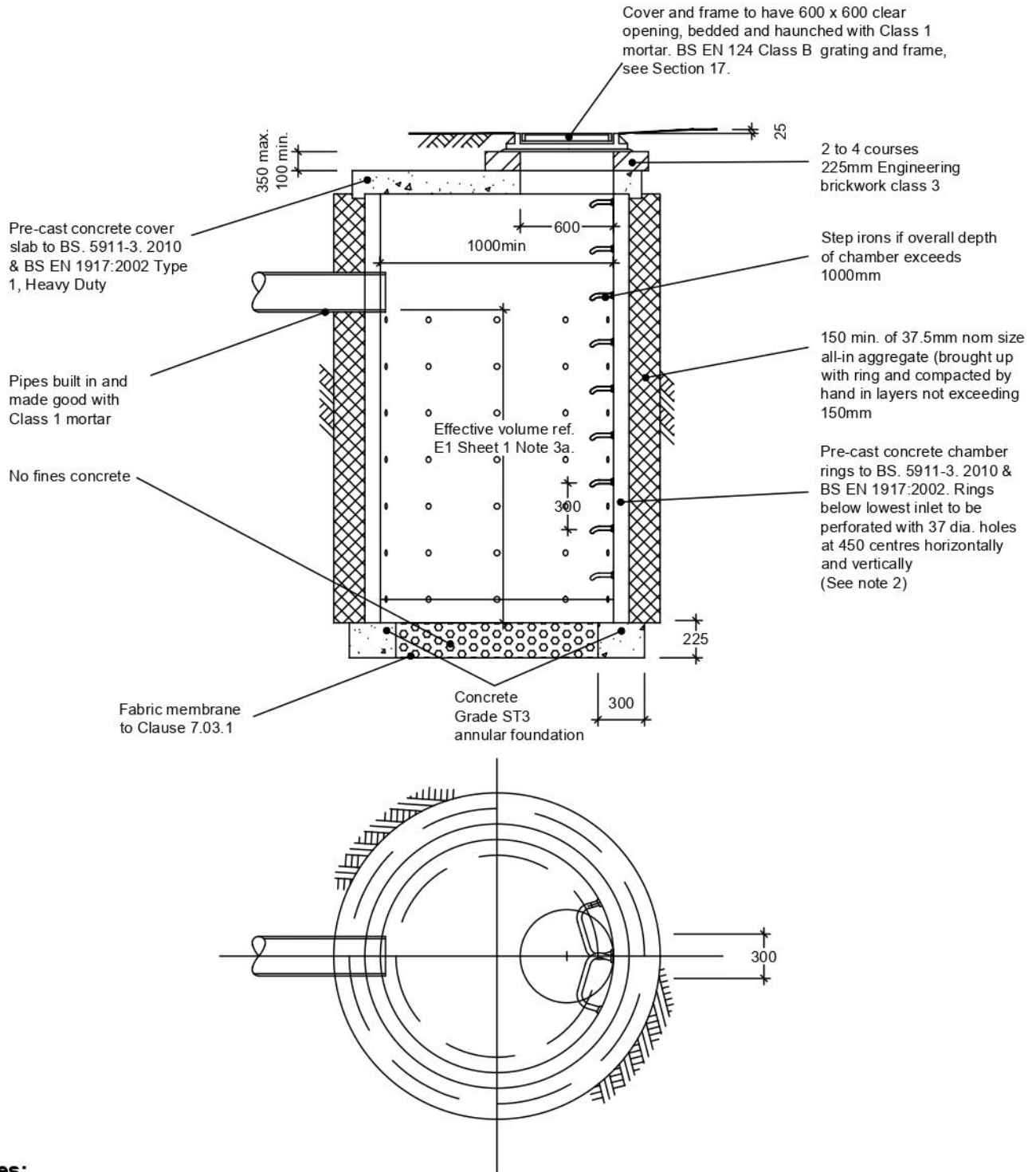
Notes:

Manhole rings, slab and ST 1 concrete to be made using sulphate resisting concrete.

Excess excavation concrete backfill to be ST 1 concrete



Job Title: **Drainage - Soakaway chamber details**

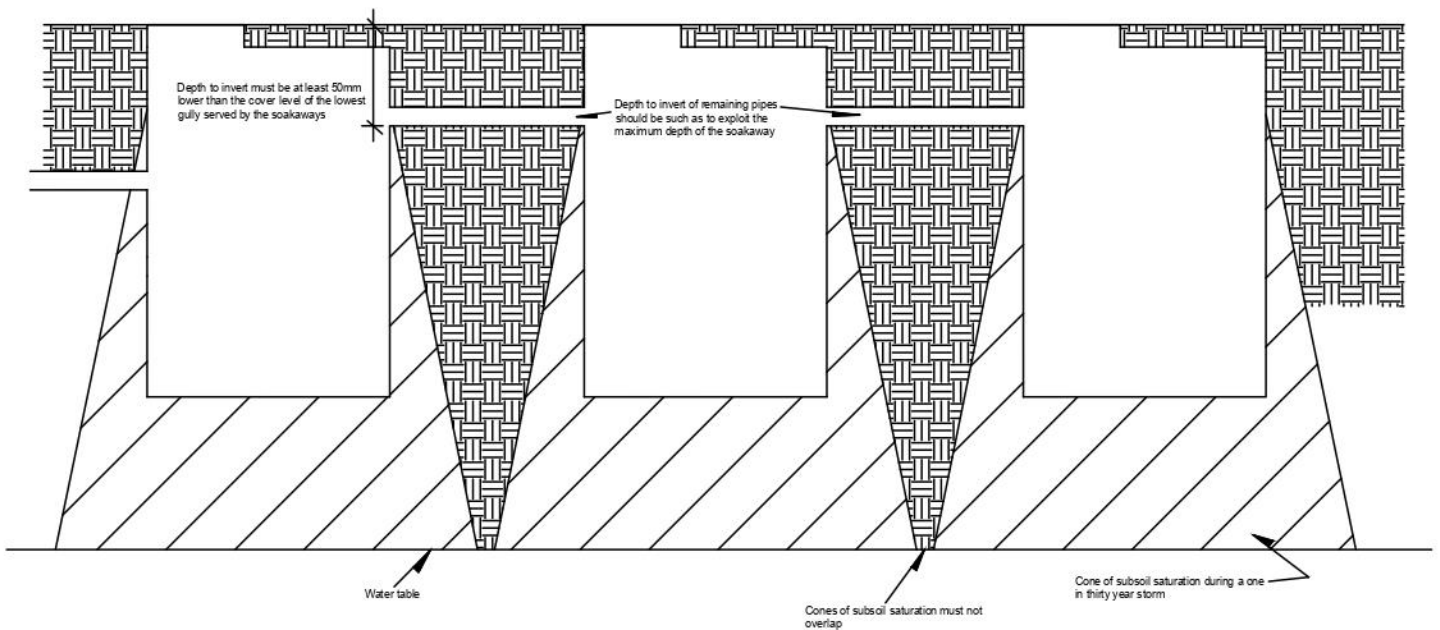
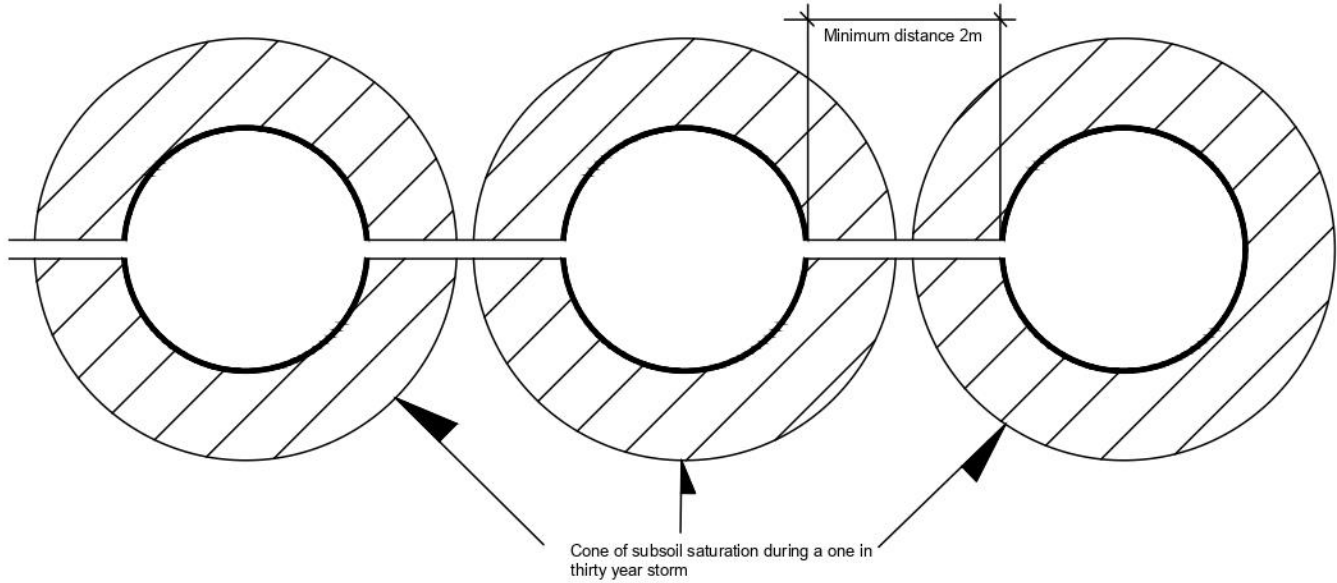


Notes:

1. Manhole rings, slab and ST3 concrete to be made using sulphate resisting concrete.
2. At least one perforated ring must be provided, with more perforated segments required to match depth of permeable strata up to the pipe invert.



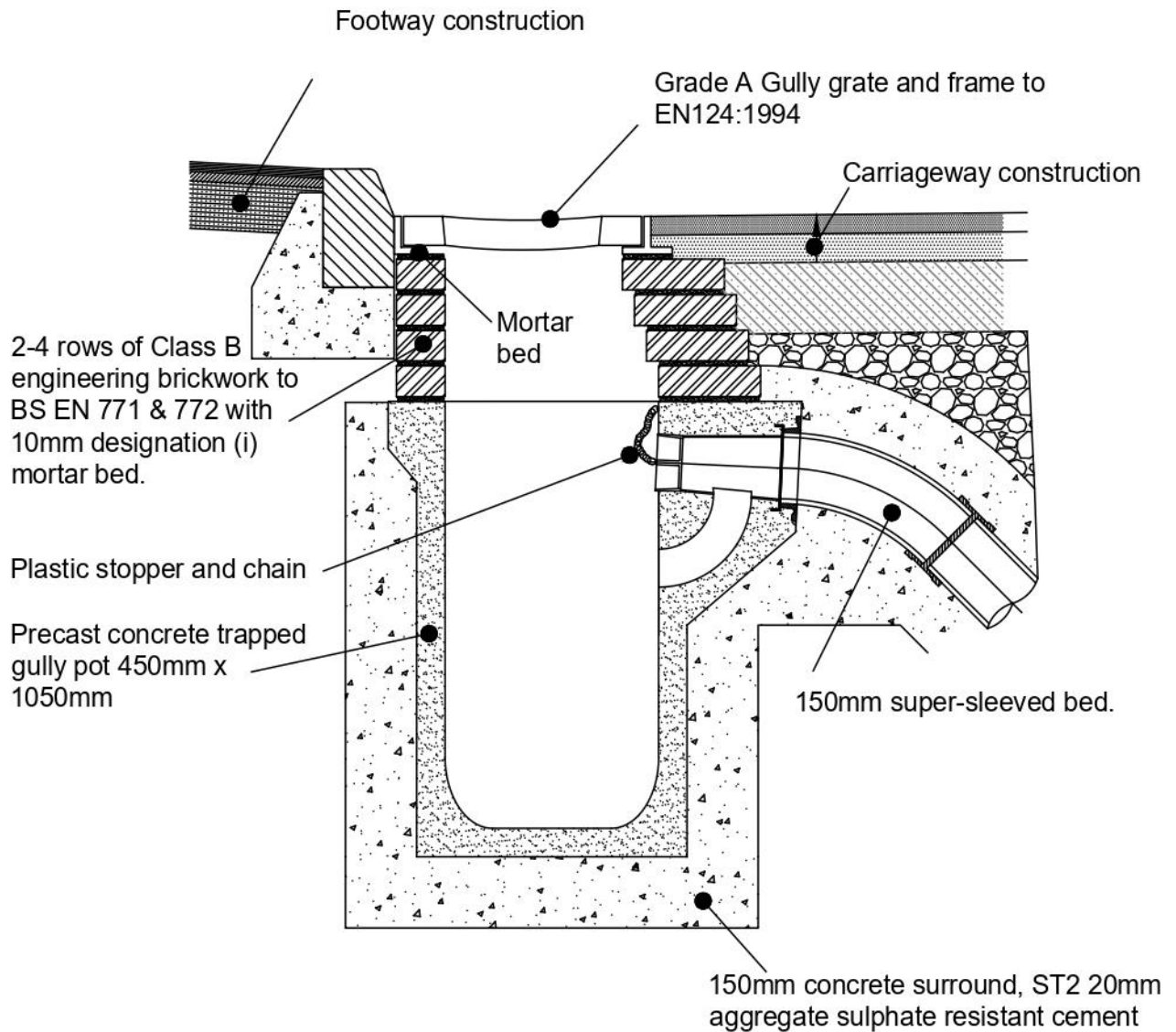
Job Title: **Linked soakaways diagrammatic layout**



1. The maximum number of soakaways that will be permitted to be linked is three
2. All soakaways must be located at least 5m away from the existing/proposed carriageway/shared surface of the adopted public highway
3. All soakaways must be situated within the proposed adopted public highway



Job Title: **Drainage - Trapped carriageway gully**

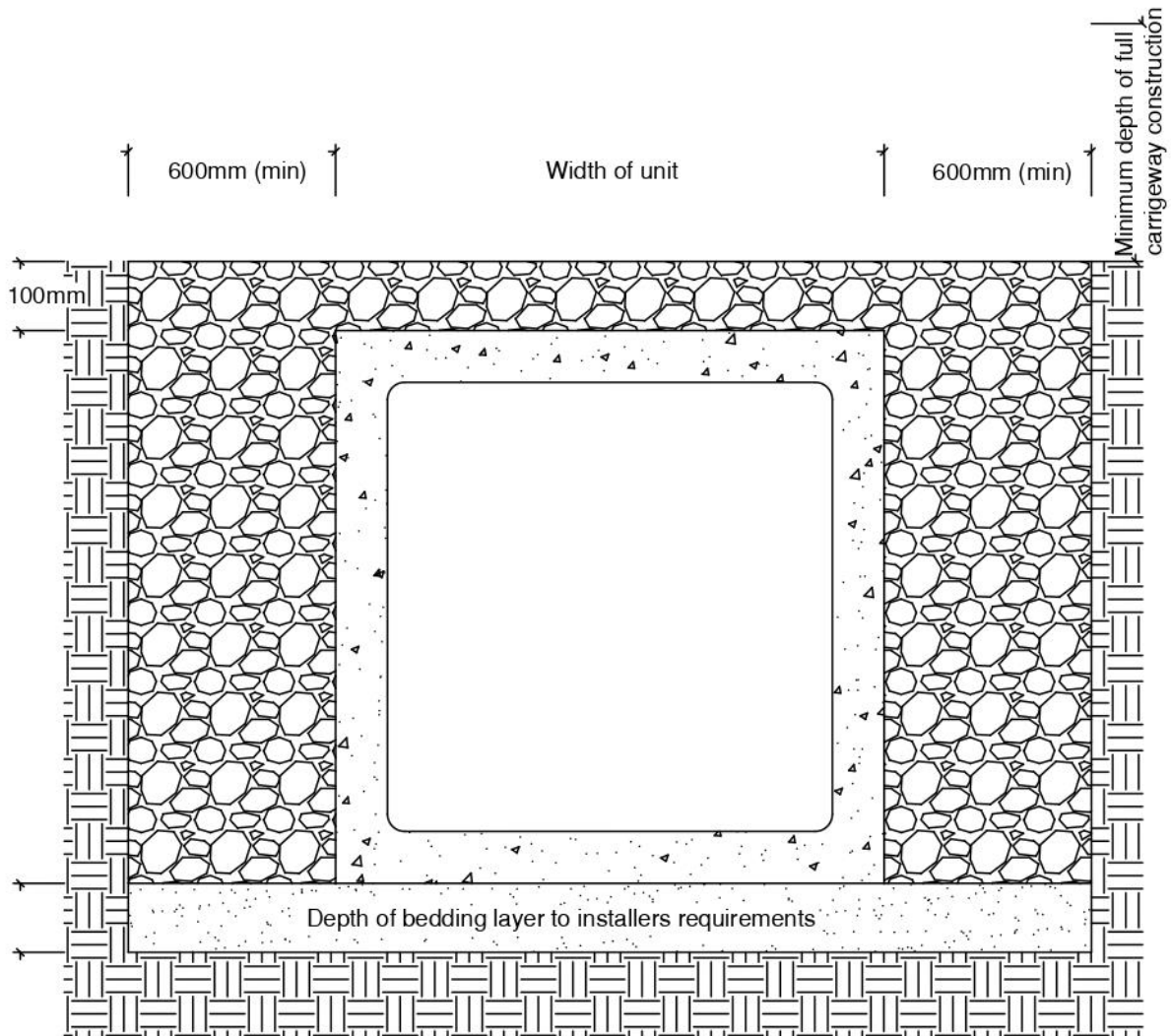


NOTES

1. Gully pot and outlet pipe to a depth of 1.2m to be surrounded in 150mm ST2 concrete.



Job Title: **Box culvert section under adopted public highway**

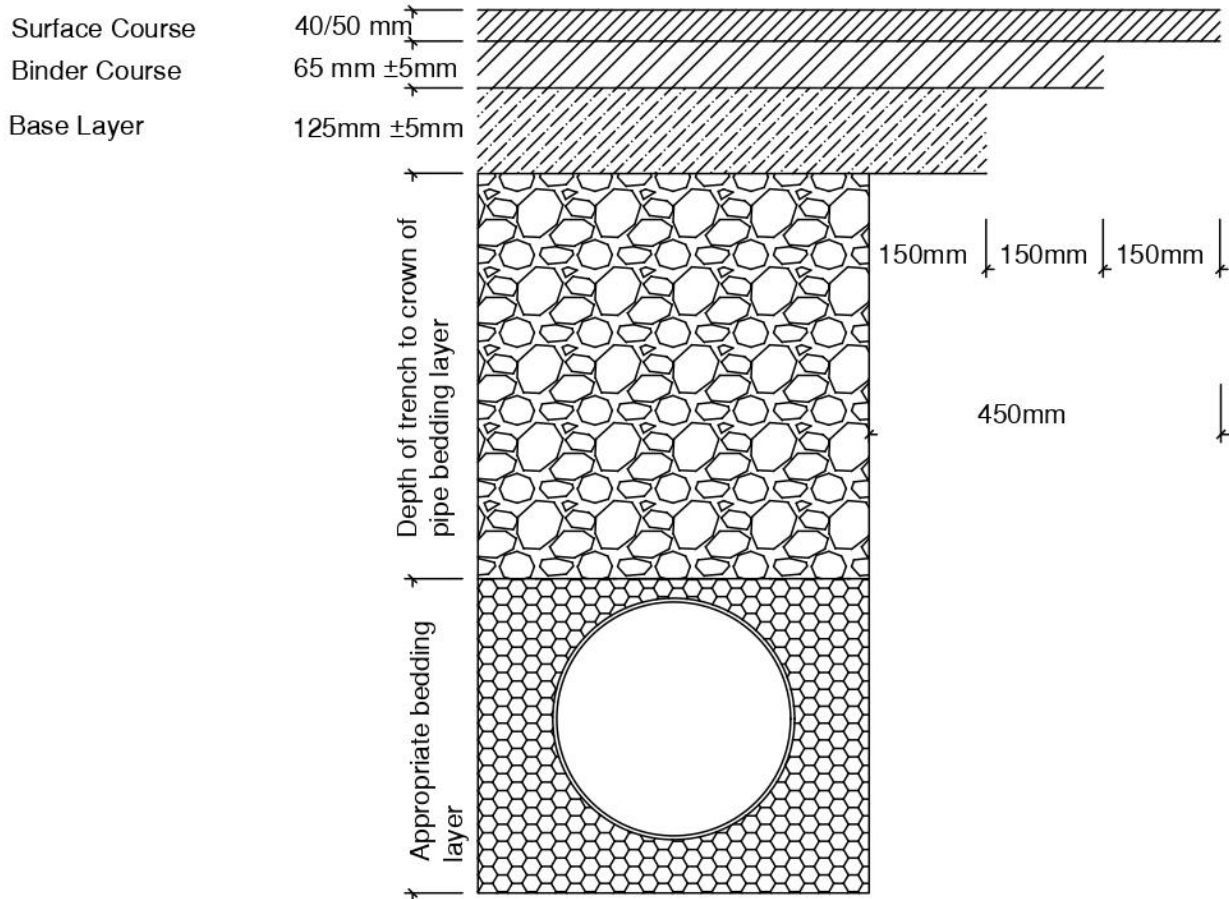


Notes

1. The sides and base of the excavation shall be trimmed, leveled and shaped so that there are no under cuts, irregular slopes, bows or similar disruptions .
2. The back fill to the side of the box culvert and the capping layer to the highway construction shall be a 6N material.
3. The top of the box culvert shall be at least 100mm below the lowest level of the highway construction material; this depth will be dependant on the CBR values of the site. The capping shall be a 6N material.



Job Title: **Trench reinstatement in existing adopted public highway only**

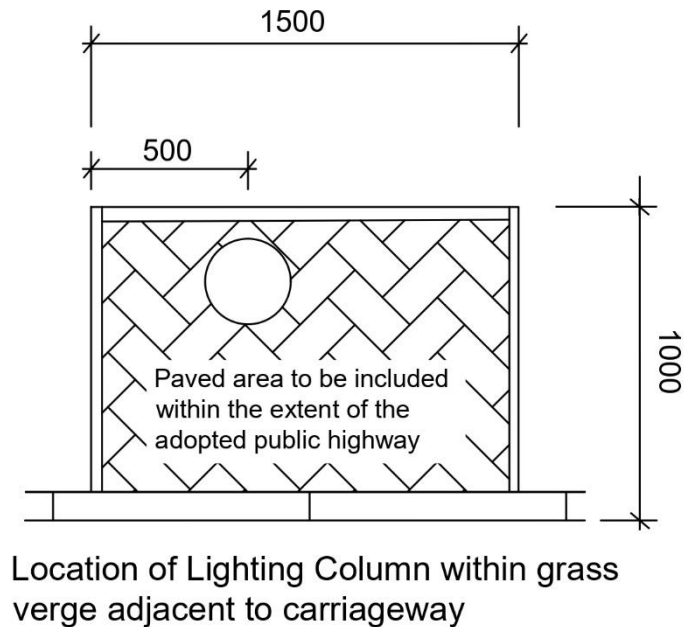
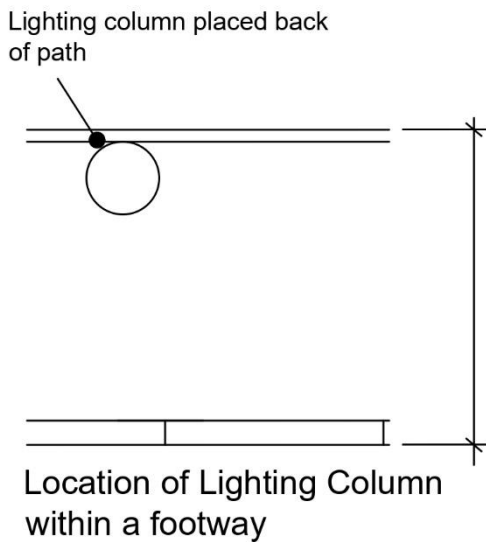
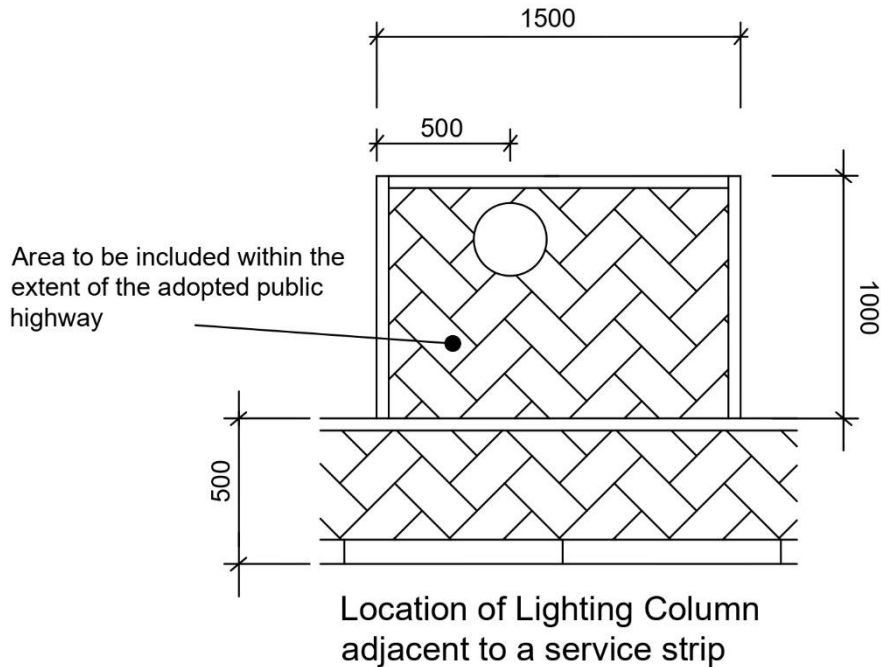


Notes

1. The stepping of the reinstatement shall be undertaken on both sides of the trench.
2. The edges of the reinstatement shall be sealed using hot pitch with a minimum width of 40mm.
3. The total bound bituminous or asphalt thickness must be at least 215mm.
4. The pipe bedding shall comply with Manual of Contract Documents for Highway Works Vol. 3 drawing F1, type Z if less than 1.2m from the highway surface or type S in all other cases. All backfill above the bedding layer shall be granular material to clause 803 laid in 150mm thick layers.



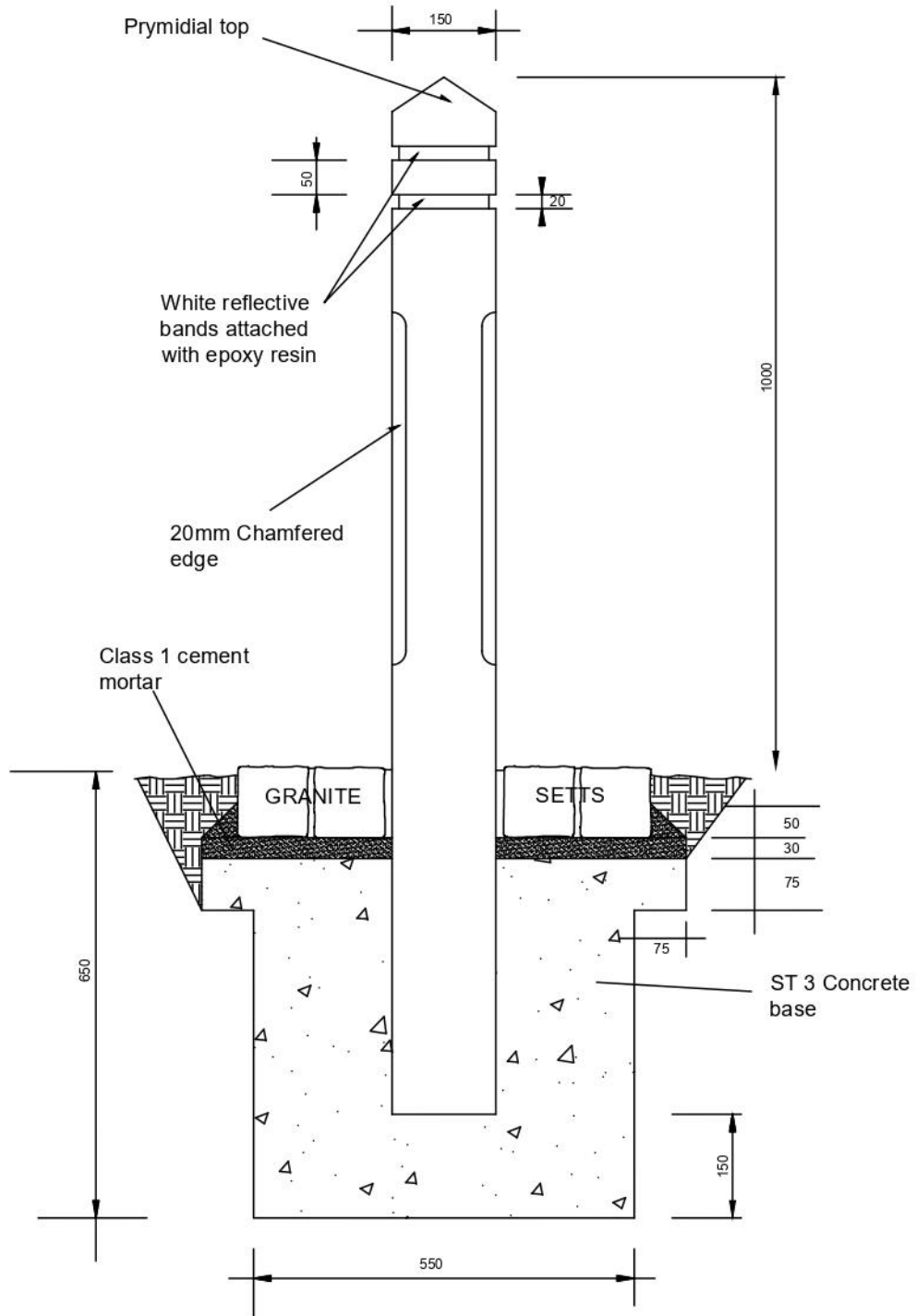
Job Title: **Typical lighting unit positions**



1. All doors to lighting columns must be positioned facing away from the on coming traffic, so that the operative faces the on coming traffic when working on the column

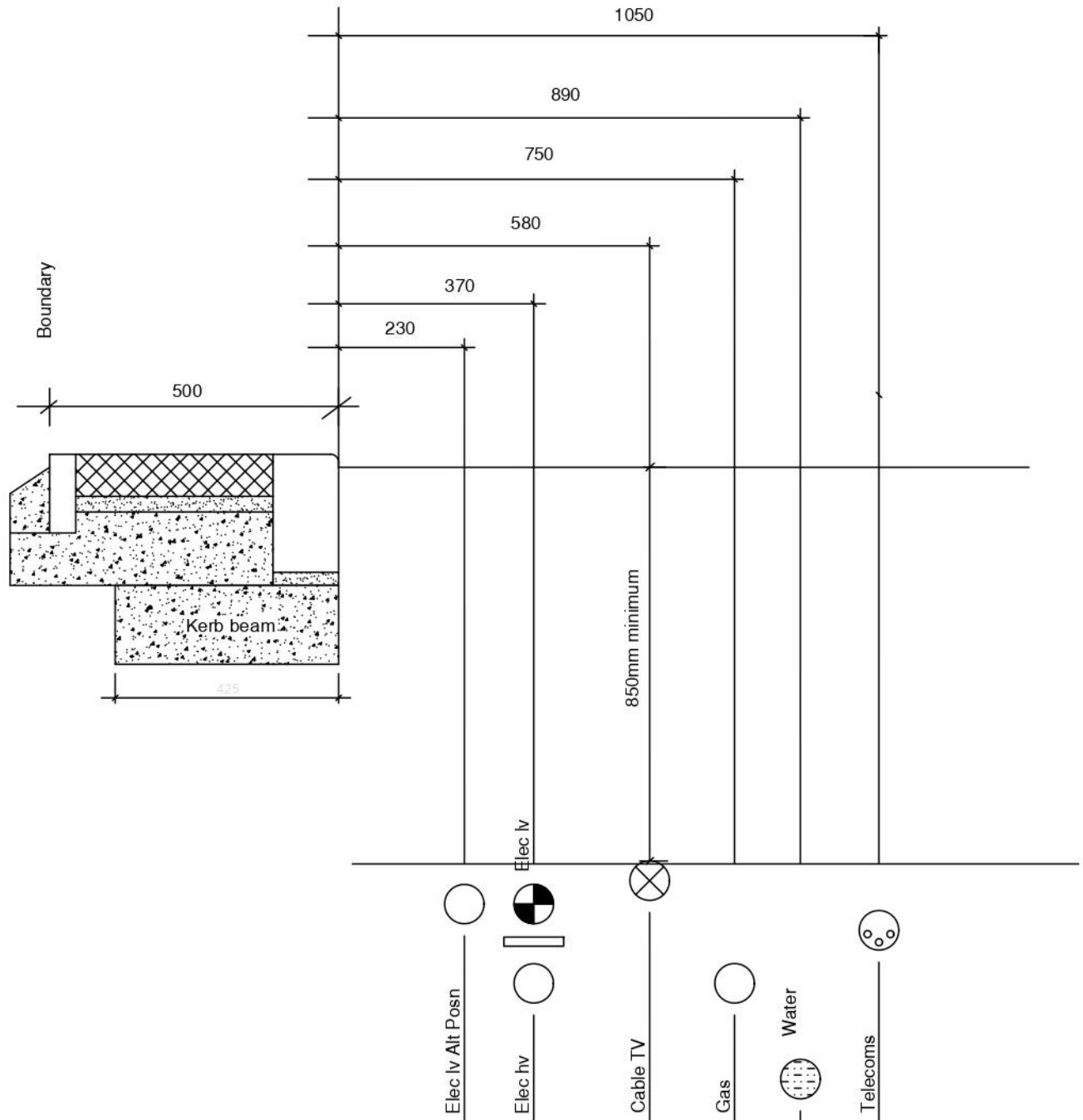


Job Title: **Timber bollard detail**





Job Title: **Public Utilities - Preferred layout shared surface**

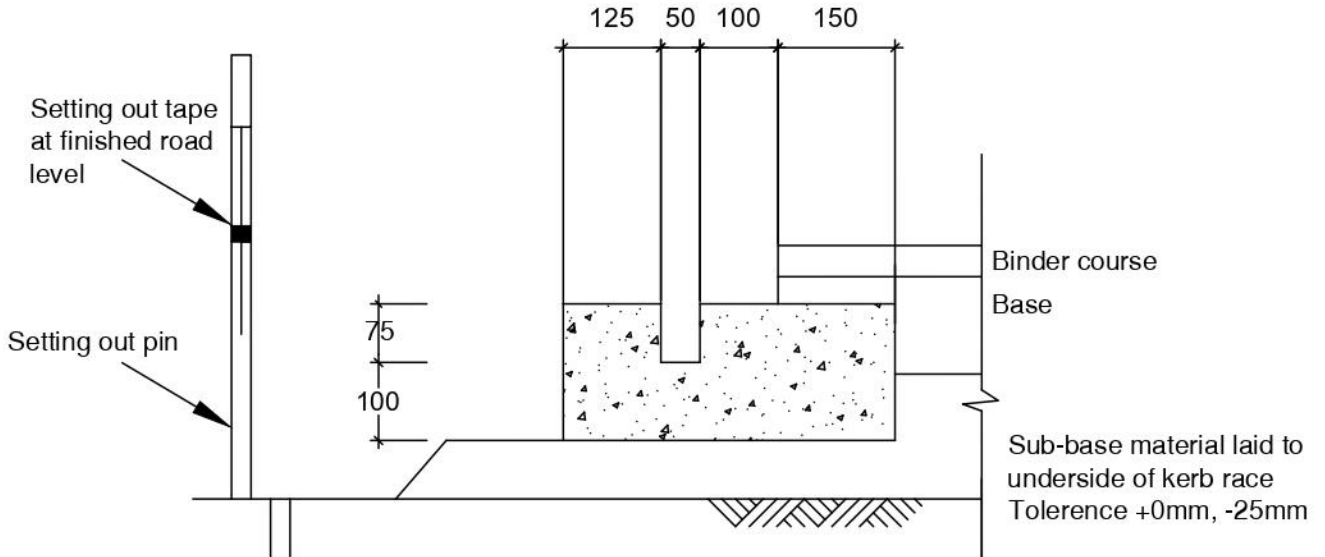


Notes

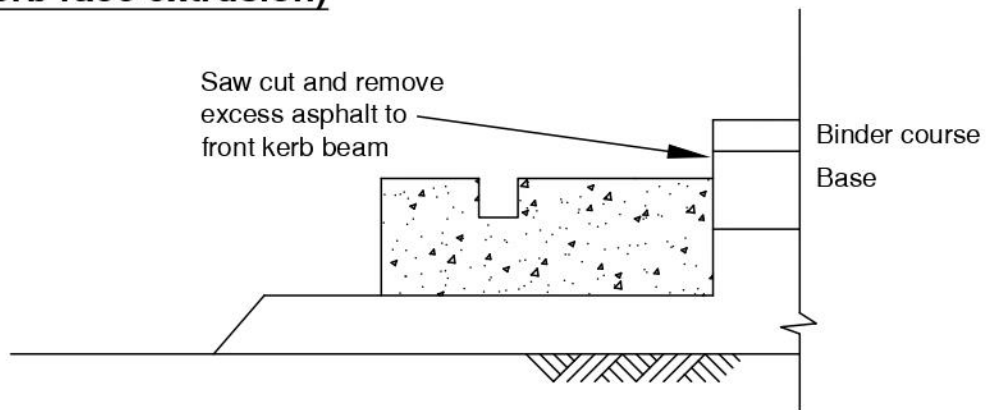
1. Preferred layout for mains in an 6000mm minimum wide shared surface for new works, (where this width is to be provided as part of the approved layout).
2. The Developer's attention is drawn to the economic advantages of utilising "common-trenching" techniques for installation of services wherever practicable.
3. The developer will ensure that the service boxes to the Public Utilities plant are orientated so that they are in line with any blockwork areas, avoid dropped kerbs (of any type) and are in general straight to the kerb line.



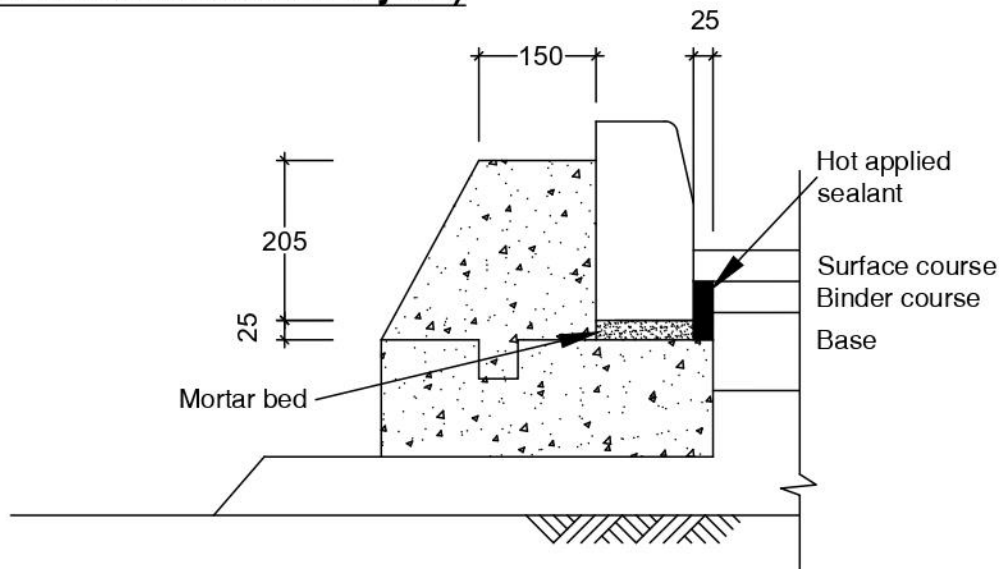
Job Title: **Extruded kerb beam**



Stage 1 (Kerb race extrusion)



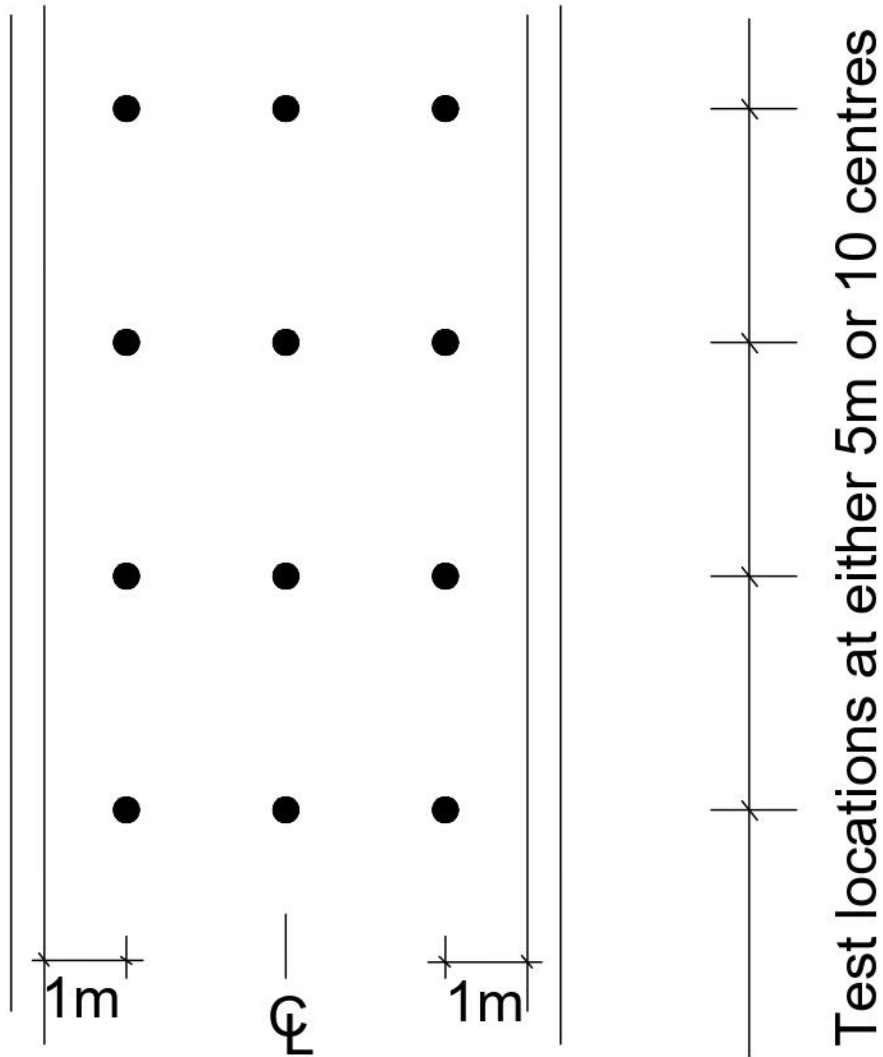
Stage 2 (Cut back bituminous layers)



Stage 3 (Kerb, backing and sealing front of kerb)

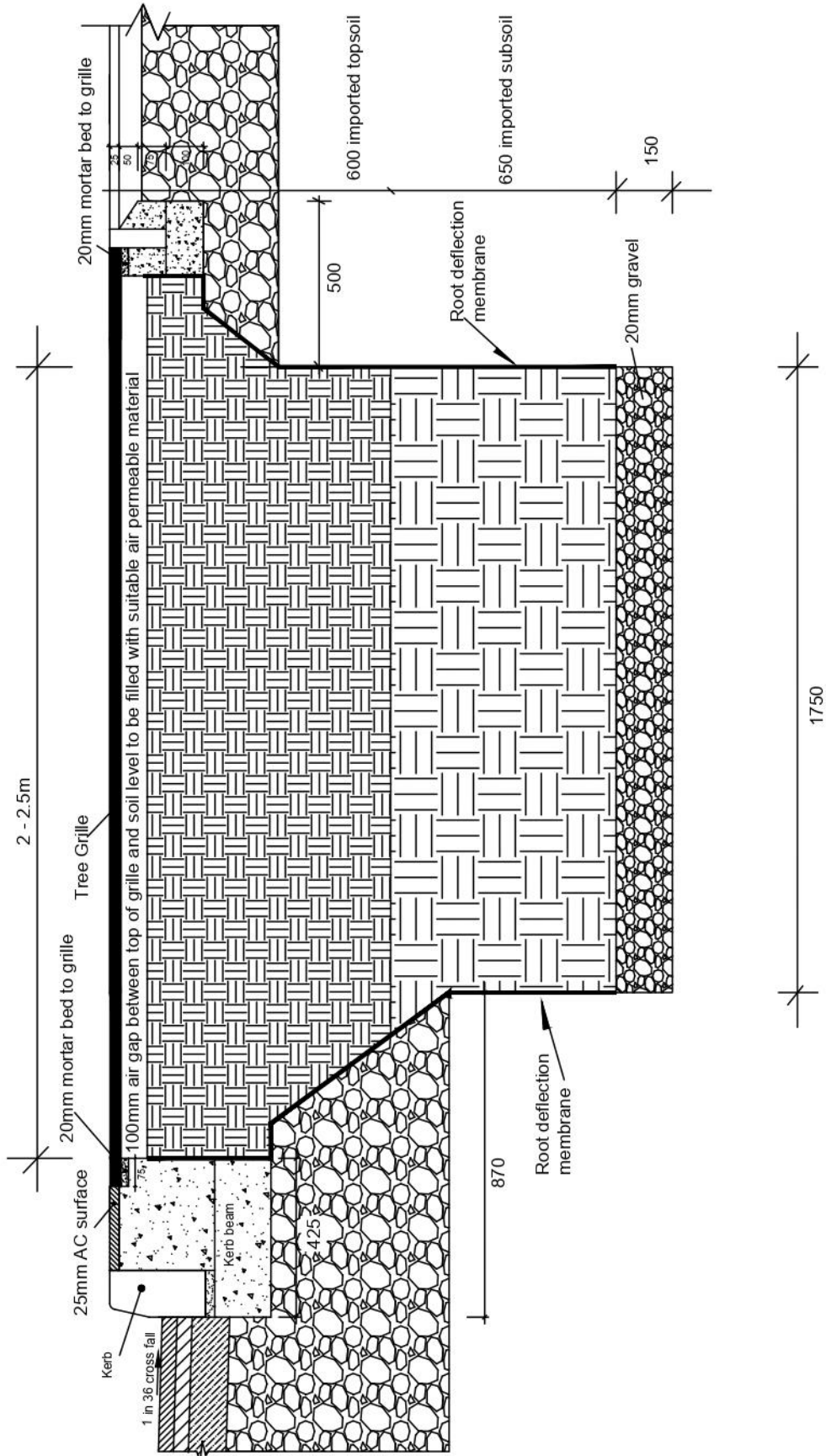


Job Title: **Pavement foundation testing regime**



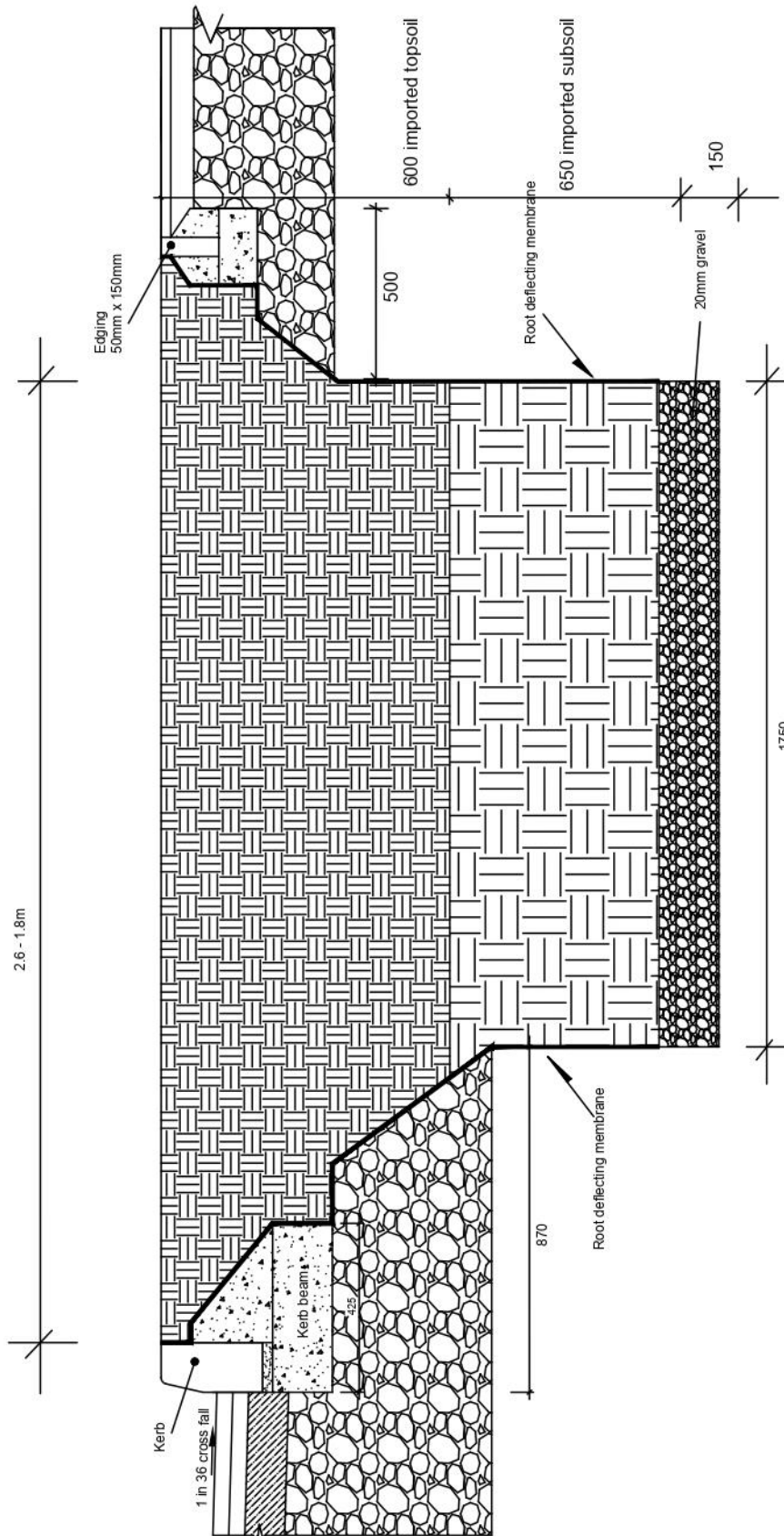


Job Title: **Tree pit in hard paving**



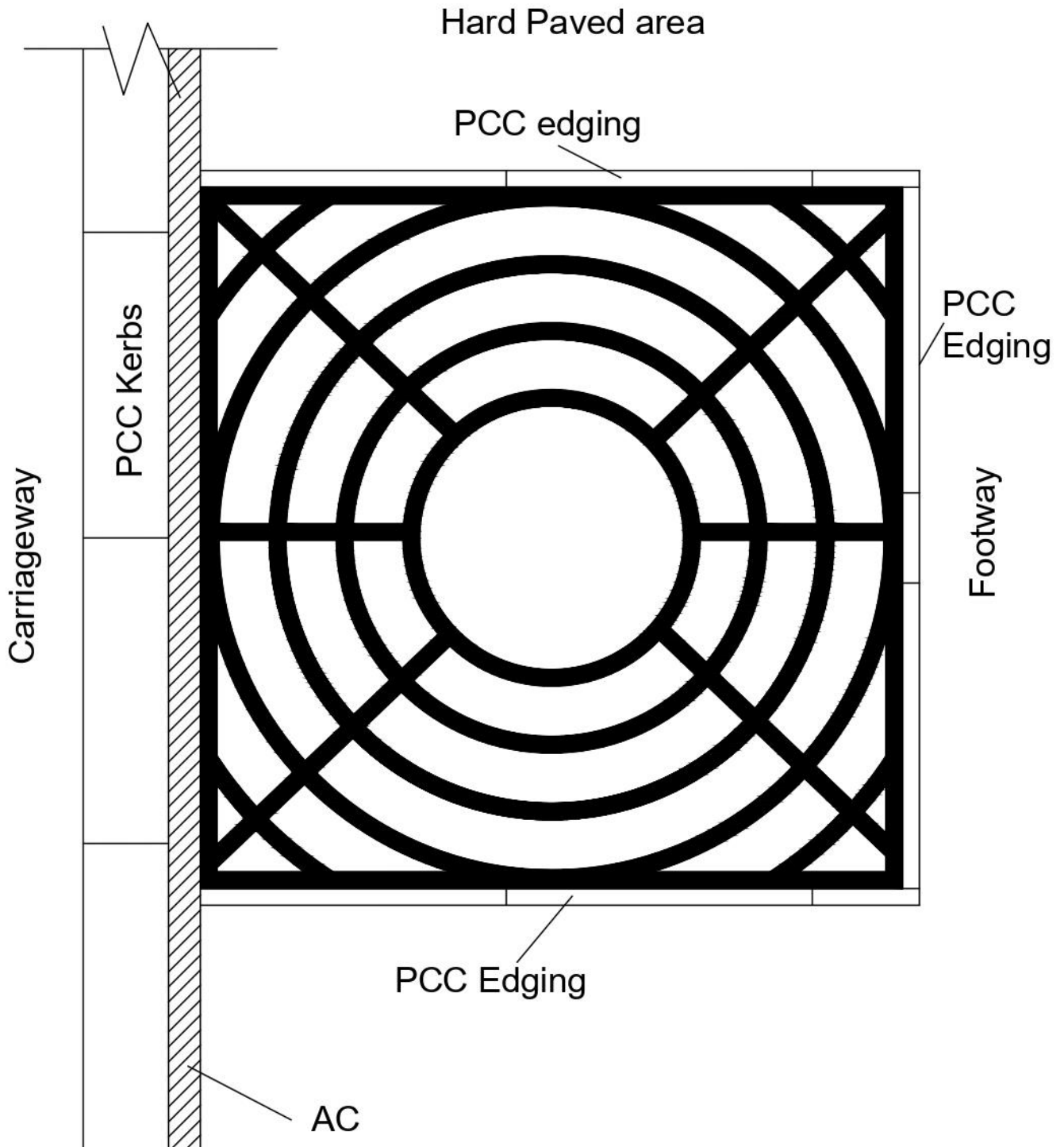


Job Title: **Tree pit in soft area**





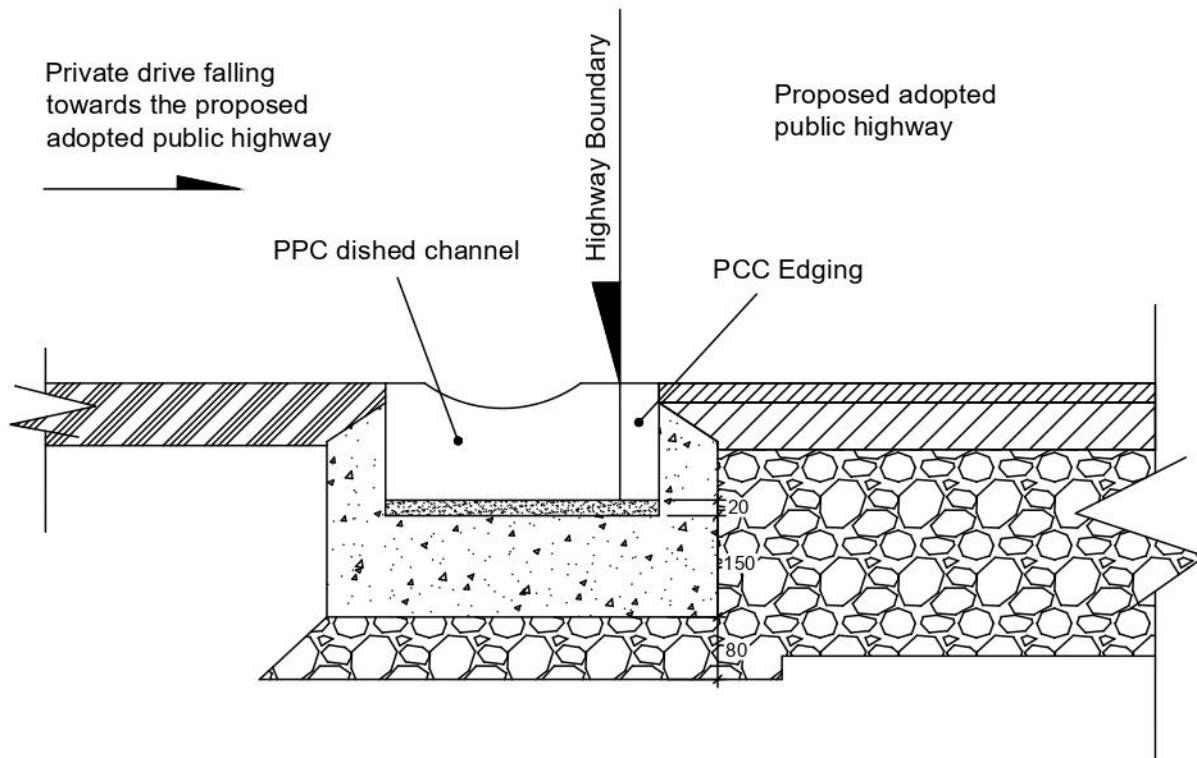
Job Title: **Tree grille detail**



1. The tree grille must be at least 2 sq.m in area



Job Title: **Preferred private drive drainage detail**

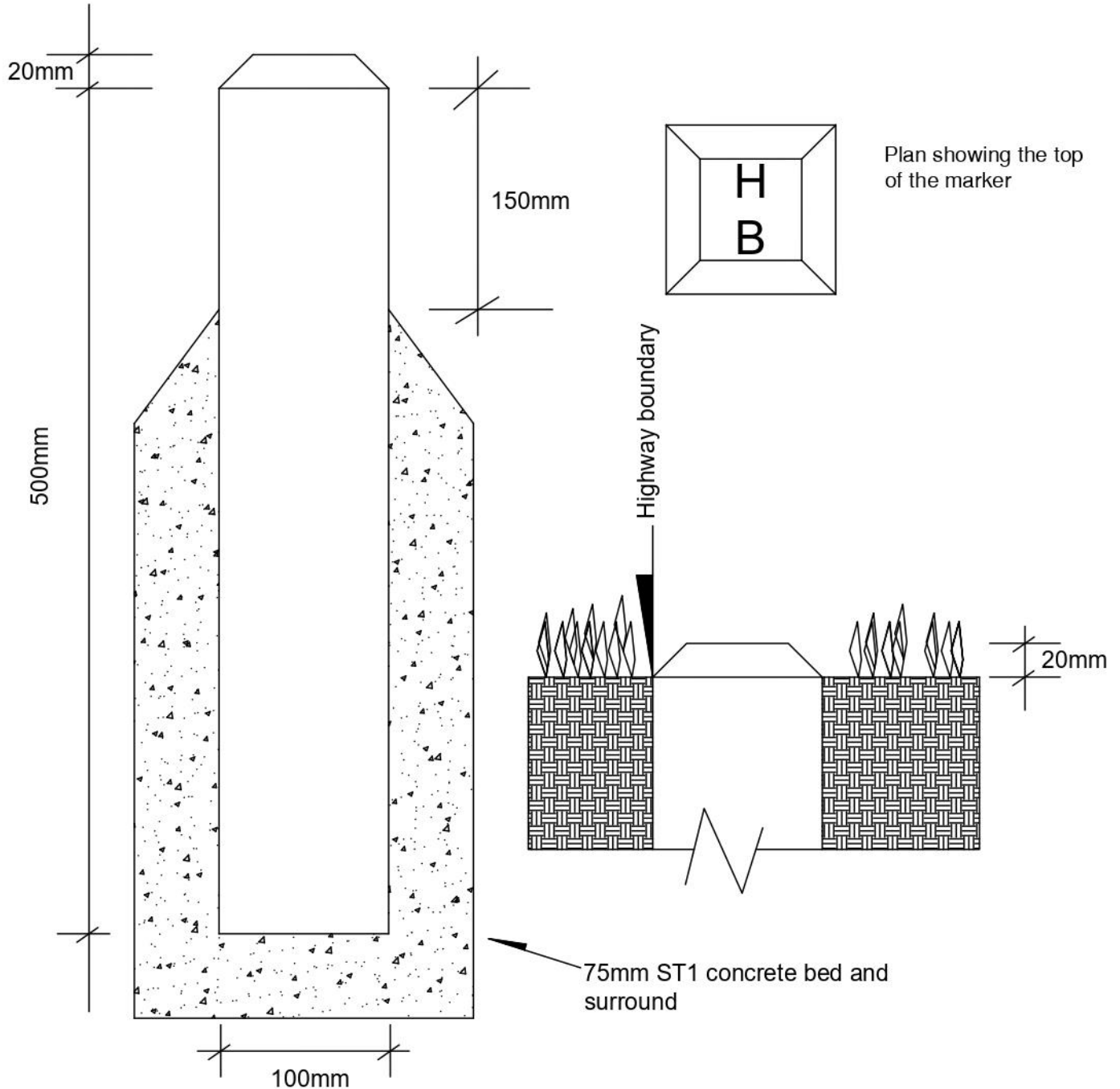


Notes:

1. Dished channels shall be installed between any areas of private land that fall towards the proposed adopted highway
2. The precast concrete dished channel shall fall to a soakaway or piped connexion to the private system on the site, no private water will be permitted into or on to the proposed adopted public highway.
3. The dished channel shall be laid on 20mm of class 1 mortar to allow a suitable fall to be created.
4. All dimensions are in millimetres



Job Title: **Highway boundary marker in soft**

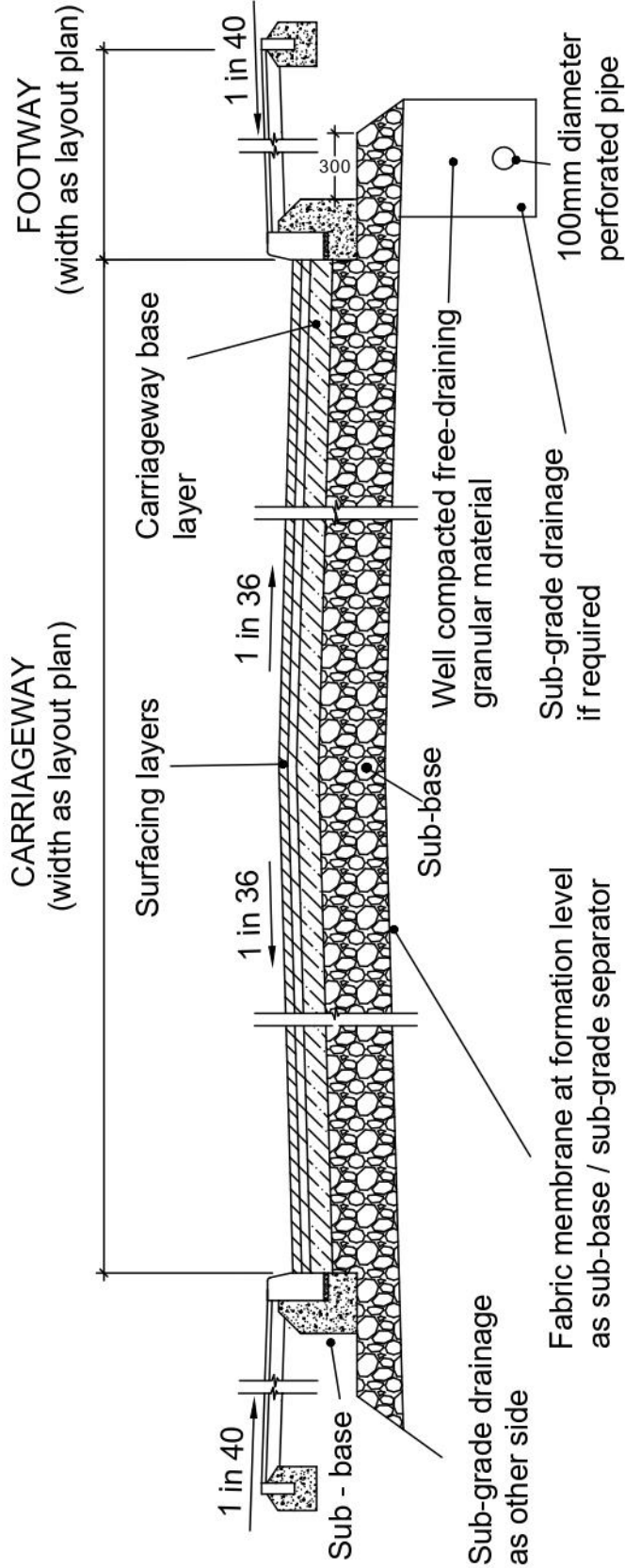


1. The boundary maker shall be manufactured in sulphate resisting pre-cast ST3 Concrete
2. The X height of the letters shall be 20mm and shall be written in Ariel Font with a minimum depth of 5mm
3. The boundary marker shall be installed so that it projects 20mm above the finished grass level in verge or soil level in a planting area.



Job Title: **General cross section**

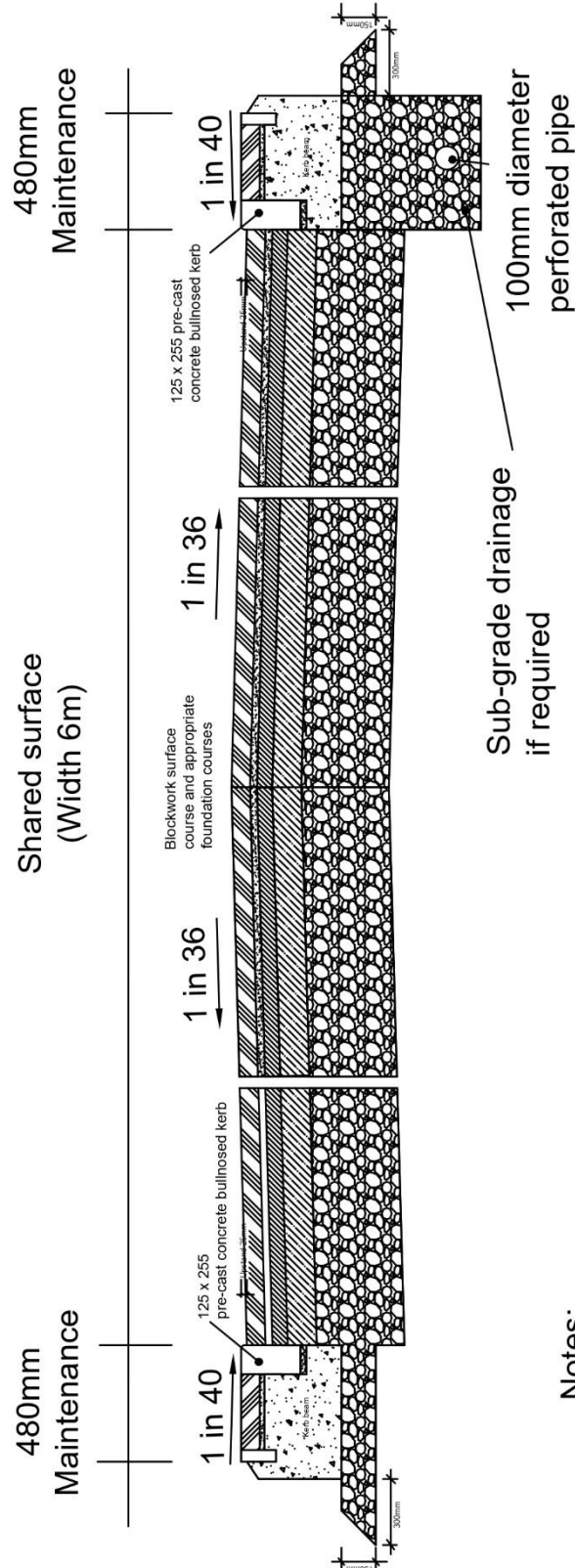
GENERAL CROSS-SECTION





Job Title: **General cross section shared surface**

GENERAL CROSS-SECTION SHARED SURFACE



Notes:

1. The surface course of a shared surface must be blockwork
2. The Maintenance Strip is to enable the Highway Authority to maintain the kerb line and shall not be used for the installation of third party plant. The maintenance strip shall be hard paved.
3. For details of the Highway Boundary marker see appendix 29