Lincolnshire County Council

Highway and Flood Authority

SECTION 278 WORKS

SPECIFICATION and CONSTRUCTION

March 2017 Edition

To be used in the
Construction of Section 278 works
which are to become
Highways Maintainable at the Public Expense

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Working for a better future

FOREWORD

INTRODUCTORY STATEMENT

This document is the initial edition of "Section 278 Specification and Construction."

It should be read and used in conjunction with the Lincolnshire Development Roads and Sustainable Drainage Design Approach and the Lincolnshire County Council "Typical Details" drawings.

Electronic copies of this Specification and Standard Details drawings can be found on the County Council website, LCC Connects:-

www.lincolnshire.gov.uk/

This Specification will be subject to review and amendment. The version of the Specification, current at the time of signing the Section 278 agreement, will apply to works covered by that agreement.

Version 1.0 of this document is the first edition and is dated 1st March 2017.

CONTENTS

GENERAL GUIDANCE NOTES

G.1 INTRODUCTION

G.1.1 Lincolnshire County Council (LCC) has the statutory function of the Lead Local Flood authority (LLFA), and as well as being consulted on Highways, it is also a statutory consultee on local flood risk. Any variations that may be required by or agreed with the Highway and Flood Authority shall be in writing. Advice is provided on good highway design and construction, flood risk management and sustainable drainage (SuDS) principles at all stages of the planning process. Prospective developers are advised, therefore to consult the Highway and Flood Authority when considering new highway proposals, preparing a Drainage Strategy and planning application drawings for submission to the Planning Authority.

G.2 PERMANENT TRAFFIC SIGNS AND ROAD MARKINGS

G.2.1 Where it is deemed by the Highway and Flood Authority that, in the interests of highway safety and/or required by regulations, traffic signs are required to be erected and/or road markings need laying, as part of the Section 278 works Developers will have to provide them at their cost.

G.2.2 All traffic signs shall be designed and erected in accordance with the current "Traffic Signs Regulations and General Directions", the "Traffic Signs Manual" and any amendments and extensions thereof.

G.2.3 For Directional, informatory or warning signs with supplementary plates, a detailed drawing of the sign's face must be provided to the Street Lighting and Traffic Signs Section for approval – guidance may also be given on the required signing by this Section if necessary.

G.2.4 All traffic signs must comply with BS EN 12899-1:2007 and its National Annex, the sign must also be CE Marked on the rear. A Sign manufactured in microprismatic material must comply with BS 8408:2005.

G.2.5 Road markings shall be in accordance with BS EN 1436 and shall have the following minimum standards of performance for a minimum period of 2 years from the date of application.

Table G/1 Performance Standards for Road Markings

Property	BS EN 1436 Reference	Requirement*	Value
Colour	Table 6	White Yellow Class Y1, Y2	X, Y co-ordinates given X, Y co-ordinates given
Skid Resistance	Table 7	Class S1 Class S1	45 45
Retroreflectivity	Table 2 Class of R_L for dry markings	Class R2 Class R1	100 80
Retroreflectivity	Table 3 Class of RL for road markings in conditions of wetness	Class RWD	No Requirement

Note: 1 = White, 2 = Yellow

G.3 WORKS WITHIN THE PUBLIC HIGHWAY

G.3.1 Any necessary excavations carried out in the existing public highway will require permits under the New Roads and Street Works Act (NRSWA) 1991 and/or permission under the Highways Act 1980. These works will also be subjected to the notification requirements for Traffic Management Act 2004. Details of these requirements and permit applications can be obtained from The Executive Director for Environmental and Economy.

G.3.2 Any activity that has the potential to cause delay or disruption or any works that involve breaking up the Highways is 'Registerable works' and must be notified.

G.3.3 Should the developer fail to give sufficient notice he may be required to pay a Fixed Penalty Notice (FPN). Fixed penalty notice offers the developer the opportunity to discharge any liability to conviction for a noticing offence, by payment of the penalty. However, the Highway and Flood Authority retains the power to take an alleged offender to the Magistrates' Courts, instead of giving an FPN. The objectives of the FPN system are to encourage accurate and timely notices and to improve co-ordination of the works with the aim of minimising delays and disruption arising from roads and street works.

G.3.4 Such permits and permissions will only be granted by the Highway and Flood Authority once the Developer has signed and completed the Section 278 Agreement. Should the developer enter onto the existing highway in advance of this, then their excavations will be considered illegal interference with the highway and appropriate enforcement action will be instigated.

G.3.5 All works conducted within the public highway must be carried out and maintained to the satisfaction of the Highway and Flood Authority.

G.4 SERVICE AND SERVICE DUCTS

G.4.1 Utility services and service ducts, both new and diverted existing, shall not be installed within the carriageway or footway construction. They shall be placed within the underlying subgrade.

G.5 CDM REQUIREMENTS

G.5.1 In accordance with Regulation 20/2 of the CDM Regulations 2015, once the site is adopted the Developers shall pass to the Highway and flood Authority their Health and Safety file, including any as built drawings for any structure, i.e. culverts, highway drains and the road itself. The Developer's CDM Principle Designer should ensure the Highway and Flood Authority is given this file which must include factors which could influence future maintenance e.g. land contamination areas, maintenance of SuDS, drains and culverts, etc.

G.6 SPECIFICATIONS, CODES OF PRACTICE ETC

G.6.1 References made to Specifications, Codes of Practice, etc. are current at the time of publication. Where any are superseded by new documents the Developer should make reference to the most up-to-date edition at the time of construction.

G.7 COMMUTED MAINTENANCE PAYMENTS

G.7.1 In the event of Developers proposing alternative materials and features to those detailed in this specification attention is drawn to Clause 1.1.22.4. Such materials and features are often more expensive to replace and or have a shorter lifespan than those specified. In view of this the Highway and Flood Authority makes a charge to cover the additional maintenance costs for such materials and features.

G.8 DELIVERY TICKETS

G.8.1 Delivery tickets and, when applicable, evidence of C E Marking, shall be available on request by the Highway and Flood Authority Officer.

G.9 PROXIMITY OF NON-ADOPTABLE STRUCTURES

G.9.1 Structures higher than 1.37m not for adoption by the Authority shall not be within 3.66m of the highway boundary.

1. CONSTRUCTION STANDARDS

1.1 GENERAL PRINCIPLES

1.1.1 Conformity of Standards

The construction methods, materials and standards adopted shall conform with the following except where varied by this specification:-

The relevant British (and relevant European) Standard specifications.
Highways England current Specification for Highway Works.
TRL Laboratory Report 1132 - "The Structural Design of Bituminous Roads"
Highways England current Pavement Design and Maintenance Manual (Volume 7) as amended by ADEPT guidance.
Lincolnshire County Council Highways and Planning Directorate Code of Practice - "Highway Works: Standards, Materials, Testing - HT/14/1/94"

1.1.2 Variation of Approved Details

Details shall be to the satisfaction of the Highway and Flood Authority and any variation from the details approved must be communicated in writing and agreed in writing prior to the variation work being undertaken.

1.1.3 Site Investigation

Sufficient site investigation shall be carried out to enable the design of new construction and intersection with the adjacent carriageway and to assess the impact on other highway infrastructure. The investigation shall include trial pitting and recovery of samples for laboratory testing, see Cl 1.1.5 below. Alternatively coring of the existing carriageway and Dynamic Cone Penetrometer (DCP) testing to a method approved by the Flood and Water Authority may be employed to assess the strength and condition of the underlying layers and materials.

1.1.4 Sub-grade

1.1.4.1 The Construction Chart, Section 2, gives alternative construction treatments for localised soft spots. If either the sub-grade or soft spots have a CBR below 1½% then specialist advice is required. It may be necessary to provide sub-grade drainage or other soil strengthening techniques such as incorporating a geosynthetic product or products (Clause 6.7.1) or stabilisation (Clause 6.7.2).

1.1.4.2 The depth and type of treatment and the form of construction of the carriageway to be used must be agreed before the work commences.

1.1.4.3 A Developer may consider the use of a combined or composite geosynthetic product which has two principal functions in a pavement foundation. The first is as a separator between the sub-base and sub-grade. The second is as a foundation reinforcing agent which can reduce the sub-base thickness with consequential economies in construction. See Figure 6/1.

1.1.4.4 The type of geosynthetic product to be used, its purpose and any proposed reduction in sub- base thickness must be agreed before construction commences (Clause 6.7.1).

1.1.5 California Bearing Ratio Test (CBR)

1.1.5.1 CBR samples must be recovered as part of the required site investigation see Clause 1.1.3. The relevant CBR compaction method is described in BS 1377 (1990) Part 4 Clause 7.2.4.4 Method 5. Where more than 25% of material is retained on the 20mm sieve, advice shall be sought from a suitably qualified engineer. The engineer will advise the laboratory on what action to take with the material >20mm. The sample to be tested is to be a representative sample taken between the anticipated formation level and 0.50m below formation and should be compacted with a 2.5kg hammer and normally tested with six 2kg surcharge weights. A CBR result for the top and bottom of the compacted sample shall be reported.

1.1.5.2 The developer shall propose Design CBR(s) based on the Laboratory CBR results and the revealed ground conditions. These shall take into account allowances for cohesive sub-grades (details below).

1.1.5.3 The proposed design CBR will be agreed by the Highway Authority in order to derive the appropriate construction thicknesses. In most instances, the worst CBR result will be used for the site as a whole, but a sub-grade inspection may be necessary to define where changes in design CBR values are to be used. (i.e. where ground conditions change).

1.1.5.4 As cohesive (or clayey) soils are moisture susceptible, the strength of clayey sub-grades may vary due to changes in water content before or after construction.

1.1.6 Carriageway Construction Thickness (Frost Susceptibility)

1.1.6.1 When CBR tests have been carried out, the thickness given in the chart may be used. Additionally, if tests show the sub-grade to be non-frost susceptible, then further economies in the thickness may be made. In such cases any proposed reduction in sub-base thickness must be agreed before construction commences. All subgrades shall be assumed frost susceptible in the absence of appropriate testing

1.1.6.2 For frost heave, materials shall be tested in accordance with BS 812: Part 124 except that the use of the silica sand and limestone filler reference specimens is not mandatory. Materials are classified as non-frost susceptible if the mean heave is 15.0mm or less.

1.1.7 Laboratory Reports and Test Results

1.1.7.1 The Highway Authority will accept reports containing test results only from UKAS Accredited Laboratories which are specifically accredited for the tests in question. The County Council's Materials Laboratory - Lincs Laboratory will offer further advice on this matter if requested to do so, and are able to carry out materials testing and consultancy work on a rechargeable basis. Lincs Laboratory is a UKAS Accredited Laboratory (Testing No 0699). Correspondence should be addressed to:- The Laboratory Manager, Lincs Laboratory, St Georges Lane, Riseholme, Lincoln, LN2 2LQ, telephone: (01522) 530355, fax: (01522) 510573 or E-mail lincslab@lincolnshire.gov.uk.

1.1.8 Plate Bearing Tests

1.1.8.1 It is important that unbound granular materials are not segregated and are adequately compacted. Attention is specifically drawn to Clause 8.1. The Highway and Flood Authority will carry out Plate Bearing Tests or Light Drop Weight Tests to ensure compliance with this requirement.

1.1.9 Approved Suppliers, Test Methods and Working Standards

1.1.9.1 All materials shall be obtained from a source currently approved by the Highway and Flood Authority. The current list of suppliers is maintained by Lincs Laboratory and can be accessed via http://microsites.lincolnshire.gov.uk/lincslab/publications/lcc-publications Developers are advised to ensure that contractors working on their behalf are experienced in working to the standards required by the Highway and Flood Authority. Prior to conducting tests on behalf of the Developer, the Test House shall submit details of the Test Procedure to be used to the Lincs Laboratory. Testing shall not take place until the Test House has received approval for the proposed Test Procedure.

1.1.9.2 Developers are required to inform the Highway and Flood Authority of proposed material suppliers and sources and sub-contractors to be used, prior to the commencement of any such elements of work being conducted.

1.1.10 Trafficking of Binder Course

1.1.10.1 The Developer's attention is specifically drawn to the effect of trafficking exposed binder course materials prior to the application of the final surface course. The binder course shall be thoroughly cleaned and a bond or tack coat to Clause 9.2 applied prior to the laying of the surface course. It may be necessary to use high pressure washing equipment if heavy contamination has occurred. Prolonged exposure to trafficking may result in the binder course becoming so adversely affected that its replacement will be necessary prior to laying the surface course.

1.1.11 Trafficking of Roads, Contamination and Storage of Material

1.1.11.1 Traffic in connection with the related housing/building development must not use roads until constructed to the requirements of this specification. It is important that materials used in the construction of the areas to be adopted are not contaminated. Control should be such that only vehicles and plant associated with the roadworks be allowed to traffic the formation level and sub-base layers before and during construction. Formation that is damaged and sub-base that becomes contaminated by materials used in adjoining building works, top soil, clay, etc will not be adopted. At no stage during the construction of carriageways shall materials be stored thereon.

1.1.12 Kerbing

1.1.12.1 Kerbs shall be installed prior to the full depth of the carriageway binder course being placed.

1.1.12.2 The Developer's attention is drawn to the need to protect laid lengths of kerbing, channels and edgings. It may be necessary for this protection to take the form of a physical barrier such as concrete over protection with a polythene or geotextile membrane.

1.1.12.3 All damaged kerbs, channels and edgings shall be replaced prior to the application of carriageway or footway final surface course. **Where more than 4 separate kerbs, channels or edgings are damaged within any 10m length, the entire 10m length must be replaced,** using undamaged kerbs, channels or edgings in accordance with the specification.

1.1.12.4 Where it becomes necessary to replace kerbing, channels or edgings damaged following the application of final surface course to footway or carriageway, a minimum 2m length of Surface Course, full width of the footway, shall be replaced. If damage is caused to the adjacent carriageway surface course the surface course shall be replaced for a minimum

of 5m for half the width of the carriageway. This Clause shall also apply where the Developer wishes to make minor changes to laid kerbing e.g. when adjusting the position of a vehicular crossing.

1.1.12.5 All kerbs needing replacement shall be removed from the footway side.

1.1.12.6 The kerb/channel bed shall, always be laid separate to the backing as shown on the typical section through carriageway edge details; Figure 1/3. This is due to the high level of kerb damage experienced on development roads and the resulting need to replace kerbs at a late stage of construction whilst causing the minimum damage to the overall construction. In addition should the alternative kerb installation methods below be employed then the separate kerb bed/race can be utilised as level control for the first layer of binder course.

1.1.13 Minimum Depth Flexible Construction

1.1.13.1 The Construction Chart provides alternative flexible designs based on the principle of replacing some of the granular foundation with bituminous material, known as 'bituminous replacement'. Highway construction practice on these thin foundations will have to be reviewed, normal procedures may not be appropriate due to the reduced ability of the foundation to carry construction traffic e.g. tracked rather than wheeled pavers to lay the binder course. Construction must be phased such that any excavated area is covered the same day with sub- base and this protected to prevent the ingress of water.

1.1.13.2 The sub-base shall conform to Clause 8.1 and shall be Type 1. Since part of the normal granular foundation has been replaced with bituminous material the in-situ CBR requirement on top of the sub-base is not appropriate. Instead the sub-base shall comply with the in-situ density requirement stated in Clause 8.1. This sub-base layer is not designed to carry other construction traffic.

1.1.13.3 When the sub-grade CBR is 3% or less consideration should be given at the site investigation stage to incorporate a geo-synthetic separator at the sub-grade/sub-base interface. Minimum depth flexible construction is not permitted on any site where the site investigation has identified a risk from soil shrinkage and heave.

1.1.13.4 Attention is drawn to the need to provide frost protection when the sub-grade is classified as frost susceptible. Additional bituminous material is required to provide the protection rather than increasing the thickness of non-frost susceptible Type 1 sub-base as in the normal flexible charts. Research has revealed that dense bituminous material offers added protection due to its increased insulating effect and by limiting water penetration into the pavement structure. For frost susceptible subgrades a minimum total thickness of 275mm of bituminous bound material is required for Minimum Depth Flexible Construction roads.

1.1.14 Surface Water Drainage Swales and Flow Conveyance

1.1.14.1 Construction plant should not be driven over a swale or conveyance channel to avoid compaction of permeable soils. Where necessary, barrier fencing should be used, particularly where infiltration swales are being constructed. Run-off of silts during construction should be prevented from entering swales and channels. Clay should not be mixed with topsoil as this adversely impacts on infiltration properties of the surface layer.

1.1.14.2 Channels must be constructed to be self-cleansing of silt and allow easy cleaning and maintenance, and the outlet constructed to act as a mini separator for effective removal of pollutants. The preferred system to be used is a clear concrete channel of sufficient strength and durability, incorporating a defined edge.

1.1.15 Surface Water Drainage Filter Drains, Infiltration Trenches and Grass Filter Strips

1.1.15.1 Application and the use of Filter Drains, Infiltration Trenches and Grass Filter Strips will be acceptable.

1.1.15.2 Filter trenches must not be constructed near septic tanks or leachate areas, and measures to minimise soil compaction and soil erosion during construction must be used. To prevent silting of the drainage pipe and soil erosion over time, a geo-textile membrane to clause 5.9 shall be used on the inside of the trench with a higher permeability than the surrounding soil. Filter drains shall not be brought into use until construction and landscaping of the surrounding site draining to them has been completed.

1.1.15.3 The use of infiltration trenches for disposal of surface water must be site specific. Protection to the infiltration trench shall be provided from all construction plant activity until construction on the site is completed, and it should not be used for drainage of the site during construction. Compaction of the surrounding ground shall be avoided so as not to affect the infiltration characteristics of the soil.

1.1.15.4 Grass filter strips are to be constructed 25mm below the road channel level to prevent build-up of silt at the road edge and impeding run-off. The filter strip must be constructed to provide an even and consistent longitudinal slope, with no severe undulations that will cause localised ponding and promote flow in surface channels and erosion of topsoil. A newly constructed filter strip must be protected from stormwater flows unless a good sward of grass has been established. At all times a working method should be adopted which will protect filter strips during construction. However, following planting, if more than 30% of the area is bare after 4 weeks, reseeding will be required to achieve a good 90% established sward. If sediment from construction works accumulates on the filter strip, removal will be required prior to adoption.

1.1.16 Commuted Maintenance Payments and Fees

1.1.16.1 Alternative materials and features to those detailed in this specification are often more expensive to replace or have a shorter service life to those specified.

1.1.16.2 **The additional costs associated with assessing such alternatives, including testing, will normally be borne by the proposer and the Highway and Flood Authority will require certain commuted sums to be paid by the developer for additional maintenance costs as follows:-**

1.1.16.3 **Sustainable Drainage Systems (SuDS)**

When adopting SuDS components draining private water, and in addition to existing highway related bonds, fees and charges, a "one off" service payment will be required by the HIGHWAY AND FLOOD AUTHORITY from the developer (prior to commencement of SuDS construction), related to the current W&Sc surface water charge levied on property already connected to surface water sewerage infrastructure. Calculation details of this service payment will be provided by LCC at pre-planning application consultation stage.

For clarity, the Highway and Flood Authority will only consider for adoption any systems which are an integral part of the highway system. Roof water directly discharging into highway surface water drainage infrastructure from residential property may be acceptable following prior approval from the Highway and Flood Authority.

1.1.16.4 **Non-Standard Surfacing and Alternative Materials**

Where materials that are not within the current specification adopted by the Highway and Flood Authority are used in surfaced areas, a commuted sum for maintenance will be required.

1.1.16.5 **Structures and Other 'Extra Over' Items**

Highway structures; retaining walls, culverts, bridges and public transport infrastructure, are considered as 'extra over' standard adoptable works. These will require commuted sums to take account of their future maintenance.

Where items, as listed above, in this clause are proposed, the developer will be informed that a commuted maintenance payment will be written into the Section 278 Agreement.

1.1.16.6 **Street Lighting, Street Furniture, Traffic Signals and Signs**

Where installations, finishing's, materials, features etc., which would incur additional maintenance or replacement costs (when compared with those required by the Highway and Flood Authority current specification) are required, a commuted sum for the additional maintenance cost will be required.

1.1.17 **Tree Planting and Root Barriers**

Where trees are to be planted within 5m of footways or highways a root barrier is required between the tree root system and the highway structure. A propietary, high strength, photo and bio degradation resistant root barrier 2mm thick with a minimum width of 1.0m should be used. Where individual trees are to be planted in tree pits with highway or footways adjacent, the use of preformed root directors may be more appropriate.

1.1.18 Services and Service Ducts

Utility services and service ducts shall be installed within the sub-grade below the carriageway or footway construction. Capping layers are classified as part of the construction. The location of dedicated service crossing points requires approval in order to limit/control the number in pervious road construction.

1.2 SUB-BASE

1.2.1 Sub-base shall conform to Clause 8.1 and shall be Type 1 for Carriageways. A minimum in-situ CBR value of 30% and/or a minimum stiffness of 35 MPa will be required on all roads. CBR or stiffness values shall be determined by Plate Bearing Tests or Light Weight Drop Tests respectively in accordance with Clause 8.2.

1.2.2 For carriageways and footways, not more than one in ten field dry density determination, as detailed in BS 1377:Part 9, (clause 2.2) where undertaken shall be less than 90% of the maximum dry density for that particular sub-base as determined by the vibrating hammer test in BS EN 13286-4.

1.3 BINDER COURSE

1.3.1 For carriageways, Binder Course materials shall be 20mm size recipe mix Dense Binder Course **AC 20 Dense bin 40/60 rec** to Clause 9.1 and shall be laid in a single layer or combination of layers not less than 50mm in thickness nor greater than 110mm in thickness. Compaction must be in accordance with Clause 7.2 to a void content within the range 2%-8% and all layers must be bonded together. Bond shall also be achieved with any bound underlying material.

1.4 SURFACE COURSE

1.4.1 For carriageways the Surface Course shall be 40mm of 10mm size Close Graded Surface Course (AC 10 close surf 70/100 or 100/150) to Clause 7.3. compacted in accordance with

Clause 7.2 to a void content within the range 2%-10% or 40mm of Hot Rolled Asphalt (HRA 30/14F surf 40/60 des Incorporating 20mm pre-coated chippings) to Clause 9.6 to a void content within the range 2%-6%. The aggregate shall be from a source approved by the Highway and Flood Authority and shall have minimum polished stone value of 55, unless a higher PSV is required by the Highway and Flood Authority and a maximum abrasion value of 16. Only aggregates in the Lincolnshire County Council Approved Supplies Information Booklet shall be used.

New Surface Course shall match the adjacent. If the carriageway lane is surfaced with materials other than AC10 or HRA guidance shall be sought from the Highway and Flood Authority.

1.5 FOOTWAY CONSTRUCTION

This shall comprise:-

1.5.1 Bituminous Surfacing

100mm of Type 1 sub-base to Clause 1.2
100mm of 20mm size Dense, 70/100 or 100/150 Binder Course (AC 20 dense bin rec) to Clause 9.1 compacted to a void content within the range 2%-10%.

25mm of 6mm size Dense 70/100 or 100/150 Surface Course (AC 6 dense surf) to Clause 9.4 compacted to a void content within the range 2%-10%.

FIGURE 1/1a - JUNCTION DETAIL WITH EXISTING CARRIAGEWAY

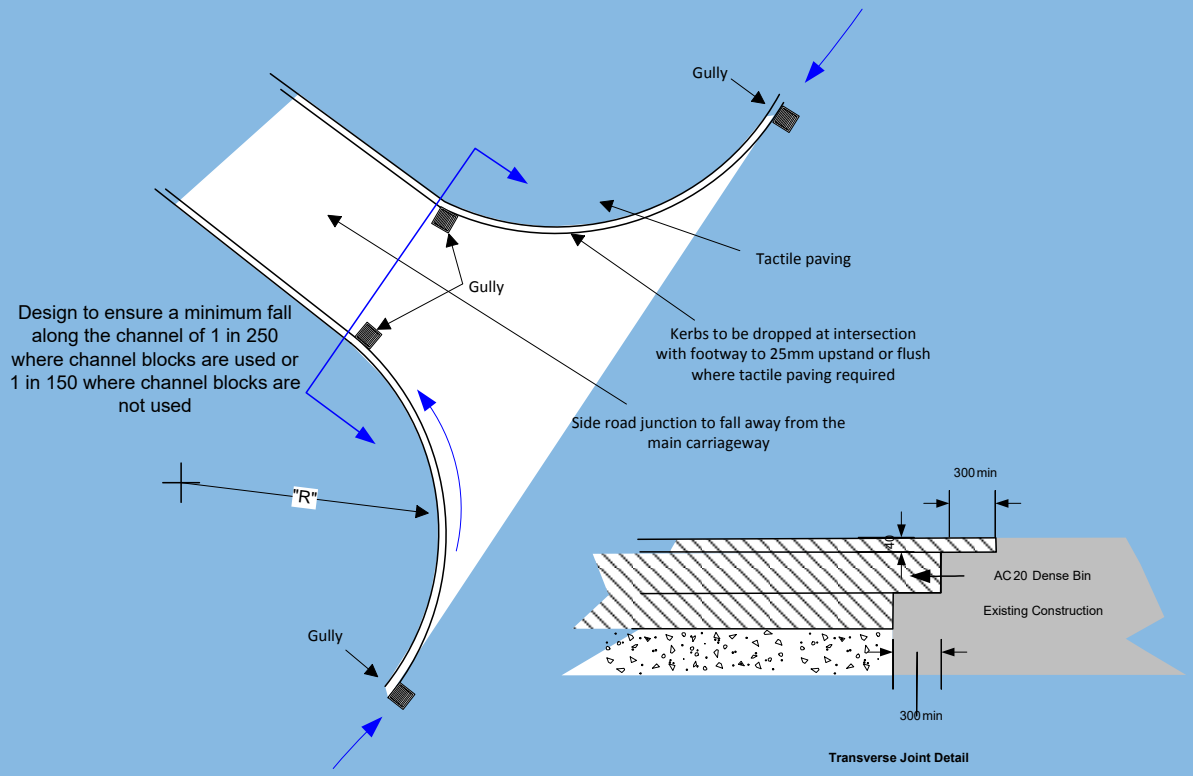
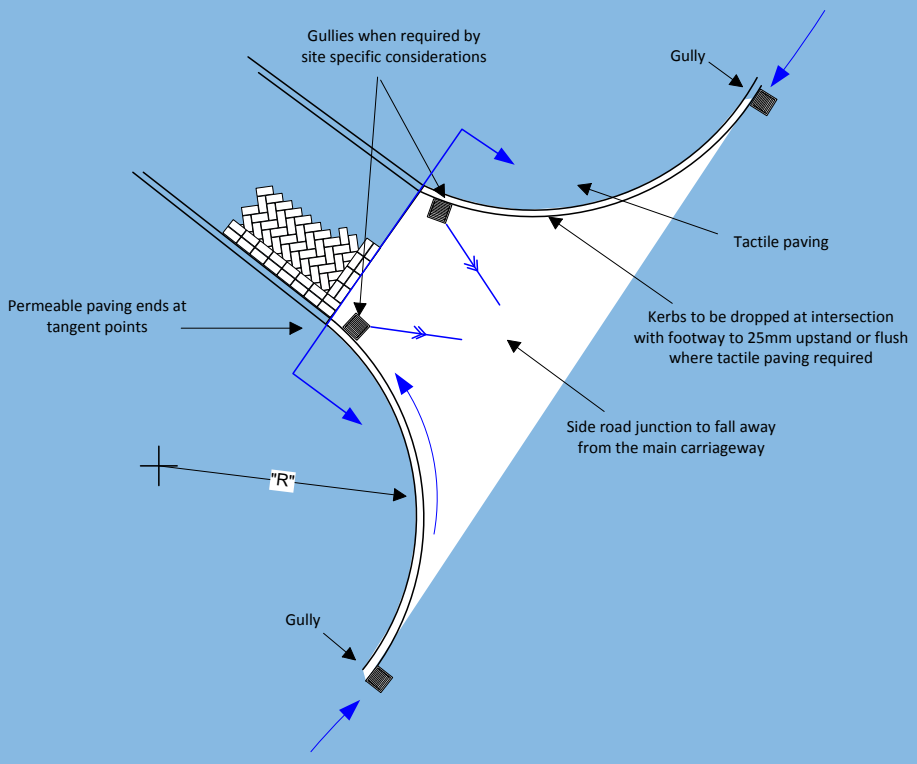


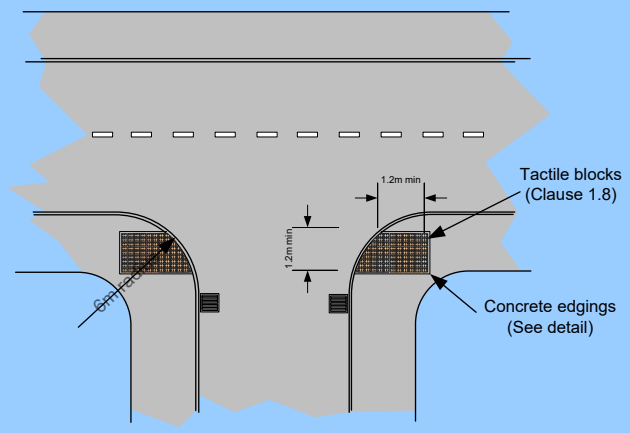
FIGURE 1/1b - JUNCTION DETAIL WITH PERVIOUS PAVEMENT



1.6 TACTILE PAVING CROSSINGS FOR PEDESTRIANS

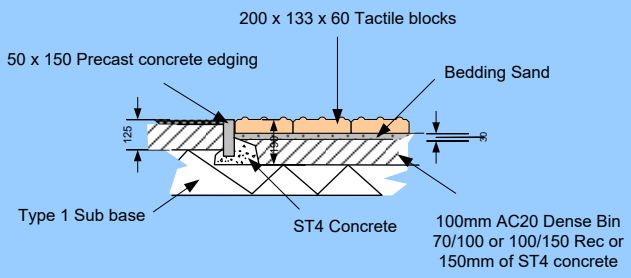
1.6.1 Blister tactile paving crossing points shall be provided at all junctions, crossings at link footways and at kerb to kerb flat top road crossings.

FIGURE 1/2 TACTILE PAVING – TYPICAL DETAIL



NB Tactile blocks should not encroach on the 1.6m dropped kerbs

TYPICAL UNCONTROLLED CROSSING POINT AT JUNCTION



CONCRETE EDGE DETAIL – TACTILE PAVING

1.6.2 Tactile paving shall be 'dimple' high strength concrete blocks, 200mm x 133mm x 60mm paving blocks, with concrete edging around the outside of the blocks. The surface colour shall be buff.

1.6.3 Tactile paving shall be installed in the line of travel, along the full length of a minimum of 1.6m flush dropped channel blocks. Flush kerbs to comprise 125mm x 150mm precast concrete channel blocks. The back edge of the tactile paving surface shall be at right angles to the direction of crossing

1.6.4 Developers shall take care not to locate service boxes (e.g. BT) where tactile paving is required.

FIGURE 1/3 - TYPICAL SECTION - CARRIAGEWAY AND FOOTWAY EDGE

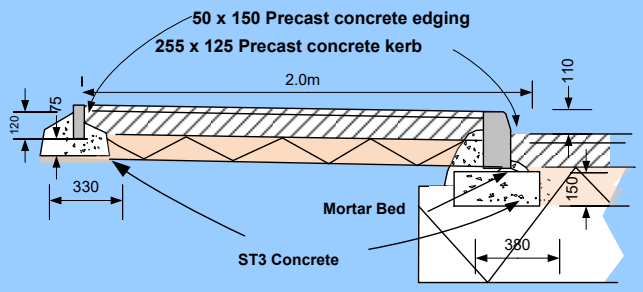
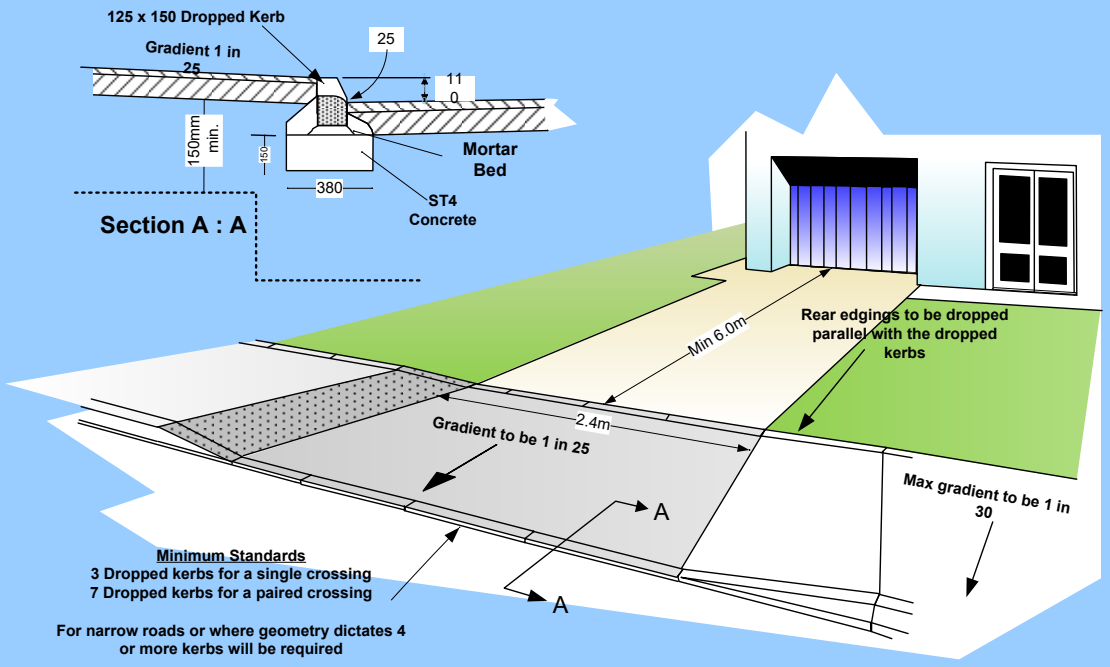


FIGURE 1/4 - DOMESTIC VEHICLE CROSSING



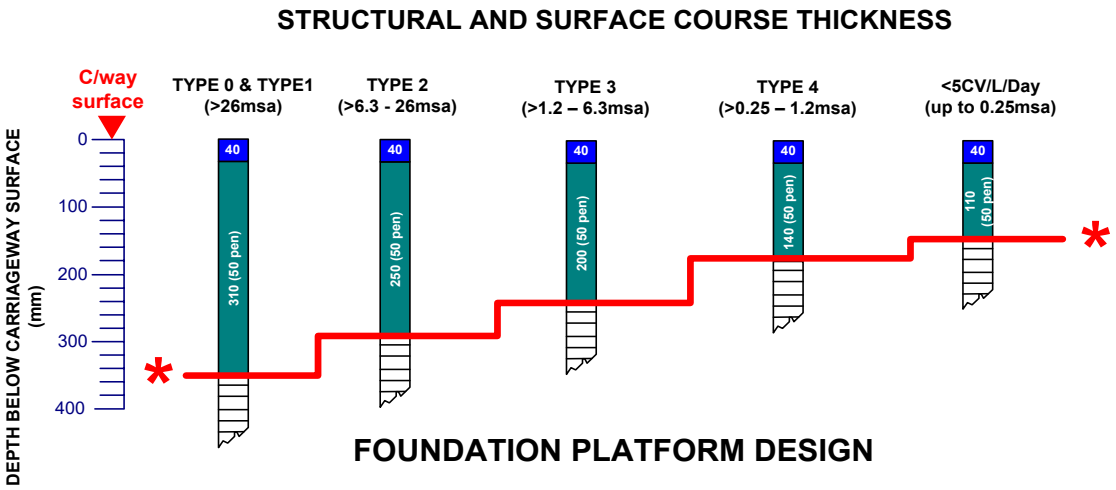
1.6.5 A full set of Lincolnshire County Council's typical highway details can be viewed on line at: www.lincolnshire.gov.uk/residents/environment-and-planning/planning-and-development/typical-details-for-highway-works.

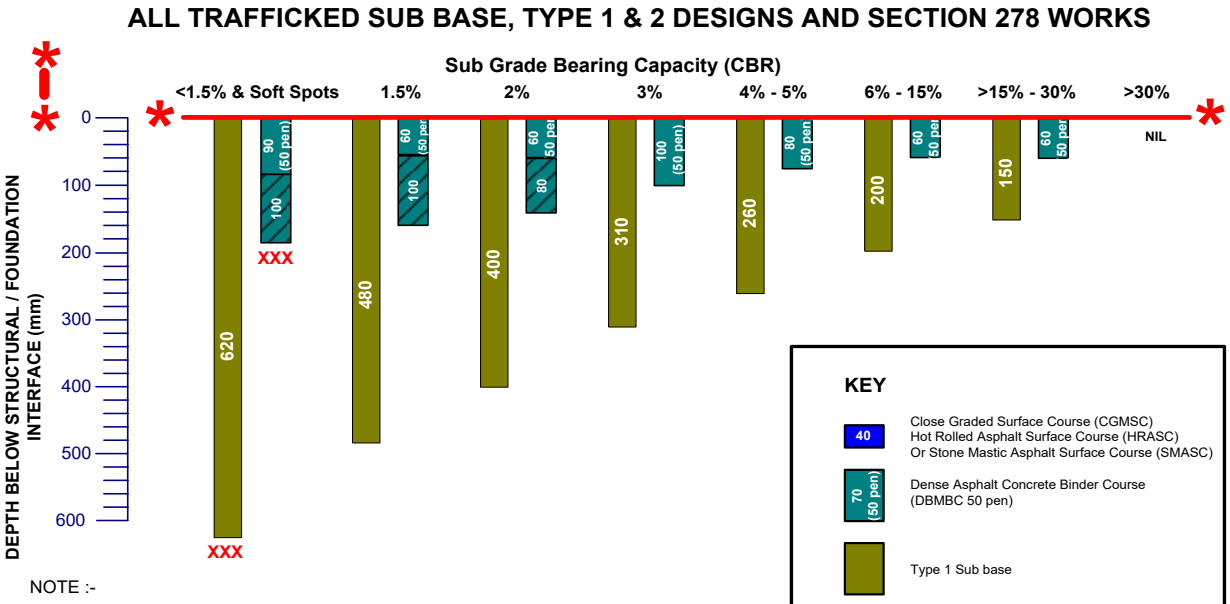
2.0 CONSTRUCTION CHART

2.1.0 The Construction Chart summarises the Highway and Flood Authority's structural requirements for adoptable highways

5/12/2017

SECTION 278 WORKS 40 YEAR DESIGN LIFE (TO CRITICAL CONDITION)





NOTE :-

1) Regardless of the CBR value, unless the subgrade has been proven to be non-frost susceptible, sub base must be thick enough to provide 450mm of frost cover

2) When using a bituminous replacement design the total thickness of bituminous bound material must provide 275mm of frost cover

TABLE 2/1 - BELLMOUTH CONSTRUCTION - MAJOR WORKS[*3]

	CATEGORY				
CONSTRUCTION	**1**	**2**	**3[*1]**	**4[*1]**	**< 5 CV/L/Day**
SURFACE COURSE	40mm HRA	40mm HRA	40mm 10mm CGSC	40mm 10mm CGSC	40mm 10mm CGSC
BINDERCOURSE	310mm	250mm	200mm	140mm	110mm
SUB BASE[*2]	620 + Geosynthetic	620 + Geosynthetic	620 + Geosynthetic	620 + Geosynthetic	620 + Geosynthetic

*1 - To match existing adjacent carriageway based on site location

*2 - Thickness can be modified subject to CBR values

*3 - Projected NRSWA Category after development complete based on traffic assessment for the site

NOTE - This can increase

3. TRAFFIC AND SAFETY MEASURES DURING CONSTRUCTION

3.1 TEMPORARY TRAFFIC SIGNS

3.1.1 The Developer shall erect and maintain on the site and on the approaches to the site all traffic signs and traffic control signals necessary for the direction and control of traffic. The signs shall conform to the current Safety at Street Works and Road Works Code of Practice and where applicable The Traffic Signs Manual Chapter 8 “Traffic Safety Measures and Signs for Roadworks and Temporary Situations”. The signs shall be reflectorised and kept clean and legible.

3.1.2 All temporary traffic signs used require the prior approval by the Highway and Flood Authority. Where unauthorised signs and/or fly posting etc. takes place the Highway and Flood Authority will take appropriate enforcement action to rectify the situation.

3.2 CONTROL OF TRAFFIC

3.2.1 If, during any part of the construction, it becomes necessary to restrict or interfere with the flow of traffic on the public highway, then approval and approval must be obtained from the Highway and Flood Authority. A minimum of two weeks' notice will be required for such approval. Notification lead-in times that may be longer are subjected to the duration of the works in accordance with the Traffic Management Act 2004.

3.2.2 Where traffic signals are required, a minimum of two weeks' notice is also required from the Highway and Flood Authority as above. For Trunk Roads this notice is extended to six weeks and approval is required from the Highways England.

3.2.3 Three or four-way temporary signals will require separate approval by the Traffic Signals Engineer and require a minimum of four weeks' notice.

3.3 TEMPORARY DIVERSION OF TRAFFIC

3.3.1 The Developer shall construct temporary diversion ways wherever the works will interfere with existing public or private roads or other ways over which there is a public or private right or way for any traffic, including pedestrians. Any diversion shall be suitable in all respects for the type and volume of traffic requiring to use it. It shall be constructed in advance of taking up the existing way and regularly maintained. Developers are reminded of the statutory three months' notice (13 weeks) required to obtain a road closure.

3.4 SAFETY CODES

3.4.1 The Developer shall comply with the current Safety at Street Works and Road Works Code of Practice and where applicable The Traffic Signs Manual Chapter 8 “Traffic Safety Measures and Signs for Roadworks and Temporary Situations” and all of the relevant current safety standards.

3.5 EXCAVATIONS

3.5.1 The Developer shall ensure that all excavations on the site and on the approaches to the site are adequately signed, fenced and supported.

3.6 MATERIALS ON THE HIGHWAY

3.6.1 No building materials etc. shall be stored on the public highway, without the permission of the Highway and Flood Authority. Care should also be taken not to impede visibility at junctions through the inappropriate storage of materials on site.

3.7 MUD, ETC., ON THE HIGHWAY

3.7.1 Developers are reminded that under the Highways Act 1980, they are responsible for ensuring that the existing public highway is kept clear from mud, stones, silt, etc. at all times.

3.7.2 Every effort should also be made to keep sites in a safe and tidy condition.

3.8 WIDE LOADS

3.8.1 Where works affect the public highway and cause a reduction in width to that highway, possible conflicts may occur regarding the movement of abnormal loads. Therefore, if the works involve the reduction in carriageway width to less than 4.1m, or the width between street furniture (or other obstructions) above kerb level to less than 6.0m, the Abnormal Load Officer must be notified of the changes. The above dimensions apply to straight or near straight roads and these values need increasing on sharp bends or roundabouts.

3.8.2 This guidance applies to all temporary and permanent works, affecting classified and unclassified roads

4. SITE CLEARANCE

4.1 CLEARING SITE

4.1.1 Trees, stumps and tree roots within the proposed highway shall be removed. Holes left by the demolition of buildings, by uprooting trees etc., shall be filled in accordance with Clause 6.1.1.

5. DRAINAGE and SuDS

5.1 GENERAL PRINCIPLES

5.1.1 As a potential adopting authority, drainage infrastructure (including some types of sustainable drainage), necessary to drain any prospective public highway can be offered for adoption to the Highways and Flood Authority under a Section 278 agreement.

5.1.2 The historic process for the drainage of developments has been that the developer enters into an agreement with the appropriate sewerage undertaker under Section 104 of the Water Industry Act 1991 for the design and construction of the foul and surface water sewers. The Highway and Flood Authority, in these circumstances normally only adopts road gullies and the connections to the surface water sewer.

5.1.3 However, whilst this is the case for foul water sewers, sustainable drainage principles for surface water shall be incorporated in all developments as a requirement of both the planning and adoption process.

5.1.4 The Developers attention is drawn to the list of information required to commence a drainage design check. The list is included in Appendix 1, Design Guidance and Design Submission. Failure to provide the information requested will delay the processing of the submission.

5.1.5 The Developer shall submit the designer's risk assessments for the design, operation and maintenance of the highway drainage system.

5.1.6 Pumping Stations and rising mains will not be considered for adoption as part of a highway drainage system.

5.1.7 Details for any part of the drainage network which is classified as a highway structure such as headwalls shall be submitted for approval by the Highway and Flood Authority. Section 11 of this Specification applies.

5.2 SURFACE WATER DRAINAGE DESIGN AND LAYOUT

5.2.1 Highway SuDS layout, design and construction should be in accordance with the contents of this document, Non Statutory Technical Standards for Sustainable Drainage, LASOO's Best Practice Guidance and the Lincolnshire Development Roads and Sustainable Drainage Design Approach.

5.2.2 Manholes, catchpits and sewers should be sited with due regard to public utility services. A manhole or catchpit should be built at every change of alignment or gradient; at the head of all pipe runs; at every junction of two or more pipes (other than gully connections); wherever there is a change in the size of pipe. Manholes should not be further apart than 100m and for catchpits 90m.

5.2.3 When in a highway, the outside of the pipe should be in the vehicle carriageway (not footway) and be at least 1m from the kerb line. The outside of manholes should be at least 0.5m, preferably 1.2m from the kerb line.

5.2.4 Geo-cellular crates are not permitted beneath the adoptable highway.

5.2.5 All highway drainage systems shall be situated within land which is to be adopted by the Highway and Flood Authority.

5.2.6 Only in exceptional circumstances will elements of the highway drainage system be permitted within an area of public open space, subject to the written approval of the Planning Authority. Where such circumstances do arise, the land owner (developer) will be required to provide a Grant of Easement giving the Highway and Flood Authority right of access at all times for repair and maintenance purposes.

5.2.7 Where easements, wayleaves, consents and the like are necessary the Developer is required to submit a draft of any such document to the Highway and Flood Authority. Technical approval will not be granted until the documents have been approved. Should the circumstances of the easements, wayleaves consents and the like change following approval the Highway and Flood Authority must be notified in writing immediately. In these circumstances the Highway and Flood Authority reserves the right to rescind technical approval until new easements, wayleaves, consents and the like have been submitted.

5.2.8 Minimum easement widths are shown in Table 5/1. Where other pipe layouts are proposed i.e. dual systems, filter drains and infiltration tanks, advice must be sought from the Highway and Flood Authority.

Table 5/1

Minimum distances of buildings and structures from prospective highway drains

Sewer Diameter	Up to 449mm diameter	450 – 749mm	750 - 924	925 and above	Box culverts, the greater of
Depth to invert <3m	3.0m	3.5m	4.0m	5.0m	4.0m or 2m from the outside edge
Depth to invert >3m	Seek advice	Seek advice	Seek advice	Seek advice	Seek advice

Note 1: Distance shall be taken as centreline of pipe unless otherwise stated

5.2.9 Infiltration devices shall be a minimum of 5m from any structure. The Highway and Flood Authority will require a minimum easement of 2m from the outside edge of the infiltration device. In certain circumstances the Highway and Flood Authority may stipulate a larger easement.

5.2.10 There shall be no physical obstructions or structures on, above or below the easement route with the exception of minor services and simple fencing that may cross the route perpendicularly.

5.2.11 Developers shall seek the advice of the Highway and Flood Authority when the easement is to be landscaped as there may be restrictions on layout and species allowed. This should be considered when the developer submits landscaping proposals with his planning application.

5.2.12 Where pipe lengths are located outside the adoptable public highway manholes and ancillary structures shall be accessible by conventional sewer cleaning equipment (e.g. Large combination jetting/vacuum unit).

5.3 CONNECTIONS TO EXISTING DRAINS OR PUBLIC SEWERS

5.3.1 Before entering or breaking into an existing sewer or drain, the Developer must obtain the permission of the Authority responsible for the pipeline or watercourse to which the connection is to be made.

5.3.2 Where excavation within the existing public highway is necessary, the permission of the Highway and Flood Authority must be obtained and a permit to work in the highway under the

New Records and Streetworks Act must be obtained from the Highway and Flood Authority. In addition to the Permit (section 50 licence) the Developer (work promoter) must give the relevant notification for the works under the Traffic Management Act 2004. The minimum notification periods are subject to the duration of the works.

5.3.3 Should a developer wish to drain any part of the works to an existing highway drainage system, the developer will be required to submit a full survey of the existing system together with calculations which adequately demonstrate its suitability to accept additional flows. Should it become necessary to improve the existing highway drainage system within the existing public highway, agreement will be required under Section 278 of the Highways Act 1980.

5.3.4 Discharge into any existing drain from the development shall be restricted to a rate agreed with the responsible authority. This shall, at a maximum, be the green field runoff rate of the prospective highway to be drained. Greenfield runoff rate calculations shall be verified by the Highways and Flood Authority.

5.3.5 The Developer should be aware that particular conditions may be imposed for connections to brick sewers, large diameter sewers or where adverse conditions make construction of a manhole difficult. The Undertaker or Highway and Flood Authority may elect to make the connection at the Developer's expense. This should be taken into account when designing the system.

5.3.6 In general, the connection into an existing highway drainage system will require the construction of a new manhole.

5.3.7 Notice needs to be taken of the Undertaker's or Highway and Flood Authority's health and safety procedures for working in public sewers or existing highway drainage systems.

5.4 SURFACE WATER DRAINAGE HYDRAULIC DESIGN

5.4.1 The System should be designed for surface water and groundwater not to flood any part of the development in a 1 in 30 year return period design storm except in designated flood areas.

5.4.2 The Wallingford Procedure shall be used to design piped drainage systems up to and including 2 year storm return periods with durations up to and including 120 minutes.
With detailed reference to the SuDS Manual (C753), the drainage system should be designed to mimic natural drainage routes, infiltration rates and discharges. It should encompass the natural topography and where possible avoid the use of pipes and storage tanks. However, where integrated piped solutions are proposed, the design capacity should be considered under pipe full conditions to accept the following design storms (i.e. without surcharging above pipe soffit):
Sites with average ground slopes greater than 1% 1 in 1 year event
Sites with average ground slopes 1% or less 1 in 2 year event Sites where consequences of flooding are severe
(e.g. existing basement properties adjacent to new development) 5 years

5.4.3 The proposed drainage design shall be simulated with both FSR and FEH rainfall data. Drainage design shall take into account the latest Government guidance on climate allowance.

5.4.4 Industry recognised software may be used provided its input data and output files are compatible with Microdrainage. Proprietary manufacturer/supplier software may be used provided that their materials are intended to be used on the development and they have been approved, prior to design, by the Highway and Flood Authority. When proprietary software is used the Highway Authority may request alternative calculations to confirm the outputs. If the developer opts to change material supplier on site the Highway and Flood Authority may request new calculations.

5.4.5 The development should be designed to cope with run off from highway areas, including; roads, footways, access crossings, lay-bys and verges to be adopted by the Highway and Flood Authority, drain to the drainage system to be adopted. For these areas, an impermeability of 100% shall be assumed. No other areas should drain directly or indirectly to the highway to be adopted.

5.4.6 The minimum pipe velocity shall be 1m/sec at pipe full flow for the design storm. Where the Highway and Flood Authority approves oversized pipes for the storage of highway water runoff the minimum proportional velocity shall be 1.0m/sec for the design storm flow. The Developer shall supply proportional velocity calculations for the design storm.

5.4.7 For SuDS refer to Design Data show in Figures 5/7 to 5/13

5.4.8 The roughness value (ks) for pipeline design should be 0.6mm. Manning's n shall be used for the roughness coefficient in SuDS design.

5.4.9 No latent storage allowance shall be made within the hydraulic calculations e.g. gully pots & laterals. In Microdrainage this is known as the MADD factor and it shall be set to zero.

5.4.10 The Developer shall take into account the condition of the receiving waterbody or drain during the required storm simulations. Should the highway drain outfall be submerged or impeded in any way then the Developer will be required to undertake further simulations of the highway drainage system under such conditions.

5.5 PIPES, COUPLINGS, FITTINGS and ANCILLARY PRODUCTS

5.5.1 Highway drains laid within the adoptable carriageway shall have a minimum of 1.2m cover. This shall be measured from the top of pipe barrel to the finished road surface. Where this is not achievable, the pipe will be subject to special protective measures detailed by clause 5.15.8.

5.5.2 Pipes situated within non-trafficked areas shall have a minimal cover of 0.9m. Where this is not achievable, the pipe will be subject to special protective measures detailed by clause 5.15.8.

5.5.3 The minimum size of highway drains to be adopted is 150mm nominal internal diameter.

5.5.4 Pipes/conduits greater than 600mm diameters are classed as highway structures and therefore Section 11 of this Specification applies.
One type of pipe shall be used between manholes and catchpits. All pipes and joints shall be jointed in accordance with the manufacturer's instructions.

Vitrified Clay Pipes and Fittings

5.5.5 Vitrified clay pipes and fittings shall have flexible mechanical joints. Pipes shall comply with the relevant requirements of BS EN 295 and BS 65 (surface water pipes only).

Concrete Pipes and Fittings

5.5.6 Unreinforced and reinforced concrete pipes and fittings with flexible joints shall comply with the relevant provisions of BS EN 1916:2002 and BS5911-5:2004 + A1:2010.

5.5.7 All pipes and fittings shall have gasket-type joints of spigot and socket or rebated form, unless otherwise agreed with the Highway and Flood Authority.

5.5.8 Particular requirements from the options listed in Appendix A of BS 5911: Part 100 should be shown on the Drawings.

Ductile Iron Pipes and Fittings (Highway Authority approval required)

5.5.9 Ductile iron pipes and fittings shall comply with the relevant provisions of BS EN 598.

5.5.10 Ductile iron pipelines shall be designed and installed in accordance with the manufacturer's instructions.

5.5.11 The internal lining of the pipe, if necessary, shall resist attack by contaminants typically found in highway surface water runoff.

5.5.12 The Developer will provide independent soil contamination and resistivity data to determine the required external anti corrosion coating for the pipes and type of pipe seal.

Other Materials

5.5.13 Other materials, with the exception of plastic which is not permitted, will be considered on a site specific basis.

5.5.14 The Developer will be expected to provide all necessary technical information and design calculations required by the Highway and Flood Authority. Where the Highway and Flood Authority deems it necessary the Developer will be responsible for independent technical checks and testing.

Linear and Combined Kerb Drainage

5.5.15 Linear and Combined Kerb Drainage systems are only permitted with prior approval from the Highway and Flood Authority.

Flexible Couplings

5.5.16 Flexible couplings shall comply with the provisions of WIS 4-41-01 and BS EN 295-4.

Flow Control Devices

5.5.17 The use of a flow control device is subject to the approval of the Highway and Flood Authority. They shall be self-cleaning and require no power input or have any moving parts and have a bypass door fitted which can be operated at cover level. The Highway and Flood Authority may request a high level overflows or ancillary drain down device.

5.5.18 Flow control devices shall be constructed of grade 316S31 stainless steel and installed using Grade 316S31 stainless steel fixings all in accordance with BS970 Part 1, BS ENs 10084, 10085, 10087, 10088, 10095 and 10250-4.

5.5.19 The minimum aperture shall be 75mm and have a design flow of over 4l/s.

5.5.20 Precast or preformed flow control device chambers are preferred by the Highway and Flood Authority provided the access requirements in Table 5/2 can be met. Where the highway drain layout or access requirements do not permit this then insitu flow control device chambers shall be design in accordance with the following criteria:

5.5.21 The design of the flow control device chamber shall be to direct the incoming flow to the flow control device intake with minimal turbulent flow.

5.5.22 The flow control device chamber shall be approved by the flow control device supplier.

5.5.23 The flow control device chamber shall contain a sump to act as a catchpit.

5.5.24 The Developer shall submit a site specific design and specification sheet provided by the manufacturer of the flow control device for the development in question. The design shall clearly indicate the suitability of the flow control device for intended purpose. Generic designs and specifications are not permitted.

Orifice Plates

5.5.25 The use of orifice plates is subject to the prior approval of the Highway and Flood Authority. The minimum aperture shall be 75mm, Orifice plates will not be accepted as the final outlet from any drainage system.

Throttle Pipes

5.5.26 The use of throttle pipes is subject to the prior approval of the highway and Flood Authority. The minimum pipe size acceptable is 150mm. Throttle pipes will not be accepted as the final outlet from any drainage system.

Ancillary Devices (Penstocks, Flap valves etc.)

5.5.27 The Developer shall seek the approval of the Highway and Flood Authority before incorporating any ancillary devices within the highway drainage system. Ancillary devices will comply with the relevant European or British Standard or have third party accreditation.

5.5.28 Ancillary devices will not require any energy input, or have any mechanical parts, except where absolutely necessary, and they shall be virtually maintenance free.

5.5.29 Ancillary devices shall be installed in accordance with the manufactures instructions. All fixings shall be Grade 316S31 stainless steel fixings all in accordance with BS970 Part 1, BS ENs 10084, 10085, 10087, 10088, 10095 and 10250-4.

5.6 MANHOLES

5.6.1 Figures 5/1 to 5/4 show typical details of manholes with depths from cover level to soffit of pipe not exceeding 6m. No significant departure from these shall be made without approval by the Highway and Flood Authority. However, in special circumstances where there is a significant risk of high levels of detritus entering the drainage system catchpit manholes may be specified by the Highway and Flood Authority. Manholes should be designed and constructed in accordance with BS EN 752-3.

5.6.2 Manhole diameters (Type A and B only) should be in accordance with Table 5/2 below:

Table 5/2

Diameter of largest pipe in manhole (mm)	Internal diameter of manhole (mm)
Less than 375	1200 (1050 where depth to soffit is 1.35 m – 1.5m)
375 – 700	1500
750 – 900	1800
Greater than 900	Consult Highway and Flood Authority

5.6.3 The internal diameters quoted above are considered to be the minimum. Where two or more pipes enter the manhole, the internal diameter may have to be increased to accommodate the minimum width of benching. Pipes of different diameters entering manholes should be installed with soffits at the same level.

5.6.4 The height of a Type A manhole (benching to slab soffit) should normally be in excess of 2000mm. When this is impracticable, Type B manholes are preferred subject to an absolute minimum height (benching to slab soffit) of 900mm.

5.6.5 The dimensions of Types C and D manholes should be as shown on Figures 5/3 and 5/4.

Precast Concrete Manholes

5.6.6 Precast concrete manhole units of circular cross-section for manholes shall comply with the relevant provisions of BS EN 1917:2002 and BS 5911-3:2010 + A1:2014. Units which bed into bases shall be manufactured so that imposed vertical loads are transmitted directly via the full wall thickness of the unit. For joints between units and the underside of slabs, joint profiles shall be capable of withstanding applied loadings from such slabs, and spigot-ended sections shall only be used where the soffit of the slab is recessed to receive them.

5.6.7 Precast concrete sections for manholes shall be constructed with steps and slab, rungs aligned correctly.

5.6.8 The jointing material for precast units shall be mortar or a proprietary bitumen or resin mastic sealant, with the concrete surfaces prepared in accordance with the manufacturer's recommendations.

5.6.9 Joints shall be made so that the required jointing material fills the joint cavity. Any surplus jointing material which is extruded inside the manhole shall be trimmed off and joints shall be pointed on completion.

5.6.10 Concrete surrounds to manholes, chambers and the wet wells shall be C16/20 and the height of each concrete pour shall not exceed 2m. Each construction joint shall break joint with the precast sections by at least 150mm.

Step Rungs

5.6.11 Step rungs in accordance with BS EN 13101:2002 shall be provided in all manholes (except Type D) at 300mm intervals. They shall be of galvanised mild steel or plastic encapsulated type.

Ladders

5.6.12 Mild steel ladders for vertical fixing shall comply with the relevant provision of BS 4211, Class A and PD970. After fabrication, mild steel ladders shall be hot dip galvanised in accordance with BS EN ISO 1460.

5.6.13 Stainless steel ladders for vertical fixing shall be fabricated from Grade 316S31 steel complying with BS970: Part 1 and BS EN 10085, BS EN 10085, BS EN 10087, BS EN 10095, BS EN 10250, BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 or BS EN 10259.

Safety Chains

5.6.14 Safety chains shall be provided in manholes where the outgoing pipe exceeds 600mm diameter. Safety chains shall be installed in accordance with Figure 5/5.

5.6.15 Safety chains shall be mild or stainless steel. After manufacture, mild steel safety chains shall be hot dip galvanised in accordance with BS EN ISO 1460 and BS EN ISO 1461.

5.6.16 Mild steel safety chain shall be 8mm nominal size Grade M(4) non calibrated chain, Type 1, complying with BS EN 818-1.

5.6.17 Stainless steel safety chains shall be manufactured from Grade 316S31 steel complying with BS 970: Part 1. Chain links shall be welded and have an internal length not exceeding 45mm and an internal width of 12mm and 18mm. The fins caused by welding shall be removed and the weld shall be smoothly finished all round.

5.6.18 When tested in accordance with BS EN 818-1, each chain shall withstand a breaking force of 30kN and a proof force of 15kN.

High Strength Concrete Topping to Inverts and Benchings

5.6.19 Inverts and benchings in manholes shall have a screeded, ridged finish and shall have a smooth, high strength concrete topping applied to a ridged screed finish. This topping shall be brought to a dense and smooth finish with a steel trowel.

5.6.20 High strength concrete topping shall be produced, laid and finished in accordance with the relevant provisions of BS 8204-2 and the following approximate mix proportions by weight shall be used: one part cement, one part natural sand and two parts single sized coarse aggregate.

5.6.21 Aggregates for high strength concrete topping (granolithic finish) shall comply with BS EN 12620, D=10mm, graded in accordance with Table 2 of that Standard.

Access to inverts greater than 600mm diameter

5.6.22 Where the pipe diameter is greater than 600mm access into the channel shall be provided in accordance with Figure 5/5.

Rocker Pipes

5.6.23 A flexible joint shall be provided as close as is feasible to the outside face of any manhole into which a pipe is built. The design of the joints shall be compatible with any subsequent movement.

5.6.24 The recommended length of the next pipe (rocker pipe) away from the manhole should be as shown in Table 5/3 below:

Table 5/3

Nominal Diameter (mm)	Effective Length (m)
150 to 600	0.6
675 to 750	1.0
Over 750	1.25

Stub pipes into manholes shall be of rigid material.

Warning Signs

5.6.25 Warning signs shall be located in the upstream, downstream and actual manholes containing ancillary devices and structures i.e. flow control devices, storm water tanks etc.

5.6.26 The signs shall be designed in accordance with BS 5499-1:2002 utilising sign reference BS EN ISO 7010:2012 + A5:2015 with supplementary text specific to the hazard and agreed by the Highway and Flood Authority.

5.6.27 The signs shall be manufactured from materials that are not adversely affected by the environment and effluent typically found in surface water sewer systems. The signs shall be clearly legible for a minimum of 10 years.

5.6.28 The signs shall be mechanically fixed within the manhole where they can be clearly read without entering the chamber and in a position where they will not hinder access into the chamber. The fixing position shall be agreed with the Highway and Flood Authority. The fixings shall be Grade 316S31 stainless steel in accordance with BS970 Part 1, BS ENs 10084, 10085, 10087, 10088, 10095 and 10250-4.

FIGURE 5/1 - TYPICAL MANHOLE DETAIL - TYPE A
Depth from cover level to soffit of pipe 3m to 6m

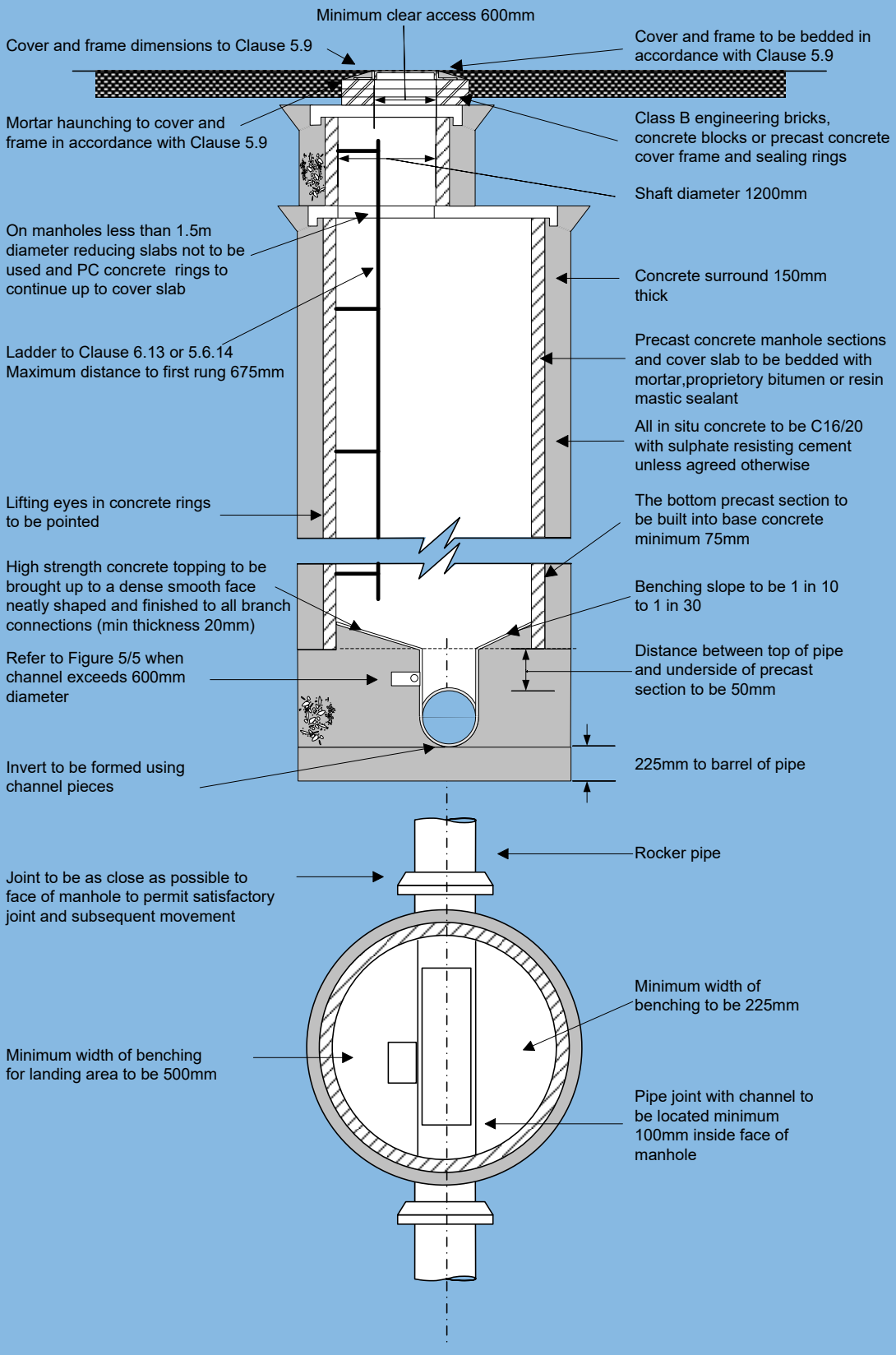


FIGURE 5/2 - TYPICAL MANHOLE DETAIL - TYPE B
Depth from cover level to soffit of pipe up to 3m

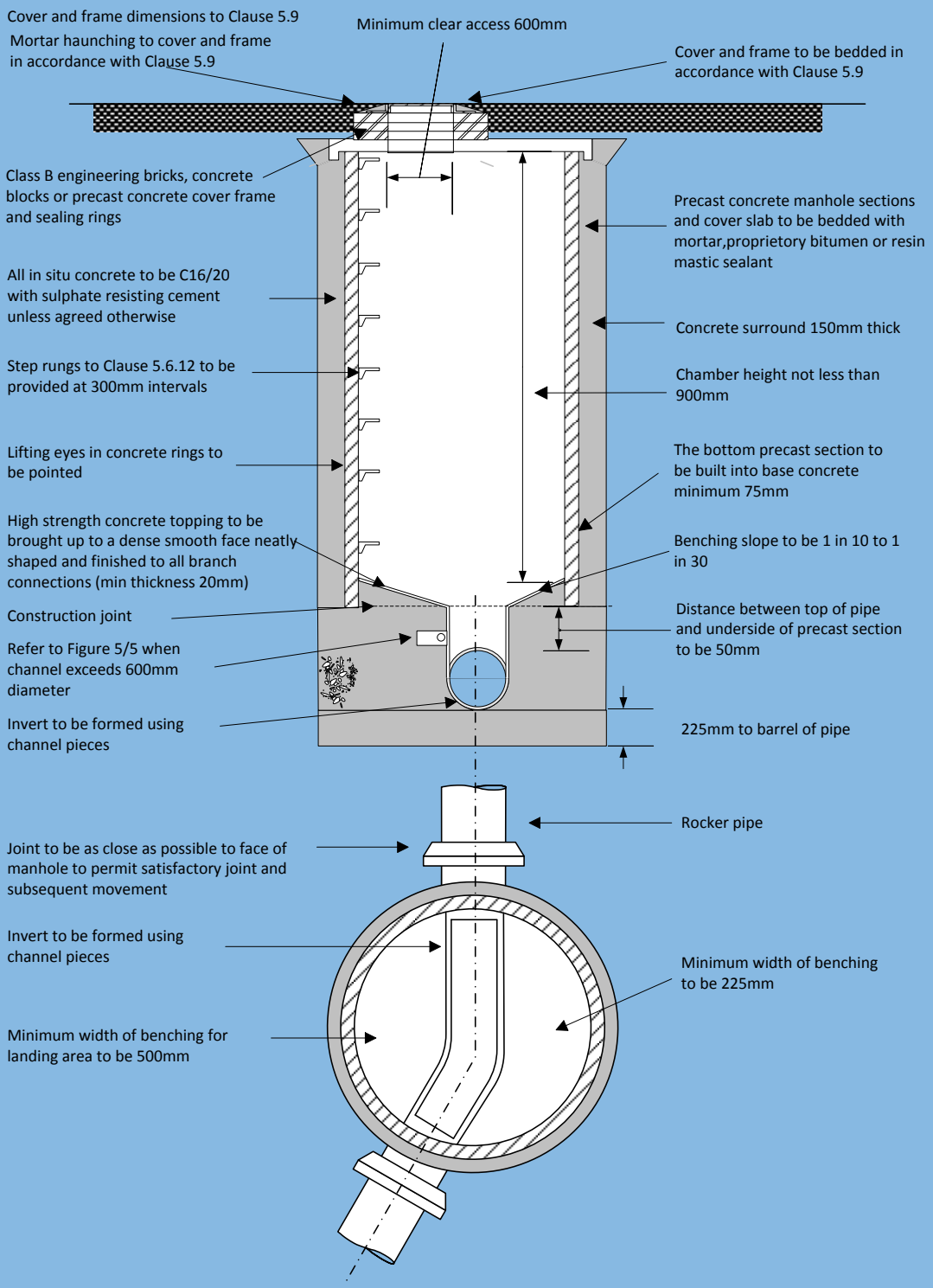


FIGURE 5/3 - TYPICAL MANHOLE DETAIL - TYPE C
Depth from cover level to soffit of pipe 1.0m to 1.5m

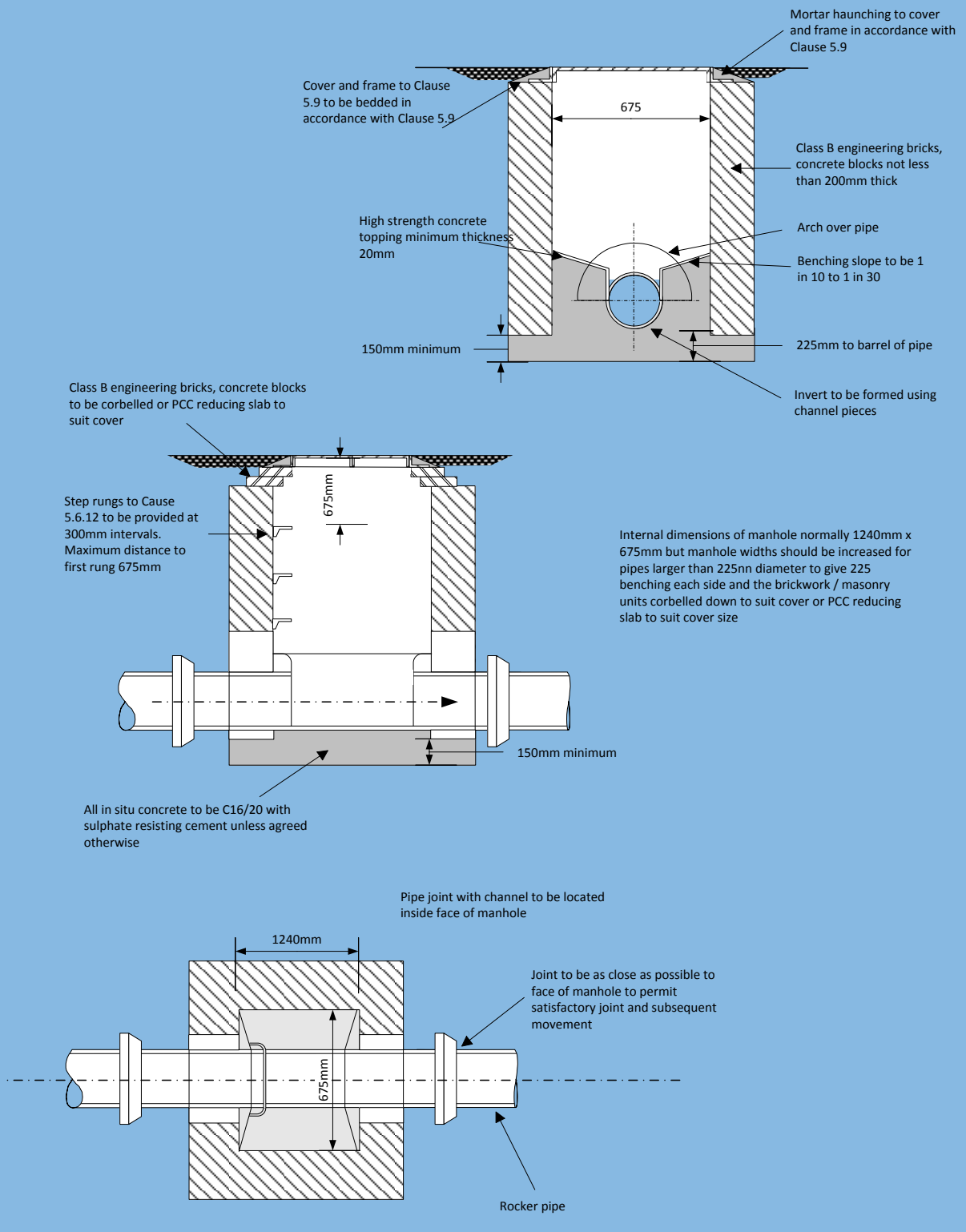
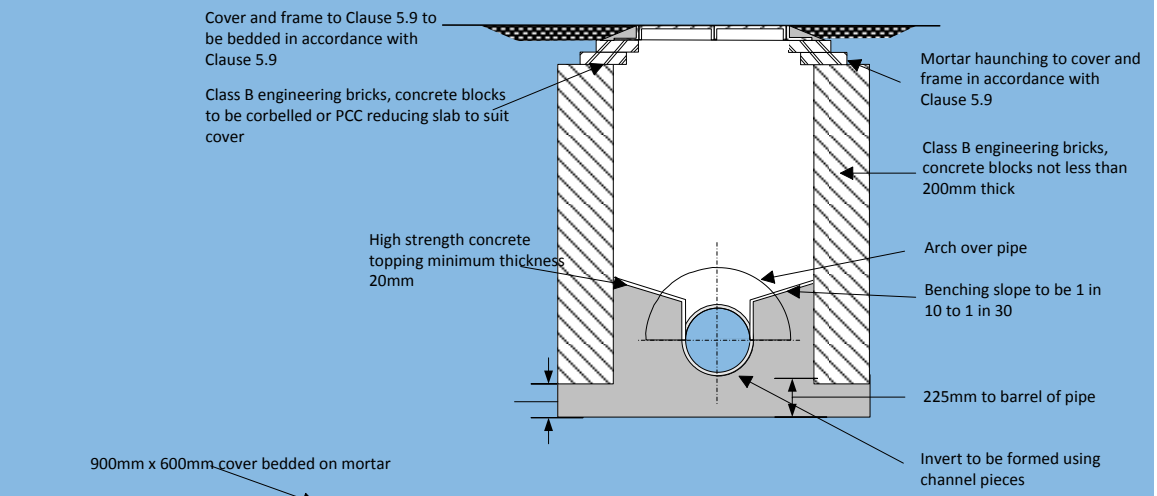
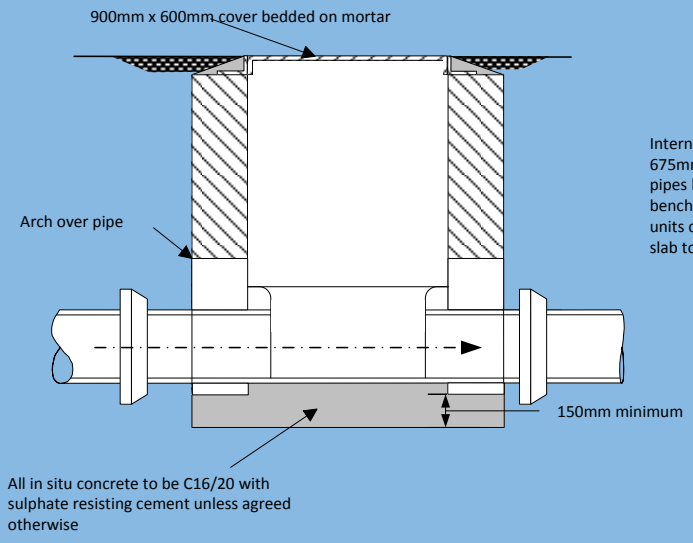


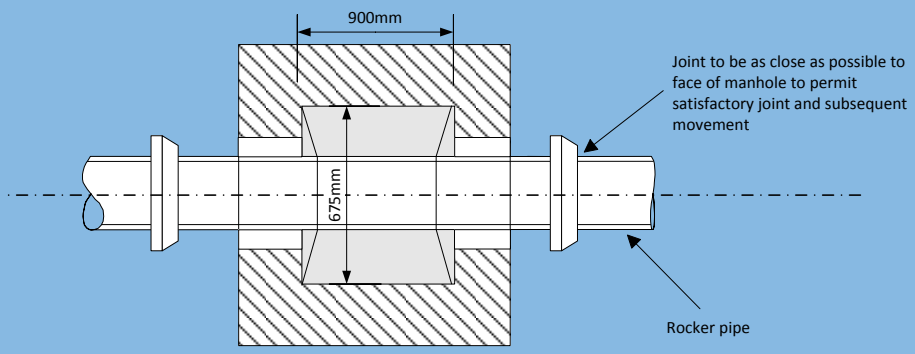
FIGURE 5/4 - TYPICAL MANHOLE DETAIL - TYPE D
Depth from cover level to soffit of pipe less than 1.0m





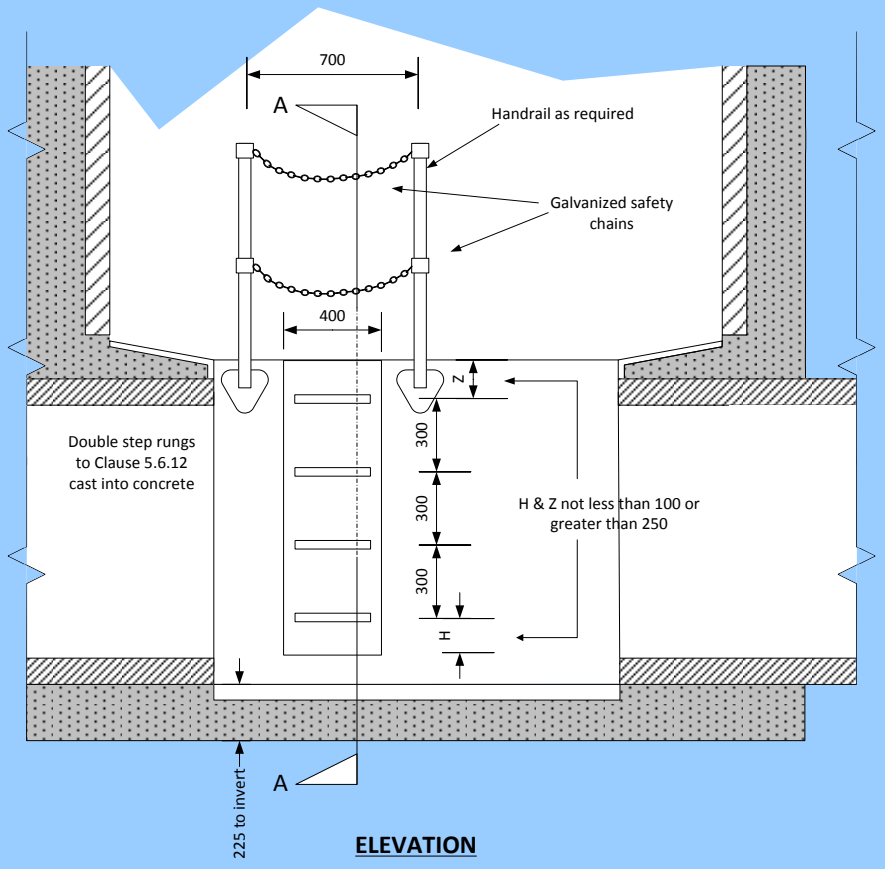
Internal dimensions of manhole normally 900mm x 675mm but manhole widths should be increased for pipes larger than 225nn diameter to give 225 benching each side and the brickwork / masonry units corbelled down to suit cover or PCC reducing slab to suit cover size

Pipe joint with channel to be located inside face of manhole

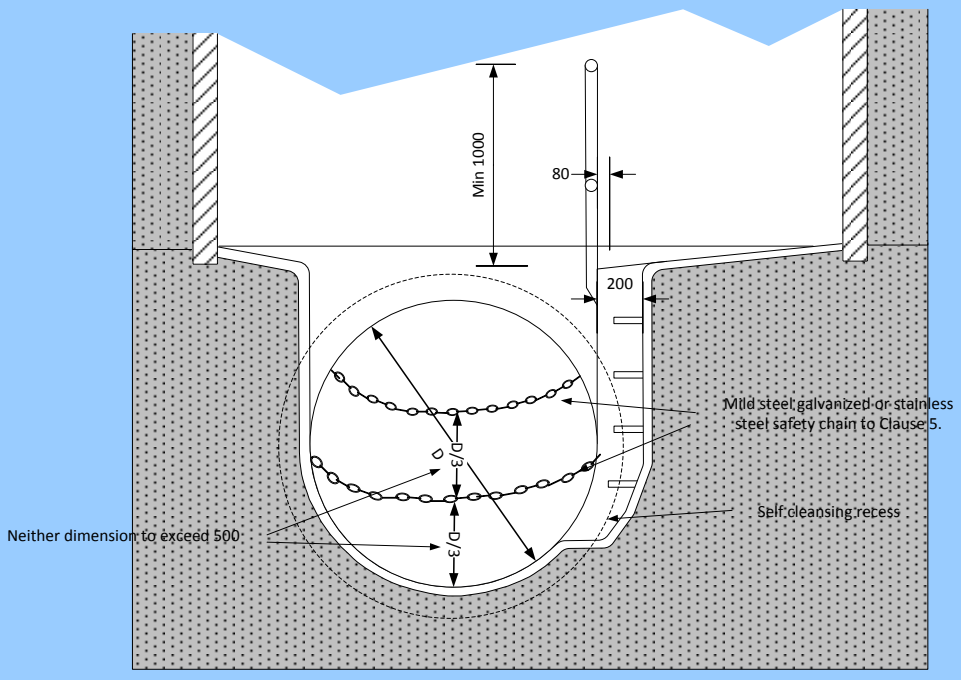


The use of precast rectangular concrete manhole units with 150mm C16/20 concrete surround is permitted. The concrete to be made with sulphate resisting cement unless otherwise agreed.

FIGURE 5/5 - ACCESS TO INVERT FOR PIPE DIAMETER EXCEEDING 600mm

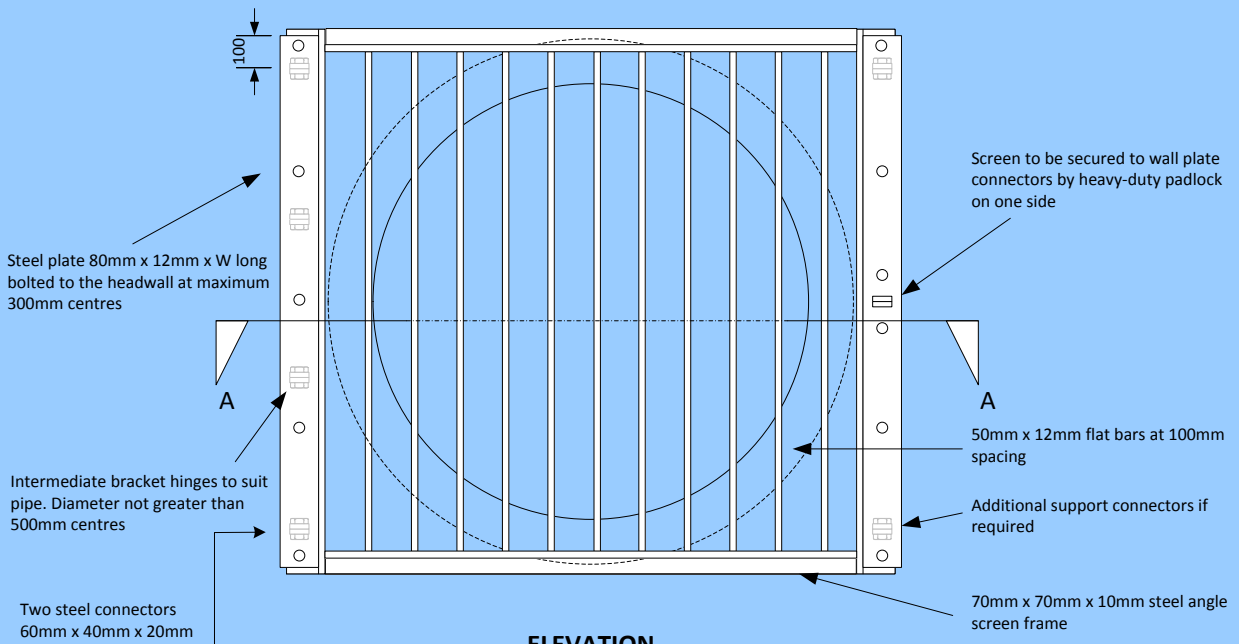


ELEVATION

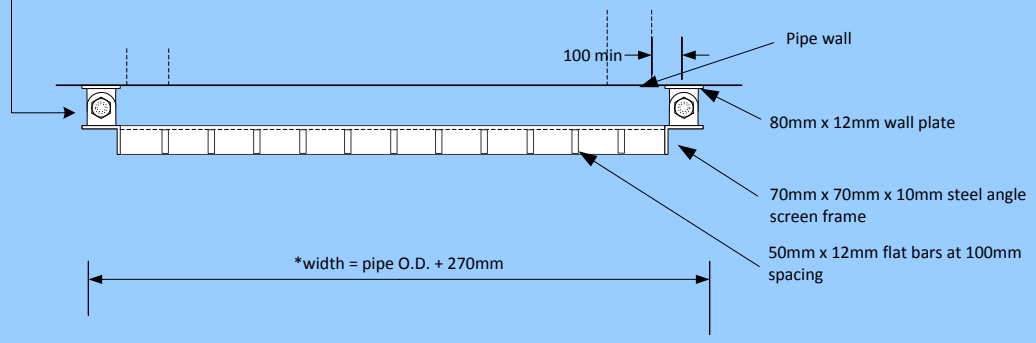


SECTION A-A

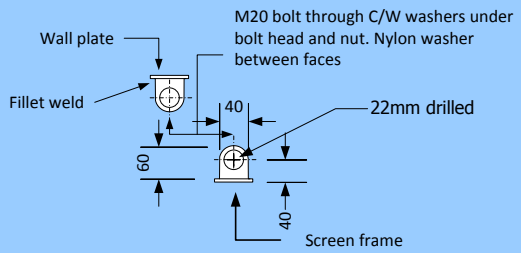
FIGURE 5/6 - TYPICAL OUTFALL SAFETY GRILLE
For Outfalls of 350mm Diameter Or Greater and No Flap Valve



ELEVATION



SECTION A-A



DETAIL OF CONNECTOR

NOTES :-
1 *width (W) to suit pipe outside diameter
2 Mild steel fabrication to be hot dip galvanized to BS EN 1461
3 Where flap valve is present advice should be sought from the Highway and Flood Authority

5.7 GULLIES AND CONNECTIONS

5.7.1 Spacing of gullies shall be determined on the basis of one gully per 180 square metres of impervious area to be drained, including footways, access crossings, lay-bys and verges.

5.7.2 Double gullies must always be provided at low points and each must have its individual connection to the main sewer.

5.7.3 All gullies shall be trapped.

5.7.4 Gully laterals shall not exceed 12m in length.

5.7.5 Gully laterals shall be protected in accordance with Clause 5.13.4.

5.7.6 Where footways and cycle ways are separated from carriageways, gullies connected to the highways drainage system must be provided where surface water could otherwise discharge onto adjacent property or cause flooding of footways or carriageways.

5.7.7 Where gullies are to installed at road junctions they should be sited upstream of the tangent point at road junctions so that surface water in the channel line does not flow across the junction. Care shall be taken to avoid ponding bear the midpoint of radius kerbs. Where the road super-elevates, a gully should be sited just before the point where the adverse camber is removed to prevent water in the upstream channel flowing across the carriageway.

5.7.8 Care should be taken to avoid ponding in the transition length, when the longitudinal gradient is flat or where there are traffic islands, central reserves or traffic-calming measures. Gullies shall not be sited within pedestrian crossing points. They should be located directly upstream of the crossing point..

5.7.9 Gullies should be sited carefully and not where traffic would be prevented from passing the maintenance gully tanker whilst they are being emptied, for example within a carriageway width restriction.

5.7.10 Gullies shall be precast concrete (see figure 5/7 – Typical Gully Details).

5.7.11 Precast concrete gullies shall be unreinforced and comply with the requirements of BS5911-2.

5.7.12 Salt glazed ware gullies shall comply with the requirements for round gullies as specified in BS65.

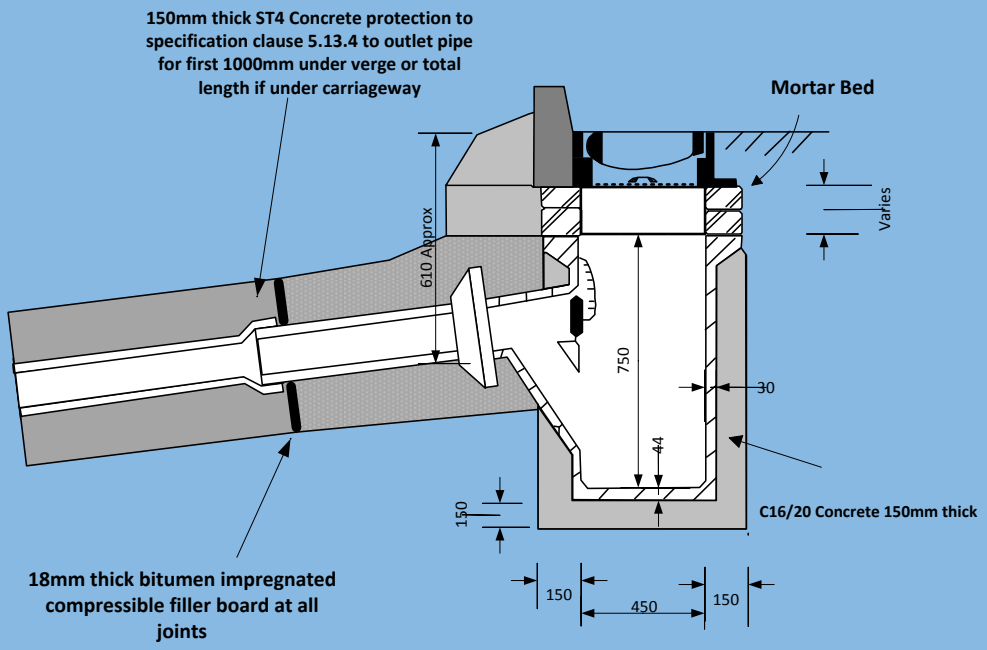
5.7.13 Gullies shall be at least 750mm deep by 450mm diameter with 150mm outlet, trapped and with stoppered rodding eye and chain.

5.7.14 Footway gullies shall be rectangular self-glazed ware or precast concrete to the approval of the Highway and Flood Authority. The gullies shall be 250mm square and 475mm deep, internal dimensions, and have a 150mm diameter outlet unless otherwise agreed with the Highway and Flood Authority.

5.7.15 Gullies shall be laid on and surrounded with 150mm thickness of C16/20 concrete to clause 12.1 made with sulphate resisting cement unless agreed otherwise.

5.7.16 Junction pipes for gullies which are laid but not immediately connected to gullies shall be fitted with temporary plastic stoppers or seals and the position of all such junctions shall be clearly defined by means of stakes or tracing wires, properly marked and labelled.

FIGURE 5.7 - TYPICAL GULLY DETAILS



TYPE G5
TRAPPED ROAD GULLY

NOT TO SCALE

NOTES:-

1) Cover and frame uncoated iron to Clause 5.11.1.

2) Mortar bed and benching to Clause 15.

3) Bricks to be Class B engineering bricks to BS EN 771-1 (single course where necessary to obtain satisfactory fall. Corbelled if required. Frames to be bricked on all four sides.

4) All in situ concrete to be ST4 with sulphate resisting cement unless agreed otherwise.

5) Position of outlet pipe varies in plan.

6) In situ ST4 concrete 150mm thick surround to outlet pipe for first one metre under verge or total length if under carriageway.

7) Where grating is to be trafficked or laid against within 24 hours of frame being placed in position, then a suitable Ultra rapid hardening mortar and concrete (Monoset 241 or similar) shall be used to bed cover and frame.

5.8 Not Used

5.9 FILTER MEMBRANE (GEOTEXTILE)

5.9.1 All membranes, textiles and liners should be designed, manufactured and installed in accordance with the relevant Standards, Codes of Practice and Manufactures Guidance. They should be selected in accordance with specific site conditions and be fit for purpose. All proposals need written technical approval from the Highway and Flood Authority prior to installation and use.

5.9.2 Geotextiles used in infiltration features shall be selected on the infiltration rate confirmed in the ground investigation stage. This shall also be compatible with the soil particle size on site.

5.9.3 All woven geotextiles shall have a minimum tensile strength of 30kN/m in each direction. Non-woven geotextiles shall have a minimum tensile strength of 15kN/m when tested in accordance with BS EN ISI 10319: 1996.

5.9.4 For woven geotextiles the pore size shall be 90% finer than 200/um.
Non-woven geotextiles shall have a pore size 90% finer than 100/um

5.9.5 All Geotextiles shall have a CBR puncture resistance of 3 kN.

5.10 BRICKWORK AND BLOCKWORK

5.10.1 Concrete bricks or blocks to be used in manholes, gullies and chambers shall be precast concrete masonry units manufactured in accordance with BS 6073 containing a minimum of 360 kg/m^3 of sulphate resisting cement, having a maximum water/cement ratio of 0.45, a minimum compressive strength of 50 N/mm^2, and a maximum water absorption of 7%.

5.10.2 Clay bricks to be used in manholes, gullies and chambers shall be Class B Engineering complying with the relevant provisions of BS EN 771-1 and particularly Table NA.6.

5.10.3 The shapes and dimensions of special bricks shall comply with the relevant provisions of BS 4729. All bricks shall be category F.

5.10.4 Brickwork and blockwork construction shall be in accordance with the relevant provisions of BS 5628-3.

5.10.5 Brickwork and blockwork shall be built in English bond. Bricks and blocks shall be set in mortar with all bed and vertical joints filled solid; exposed work shall be flush pointed as the work proceeds. The moisture content of the bricks and blocks shall be adjusted so that excessive suction is not exerted on the mortar.

5.10.6 Bricks and blocks in each course shall break joint correctly with the bricks/blocks underneath. The courses shall be laid parallel, with joints of uniform thickness, and shall be kept straight or regularly curved as required. Brickwork and blockwork shall be gauged to rise 300mm in four courses. Vertical joints shall be in alignment as required by the bond and shall have an average thickness of 10mm. Bricks and blocks forming reveals and internal and external angles shall be selected for squareness and built plumb.

5.10.7 Brickwork and blockwork shall rise uniformly; corners and other advanced work shall be racked back and not raised above the general level more than 1m. No brickwork or blockwork shall be carried up higher than 1.5m in one day. No bats or broken bricks or blocks shall be incorporated in the work unless essential for bond.

5.10.8 Oversail corbelling shall not exceed 30mm on each course.

5.10.9 Materials used in bricklaying and block-laying shall be frost-free, and no bricks or blocks shall be laid when the ambient temperature is below 3°C, unless special precautions are taken. Completed work shall be protected adequately during cold weather.

5.11 COVERS AND FRAMES

5.11.1 Manhole and gully covers and frames shall comply with the relevant provisions of BS EN 124 and shall be cast iron or ductile iron.

5.11.2 Manhole covers and frames shall be of a non-rocking design which does not rely on the use of cushion inserts. Covers and frames shall be ergonomically designed to ensure individual lift loads comply with manual handling legislation and the Management of Health and Safety at Work Act. Covers shall be hinged to the frame and when open they shall rest at an angle greater than 100^{o} and locked in position to prevent accidental closing. The sections of cover must be capable of being removed from the frame to facilitate better access. In specific situations the Highway and Flood Authority may request manhole covers and frames that can be safely lifted by one operative for the purposes of routine visual inspection of ancillary equipment in highway drainage systems.

5.11.3 Manhole frame depths will be in accordance with Table 5/4.

Table 5/4 Minimum manhole frame depths

Carriageway Description	Minimum frame depth (mm)
A roads and dual carriageways	150
Bus services routes (including future routes)	150
All other roads except residential cul-de-sacs	150
Residential cul-de-sacs	100

5.11.4 Class D 400 covers and frames shall be used in carriageway and shared surface areas and shall have a minimum polished skid resistance value (PSRV) of 50. In areas of high stress the Highway and Flood Authority may increase the loading classification of covers and frames and increase the minimum PSRV for covers.

5.11.5 The minimum clear opening of manhole covers shall be in accordance with Table 5/5

Table 5/5 Minimum Manhole Cover Sizes

Depth to soffit m cover level (m)	Diameter of largest pipe in manhole[a] (mm)	Minimum clear opening size[b,c] (mm)
< 1.5	150 225 to 900 > 900	900 x 600 1220 x 685 Seek advice
≥ 1.5	150 to 900 >900	600 x 600 Seek advice
> 3.0	Seek advice	Seek advice

Notes:

a) Assuming single pipe entry. Multiple pipe entries may require larger and/or multiple covers.
b) Manhole with ladders may need larger opening.
c) Where ancillary devices are situated in manholes, larger clear openings than stated or multiple covers may be required.

5.11.6 Gully covers shall be hinged, but not removable, and shall have a nominal clear opening width of 450mm and a minimum area of waterway of at least 900cm^2 for carriageways, and a clear opening of at least 300mm x 300mm for footways. The upper surface of gully gratings shall be flat and slots in gratings or between gratings and frames shall not be orientated parallel to the direction of traffic except where the slots are less than 150mm long or less than 20mm wide. Where gradients are steeper than 1 in 50, storm pattern grids shall be provided.

5.11.7 Manhole and gully frames shall be set to level, bedded and haunched externally over the base and sides of the frame on an approved bedding material and in accordance with the manufacturer's instructions. The frame shall be entirely seated on at least two courses of Class B engineering bricks, or on precast concrete masonry units or on precast concrete cover frame seating rings to regulate the distance between the top of the cover and the top rung to no greater than 675mm. A mortar fillet shall be provided where the corners to an opening in a slab are chamfered and the brickwork is not flush with the edges of the opening.

5.11.8 Frames shall be bedded on a non-shrink proprietary material which shall have a workable life of 15 minutes. The compressive strength of the bedding material shall exceed 30N/mm^2 and its tensile strength should exceed 5N/mm^2. The bedding material must be appropriate for the site and weather conditions at time of mixing. The depth of bedding material shall not exceed the manufacturer's recommendations. The bedding material shall be mixed and laid in accordance with the manufacturer's instructions. Packing materials are not permitted unless approved by the bedding material manufacturer and the Highway and Flood Authority.

5.11.9 Only materials complying with Clause 9 generally and in particular Clauses 9.1, 9.2, 9.3, 9.4 (footway only) and 9.5 shall be used to re-instate the surfacing around gullies and frames following their installation or adjustment. The materials shall be placed in layers such that the compacted quickness of the individual layer shall not be less than 2.5 times and not greater than 5 times the nominal size of the material. When material to Clause 9.6 is used as the surface course layer coated chippings to Clause 9.6 shall be incorporated within such surface course.

5.12 EXCAVATION FOR DRAINAGE WORKS INCLUDING CHANNELS, SWALES AND PONDS

5.12.1 The Developer shall carry out his operations in such a manner as to avoid damage to, or deterioration of, the formation of excavations.

5.12.2 Soft spots shall be removed from the bottom of trenches and other excavations, which shall then be refilled to formation level with the same material as the permanent work which is to rest on that formation. Any void which results from over-excavation below formation level shall be refilled in the same manner.

5.12.3 Trenches shall be excavated so that the effective width is maintained within any limit imposed by the design of the pipelines.

5.12.4 Trenches, manholes and all excavations shall be adequately supported at all times and, where directed or required, the supports shall be left in trenches or excavations.

5.12.5 The Developer shall not allow water to accumulate in any part of the works. Water arising from or draining into the works shall be drained or pumped to a consented disposal point. Any drainage sumps required shall, where practicable, be sited outside the area excavated for the permanent works, and shall be refilled with Type 1 sub-base material or ST1 concrete to the level of the underside of the adjacent permanent works.

5.12.6 The Developer shall take all necessary precautions to prevent any adjacent ground from being adversely affected by loss of fines through any dewatering process.

5.13 BACKFILLING OF TRENCHES FILTER DRAINS AND SWALES

5.13.1 Subject to the requirements of Clause 5.14.1, backfilling shall, wherever practicable, be undertaken immediately the specified operations preceding it have been completed. Backfilling shall not, however, be commenced until the works to be covered have achieved a strength sufficient to withstand all loading imposed thereon.

5.13.2 Backfilling around manholes and gullies shall be undertaken in such a manner as to avoid uneven loading or damage.

5.13.3 Excavations not situated beneath the carriageway or footway shall be refilled with approved and suitable excavation material as defined and classified by the Specification for Highway Works. All filling shall be deposited and compacted in layers, not exceeding 150mm loose depth, to a density not less than 95% of the maximum dry density for that particular filling, as determined by the light hammer test BS1377: Part 4: Tests 3.3 and 3.4. Trench support systems shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn trench support systems. The Highway and Flood Authority may require the use of sub-base to Clause 8.1 in place of excavated material where trenches are deep or narrow.

5.13.4 All trenches and other excavations beneath or within 1m of carriageways and footways, including drains in carriageways, footways and vehicle crossings, must be refilled with sub-base as specified in Clause 8.1. It is accepted that due to trench widths, the requirements to use rollers to compact the sub-base in trenches may be inappropriate. In these circumstances, alternative compaction equipment may be used to ensure that the compaction requirements are met.

5.13.5 Filter drains including those forming the base of swales shall be backfilled with Type B filter material which shall consist of natural or recycled coarse aggregate or recycled concrete aggregate complying with BS EN 13242 and the following:

(i) for Type B, geometrical requirements in accordance with Table 5/3 and BS EN 13242;

(ii) a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, clause 5.2 and Table 9;

(iii) a water-soluble sulfate content of less than 1.9 grams of sulfate (as SO_3) per litre when tested in accordance with BS EB 1711-1, clause 10;

(iv) volume stability of slags as in Table 5/6;

(v) all other requirements in Category NR;

(vi) be non-plastic when tested in accordance with BS 1377:Part 2.

5.13.6 Recycled aggregate used as filter material shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol, produced in conjunction with the Environment Agency *Aggregate From Inert Waste*.

5.13.7 The result of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highway and Flood Authority on request.

5.13.8 When recycled aggregate including recycled concrete aggregate is used in accordance with this Clause, it shall not have more than 1% by mass of foreign materials including wood, plastic and metal when tested in accordance with BS EN 933-11. The test shall be carried out by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accord with the test method.

5.13.9 The aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note - Managing Reclaimed Asphalt - Highways and Pavements

Table 5/6 Grading and geometrical requirements for filter drain and soakaway material

	Type B
Standard	BS EN 13242
Size, mm	20/40
Grading and oversize categories	G_C80-20
Oversize category	-
Category for tolerances at mid-size sieves	GT_{NR} (no requirement)
Category for maximum fines	f_{NR} (no requirement)
Volume stability of blast furnace slags	Free from dicalicum silicate and iron disintegration
Volume stability of steel (BOF and EAF) slags	V_5
Summary grading requirements	
Sieve size, mm	Percentage by mass passing
80	100
63	98-100
40	80-99
20	0-20

5.14 PIPELAYING

5.14.1 Where socketed pipes are required to be laid on a granular or sand bed, or directly on a trench bottom, joint holes shall be formed in the bedding material or formation to ensure that each pipe is uniformly supported throughout the length of its barrel and to enable the joint to be made.

5.14.2 Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

5.14.3 Where pipes are required to be bedded directly on the trench bottom, the formation shall be trimmed and levelled to provide even bedding of the pipeline and shall be free from all extraneous matter that may damage the pipe, pipe coating or sleeving.

5.14.4 Pipes and fittings shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying.

5.14.5 Suitable measures shall be taken to prevent soil or other material from entering pipes, and to anchor each pipe to prevent flotation or other movement before the works are complete.

5.14.6 Pipes shall be cut in accordance with the manufacturer's recommendations. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used.

5.14.7 Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care should be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.

5.14.8 Where concrete pipes are cut, any exposed reinforcement shall be sealed with an epoxy resin mortar.

5.14.9 The position of the internal face of any highway drain shall not deviate from the line and level described in the Agreement or agreed variation by more than ± 20mm, provided that no pipeline shall have a reverse gradient.

5.15 BEDDING, LAYING AND SURROUNDING OF PIPES

5.15.1 Immediately following the excavation of the trench, the pipes shall be laid and jointed on the pipe bed. Pipes shall be laid so that each one is in contact with the bed throughout the length of its barrel. Brick, concrete setting blocks or other hard material shall not be placed under the pipes for temporary support. In the case of socketed or sleeved jointed pipes, the bed shall be cut away and removed at each socket or sleeve so that the socket or sleeve does not bear on the bed.

5.15.2 Pipe bedding and haunching or surrounding material shall consist of natural and/or recycled aggregate including recycled concrete aggregate complying with BS EN 13242. Recycled aggregates used as pipe bedding and haunching or surrounding material shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol, produced in conjunction with the Environment Agency *Aggregate From Inert Waste*. The results of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highway and Flood Authority on request. Where recycled coarse aggregate or recycled concrete aggregate is used in this Clause it shall not have more than 1% by mass of foreign materials including wood, plastic and metal when tested in accordance with BS EN 933-11 by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method (see Clause 1.1.14) and comply with the requirements in Table 5/7 and 5/8. The aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note – Managing Reclaimed Asphalt – Highways and Pavements. Pipe bedding, haunching and surrounding material shall comply with the following:

Geometrical requirements in accordance with Table 5/7 or Table 5/8;

A resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, clause 5.2 and Table 9;

A water soluble sulfate content of less than 0.19% (as SO_3) when tested in accordance with BS EN 1744-1, clause 10; (d) Blast furnace slags shall be free from discalcium silicate and iron disintegration;

The volume stability of steel (BOF and EAF) slags shall be V_5;

All other requirements in Category NR.

Table 5/7: BS EN 13242, Coarse aggregate for pipe bedding, haunching and surrounding material

BS EN 13242, Coarse aggregate (clause 4.3.2)		
Category for general grading requirements	**G_c80-20**	
Category for tolerances at mid-size sieves	**GT_{NR} (no requirement)**	
Category for maximum values of fines content	**Gravel – $f_{1.5}$** **Crushed rock, recycled aggregate – f_4**	
Nominal pipe diameter, mm	**Aggregate size, mm**	
	Graded	**Single sized**
Not exceeding 140	**-**	**4/10**
Exceeding 140 but not exceeding 400	**2/14, or 4/20**	**4/10, 6/14 or 10/20**
Exceeding 400	**2/14, 4/40 or 4/40**	**4/10, 6/14, 10/20 or 20/40**

Table 5/8: BS EN 13242, Fine and all-in aggregate for pipe bedding, haunching and surrounding material

BS EN 13242, Fine and all-in aggregate (clause 4.3.3)		
	Fine	**All-in**
Category for general grading requirements	**Category G_F80**	**Category G_A80**
Category for tolerances on manufacturer's Declared typical grading	**GT_{FNR} (no requirement)**	**GT_{ANR} (no requirement)**
Category for maximum values of fines content	**Gravel – f_3 Crushed rock, recycled aggregate – f_{11}**	
Nominal pipe diameter, mm	**Aggregate size, mm**	
	Fine	**All-in**
Not exceeding 140	0/1, 0/2, 0/4 or 0/6	0/10
Exceeding 140 but not exceeding 400		0/10 or 0/20
Exceeding 400		0/10, 0/20 or 0/40

5.15.3 Following placement of the pipe and surrounding material the pipe shall be marked by a detectable warning mesh located immediately on top of the pipe surrounding material. The detectable warning mesh should be colour coded as recommended in Volume 1 NJUG Guidelines on the Positioning and Colour Coding of Underground Utilities.

5.15.4 150mm diameter pipes (typically gully laterals) to be surrounded with concrete shall be supported on precast concrete setting blocks, the top face of each block being covered with two layers of compressible packing.

5.15.5 Precast concrete setting blocks for pipes shall have rectangular faces, with sufficient plan area to prevent punching of the blinding concrete or formation and to provide an adequate seating for the pipes. Blocks shall be manufactured from ST4 concrete using the same type of cement as in the adjacent concrete bed, and be cast in an approved mould. Blocks shall not be used until they have achieved a cube strength of 13.5 N/mm^2.

5.15.6 Concrete provided as a protection to pipes shall be ST4 placed to the required depth of 150mm above and below the pipe for the full width of the trench in one operation. Where pipes with flexible joints are used, concrete protection shall be interrupted over its full cross-section at each pipe joint by a shaped compressible filler.

5.15.7 Compressible filler for interrupting concrete protection to pipes shall consist of bitumen impregnated insulating board to BS EN 120 and BS EN 317, or other equally compressible material. The thickness of compressible filter shall be as given in Table 4/9 below:

Table 5/9

Nominal diameter of pipe (mm)	Thickness of compressible filler (mm)
Less than 450	18
450 – 1200	36
Exceeding 1200	54

5.15.8 Compressible packing for use between pipes and precast concrete setting blocks shall consist of bitumen damp-proof sheeting complying with BS 743.

150mm diameter and above (main runs) Ductile iron pipes in accordance with Clauses 5.5.7/8/9/10.

or

A reinforced concrete slab that does not allow any loading to bear on the highway drain. The design shall be specific to the location and take into account construction as well as road vehicle loadings and the bearing capacity of the ground and trench width.

5.15.9 A further surround about the bed, haunch and surround described above shall be provided to a height of 380mm above the top of the pipe with trench fill material, except there shall not be any stones of lumps of clay >40mm nominal diameter.

5.16 INSPECTION TESTING AND CLEANSING

5.16.1 The Developer shall afford opportunity for the Highway and Flood Authority to examine any work which is about to be covered up or put out of view, and to examine foundations before permanent work is to be placed thereon.

5.16.2 The Developer shall give at least five clear working days' notice to the Highway and Flood Authority before any formation is covered with permanent work and before testing any pipeline. The Highway and Flood Authority will witness all tests to pipelines.

5.16.3 Pipelines shall be tested by the Developer after they are jointed and before any concreting or backfilling is commenced, other than such as may be necessary for structural stability whilst under test.

5.16.4 A further test shall be carried out after the backfilling is complete.

5.16.5 Pipelines up to and including 750mm nominal diameter shall be tested by means of an air or water test; and sewers greater than 750mm nominal diameter by a visual examination. Visual examination may include a CCTV survey and/or walk-through inspection in accordance with clauses 5.14.16 and 5.14.17 respectively and provide the Highway and Flood Authority with the results for consideration. Pre-cleansing of the pipeline in accordance with clause 5.14.14 may be necessary. CCTV surveys will be required for all perforated pipe lines.

5.16.6 Pipelines to be air tested shall have air pumped in by a suitable means until a pressure of 100mm head of water is indicated in a U-tube connected to the system. The pipeline shall be accepted if the air pressure remains above 75mm head of water after a period of five minutes without further pumping, following a period for stabilisation. Failure to pass the test shall not preclude acceptance of the pipeline if a successful water test can subsequently be carried out, as follows.

5.16.7 The test pressure shall not be less than 1.2m head of water above the pipe soffit or ground water level, whichever is the higher, at the highest point, and not greater than 6m head at the lowest point of the section. Steeply graded pipes shall be tested in stages in cases where the maximum head, as stated above, would be exceed if the whole section were tested in one length.

5.16.8 The pipeline shall be filled with water and a minimum period of two hours shall be allowed for absorption, after which, water shall be added from a measuring vessel at intervals of five

minutes and the quantity required to maintain the original water level noted. Unless otherwise specified, the length of sewer shall be accepted if the quantity of water added over a 30 minute period is less than 0.5 l per linear metre per metre of nominal diameter.

5.16.9 Notwithstanding the satisfactory completion of the above test, if there is any discernible leakage of water from any pipe or joint, the pipe shall be replaced and/or the joint remade, as appropriate, and the test repeated until leakage is stopped.

5.16.10 Should there be any concerns over the integrity of a pipeline at any stage of the Development, the Highway and Flood Authority may request the Developer to carry out a visual inspection in accordance with clauses 5.14.16 and 5.14.17 and provide the Highway and Flood Authority with the results for consideration. Pre-cleansing of the pipeline in accordance with clause 5.14.14 may be necessary.

5.16.11 Pipelines and manholes shall be inspected and tested for infiltration, after backfilling. All inlets to the system shall be effectively closed, and any residual flow shall be deemed to be infiltration.

5.16.12 The pipeline and manholes shall be accepted as satisfactory if the infiltration, including infiltration into manholes, in 30 minutes does not exceed 0.5 l per linear metre per metre of nominal bore.

5.16.13 Notwithstanding the satisfactory completion of the above inspection or test, if there is any discernible flow of water entering the sewers of manholes which can be seen either by visual or CCTV inspection, the Developer shall take such measures as are necessary to stop such infiltration.

5.16.14 On completion of construction, internal surfaces of pipelines, gullies, linear drainage systems and manholes shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into existing public sewers, highway drains, or water courses. The pipelines, gullies and manholes shall be maintained in a clean and serviceable condition by the Developer until they are adopted by the Highway and Flood Authority. Jetting pump pressures shall not exceed the pressures shown in Table 5/10 and jetting flow rates shall exceed the figures in Table 5/11

Table 5/10 Maximum jetting pump pressures

Material	Maximum pump pressure (bar/psi)
Clay	340/5000
Concrete	340/5000
Ductile iron	Seek Advice
Plastic – Structural Wall	127/1900
Plastic – Solid Wall	127/1900

Table 4/11 Minimum Jetting Flow Rates

Pipe Diameter (mm)	Minimum jetting flows (l/min)
<230	156
231 – 450	270
451 - 900	300
901 - 1600	342

5.16.15 Immediately prior to the commencement of the maintenance period the developer shall clean the highway drainage system and ancillary equipment to the satisfaction of the Highway and Flood Authority with respect to Clause 5.14.14.

5.16.16 Following cleansing of the highway drainage system, the developer shall undertake a CCTV survey of all pipes and culverts (including gully laterals) comprising the highway drainage system. The CCTV survey shall be reported in accordance with BS EN 13508 Part 1:2012 and BS EN 13508 Part 2:2003 + A1:2011. The CCTV surveyor shall hold a WTI Pipe Sewer Condition and Classification certificate or similar approved. Where a brick sewer has been connected into the CCTV operator shall also hold a WTI Brick Sewer Condition and Classification certificate or similar approved.

5.16.17 The CCTV survey shall be presented in DVD format together with a written report and dispatched to the Technical Manager Development or nominated representative for review or approval. Any defects found will be made good by the Developer prior to adoption.

5.16.18 Where the diameter of the pipeline exceeds the manufacturers operating limits of available sewer CCTV equipment the Developer shall organise a walk through inspection of the pipeline by specialist contractors. The appointed specialist contractor shall be competent, experienced and trained in undertaking such surveys in confined spaces and the surveyor recording the defects shall hold a WTI Pipe Sewer Condition and Classification certificate or similar approved and record and present the survey in accordance with BS EN 13508 Part 1:2012 and BS EN 13508 Part 2:2003 + A1:2011. Where the pipeline inspection includes brick pipelines the surveyor shall also hold a WTI Brick Sewer Condition and Classification certificate or similar or approved.

5.16.19 The survey photographs will be recorded onto DVD and presented with a written report to the Highway and Flood Authority for review / approval. Any defects found will be made good by the Developer prior to adoption.

ANNEX 1 – DESIGN GUIDANCE AND DESIGN SUBMISSION

As a guide, on receipt of a complete submission, a minimum of eight weeks should be allowed for technical audit and acceptance of S.278 works highway design submissions. However, this is dependent on the scope and complexity of the works, the quality of the submission and timely provision of responses to issues raised.

Detailed Design – Guidance

The design is to be in accordance with the Highway Authority's Design Standards and Departures for Highway Schemes – Improvements Maintenance and Developments which is available on its website. LCC standard details drawings (available on the LCC website) are to be used in all cases, except where the agreed design standard permits the use of other details.

The level of detail required for consideration of technical acceptance will depend on the scope, complexity, value and location of the proposed works. To avoid potential abortive work and delaying technical acceptance, the design submission should include all relevant information from the list below, together with other supporting drawings, documents and calculations.

The standards current at the time designs are prepared are to be used. Designs submitted for acceptance more than six months after design completion may be rejected if the Highway Authority considers that the standards are no longer applicable.

Requirements for the design and construction of highway structures (i.e. over 600mm clear span or retained height) are provided in the LCC document *Small Highway Structures Design Guide.* There is a requirement to obtain the appropriate Technical Approval for the structure in advance of construction. This is dependent upon the type of structure, and may include the need for Approval In Principle, a Design Certificate and a Check Certificate.

General Details to be submitted:

- Brief description of the development and intended S.278A works.
- Schedule of all drawings and documents submitted in the package.
- S278 Limits Drawings (maximum size A3) for binding into the Agreement:
    - Site location clearly showing the site in relation to its surroundings, at a suitable scale (1:1250/1:2500), with a six figure Ordnance Survey grid reference.
    - General layout of the S278 works showing existing highway boundaries and the limits of the permanent S278 works (inclusive of suitable working space and reasonable traffic safety and management measures, but excluding temporary diversion routes outside the limits of the permanent S.278 works). To a suitable scale (1:500/1:200) with the limits bounded in a thick red line and any land to be transferred for highway purposes coloured blue and also bounded with a thick red line.
- Land Interest/Transfer Drawing – at a suitable scale (1:1250/1:500/1:200), showing land to be transferred coloured pink and bounded with a thick red line and showing a six figure Ordnance Survey grid reference. It is also to show the quantity of the land to be transferred in square metres and current owner details. Maximum size A3 for binding into the Agreement.
- A 3D topographical survey of the S.278A site, containing existing level information.
- Constraints on the design and how dealt with (e.g. Traffic Regulation Orders, Tree Preservation Orders, Services / Statutory Undertakers, Environmental Assessment and Surveys etc).
- Documented solutions to issues identified through any Transport Assessment and Travel Plan, e.g. public transport infrastructure, traffic calming, pedestrian requirements.

- Intended method of dealing with existing Rights of Way.
- Details of special materials, e.g. required in conservation areas, street furniture.
- Existing traffic flows and speeds (Annual Average Daily Traffic Flows and 85th percentile speed).
- Design speed for each highway link.
- Designers risk assessments and CDM pre-construction information.
- Where projects are notifiable under CDM, a copy of the issued F10 form.
- Works construction cost estimate based on detailed Bill of Quantities or Activity Schedule.
- Actual or estimated cost of diversion or protection of services / statutory undertakers' equipment.
- Stage 2 Safety audit report, design team response and exception report.
- Programme for the development, including milestones in relation to the S278 Works Construction programme (such as road space booking, latest dates for diversion of services, S.58 etc).
- S278 Works Construction programme, which must include the main stages of construction, traffic management changes and compliance with road space booking restrictions.

Design Details to be submitted:
Full list of design and construction standards used.
Completed forms for any relaxations or departures from standards.
Appropriately scaled drawings and supplementary details showing:

- General Arrangement (incorporating site location plan), showing extent of site, temporary accesses, details at tie-ins to existing highway etc.
- Site clearance details, including a key of items to be removed and any necessary schedules etc.
- Fencing, noise and environmental barriers (plan, construction and foundation details).
- Drainage details:
    - Layout, showing existing and proposed: pipe runs (with sizes, gradients, diameters, depths, cover, backfill), manhole and gully, sizes, inverts positions and details, outfall.
    - Layout and all details of Sustainable Drainage Systems (SuDs).
    - Drainage/hydraulic design calculation, calculations/data for gully spacings, discharge calculation at outfalls etc.
    - Full drainage schedule with unique numbering, all relevant details and adopting body.
    - Details of any attenuation, retention storage with supporting calculations and information on any mechanical items, e.g. hydrobrakes or pumps.
    - Details of any petrol interceptors.
    - Contour plans showing existing and proposed.
    - Proof of consent to discharge
    - S.104 Agreement
    - CCTV videos of any existing drainage used as connection/outfall.
- Earthworks details, with embankment/cutting construction and materials, verge treatments etc.
- Carriageway and footway construction indicating areas and details of different constructions, areas of planning / inlay / overlay / reconstruction, detail and adequacy at interface with existing highway construction, trench reinstatements etc. NB Evidence of adequacy of construction (e.g. cores of existing construction / pavement calculations / reference to traffic volume and type) must be submitted.
- Kerbing, edging and channel details; including areas of over-break and reinstatement of surrounding carriageway and footway construction.
- Traffic signs and road markings; including schedules of new traffic signs and road markings
- Landscaping; planting strategy (areas, species, density, specifications), preparation works and soil types, details and cost of maintenance regime (horticultural management plans etc)
- Road lighting and illuminated signs (including street lighting designs calculations)

- Electrical works; ducts, service chambers, underground cables (including calculations and details of protective devices), position of feeder pillars and schematic cable diagrams etc.
- Structures details:
    - Drawings showing positions, orientation and all construction details.
    - Independent of the formal Technical Approval all calculation, drawings, details and specifications relevant to the structure.
    - Proposals for key stage inspection by the Highway Authority.
- Services / statutory undertakers (showing any existing and proposed alteration/protection measures/diversions etc).
- Vertical Sections with suitable exaggerated vertical scales, showing boundaries of sections and contours with flow arrows.
    - Cross sections indicating existing and proposed levels and profile.
    - Longitudinal sections showing proposed centreline and channels in relation to existing level, with proposed gradients, k values for sag and crest curves and a horizontal schematic indicating curve radii, transitions, gradient etc.
- Swept turning paths for appropriate vehicles around proposed junctions and highway scheme.
- Accommodation works; details of alterations to fencing, accesses, driveways etc (Details of consultations and agreements with landowners also to be submitted).
- Easement and way-leave layouts required for future maintenance purposes (e.g. for drainage outside the highway limits).
- Temporary traffic management measures, road closures and diversion routes (suitable for local, freight and public service vehicles) with temporary signing layouts.
- Junction Details for each junction:
    - 1:500/1:200 scale layout plan/drawings, using a topographical survey of the site, showing proposed spot levels, channels, crown lines and contours.
    - Identification and segregation details of suitable routes through/across the junction for pedestrians and cyclists.
    - Turning flow data for existing, generated and forecast for AM and PM peak periods.
    - For Priority Junctions:
        - Design checklist showing geometric compliance with the design standard agreed with the Highway Authority (e.g. DMRB (Vol.6) 'TD 42 – Geometric Design of Major/Minor Priority Junctions' and 'TD 41 – Geometric Design of Vehicular access to All-Purpose Trunk Roads').
        - Traffic reserve capacity calculations for the AM and PM peak periods using the latest version of PICADY.
        - Justification of the chosen specific layout.
    - For Roundabouts:
        - Design checklist showing geometric compliance with design standard agreed with Highway Authority (e.g. DMRB (Vol.6) TD 16 – Geometric Design of Roundabouts).
        - Traffic reserve capacity calculations for the AM and PM peak periods using the latest version of ARCADY.
        - Drawings showing deflection and visibility.
    - For Traffic Signal Junctions:
        - Layout plan/drawings to include details and locations of signal heads, poles, feeder pillars, control boxes, ducting layouts etc.
        - Design checklist showing geometric compliance with design standard agreed with the Highway Authority (e.g. DMRB (Vol.6) 'TD 50 – The Geometric Layout of Signal Controlled Junctions and Signalised Roundabouts')
        - Traffic reserve capacity calculations for the AM and PM peak periods using the latest version of LINSIG or TRANSYT (where appropriate).

- Pedestrian Crossing details for each facility:
    - 1:500/1:200 scale layout plan/drawings, using a topographical survey of the site, showing signal heads, pole position, feeder pillar, control box, ducting layouts etc.
    - Design checklist to ensure compliance with design standard agreed with Highway Authority or the following standards/guidance:
        - Traffic Advisory Leaflet (TAL) – 01/02 The Installation of Puffin Crossings.
        - TAL – 04/98 Toucan Crossing Development.
        - TAL – 10/93 "Toucan" An unsegregated Crossing for Pedestrians and Cyclists.
        - Statutory Instruments No.2400 – Road Traffic – The Zebra, Pelican and Puffin Pedestrian Crossing Regulations & General Directions 1997.
        - Local Transport Note 2/95 – The Design of Pedestrian Crossings.
        - Design Manual for Roads and Bridges (DMRB) Vol.8 – TA 05/05.
        - DMRB Vol.6 – TA 86 Layout at Large Signal Controlled Crossings.
        - DMRB Vol.8 – TD 35 MOVA Traffic Control.
        - DMRB Vol.8 – TA 12 Signals on High Speed Roads.
        - DMRB Vol.8 – TA 16 General Principles of Control by Signals.
        - DMRB Vol.8 – TA 68 Assessment & Design of Pedestrian Crossings.

6. EARTHWORKS

6.1 FORMATION LEVEL

6.1.1 Formation level is the finished level of the existing soil after completion of the earthworks, i.e. the underside of the sub-base. Any excess depth excavated shall be backfilled with sub-base material in accordance with Clause 8.1.

6.1.2 Within 24 hours of the final preparation of the formation level it shall be covered with a minimum thickness of 150mm of compacted sub-base in accordance with Clause 8.1. Construction traffic shall not run on the prepared formation.

To prevent problems of weed growth, a suitable weed killer should be applied to the formation of the footway.

6.2 TOPSOIL

Turf and all topsoil shall be removed from the area of the roadworks and stockpiled for re-use. Topsoil shall mean the top layer of soil which can support vegetation. The depth of topsoil should be established in the ground investigation and will be the subject of confirmation during formation key stage checks. Imported topsoil shall be Class A multipurpose as defined by BS 3882:2015 Cl 4.1 and Table 1.

6.3 SOILING, GRASSING AND TURFING

6.3.1 Soiling and compacting of the side slopes of cuttings, embankments and verges shall be carried out to an even surface with a minimum compacted thickness of 100mm of topsoil. (The use of the word 'compacting' is as a preparation for seeding or turfing and should be carried out by treading the area several times in different directions and then rake several times also in different directions. Vibrating compactors should never be used for this operation.)

6.3.2 All surfaces to be grassed shall, immediately before sowing, be reduced to a fine tilth and all stones over 20mm diameter and all harmful material shall be removed. Fertilizer from an approved manufacturer, in the following parts - 10 Nitrogen: 15 Potassium: 10 Phosphorous shall be spread in two directions at a total rate of 50gm/m². Grass seed from an approved manufacturer, shall be spread in two directions at a total rate of not less than 1kg to 50m² and shall consist of the following parts:-

For Non SuDS applications:

25% Barkoel Crested Hairgrass
20% Hardtop Hard Fescue
35% Barpearl Slender Creeping Red Fescue
20% Bargreen Chewings Fescue

70% Wildflowers

Bird's Foot Trefoil, Common Knapweed, Common Sorrel, Creeping Bent, Creeping Buttercup, Crested Dogstail, Lady's Bedstraw, Meadow buttercup, Meadow Foxtail, Meadowsweet, Plantain, Ragged Robin, Salad burnet, Selfheal, Slender Creeping Red Fescue, Smoothstalked Meadowgrass, Sweet Vernal Grass, Wild Carrot, Wild Red Clover, Yarrow.

30% Grasses

Creeping Bent, Meadow Foxtail, Sweet Vernal Grass, Crested Dogstail, Slender Creeping Red Fescue, Smoothstalked Meadowgrass.

6.3.3 For SuDS applications the grass mixture will vary depending on the type, use and location of the SuDS solution being seeded, therefore the specific seed mix should be agreed with the Highways and Flood Authority on a site by site basis.

6.3.4 Turfing shall be carried out on topsoil using turfs to BS 3969:1998+A1:2013 Recommendations for turf for general purposes, to give a total minimum thickness of 100mm of topsoil. Turfs shall be clean, strong, well bonded and lightly beaten. They shall be laid diagonally across side slopes. All turves shall be used within 3 days of cutting during the period 1 April to 31 August or within one week of cutting during the remainder of the year; turves not used within these periods shall be regarded as topsoil.

6.3.5 Grassed areas shall be maintained up to and during the 12 month maintenance period in order to control weed growth and to prevent the grass from exceeding 50mm in height at adoption for SuDS.

6.4 EMBANKMENTS AND CUTTINGS

6.4.1 Where the nature of the works are such that embankments or cuttings are necessary then the excavation, classification and placement of materials shall be in accordance with the requirements of Highways England's current Specification for Highway Works. The site investigation shall address such matters as slope stability, settlement and, where necessary, heave. The ground investigation and associated testing will need to be undertaken, to determine if the materials are acceptable and if so, to classify them as either Class1 or Class 2 general fill materials.

6.4.2 The proposal to use a particular Class 1 or Class 2 material shall include:-

- The proposed material source.
- Proposed material classification against the requirements of Clause 601, Table 6/1. Where acceptable limits are not quoted in the Table, these will have to be determined for the particular source of material and its end use.
- Proposed means of monitoring the material's suitability as it is delivered to site, included sampling and testing frequency.
- Proposed method of compaction and type of plant to be used.
- Proposed means of monitoring its placement and in particular its end product compaction.
- Proposed method of assessing the design CBR at sub-formation level, that is on the placed and compacted fill material, to permit adjustment to the final sub-base design thickness. This design CBR is likely to be different to that determined on the existing sub- grade.

Developers will require the professional services of an experienced Geotechnical Engineer to prepare their documentation. All laboratory testing must be undertaken by an UKAS accredited laboratory.

The cost of all the additional work associated with preparing and undertaking their proposal will be at their expense.

6.5 DISPERSAL OF STANDING WATER

The Developer must ensure the rapid dispersal of water shed onto or entering the site from any source at all times during construction, particularly water which is shed onto the completed sub-grade, swales or other SuDS components under construction. The Developer shall provide within the works where necessary, temporary watercourses, ditches, drains, pumping or other means of maintaining the site clear from standing water.

6.6 EXCAVATIONS WITHIN PROPOSED HIGHWAY LIMITS

Before construction of the carriageway, footways, or verge is begun, excavations, placement and backfilling for all drains, sewers, cables, ducts or other special formation work shall be completed. This includes the appropriate treatment of any land drains encountered as per Clause 6.7.3.

6.7 GROUND IMPROVEMENT

6.7.1 Geosynthetics (Geotextile/Geogrid/Geocomposite)

6.7.1.1 Geotextiles, when used as a separation layer between sub-base and sub-grade, shall be handled and laid as described in this clause and shall comply with the following:-

(i) They shall be capable of sustaining a minimum tensile load of 15kN/m. This figure shall be ascertained by the Wide Width Strip Test in accordance with BS EN ISO 10319.

(ii) The geotextile shall have a permeability to water flow at right angles to its plane of not less than 10 litres per m² per second under a constant head of water of 100mm. The result will have been determined in accordance with BS EN ISO 11058.

(iii) The pore 0_{90} size shall be between 60 microns and 300 microns. The result will have been determined in accordance with BS EN ISO 12956. The 0_{90} value refers to the pore size below which lies 90% of the pore sizes in the geotextile.

(iv) The properties of geotextiles shall be determined at an approved laboratory using agreed test procedures before use in the works. The particular geotextiles to be used in the works shall also be agreed by the Highway and Flood Authority in advance of construction commencing.

(v) Geotextiles shall be stored so that they will not be damaged by sunlight or ultraviolet light, temporary exposure shall not exceed 5 hours and they shall also be kept free of contamination and not suffer mechanical damage. Where made ground or fill is known to be present within the site, evidence will be required to demonstrate that the geosynthetic will be chemically and biologically resistant to these soils and/or its leachates. An Immersion Test, specific to the site conditions, may be required. Also, confirmation that the geosynthetic will not release toxic materials will also be required, under both natural conditions or chemical degradation.

(vi) Geotextiles shall be laid with a minimum 500mm overlap between sheets. The sub- grade must be smooth prior to the rolling out of the geotextile and no trafficking on the geotextile prior to placement of the sub-base or granular layers will be permitted. Furthermore, the only traffic permitted on the sub-base thereafter is that necessary for the construction of the remaining roadworks up to the level approved for trafficking in this specification.

(vii) When soils are very weak, it will be necessary to additionally incorporate a geogrid see below. Alternatively, an acceptable geocomposite may be installed.

(viii) The proposed geosynthetics must comply with the CE marking requirements and the Quality Control Certificate(s) will be required for the delivered geosynthetic.

6.7.1.2 Geogrids, used for reinforcement of unbound aggregate in very weak ground when installed between the sub-base or capping layer and the sub-grade shall be handled and laid as described in this clause and shall comply with the following:-

(i) The Quality Control Strength of the geogrid, when tested in accordance with ISO 10319 and expressed as the lower 95% confidence limit in accordance with ISO 2602 – 1980 (BS 2846, Part 2, 1981), shall be 40kN/m with a peak strain of around 11% in both the longitudinal and transverse directions.

(ii) In addition, typically the loads at 2% and 5% strain shall be 14kN/m and 28kN/m respectively in both the longitudinal and transverse directions.

(iii) The ribs of the geogrid shall be of rectangular cross section in both the longitudinal and transverse directions with a nominal edge thickness of 1.35mm.

The geogrid nominal aperture size shall be 30mm x 30mm. However, triangular aperture geogrids are available and these must be agreed with the Highway and Flood Authority

before installation.

(iv) The geogrid shall be manufactured from polypropylene sheet, oriented in two directions so that the resulting ribs shall have a high degree of molecular orientation which continues through the area of the integral node.

(v) The geogrid shall be inert to all chemicals naturally found in soils and shall have no solvents at ambient temperature. It shall not be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis and shall be non- biodegradable.

(vi) The geogrid shall have a minimum of 2% finely divided carbon black, as determined by BS 2782 Part 4, Method 452B: 1999, well dispersed in the polymer matrix to inhibit attack by ultra violet light.

(vii) The typical strength of the nodes between the longitudinal and transverse ribs, as determined by the Geosynthetics Research Institute, Drexel University, USA, Test Method GG2-87, shall be at least 90% of the Quality Control Strength in both longitudinal and transverse directions.

(viii) The geogrid shall be manufactured in accordance with the Quality Assurance requirements BS EN ISO 9001. If required by the Engineer, the Contractor shall provide evidence that the manufacturer's Quality Assurance System has been certified to conform to BS EN ISO 9001 by an external authenticating authority approved by the Department of Trade and Industry.

6.7.1.3 Lincs Laboratory can offer advice on geosynthetic types and sources, the following information will need to be supplied:-

Manufacturer's name; commercial name of geotextile;
Method of manufacture and constituent materials; mass per unit area;
Nominal thickness;
Dimensions and weight of geotextile roll;
Strength, pore size and permeability - as itemised in sub-paragraphs (i),(ii) and (iii) of this Clause.

6.7.1.4 An approved geosynthetic product may also be used to reinforce a thinner than normal pavement foundation as part of a bespoke design agreed with the Highway and Flood Authority. Any proposal to reduce the sub-base thickness must be supported by a specialist report taking into consideration the site investigation findings, the properties of the proposed product, and the following design parameters for the sub-base:-

Traffic loading = 1000 standard axles (1 standard axle = 80kN)
Maximum permitted rut depth = 40mm

6.7.1.5 Geocomposites for installation shall have the combined properties of both a geotextile and a geogrid as described above. Fibreglass strengthened geocomposites will be considered if the strength criteria detailed in 6.7.1.2 are met.

6.7.2 <u>Stabilisation</u>

Where the ground is very weak e.g. the CBR value is less than 1½% stabilisation techniques can be used. For example the addition of lime or lime and cement can be used to increase the strength of cohesive soils and cement can be used to increase the strength of granular soils. Where required, further advice on stabilisation can be obtained by contacting Lincs Laboratory

(01522 530355).

6.7.3 Existing Land Drains

Existing land drains that are encountered by the works shall be diverted or if rendered redundant by the works shall be stopped up. Disused ends of intercepted land drains shall be adequately sealed with ST3 (C12/15) concrete.

6.8 GRANULAR FILL BELOW FORMATION

Recycled aggregates used in granular fill shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol, produced in conjunction with the Environment Agency *Aggregate From Inert Waste*. The results of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highway and Flood Authority on request.

When recycled aggregate including concrete aggregate is used in accordance with this Clause, it shall not have more than 1% by mass of foreign materials including wood, plastic and metal nor a floating material in volume content exceeding 10cm³/kg when test in accordance with BS EN 933-11 by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method. Additionally, the aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note – Managing Reclaimed Asphalt – Highways and Pavements.

6.8.1 Carriageways

6.8.1.1 For all carriageways the material shall be made and constructed using unbound mixtures, complying with BS EN 13285, the requirement categories in Table 6/1 and the following classes.

6.8.1.2 The material shall be $6F_5$ Capping and shall be from a source approved by the Highway and Flood Authority and should comprise crushed rock, crushed concrete, crushed slag or combinations thereof. Secondary materials other than those listed above will be considered on an individual basis.

Table 6/1: Mixture and Grading Requirement Categories for Capping

Unbound Mixture	**$6F_5$**
Clause	6.8
Standard	BS EN 13285 Categories for unbound mixture properties
Mixture requirement category	0/80 UF_{12} OC_{75}
Designation **Maximum fines** **Oversize**	
Grading requirement category	G_E
- Overall grading	

Unbound mixtures for capping shall not have when tested in accordance with BS EN 1744-1 water-soluble sulfate (WS) contents exceeding 0.38% (as SO_3).

Unbound mixtures for capping shall not be deposited within 500 mm of metallic items forming part of the Permanent Works if, when tested in accordance with TRL Report 447 either:

the water-soluble sulfate (WS) content exceeds 0.3g of sulfate (as SO_4) per litre (Test No 1); or

the oxidisable sulfides (OS) content exceeds 0.06% of sulfate (as SO_4) (Test No 2 and Test No 4).

Aggregates used in unbound mixtures shall comply with the selected requirements of BS EN 13242 listed in Table 6/2.

Table 6/2: Requirements for Aggregates used in Capping

Unbound mixture	**Capping**
Clause	6.8
Standard	BS EN 13242 Categories for aggregate
Crushed, or broken and totally rounded particles	NR (no requirement)
- crushed rock	
Resistance to fragmentation – Los Angeles test	LA_{60}
Resistance to wear –micro-Deval test	M_{DE}NR (no requirement) The supplier shall state the value for the aggregate used.
Water absorption	WA_{24}NR (no requirement) The supplier shall state the value for the aggregate used.
Volume stability of blast furnace	Free from dicalcium silicate and iron
Volume stability of steel (BOF and EAF) slags	V_5
All other BS EN 13242 aggregate requirements	Category $_{NR}$ (no requirement)

Table 6/3: Summary Grading Requirements for Granular Fill $6F_5$ Capping Layer

Sieve Sizes mm	**Percentage by Mass Passing**
125	100
80	75-99[1]
40	50-90
20	30-75
10	15-60
2	0-35
0.063	0-12

Note 1: The percentage passing 80mm may be greater than 99% but in such cases the

supplier shall declare the typical grading.

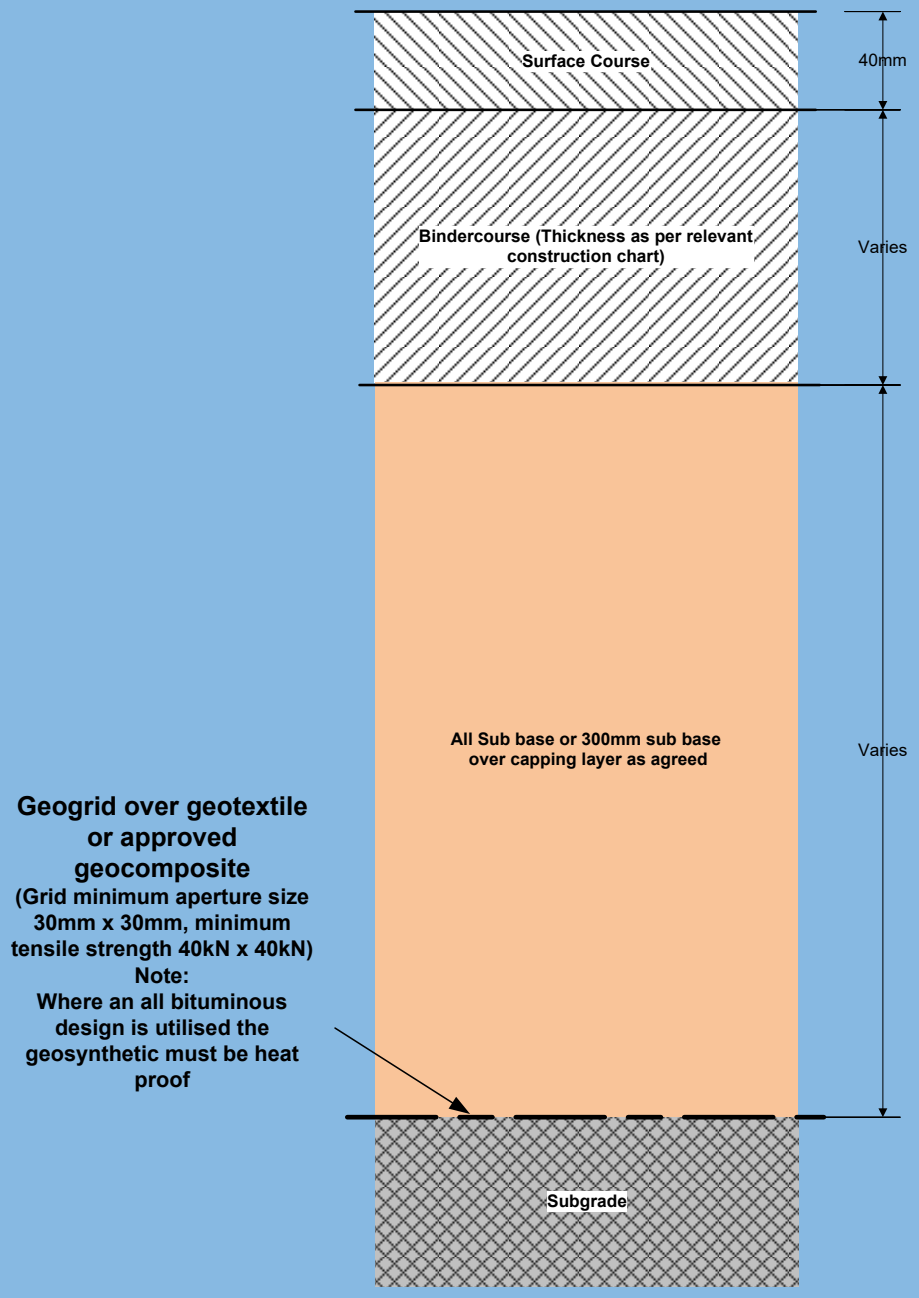
6.8.1.3 Recycled aggregates in unbound mixtures for granular fill shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol, produced in conjunction with the Environment Agency *Aggregate From Inert Waste*. The results of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highway and Flood Authority on request.

When recycled aggregate including concrete aggregate is used in accordance with this Clause, it shall not have more than 1% by mass of foreign materials including wood, plastic and metal when tested in accordance with BS EN 933-11 by a suitably trained technician who has demonstrated competence in classifying the constituent classes in accordance with the test method. Additionally, the aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note – Managing Reclaimed Asphalt – Highways and Pavements.

6.8.1.4 $6F_5$ Capping Layer material shall be transported, laid and compacted at a water content, determined in accordance with BS EN 1097-5 in order that such compaction can be achieved that an equivalent in situ CBR value, determined by the plate bearing test, of >15% is attained at the surface of the finished layer.

6.8.1.5 The $6F_5$ Capping Layer materials shall be laid in one or more layers, each not exceeding 225mm compacted thickness appropriate to the compaction plant used (whichever is the lesser) to give the specified total depth and width of granular fill. Each layer should be placed and spread evenly without delay.

FIGURE 6/1 – TYPICAL ROAD SECTION SUBGRADE CBR LESS THAN 1.5%



Geogrid over geotextile or approved geocomposite
(Grid minimum aperture size 30mm x 30mm, minimum tensile strength 40kN x 40kN)
Note:
Where an all bituminous design is utilised the geosynthetic must be heat proof

All services within the carriageway to be installed within the subgrade.
Bespoke designs for subgrade reinforcement must be agreed with the Highway and Flood Authority.

7. ROADWORKS - OVERALL REQUIREMENTS

7.1 HORIZONTAL ALIGNMENT, SURFACE LEVELS, LAYER THICKNESSES AND SURFACE REGULARITY

7.1.1 Highways England's requirements for horizontal alignments, surface levels of pavement courses and surface regularity are replaced by this Clause.

7.1.2 If the works do not comply with the requirements of this Clause, rectification shall be in accordance with the requirements of the Highways England's current Specification for Highway Works as modified by this Clause or as may be otherwise agreed in writing by the Highway and Flood Authority.

7.1.3 Horizontal alignment as shown on the drawings, shall be determined from the edge of the carriageway pavement surface, as shown on the drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of plus/minus 13mm.

7.1.4 The installation of kerbs shall be prior to Binder Course being placed as specified in Clause 10.1.

7.1.5 The level of any point on the surface of each of the pavement courses of the carriageway, footway or vehicle crossing, (i.e. the true level as specified), after completion of compaction, shall conform to that shown on the drawings and shall be within the tolerances shown below:-

Table 7/1
Tolerances in surface levels of Pavement Courses

Course	Tolerance from specified levels (mm)
Sub-Base	$^{+10}_{-30}$
Binder Course	± 6
Block Paving Laying Course	± 6
Surface Course including Block Paving	± 6

The tolerances for pavement courses shall be within those shown below.

Table 7/2
Tolerances for Pavement Courses

Course	Tolerance from specified layer thicknesses(mm)
Sub-Base	- 0 + 40
Binder Course	±6
Block Paving Laying Course	±6
Surface Course including Block Paving	±6

7.1.6 Furthermore, the combined thickness of surfacing (bituminous materials or bituminous Binder Course materials and block paving) shall not be reduced in thickness by more than 6mm from that specified.

7.1.7 In addition, when tested with the TRL Rolling Straight Edge on any line, irregularities must not exceed those given below:-

Table 7/3
Tolerances - TRL Rolling Straight Edge

	Surface Course				Binder Course			
Irregularity	4mm		7mm		4mm		7mm	
Traverse length (metres)	300	75	300	75	300	75	300	75
Number of irregularities	20	9	2	1	40	18	4	2

No irregularities shall exceed 10mm

For works of lengths of between 75m and 300m the maximum permitted irregularities shall be calculated by a pro-rata scaling down (to a zero base length) of the 300m permitted number of irregularities.

For works of lengths less than 75m the maximum permitted irregularities shall be calculated by a pro-rata scaling down of the 75m length permitted number of irregularities

For block paving the surface shall not deviate by more than 10mm under a 3metre straight edge. The difference in level at the joints of adjacent paving units shall not exceed 2mm.

7.2 COMPACTION OF BITUMINOUS MATERIALS

7.2.1 The choice of materials, design of mix and method of laying shall be consistent with obtaining mechanical key and physical adhesion between all new layers and obtaining cohesion throughout and with any bound underlying material. Cohesion/adhesion shall be assessed from 150mm diameter cores cut into the material when cold and shall be deemed to exist when detachment does not occur with the core suspended vertically for one minute. Compliance with this requirement must be obtained at all times after laying and will be deemed to occur when no more than 1 in 10 cores taken from any area fail the above test.

7.2.2 The material shall be uniformly compacted by an appropriate roller capable of meeting the air void requirements across the full width of the material. 8 to 10 tonne smooth wheel rollers, multi-wheeled pneumatic tyred rollers or double driven vibrating rollers (2 tonnes minimum dead weight) may be used provided that the surface level of pavement courses meet the requirements of Clause 7.1.

7.2.3 The compaction process of Binder Course shall be controlled on site by the use of an Indirect Density Gauge (IDG). The use of an IDG on Surface Courses is optional. It is essential the surfacing contractor knows the target density for the particular material being laid and through this information he should be able to demonstrate **potential** compliance with the specification requirements. **The Indirect Density Gauge will not measure the absolute density of the material being laid, this can only be determined by the taking of cores**. It is however, good at indicating the maximum gauge density that can be achieved on site for the particular conditions prevailing at the time. That density will be influenced by temperature, climatic conditions and whether the roller type selected is operating in accordance with the manufacturer's recommendations both for frequency and operating speed. The layer thickness and the actual composition of the material can also influence the ultimate density and thereby air voids reported from the cores tests.

7.2.4 Calibration of the IDG shall be carried out in general agreement with **Clauses 2.5.5.3.2 and 2.5.5.3.3 of BS1377: Part 9.** Compliance with the Specification, in the case of bituminous materials, will be assessed from waxed cores in accordance with BS EN 12697-6.

7.2.5 Attention is particularly drawn to the mixing temperatures given in BS EN 13108-1 and BS EN 13108-4, the temperatures given in BS 594987, and the rolling temperatures summarised in the following table:-

Table 7/4

Material	Binder Grade	Temperature °C		
		BS EN Maximum on Mixing	BS Minimum on Delivery	Min on Rolling
Dense and Close Graded Bitumen Asphalt Concrete	40/60	190	130	100
	70/100	180	130	95
	100/150	170	120	95
Hot Rolled Asphalt Surface Course	40/60	190	140	100

7.2.6 It should be noted that 6mm size Dense Surface Course Asphalt Concrete when used as a footway Surface Course is particularly sensitive to adverse laying conditions. The risk of failing to comply with the end performance requirements contained in this specification will be significantly increased when laying during adverse weather conditions occurs, or the compaction process is not completed by the minimum rolling temperature above. Working methods should be reviewed in cold weather in order to minimise rapid cooling of delivered materials.

7.2.7 The choice of materials, design of the mix and method of laying shall ensure that the air voids of compacted bituminous materials shall comply with the following table:-

Table 7/5

Material	AIR VOIDS %		
	Normal Range [1]	1 in 10 Max [2]	Absolute Max [3]
Footway Dense Binder Course	2 – 10	10	12
Footway Dense Surface Course	2 – 10	10	12
Carriageway Dense Binder Course	2 – 8	8	10
Carriageway Close Graded Surface Course	2 – 10	10	12
Carriageway Hot Rolled Asphalt Surface Course	2 – 6	6	8

Notes

[1] No results are permitted with air voids below 2%
[2] Not more than 1 in 10 results permitted above this value
[3] No values permitted above this value. This includes any for cores extracted wholly within 250mm or less from a joint [4]

7.3 Air Voids and Bond

7.3.1 Cores shall be extracted in accordance with BS EN 12697-27 and shall be 150mm diameter. Core densities shall be determined on core specimens in a dried condition having been oven dried at 40^{O}C to constant mass and in accordance with BS EN 12697-6. Cores of asphalt concrete or thin surface course shall be tested in a waxed condition, Procedure C. Cores of Hot Rolled Asphalt shall be tested to Procedure A. Determination of bond, thickness and air voids shall be conducted in accordance with an approved in-house method. Air voids shall be determined in accordance with BS EN 12697-8

7.3.2 To gain approval for an in-house test method the test house shall forward a copy of the appropriate in-house test method to the Highway and Flood Authority. This should be done prior to any testing being carried out using the in-house test method.

7.4 COLD WEATHER WORKING

7.4.1 No material in a frozen condition may be incorporated in the Works.

7.4.2 Material for use in road pavements shall not be laid on any surface which is frozen or covered in ice.

7.4.3 Except for hot rolled asphalt surface course, the laying of materials containing bitumen binder shall cease if the temperature of the surface to be covered is at, or falls below, 2°C. If the surface is dry, unfrozen and free from ice, laying may proceed at air temperatures at or above 1°C provided the temperature is rising.

7.4.4 Laying of hot rolled asphalt shall cease if the temperature of the surface to be covered is at, or falls below, 5°C or if the still air temperature in the shade falls below 8°C. Attention is particularly drawn to the additional 'wind chill' factor in cold weather working conditions. Further guidance is published in the Transport Research Laboratory's (TRL) Report No. 4 (1985) "Cooling of Bituminous Layers and Time Available for Their Compaction".

7.4.5 Thin Surface Course systems shall be laid in accordance with the requirements, including weather conditions, as given in the agreed specification for the particular system.

7.5 USE OF SURFACE BY CONSTRUCTIONAL PLANT

Constructional plant shall be suitable in relation to the thickness of the pavement course to be traversed so that damage to the pavement course of the carriageway or the sub-grade material is not caused. The wheels or tracks of plant moving over the various pavement courses must be kept free from harmful deleterious material such as mud, clay etc.

7.6 RECTIFICATION

7.6.1 Where any carriageway or footway does not comply with this specification, the non-compliant area shall be made good and surfacing rectified in accordance with the Highways England's current Specification for Highway Works except:-

7.6.2 Where non-compliant binder course surface levels require rectification, this shall be achieved by at least partial removal and replacement of the existing binder course layer. This shall be achieved by planing or otherwise removing, by a method agreed with the Highway Authority, sufficient material to enable a replacement layer of binder course to be installed. For carriageways, the replacement binder course layer shall have a compacted thickness of at least 60mm. For footways the equivalent thickness is 50mm. The use of shaping/regulating material is not permitted.

7.6.3 If an area of carriageway surface course requires rectification, a minimum 5m length of at least half carriageway width shall be replaced.

For footway surface course, the minimum replacement length is 2m for the full width of footway.

Attention is drawn to the requirements of Clause 1.1.17.4.

8. SUB-BASE

8.1 AGGREGATE FOR SUB-BASE

8.1.1 Sub-base shall be made and constructed using unbound mixtures complying with BS EN 13285, the requirement categories in Table 8/1 and the following Clauses.

Recycled aggregates used in unbound mixtures for sub-base shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol produced in conjunction with the Environment Agency *Aggregate From Inert Waste*. The results of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highways and Flood Authority on request.

When recycled aggregate including concrete aggregate is used in accordance with this Clause, it shall not have more than 1% by mass of foreign materials including wood, plastic and metal when tested in accordance with BS EN 933-11 by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method. Additionally, the aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note – Managing Reclaimed Asphalt – Highways and Pavements.

Table 8/1: Mixture and Grading Requirement Categories for Unbound Mixtures for Sub-base

Unbound Mixture	**Type 1**
Clause	8.1
Standard	BS EN 13285 Categories for unbound mixture properties
Mixture requirement category	0/31.5 UF_9 OC_{75}
Designation **Maximum fines** **Oversize**	
Grading requirement category	G_p
Overall grading	
Voids Ratio	N/A

Unbound mixtures shall conform to requirements A and B below:

A) Mixtures shall conform to the following two criteria:

(1) Water-soluble sulfate (WS) content determined in accordance with BS EN 1744-1 clause 10 shall not exceed 1500mg of sulfate (as SO_4) per litre.
(2) Total sulfur (TS) content determined in accordance with BS EN 1744-1 clause 11 expressed as (S) shall not exceed 1% for aggregates other than air cooled blast furnace slag or 2% for air cooled blast furnace slag.

B) Mixtures shall conform to at least one of the following two options:

(1) When described in accordance with BS EN 932-3 and BS EN 13242 Annex A, limestone,

dolomite, blast furnace slag, steel slag or crushed concrete are predominant;

or

(2) The sulphide content of the mixture determined in accordance with BS EN 1744-1 Clause 13 is less than 0.5% (as SO_4)

When determining WS, TS or sulphide content, at least five samples of each material shall be tested. The mean of the highest two values shall be used for comparison with limiting values. The also applies if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with limiting values. The pH of the mixture shall be reported.

Unbound mixtures placed within 500mm of metallic structural elements forming part of the Permanent Works shall conform to requirements C and D below:

C) Mixtures shall conform to the following two criteria:

(1) Water-soluble sulfate (WS) content determined in accordance with BS EN 1744-1 clause 10 shall not exceed 300mg of sulfate (as SO4) per litre;

(2) Total sulfur (TS) content determined in accordance with BS EN1744-1 clause 11 expressed as (S) shall not exceed 1% for aggregates other than air cooled blast furnace slag or 2% for air cooled blast furnace slag.

D) Mixtures shall conform to at least one of the following two options:

(1) When described in accordance with BS EN 932-3 and BS EN 13242 Annex A, limestone, dolomite, blast furnace slag, steel slag or crushed concrete are predominant

Or

(2) The sulphide content of the mixture determined in accordance with BS EN 1744-1 Clause 13 is less than 0.06% (as SO4)

When determining the WS, TS or sulphide content, at least five samples of each material shall be tested. The mean of the highest two values shall be used for comparison with the limiting values. This also applies if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values. The pH of the mixture shall be reported.

Aggregates used in unbound mixtures shall comply with the selected requirements of BS EN 13242 listed in Table 8/2.

Table 8/2: Requirements for Aggregates Used in Unbound Mixtures for Sub-Base

Unbound mixture	**Type 1**
Clause	8.1
Standard	BSEN 13242 Categories for aggregate properties
Crushed, or broken and totally rounded particles	$C_{90/3}$ – see Note 1
-Crushed rock	
Resistance to fragmentation – Los Angeles test	LA_{50}
Resistance to wear – micro – Deval test	M_{DE}NR (no requirement) The supplier shall state the Value for the aggregate used.
Resistance to freezing and thawing – Magnesium sulphate soundness	MS_{35}
Water absorption	WA_{24}NR (no requirement) The supplier shall state the value for the aggregate used.
Volume stability of blast furnace slags	Free from dicalcium silicate and iron disintegration.
Volume stability of steel (BOF and EAF) slags	V_5
All other BS EN 13242 aggregate requirements	Category $_{NR}$ (no requirement)

8.1.2 Recycled aggregates used in unbound mixtures for sub-base shall be produced in accordance with the WRAP (The Waste and Resources Action Programme) Quality Protocol produced in conjunction with the Environment Agency *Aggregate From Inert Waste*. The results of all quality control checks carried out by the producer shall be compiled in accordance with the procedure set down in the above document. These shall be made available promptly to the Highways and Flood Authority on request.

When recycled aggregate including concrete aggregate is used in accordance with this Clause, it shall not have more than 1% by mass of foreign materials including wood, plastic and metal nor a floating material in volume content exceeding 10cm³/kg when tested in accordance with BS EN 933-11 by a suitably trained laboratory technician who has demonstrated competence in classifying the constituent classes in accordance with the test method. Additionally, the aggregate shall not have threshold levels exceeding those in the ADEPT Guidance Note – Managing Reclaimed Asphalt – Highways and Pavements.

8.1.3 All sub base materials shall have a laboratory bearing capacity ratio (CBR) of not less than 30% when tested in accordance with Method 2 of BS1377 Part 4 with the following provisos:-

8.1.4 Compaction in accordance with Clause 7.2.4.5 of BS1377 Part 4. The material tested shall all pass a 20mm sieve irrespective of the amount of material retained on the 20mm sieve.

8.1.5 The material shall be compacted and subsequently tested at a water content within –2% and +1% of the optimum water content determined in accordance with BS EN 13286-4. Four surcharge weights shall be used.

8.1.6 Sub-base after compaction when tested in-situ with plate bearing equipment must meet the equivalent CBR value (Clause 1.2) specified for that particular road type, when tested by a method approved by the Highway and Flood Authority.

8.1.7 Type 1 and Type 3 unbound mixtures for sub-base shall be from a source approved by the Highway and Flood Authority and be made from crushed rock, crushed slag, crushed concrete, recycled aggregates or well burnt non-plastic shale or a combination thereof and may contain up to 10% mass of natural sand that passes the 4mm test sieve. Secondary materials other than those listed above may be used if approved by the Highway and Flood Authority.

8.1.8 The mixture shall comply with BS EN 13285 and the requirements of Table 8/1. The grading requirements for Type 1 mixture are summarised in Table 8/5

Table 8/5: Summary Grading Requirements for Type 1 Unbound Mixtures for Sub-base

Sieve size, mm	**Percentage by mass passing**		
	Overall grading range	Supplier declared value grading range	Tolerance on the suppler declared value
63	100		
31.5	75-99		
16	43-81	54-72	±15
8	23-66	33-52	±15
4	12-53	21-38	±15
2	6-42	14-27	±13
1	3-32	9-20	±10
0.063	0-9		
Grading of individual batches – differences in values passing selected sieves			
Retained sieve size,(mm)	Passing sieve size (mm)	Percentage by mass passing	
		Not less than	Not more than
8	16	7	30
4	8	7	30

Aggregates used in the mixtures shall comply with BS EN 13242 and the requirements of Table 8/2.

The size fraction of the unbound mixture passing the 0.425mm size test sieve shall be non-plastic as defined by BS 1377:Part 2 and tested in compliance therewith.

8.1.9 The material shall be transported, laid and compacted at a moisture content within the range 1% above to 2% below the optimum water content determined in compliance with BS EN 13286-4 and without drying out or segregation.

8.1.10 The material shall be uniformly compacted by an appropriate roller capable of meeting the density and bearing capacity requirement across the full width of the carriageway. 8-10 tonnes smooth wheeled rollers or double driven vibrating rollers (2 tonnes minimum dead weight) may be used for the carriageway provided that the surface level of the sub-base meets the requirements of Clause 7.1.

8.1.11 Not more than one field dry density determination in ten shall be less than 90% of the maximum dry density for that particular sub-base as determined by the vibrating hammer test in BS EN 13286-4. This requirement applies to footways and vehicle crossings as well as carriageways.

8.1.12 The layer(s) when tested in situ with plate bearing equipment must meet the equivalent CBR requirement specified for that particular road type.

8.1.13 For frost heave, materials shall be tested in accordance with BS 812: Part 124, except that the use of the silica sand and limestone filler reference specimens is not mandatory.

8.1.14 Sub-base up to 225mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Sub-base material of compacted thickness greater than 225mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 110mm. Where the layers of sub-base material are of unequal thickness the lowest layer shall be the thickest layer.

8.2 PLATE BEARING TEST

8.2.1 Plate Bearing and/or Light Drop Weight testing shall be conducted to assess the adequacy of the compacted sub-base prior to the installation of the binder course.

The testing must be carried out:-

(i) To a procedure approved by the Highway and Flood Authority
(ii) In such a manner that the values obtained are representative of the full depth of sub-base placed
(iii) At least 5 working days prior to the application of the Binder Course and
(iv) At a sufficient number of locations.

8.2.2 For Plate Bearing Testing the locations should normally be spaced between 50 metres and 100 metres apart and a minimum of 2 locations is required. Each sub-base source sub base and type must be tested. A mobile kentledge of 10 tonnes will be required. Normally the plate diameter will be between 100mm and 300mm depending upon the thickness under test.

8.2.3 Prior to conducting Plate Bearing Tests the Test House shall submit details of the Test Procedure to be used to the Highway and Flood Authority. Testing shall not take place until the Test House has received approval for the proposed Test Procedure.

8.2.4 Load gauges and movement gauges will be required to be properly calibrated. The method of calculating equivalent CBR from the Modulus of Sub-grade Reaction will require to be detailed within the Test Procedure submitted for approval. The report should give first loading CBR% and EV1, second loading EV2 and the EV2/EV1 ratio (where EV = The Modulus of Deformation).

8.2.5 The bearing capacity in terms of stiffness of the finished sub-base is established by the use of a dynamic (light) plate loading technique such as Light Drop Weight Tester (Dynamic Plate Tester). Such devices shall have previously been calibrated against the plate bearing apparatus **for the particular type of material under test.** Evidence of this comparative testing will be required by the Highway Authority. Details of the source and type of material and aggregate being tested will be required.

The distance between locations tested by the dynamic plate tester shall not exceed 20 metres

Each sub base source and sub base type shall be tested.

All dynamic plate loading tests must be carried out to a procedure approved by Lincolnshire County Council.

A minimum value of 35MPa is required for sub base tested using this method

For compliance purposes i.e. resolution of disputes, the Plate Bearing Test is the definitive method.

9. FLEXIBLE SURFACING

GENERAL

Bituminous Surface Course surfacings of carriageways and footways shall not be laid until building development is complete or at such an advanced stage that damage will not occur, notwithstanding any requirements under Section 38 of the Highways Act 1980.

9.1 DENSE BINDER COURSE

This material shall be AC 20 dense bin rec to BS EN 13108-1. The binder shall conform to BS EN 12591 **grade 40/60** for carriageway construction. For vehicle crossings the binder shall be either 40/60, 70/100 or 100/150 grade and for footways 70/100 or 100/150 grade.

9.2 BOND AND TACK COATS

When required a bond coat complying with BS 594987:2015 Clause 5.5 shall be used. The bond coat shall comply with BS EN 13808:2013, Table 4, Clause 4 and shall be applied in accordance with BS 594987:2015 Clause 5.5.2. When a bond coat is not required a C40B4 (K1-40) or C60B3 (K1-60) tack coat of cationic bitumen emulsion to BS EN 13808 shall be applied to accord with the target rates given in BS 594987 Annex J to the binder course surface. The surface should be thoroughly cleaned prior to the application of the tack coat and the emulsion allowed to 'break' prior to the application of a further layer of binder course or the surface course.

9.3 CLOSE GRADED SURFACE COURSE FOR CARRIAGEWAYS

This material shall be AC 10 close surf to BS EN 13108-1. The binder shall conform to BS EN 12591 grade 70/100 or 100/150. Unless otherwise specified by the Highway Authority, the minimum PSV of the coarse "hardstone" aggregate shall be 55 and the aggregate shall be from a source classified as such by the Lincolnshire County Council Approved Supplier Information Booklet.

9.4 DENSE SURFACE COURSE FOR FOOTWAYS

This material shall be BS EN 13108-1 AC 6 dense surf.
The binder shall conform to BS EN 12591 grade 70/100 or 100/150.

9.5 NOT USED

9.6 ROLLED ASPHALT SURFACE COURSE

Rolled Asphalt Surface Course shall be BS EN 13108-4 HRA 30/14F surf 40/60 or pmb (polymer modified binder) des.

The mix shall be either LCC Special Mix or LCC Standard Mix and classified as such by the Lincolnshire County Council Approved Supplier's Information Booklet.

The binder shall be grade 40/60 (50 pen) bitumen unless polymer modified binder is specified by the Highway and Flood Authority. The coarse aggregate content of the mix shall be 30%. The minimum PSV value for coarse aggregate in the mix shall be not less than 45.

9.7 COATED CHIPPINGS

9.7.1 Coated chippings shall be 14/20mm size as described in this Clause and shall comply with BS EN 13108-4

9.7.2 Coated chippings must be delivered to the site at least four working days in advance of laying the surface course. The Contractor is advised to use chippings that have been tested and approved by Lincs Laboratory. The aggregate source shall be a source classified as meeting the required PSV by the Lincolnshire County Council Approved Suppliers Information Booklet

Table 9/1: Requirements for Aggregate used as Coated Chippings

Property	Category
Grading	14/20 G_c 85/20
Fines content	f_2
Flakiness index	FI_{20}
Resistance to fragmentation	LA_{30}
PSV	60 (min) or higher value as required by the Highways and Flood Authority
AAV	12 (max)
Durability: Water absorption to BS EN 1097-6:2000, Clause 7 - For *WA* > 2%, magnesium sulfate soundness	$WA_{24}2$ MS_{25}

Table 9/2: Grading Requirements for Coated Chippings

Grading of Chippings	
Test Sieve Size	Percentage by mass passing sieve test
40mm	100
31.5mm	98 to 100
20mm	85 to 99
14mm	0 to 20
6.3mm	0 to 5
	0 to 2

9.7.3 The binder to coat the chippings shall be 40/60 grade conforming to BS EN 12591. The target binder content shall not be less than 1,5%.

9.7.4 Texture depth will be measured using the WDM Texture Meter 2 (TM2), to determine the average Sensor Measured Texture Depth (TM2 SMTD). Measurements will be measured over one or more sections of carriageway lane 50m in length, or the complete carriageway lane if less than 50m. The minimum length will be 10m. The average texture depth for any section of Rolled Asphalt Surface Course shall be in the range of 0.75mm to 1.30mm (TM2 SMTD) for one year following substantial completion of the works.

9.8 JOINTS IN BITUMINOUS CONSTRUCTION

All joints shall be made in accordance with BS 594987 Clause 6.8 and in particular the following:-

When possible all joints shall be offset by at least 300mm from parallel joints in the layer beneath.

All longitudinal and transverse joints in surface courses shall be made flush.

Before the adjacent width is laid, surface course joints shall be made by:

a) cutting back the edge to a vertical face that exposes the full thickness of the layer; and

b) discarding all loosened material and painting or spraying the vertical face completely with a thin uniform coating of hot applied 40/60 or 70/100 paving grade bitumen, or cold applied thixotropic bituminous emulsion of similar grade or polymer modified bitumen emulsion bond coat.

Surface course joints made in this way shall be:-

- All transverse joints that have not been formed to a specific profile;
- Joints where the asphalt abuts an existing surface; and
- All longitudinal joint.

NOTE 1: Longitudinal joints in surface course may also be formed by use of an edge compactor creating a chamfered edge during the laying process. Cutting back of the longitudinal joint is not necessary in this instance.

NOTE 2: Surplus bitumen on the surface after the joint is made should be avoided. The surface of the finished joint should not be painted because of the risk of skidding and slipping. Joints in the binder course shall be treated in such a way as to enhance compaction and bonding.

NOTE: For example by use of edge compactors fitted to rollers.

9.9 RECYCLED MATERIAL

Up to 10% of crushed recycled bituminous material may be included as an aggregate replacement in Binder Course mixes. Only plants that are approved to supply Binder Course with a recycled element will be permitted to supply such materials. These materials shall comply with Clause 9.10. Details of approved plants can be obtained from Lincs Laboratory.

9.10 RESIDUAL BINDER PENETRATION

For all bituminous asphaltic concretes and asphalts made with unmodified bitumen the recovered binder penetration value, from site sampled material, shall be numerically not less than 60% of the nominal value nor more than the nominal value e.g. for a specified 50 pen (40/60 grade) binder the recovered binder shall be in the range of 30 pen to 50 pen.

9.11 COLOURED SURFACING FOR CONSERVATION AREAS AND OTHER ENVIRONMENTALLY SENSITIVE AREAS

Attention is drawn to Chapter 4: Section 9 of the Lincolnshire Design Guide for Residential Areas which details the circumstances under which and requirements for coloured surfacings to be used on Development Roads.

9.12 ANNEX B

BS EN 13108-1 Asphalt concrete- Specification

Annex B

This annex contains the specification for asphalt concrete in accordance with BS EN 13108-1 for use on adoptable highways built in accordance with this specification.

Specification for asphalt concrete

B.1 General

Asphalt concrete (Macadam type) mixture shall conform to BS EN 13108-1. Conformity shall be established in accordance with BS EN 13108-20 and BS EN 13108-21.

Constituent materials

B.2 Binder

The binder shall be paving grade bitumen conforming to BS EN 12591.

B.2.2 Bitumen

B.2.2.1 Paving grades

The paving grades for asphalt concrete are 40/60, 70/100 and 100/150.

NOTE 1 70/100 and 100/150 pen paving grade bitumen may be produced by blending in the mixer at the asphalt plant.

The grades used for blending shall be no harder than 30/45 pen, nor softer than 160/220 pen and shall conform to BS EN 12591. The producer shall be able to demonstrate that the plant is capable of adequately blending the bitumens. Measures for ensuring consistency of proportioning of the blend shall be included in plant quality management systems. These shall include evidence of type tests carried out on a laboratory blend of the bitumens to demonstrate

conformity to BS EN 12591. The quality assurance / management systems shall also include the steps to be taken to demonstrate the continuing adequacy of the process following significant changes being made to those parts of the plant involved in the process of bitumen blending. No grades of bitumen harder than 70/100 pen shall be blended in the mixer.

NOTE 2. Other grades may be in-plant blended provided that the resulting bitumen can be sampled and tested before it is added to the aggregate and to ensure it conforms to BS EN 12591.

B.2.3 Not used

B.2.4 Aggregates

B.2.4.1 Coarse aggregate

B.2.4.1.1 Type of coarse aggregate

Coarse aggregate shall be material substantially retained on a 2mm test sieve, conforming to all appropriate requirements of BS EN 13043 and consisting of one of the following.

a) Crushed rock of one or more of the following groups; basalt, gabbro, granite, gritstone, hornfels, limestone, porphyry or quartzite.

b) Gravel of one or more of the groups in a) or flint, crushed or uncrushed, or combinations of both types.

c) When gravel other than limestone gravel is used, 2% by mass of the total aggregate of either hydrated lime or cement shall be used as a filler.

d) Blast furnace slag.

e) Steel slag, either electric arc furnace slag or basic oxygen slag, with a compacted bulk density between 1,60 Mg/m^3 and 1.80 Mg/m^3 when tested in accordance with BS 812-2.

B.2.4.1.2 Particle shape

The flakiness category for aggregates for all macadam type mixtures shall be $F1_{35}$.

B.2..4.1.3 Fines content

The fines content for coarse aggregates shall be:

a) for crushed rock/slag: $\mathbf{f}_{NR}$; and

b) for gravel: f_1.

Where there is a requirement in this specification for AAV and/or PSV for the coarse aggregate component of the mixture, the values apply to the aggregate proportion retained on the 4mm sieve.

NOTE 2 The use of 2% by mass of the total aggregate of hydrated lime or cement filler reduces the risk of water stripping the binder from some aggregates, in particular flint gravel. This might also be achieved by the addition of adhesion agents to the bitumen or at the mixing stage.

NOTE 3 Aggregates other than those referred to in a) and b) above may be suitable for asphalt concrete but they are outside the scope of this specification.

B.2.4.2 Fine aggregate

B.2.4.2.1 Type of fine aggregate

The fine aggregate shall substantially pass a 2mm test sieve and be of one of the following types:

fines produced by crushing material from one of the groups specified in **B.2.4.1.1;**

a) sand; or

b) a mixture of a) and b).

B.2.4.2.2 Fines content

The fines content for fine aggregates shall be:

a) for crushed rock/slag f_{NR};

b) for sand f_{10}.

NOTE Guidance on fines quality can be found in PD 6682-2.

B.2.4.3 Added filler

If added filler is used in dense, close graded, open graded and fine graded mixtures it shall consist of crushed rock, crushed slag, hydrated lime, cement or other material approved by the Highway Authority.

The loose bulk density in kerosene of added filler, with the exception of hydrated lime, shall be in accordance with BS EN 13043:2002, **5.5.5.**

B 2.4.4 Reclaimed asphalt

Where reclaimed asphalt is to be used in asphalt concrete mixtures the following requirements shall apply.

a) All reclaimed asphalt shall be classified in accordance with BS EN 13108-8.

b) The reclaimed asphalt shall conform to the following categories:

- foreign matter – category F5;
- binder properties, - category P_{15}.

In accordance with BS EN 13108-8:2016 **5.5.3** as the reclaimed asphalt is for use only at additional percentages of less than 20% in binder courses a sampling frequency of once

per 2000t and a single batch of feedstock is specified.

NOTE 1 P_{15} is a general case, but reliable and consistent feedstocks of harder reclaimed materials might make them suitable for use, by agreement with the Highway Authority.

In accordance with BS EN 13108-1:2016, **4.4,** and unless otherwise indicated, the amount of reclaimed asphalt added to the mixture shall not exceed the following.

- surface courses 0%;
- binder course materials 10%

Where, in accordance with BS EN 13108-1:2016, **4.2.2.2** or **4.2.2.3,** the level of reclaimed asphalt addition requires the determination of combined binder properties, the penetration method shall be adopted. For information gathering purposes recovered softening point tests may be conducted on material from the same bulk sample.

B.3 Mixture specifications

B.3.1 Binder content

NOTE 1 The binder content categories in BS EN 13108 involves a correction for the density of the aggregate in the mix. The principle is that the binder content category in the standard is based on an aggregate density in the mixture of 2,650 Mg/m^3. If the aggregate is denser than 2,650 Mg/m^3 the actual binder content in the true mixture is reduced proportionally or if the aggregate is less dense it is increased. This has the intention of giving the same binder volume in mixtures regardless of aggregate density.

NOTE 2 A consideration of UK mixtures and aggregates indicated that this approach might have been detrimental, as some of the denser aggregates in practice needed higher binder contents for durability. For this reason, the binder contents in the example specifications in this guidance document are those which are required as actual soluble binder contents on analysis of the finished mixture, with no density correction. This is the same as the way in which binder content was specified in BS594 and BS 4987. They are referenced as B_{act}.

NOTE 3 For the purpose of CE marking, these actual binder contents will need to be corrected back to determine the B_{min} defined in BS EN 13108.

To convert the B_{act} target values within PD 6691 back to a B_{min} declared value from BS EN 13108, the following formula shall be used:

$$B_{min\ declared} = \frac{P_b \times B_{act}}{2{,}650}$$

Where

P_b is the mean particle density of the aggregate mixture, in megagrams per cubic metre (Mg/m^3), determined in accordance with BS EN 1097-6.

The B_{min} declared value calculated from this formula shall be in divisions of 0,2. A B_{min} declared value of 0,1 division, such as 5,3%, shall be rounded down to the nearest 0,2 value i.e. 5,2%.

B.3.2 **Not used**

B 3.3 **Not used**

B 3.4.1 to B 3.4.7 **Not used**

B 3.4.8 **Recipe dense binder course**

B 3.4.8.1 **General**

B 3.4.8.2 **Aggregate grading and binder content**

The aggregate grading and binder content at the target composition shall fall within the envelope given in Table B.11. Binder shall conform to BS EN 12591 with the grade as indicated in Clause 9 of this specification.

Table B.11
Target limits for composition for recipe dense binder course mixtures
AC 20 Dense bin XX/YY rec

Mixture Description	**20mm dense binder course**	
EN nomenclature	**AC 20 dense bin**	
Test sieve aperture size mm	**% by mass passing**	
	Targets Limits	**Tolerance about target composition [A)]**
40	-	-
31,5	100	-2/+0
20	99-100	-9/+5
10	61-63	±9
6,3 [B)]	47	±9 (Advisory)
2	27-33	±7
0.250	11-15	±5
0,063	6	±3
Aggregate type	**Binder content B_{act}**	
Limestone	4.6	±0,6
Basalt	4.7	±0,6
Other crushed rock	4.6	±0,6
Blast furnace slag of bulk density In Mg/m^3.		
1,44	5,4	±0,6
1,36	5,8	±0,6
1,28	6,2	±0,6
1,20	6,6	±0,6
1,12	7,0	±0,6
Steel Slag	4,2	±0,6
Gravel	5,0	±0,6

NOTE The specified binder content B_{act} is both minimum and maximum content for categorisation purposes.

[A)] These tolerances also apply to site sampled material unless alternative values are agreed in advance with the Highway Authority.

[B)] The amount passing this sieve shall be reported.

B 3.5 Recipe Surface Course

B 3.5.1 Not used

B.3.5.2.1 Close graded surface course

The aggregate grading of the target composition shall fall within the envelope given in Table B.14. The binder content of the target composition shall conform to Table B.14.

Binder shall conform to BS EN 12591 grade 100/150 or grade 70/100

Table B.14
Target limits for composition for close graded surface course mixtures AC10 close surf 70/100 or 100/150

Mixture Description	**10mm close graded surface course**	
EN nomenclature	**AC 10 close surf**	
	% by mass passing	
Test sieve aperture size mm	**Target Limits**	**Tolerance about the target composition [A)]**
14	100	-2/+0
10	100	-8/+5
6,3	62-68	±7
2	25-31	±6
1[B]	14-26	±4 (Advisory)
0.063	6,0	±2
Aggregate type	**Binder content B_{act}**	
Limestone	N/A	-
Basalt	5,3	±0,5
Other crushed rock	5,2	±0,5
Blast furnace slag of bulk density In Mg/m^3.		
1,44	6,2	±0,5
1,36	6,6	±0,5
1,28	7,2	±0,5
1,20	7,6	±0,5
1,12	8,2	±0,5
Steel Slag	5,0	±0,5

NOTE The specified binder content B_{act} is both minimum and maximum content for categorisation purposes.

[A)] These tolerances also apply to site sampled material unless alternative values are agreed in advance with the Highway Authority.

[B)] The amount passing this sieve shall be reported.

B.3.5.3.1 Dense surface course

The aggregate grading of the target composition shall fall within the envelope given in Table B.15. The binder content of the target composition shall conform to Table B.15.

Binder shall conform to BS EN 12591 grade 70/100 or 100/150.

Table B.15
Target limits for composition for dense graded surface course mixtures AC 6 dense surf 70/100 or 100/150

Mixture Description	**6mm dense surface course**	
EN nomenclature	**AC 6 dense surf**	
	% by mass passing	
Test sieve aperture size mm	**Target Limits**	**Tolerance about the target composition** [A]
10	100	-2/+0
6,3	98	-8/+5
2	42-56	±6
1[C]	24-46	±4 (Advisory)
0,250	11-19	±4
0.063	4-8	±2
Aggregate type	**Binder content B_{act}**	
Limestone	6,0	±0,5
Basalt	6,3	±0,5
Other crushed rock	6,2	±0,5
Blast furnace slag of bulk density In Mg/m^3.		
1,44	6,6	±0,5
1,36	7,0	±0,5
1,28	7,6	±0,5
1,20	8,0	±0,5
1,12	8,4	±0,5
Steel Slag	5,6	±0,5
Gravel	5,4	±0,5

NOTE The specified binder content B_{act} is both minimum and maximum content for categorisation purposes.

[A] These tolerances also apply to site sampled material unless alternative values are agreed in advance with the Highway Authority.
[B] Higher binder contents may be necessary with some gravel types.

[C] The amount passing this sieve shall be reported.

B.3.6 Temperature of the mixture

When using paving grade bitumens, the temperature of the mixture at any stage, measured in accordance with BS EN 12697-13, shall not exceed the limits of Table B.17.

Table B.17 Maximum temperature of the mixture.

Paving grade of binder	Temperature ^{o}C
40/60	190
70/100	180
100/150	170

9.13 ANNEX C

BS EN 13108-4 HOT ROLLED ASPHALT - SPECIFICATION

Annex C contains the specification which gives the specification for asphalt concrete in accordance with BS EN 13108-4, for use on adoptable highways built in accordance with this specification

Specification for hot rolled asphalt

C.1 General

HRA shall conform to BS EN 13108-4. Conformity shall be established in accordance with BS EN 13108-20 and BS EN 13108-21.

C.2 Constituent Materials

C.2.1 Binder

The binder shall be paving grade bitumen conforming to BS EN 12591, polymer modified bitumen conforming to BS EN 14023 or a blend of one of these with natural bitumen in accordance with BS EN 13108-4:2006, Annex B.

C.2.2 Not used

C.2.3 Aggregates

C.2.3.1 Coarse aggregate

C.2.3.1.1 Type of coarse aggregate

The coarse aggregate shall be material substantially retained on a 2mm test sieve, conforming to all appropriate requirements of BS EN 13043 and consisting of one of the following.

a) Crushed rock of one or more of the following groups, basalt, gabbro, granite, gritstone, hornfels, limestone, porphyry or quartzite.

b) Gravel of one or more of the groups in a) or flint, crushed or uncrushed, or combinations of both types.

c) Blast furnace slag.

d) Steel slag, either electric arc furnace slag or basic oxygen slag, with a compacted bulk density between 1,60 Mg/m^3 and 1,80 Mg/m^3 when tested in accordance with BS 812-2.

C.2.3.1.2 Particle shape

The flakiness category for coarse aggregates shall be $F1_{35}$.

C.2.3.1.3 Fines content

The fines content for coarse aggregates shall be f_4.

C.2.3.2 Fine aggregate

C.2.3.2.1 Type of fine aggregate

The fine aggregate shall substantially pass a 2mm test sieve and be of one of the following types.

a) sand;

b) fines produced by crushing material from one of the groups specified in **C.2.3.1.1**;

c) a mixture of a) and b).

C.2.3.2.2 Grading

For surface course mixtures the grading of the fine aggregate shall conform to the appropriate category below:

a) for Type F surface course mixtures 0/2mm G_{A90};

Fines content

The fines content for fine aggregates shall conform to the appropriate fines category below:

a) for Type F surface course mixtures f_{10};

Note Guidance on fines quality can be found in PD 6682-2.

C.2.3.3 Added Filler

Added filler shall consist of limestone, hydrated lime, cement or other filler approved by the Highway Authority. The grading of added filler shall be in accordance with BS EN 13043:2002, **5.2.1.**

The loose bulk density in kerosene of added filler, with the exception of hydrated lime, shall be in accordance with BS EN 13043:2002, **5.5.5.**

C.2.3.4 Reclaimed asphalt

The use of reclaimed asphalt is not permitted in hot rolled asphalt supplied for use on roads constructed in accordance with this specification.

C.2.3.5 Additives

Additives permitted for inclusion may include fibres, pigments and adhesion agents, the suitability of which shall be demonstrated in accordance with BS EN 13108-4:2016, **4.1**.

C.2.3.6 Coated chippings

See Clause 9.6 of this specification and C.2.8 of this Annex.

C.2.4 Not used

C.2.5 Group 2 – Surface course mixtures

C.2.5.1 Composition, grading and binder content

C.2.5.1.1 General

The grading and binder content of the target composition of surface courses shall conform to Table C.2A, Table C.2B or Table C.2C, as appropriate (see **C.2.7**). The requirements for a particular mixture shall be selected in accordance with:

for design surface course mixtures.

NOTE 1 Type F is characterised by a gap grading typical of traditional HRA surface course mixtures usually associated with the use of a fine sand, although other fine aggregates conforming to the grading may also be suitable.

C.2.5.1.2 Not Used

C.2.5.1.3 Design surface course mixtures

Design surface course mixtures shall be 30/14F from Table C.2A.

The soluble binder content shall not be less than either the greater of the minimum value from Table C.2A or the target binder content determined in accordance with the protocol described in BS 594987:2015, Annex H (see **C.2.7**) and agreed with the Highway and Flood Authority.

Specification for hot rolled asphalt

Table C.2A
Limits for target composition for surface course mixtures, Type F mixtures-
Design target aggregate gradings HRA 30/14 F surf 40/60 or pmb des.

Sieve	**Passing sieve % by mass**	
	Target Limits	**Tolerance about the target composition** [A)]
20	100	-2/+0
14	93-100	-8/+5
10	67-83	±7
2	65	±5
0,5	49-68	±8 (Advisory)
0,25	19-51	±8
0,063	9,0	±2
Minimum target binder content B_{act} % (m/m) of total mixture		
	6,5	±0,6
[A)] These tolerances also apply to site sampled material unless alternative values are agreed in advance with the Highway Authority.		
Maximum percentage of aggregate passing 2mm and retained on 0,5mm sieves		
Designation	30/14F	
Maximum percentage	14	

C.2.6 Temperature of the mixture

When using paving grade bitumens, the temperature of the mixture at any stage, measured in accordance with BS EN 12697-13, shall not exceed the limits of Table C.4.

Table C.4 Maximum temperature of the mixture

Paving grade of binder	Temperature °c
40/60	190

When using modified bitumen or additives, different temperatures might be applicable, and these shall be documented and declared as part of the regulatory marking.

C.2.7 Target binder content

NOTE 1 The binder content categories in BS EN 13108 involves a correction for the density of the aggregate in the mix. The principle is that the binder content category in the standard is based on an aggregate density in the mixture of 2,650 Mg/m^3. If the aggregate is denser than 2,650 Mg/m^3 the actual binder content in the true mixture is reduced proportionally or if the aggregate is less dense it is increased. This has the intention of giving the same binder volume in mixtures regardless of aggregate density.

NOTE 2 A consideration of UK mixtures and aggregates indicated that this approach might have been detrimental, as some of the denser aggregates in practice needed higher binder contents for durability. For this reason, the binder contents in the example specifications in this guidance document are those which are required as actual soluble binder contents on analysis of the finished mixture, with no density correction. This is the same as the way in which binder content was specified in BS594 and BS 4987. They are referenced as B_{act}.

NOTE 3 For the purpose of CE marking, these actual binder contents will need to be corrected back to determine the B_{min} defined in BS EN 13108.

To convert the B_{act} target values within PD 6691 back to a B_{min} declared value from BS EN 13108, the following formula shall be used:

$$B_{min\ declared} = \frac{P_b \times B_{act}}{2{,}650}$$

Where:

P_b is the mean particle density of the aggregate mixture, in megagrams per cubic metre (Mg/m^3), determined in accordance with BS EN 1097-6.

NOTE The mean particle density of the aggregate mixture should be calculated as the weighted mean of the apparent particle densities of the coarse and fine aggregate particle size fractions comprising the mix formulation: 0,063mm to 2mm, 2mm to 4mm, 4mm to 6.3mm, 6.3mm to 10mm, 10mm to 14mm, 14mm to 20mm, 20mm to 31.5mm, 31.5mm to 40mm.

The B_{min} declared value calculated from this formula shall be in divisions of 0,2 A B_{min} declared value of 0.1 division, such as 5,3%, shall be rounded to the nearest 0,2 value i.e. 5,2%.

C.2.8 Coated chippings for application to surface course

C.2.8.1 General

For specification purposes coated chippings shall be considered as a mixture and evaluation of conformity determined in accordance with BS EN 13108-20 and BS EN 13108-21.

C.2.8.2 Chippings

Chippings shall be coarse aggregate conforming to **C.2.3.**

The grading of chippings shall be as in Table 9/2 of this specification.

C.2.8.3 Binder content

Binder used to coat the chippings shall be 40/60 grade conforming to BS EN 12591. The target binder content shall be not less than 1,5%.

C.2.8.4 Condition of binder coating

When tested in accordance with BS EN 12697-37, the proportion of retained sand shall be not less than 4,0% for D> 16mm and 5,0% for D< 16mm. Not more than 7,5% shall fail the visual assessment.

C.2.8.5 Evaluation of conformity

Evaluation of conformity shall be carried out in accordance with BS EN 13108-4:2006, Clause **6.**

C.2.8.6 Identification

Identification should be in accordance with BS EN 13108-4:2016, Clause **7**. The delivery ticket shall contain at least the following information relating to identification:

the manufacturer and mixing plant;

the nominal size and source of the aggregate.

10. KERBS, CHANNELS AND EDGINGS

10.1 KERBS, CHANNELS AND EDGINGS (STANDARD)

10.1.1 All standard kerbs, channels and edgings irrespective of method of manufacture must comply with BS EN 1340. Unless otherwise agreed in advance in writing, kerbs, channels and concrete edgings shall be manufactured by hydraulic pressure.

10.1.2 Kerbs shall be 125mm x 255mm half battered Type HB2 Figure NA1 of BS EN 1340:2003. Channels shall be 125mm x 255mm Type CS1 Figure NA1 of BS EN 1740:2003. Radius kerbs and channels shall be in accordance with BS EN 1340. Dropper or tapered kerbs to accesses shall be 125mm x 255mm reducing 125mm x 150mm Figure NA2 of BS EN 1340:2003 to match as shown on the Domestic Vehicle Crossing diagram Fig 1 / 4.
The minimum cut length of a kerb shall be 450mm and a trowel width gap shall be left at the front face of a radius.

10.1.3 In certain situations a kerb profile, other than half battered, may be required to conform with adjacent work.

10.1.4 Kerbs shall be installed prior to Binder Course being placed, unless the alternative method of working as specified in Clause 1.1.17 is employed, which will require the binder course to be laid in two separate stages and be increased in overall thickness as specified.

10.1.5 Kerbs, channels and edgings shall be laid and bedded on a 30mm layer of cement mortar. Wet bedding of kerbs in the bedding concrete is not permitted.

10.1.6 Radius kerbs or radius channels shall be used in curves where the radius is 15 metres or less. For radii between 15m and 80m inclusive, straight kerbs of length 600mm must be used, unless channels are required in which case radius kerbs and channels will be required. For radii greater than 80m and all straights, kerbs 600mm or 900mm length shall be used.

10.1.7 Channels shall be laid to the same crossfall as the adjoining carriageway. Any unit found to be more than 3mm out of line or level at either end shall be lifted and relaid, including any necessary breaking out and replacement of the concrete foundation and backing.

10.1.8 Concrete bedding and concrete haunching for kerbs, channels and edgings shall be constructed to the dimensions shown on the Drawings and shall consist of ST3 (15N/mm²) concrete low workability as specified in Clause 12.1.

10.1.9 Channel blocks are required where the longitudinal gradient of the carriageway falls below 1 in 150. Where the gradient falls below 1 in 250 the carriageway shall be laid flat and channel blocks laid to false falls.

11. CULVERTS AND SMALL RETAINING WALLS

11.1 GENERAL

11.1.1 Pipes of 600mm diameter or greater are classified as culverts. Below this size they are classified as drainage pipes (see Clause 5).

11.1.2 A retaining wall is required where the retained height is greater than 600mm and will be subject to design checks during construction.

11.2 DESIGN AND TECHNICAL APPROVAL REQUIREMENTS

11.2.1 Structures are to be designed and drawn by suitably qualified civil engineers with a working knowledge and experience of the design of highway structures to current standards as referred to in Clause 11.3 below.

11.2.2 A document entitled “Guidance Notes and Technical Approvals for Small Highway Structures” gives more detailed guidance and is available on request from the Highway and Flood Authority.

11.2.3 Technical approval must be obtained from the Highway and Flood Authority for all highway structures prior to the commencement of construction. The procedures to be followed are defined in the Requirements for Technical Approval referred to in Clause 11.4 below. For some types of structure this means that the approval process commences with feasibility and preliminary design work.

11.2.4 In the case of works to be carried out in or adjacent to any watercourse, the design must also be submitted to any affected drainage authority for approval. The Highway and Flood Authority will require proof that this approval has been granted.

11.2.5 It is strongly recommended that a General Arrangement drawing be submitted to the Highway and Flood Authority for comment at an early stage in the design process to minimise the risk of abortive work.

11.3 SPECIFICATION

11.3.1 The specification for the works shall be the current Highways England Specification for Highway Works, applied in accordance with the notes for guidance on that Specification and incorporating all subsequent amendments.

11.3.2 Design methods and procedures for the design of highway structures are laid down in the documents listed in the Highways England's Technical Approval Schedule (see Clause 11.5 below).

11.4 BASIC DESIGN PRINCIPLES

11.4.1 The design life for highway structures is 120 years and technical design standards produced by Highways England are intended to achieve this. In addition to complying with all appropriate standards listed in the Technical Approval Schedule the designer must bear the following objectives in mind:-

(i) Safe passage for pedestrians and vehicles;

(ii) Minimisation of future maintenance costs;
(iii) Minimisation of vandalism risk;
(iv) Aesthetics and harmony with surroundings.

11.4.2 Particular care is required when designing retaining structures for areas such as footways, verges etc. If there is to be no physical barrier to prevent vehicles from gaining access to these areas, retaining structures must be designed for the appropriate accidental wheel loading or surcharge.

11.5 DESIGN GUIDANCE

11.5.1 Design guidance contained in "Guidance Notes and Technical Approvals for Small Highway Structures" referred to in Clause 11.1 above covers the following-

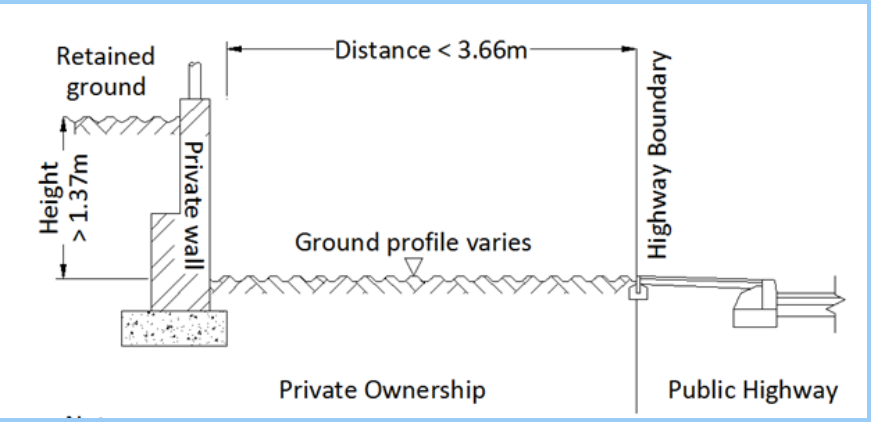
- Basic Design Considerations;
- Culverts
- Precast Concrete Box Culverts
- Precast Concrete Circular Pipes
- Corrugated Steel Buried Structures
- Retaining Walls
- Requirements for Technical Approval
- Schedule of Requirements (including information to be submitted for approval)
- Guide to Codes of Practice and Design Documents;
- Loading
- Concrete Structures (Bridges, Culverts and Headwalls)
- Corrugated Steel Buried Structures
- Extracts from the Highways England Approval Schedule, including :-
  - British Standards
  - European Standards
  - British Standard Codes of Practice
- Highways England
- Publications (TSO)
- Technical Memoranda (Bridges)
- Highways England Advice Notes

- Sustainable Drainage Systems (SuDS) Manual

11.6 PROXIMITY OF NON-ADOPTABLE STRUCTURES

11.6.1 Structures not for adoption by the Authority shall not be within 3.66m of the highway boundary.

FIGURE 11/1 – CROSS SECTION SHOWING CRITERIA FOR APPROVAL OF NON-ADOPTABLE RETAINING WALLS



Notes :-
1) Both criteria (distance and height) are to be satisfied for design approval to be necessary
2) Distance is measured to the closest point of the wall or foundation
3) Height is measured from the edge of the highway to the retained height

12. CONCRETE

12.1 CONCRETE MIXES

12.1.1 Concrete shall be ready mixed concrete complying with Clause 4.5 BS 8500-1: 2006 and BS EN 206-1:2000. The maximum aggregate size shall be 20mm. Suppliers shall be members of QSRMC and have a quality management system complying with the requirements of BS EN ISO 9001: 2000.

12.1.2 The following table gives details of Standard Prescribed concrete mixes and their related strengths.

Table 12/1

Standardized prescribed concrete	Strength class that may be assumed for structural design (Note 1)	Characteristic compressive cube strength at 28 days that may be assumed for structural design (N/mm²)
ST1	C6/8	8
ST2	C8/10	10
ST3	C12/15	15
ST4	C16/20	20
ST5	C20/25	25

12.1.3 Standard mixes shall not be used where:-

a) Sulphates or other aggressive chemicals are present in the ground water.
b) Where concrete will be subjected to road de-icing salt without addition of an air entraining agent.

In these circumstances prior consultation with the Highway Authority shall be undertaken for the selection of a suitable mix.

Admixtures and cement containing additives shall not be used without specific approval, in writing, from the Highway and Flood Authority.

Circumstances will occur when small quantities of concrete are required where the use of ready mix concrete would be prohibitively expensive. Site batched concrete will only be permitted in unreinforced applications.

For Mix details refer to the following table:-

Table 12/2

Compressive Strength (N/mm²) (Note 1)	Mix proportions by volume		
	Coarse	Fine	Cement
C12/15	4	2½	1
C16/20	4	2	1
C25/30	3	1½	1

The quantity of water used shall not exceed that required to produce a dense concrete with sufficient workability to enable it to be placed and compacted where required.

Note 1 Concrete compressive strengths are defined in terms of both cylinder strength and cube strengths. The first (lower) number gives the cylinder strength requirement; the second (higher) number is the cube strength requirement.

12.2 COLD WEATHER WORKING

12.2.1 No material below 3°C or material containing frost or ice shall be used, and mixing shall not be carried out when the still air temperature in the shade is below 3°C.

12.2.2 Concrete shall not be placed against any shutter, reinforcement, previously placed concrete or foundation which has a surface temperature below 3°C.

12.2.3 Precautions shall be taken to ensure that the temperature of the concrete is maintained above 4°C until it has hardened.

12.3 TRANSPORT AND PLACING

12.3.1 Concrete shall be so transported and placed that segregation or loss of the constituent materials does not occur.

12.3.2 All concrete shall be compacted in its final position within 30 minutes of being discharged from the mixer unless carried in continuously operated purpose-made agitators, when the time shall not be more than 2 hours after the introduction of the cement to the mix and within 30 minutes of discharge from the agitator. If the temperature of the cement entering the mixer exceeds 65°C the concrete shall be placed within 15 minutes of discharge from the mixer. Cement exceeding 75°C shall not be used in the manufacture of concrete. Concrete when deposited shall have a temperature of not less than 5°C and not more than 32°C.

12.3.3 Spaces to be occupied by concrete shall be clean and free from standing water. Concrete shall not be dropped from a height greater than 2 metres. When chutes are used they shall have a slope greater than 50° to the horizontal and they shall be kept free from coatings of hardened concrete or other obstructions.

12.3.4 Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless an approved construction joint is formed.

12.4 COMPACTION OF CONCRETE

12.4.1 All concrete shall be compacted to produce a dense homogeneous mass. It shall be compacted with the assistance of vibrators, care being taken to avoid contact with reinforcement and inserts. Placement and compaction shall be completed within 2 hours after introduction of the cement to the mix. Once compaction is complete and 2 hours has elapsed since introduction of cement to the mix, no further concrete shall be placed adjacent to the mix until 24 hours has passed since cement was added to the initial mix.

12.5 CURING OF CONCRETE

12.5.1 Immediately after completion and for 7 days thereafter, concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes, frost and from drying out.

13. BRICKWORK

13.1 BRICKWORK: GENERAL

13.1.1 Details of brickwork for sewerage and drainage purposes are given in Section 5.8. Brickwork for other purposes to be adopted by the Highway and Flood Authority shall comply with this Clause.

13.2 EXPOSED JOINTS

Exposed joints shall be treated in the following ways:-

13.2.1 Pointed Joints

Joints in brickwork shall be raked out for a depth of 14mm and pointed in mortar. Unless otherwise required by the Highway and Flood Authority joints treated in this manner shall be flush pointed.

13.2.2 Unpointed Joints

i. The mortar for joints in brickwork which are not to be pointed shall extend slightly beyond the full width of the beds and shall then be struck off with the trowel as the work proceeds.

ii. No overhand work will be allowed. Any putlog holes must be filled in with bricks identical with those already incorporated in the facework. Every third course shall be laid fair and correct to the line and all perpends shall be accurately kept.

iii. In building brickwork above concrete or stonework already completed the Developer shall also take the necessary precautions to prevent any mortar or debris from falling into the open expansion joints.

13.3 COLD WEATHER WORKING

13.3.1 No bricks or other materials below 3°C or containing frost or ice shall be used. Mortar mixing and laying bricks shall not be carried out when the still air temperature in the shade is below 3°C.

13.3.2 Bricks shall not be laid on previously laid brickwork or foundation which has a surface temperature below 3°C.

13.3.3 Precautions shall be taken to ensure that the temperature of the brickwork is maintained above 4°C until the mortar has hardened.

13.4 FACING BRICKWORK

13.4.1 The requirements for solid brickwork shall apply to facing brickwork except that the joints shall be as required by the Highway and Flood Authority. All facing brickwork shall be well bonded to the backing bricks or concrete and anchor ties of approved manufacture shall be provided where required by the Highway and Flood Authority. No facing brickwork shall be brought up at any time for more than 600mm in advance of the backing.

14. STREET LIGHTING

14.1 APPROVAL

14.1.1 Before construction commences Developers shall submit their proposals for street lighting, to the Highway and Flood Authority for approval. The lighting system (including the design and components) shall be in accordance with the requirements of the Highway and Flood Authority.

14.1.2 The layout of a proposed street lighting scheme, including any adjoining existing lighting and illuminated signs, installation shall be incorporated into the drawings.

14.1.3 The developer's proposals shall include:-

(i) Details of existing street lighting equipment, services, lighting cables or illuminated signs that would need re-siting or protection due to the works.

(ii) Proposals to modify lighting systems on existing highways which give access to the proposed development. The developer may be required to enter into an Agreement and Bond in respect of any such work. Specific advice should be obtained from the Highway and Flood Authority.

14.2 SERVICES

14.2.1 The developer shall be responsible for provision of electricity services to the lighting units or supply pillars. All services shall be laid underground.

14.2.2 The electricity company shall provide electricity services to each lighting unit. The developer may be required to provide black service ducts for electricity company services cables. Such ducts shall be installed to the relevant electricity company specification.

14.2.3 In exceptional circumstances the Highway and Flood Authority may agree to the installation of a "private" service cable to supply street lighting units. Details are available from the Highway and Flood Authority upon request.

14.3 STANDARDS

Lighting designs shall conform to BS 5489 Part 1:2013 or any subsequent superseding CoP together with regional requirements of the Highway and Flood Authority for lighting levels and specification for materials and installation works.

14.4 INSTALLATION

14.4.1 The methods used for installation and erection of highway lighting equipment shall be in compliance with the Code of Practice prepared by the Association of Street Lighting Erection Contractors.

14.5 COMPLETION AND COMMISIONING MAINTENANCE

14.5.1 The developer shall inform the Highway and Flood Authority when each lighting unit is commissioned. The developer shall also provide Electrical Test Certificate for each lighting unit. The complete installation details including electrical test certificates shall be handed to the Highway and Flood Authority prior to adoption of the relevant sections of highway.

14.5.2 Where the Developer has entered into an Agreement under Section 278 of the Highways Act 1980, maintenance of the highway lighting installation will be governed by the Agreement, which provides for Developer paying energy charges from commissioning of a properly provided installation and for the installation to be adopted for operation and maintenance by the Highway and Flood Authority. Upon adoption the payment of the energy charges will transfer to the Highway and Flood Authority.

14.6 COMMUTED SUMS

In certain circumstances the developer may be required to pay to the Highway and Flood Authority a commuted sum. Commuted sums are calculated to compensate the Highway and Flood Authority for additional maintenance costs that result from a developer's specification. Further details are given in Clause 1.1.22.

15. PLANTING

15.1 PLANTING WITHIN VERGES

Subject to specific scheme approval, ground cover planting will be considered, in verges (areas between carriageways and footways that do not contain Statutory Undertaker's plant. Areas containing such plant shall be termed Service Margins) as specified and detailed in "The Lincolnshire Development Roads and Sustainable Drainage Design Guide". **Visibility splays shall not be compromised by planting.**

Planting will NOT be permitted within Service Margins.

15.2 TREES

15.2.1 Where trees are permitted within highway limits, they shall not be planted in a manner so as to impede visibility when they are fully grown. Trees shall normally be over 1.5m and up to 3.0m overall size. They shall be obtained from an approved supplier with planting carried out between early November and March. Usually it is better to plant before mid-December, but on wet heavy soil late planting may be preferable.

15.2.2 Planting schemes, including tree species, will require the written approval of the Highway and Flood Authority and shall include details of a suitable root containment system. Where multiple trees are to be planted, a perimeter root barrier shall be installed with the agreement of the Highway and Flood Authority.

15.2.3 No Planting is to be carried out in periods of sustained frost or when the ground is frozen.

15.2.4 All plants should be well formed and healthy conforming to BS 3936. All container grown stock 8-10cm and 10-12cm should be supplied in white containers.

15.2.5 Acceptable planting methods are as follows:

Method 1	-	Single stake
Method 2	-	Double stake and bar
Method 3	-	Double stake, bar and weld mesh
cage Method 4	-	Single stake and weld mesh cage
Method 5	-	Town guard
Method 6	-	Single stake and tree tube
Method 7	-	Bamboo cane and spiral guard
Method 8	-	Single stake and spiral guard

Where trees are planted within block paved home zone areas root directors shall be installed.

FIGURE 15/3 - TREE PLANTING DETAIL
(Method 1) The Single Stake Method

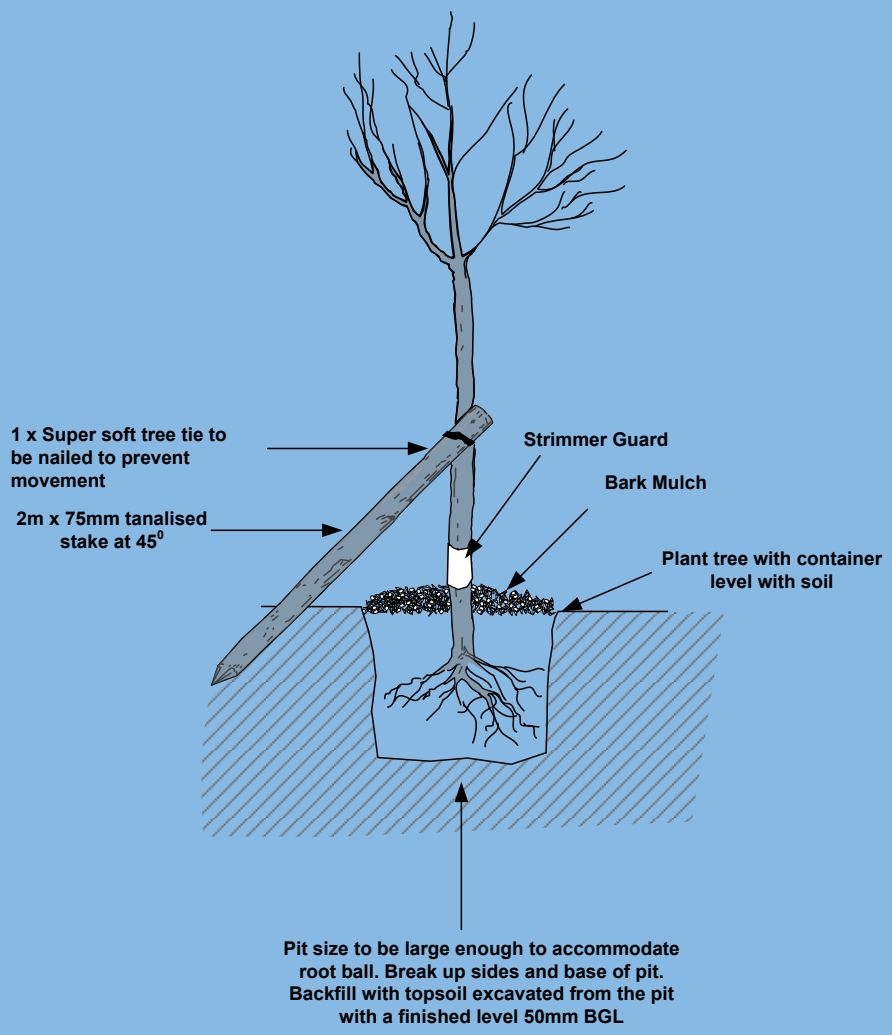
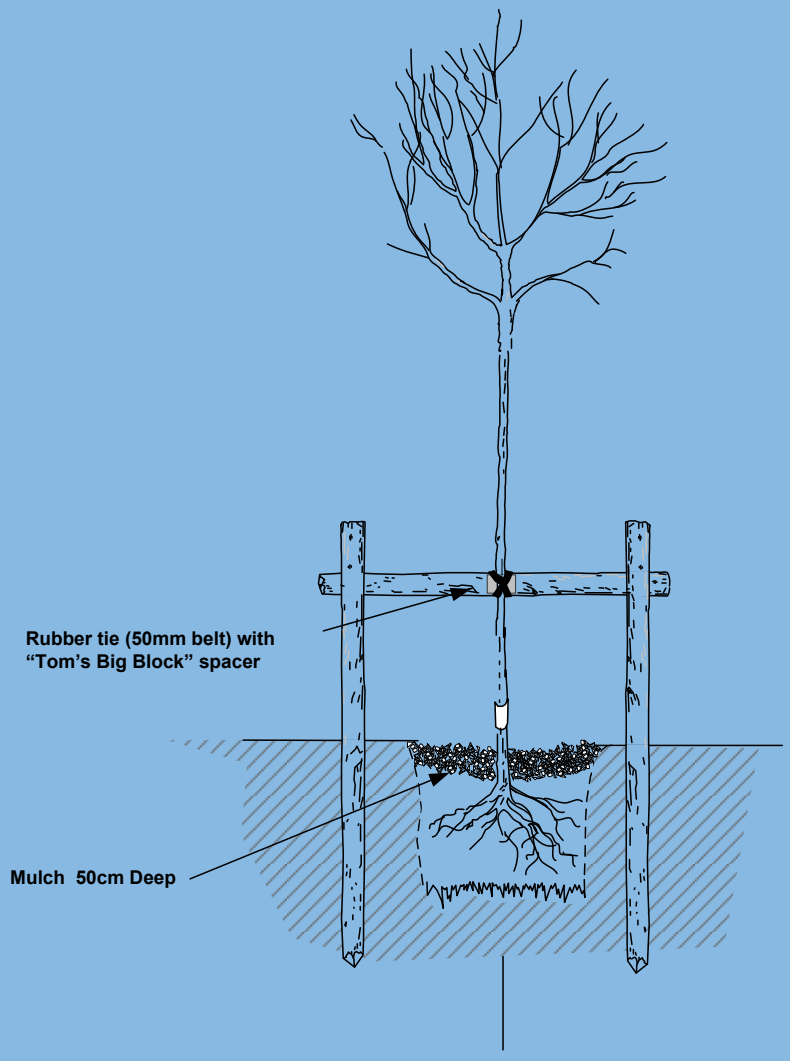
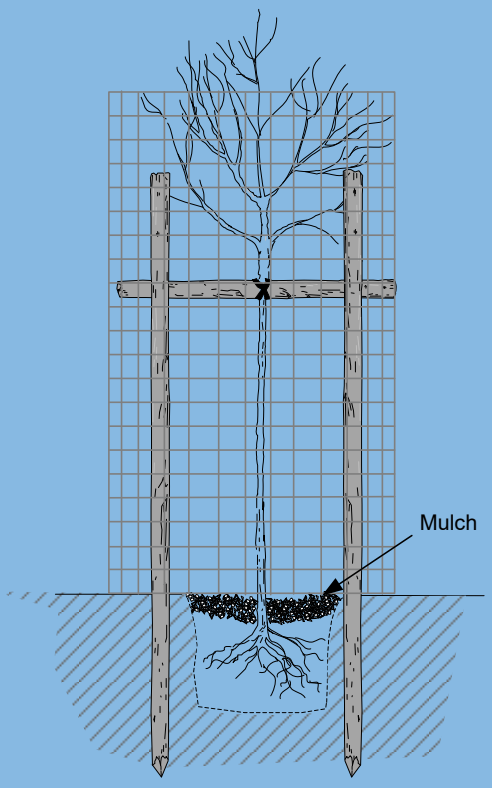


FIGURE 15/4 - TREE PLANTING DETAIL
(Method 2) The Double Stake and Bar Method

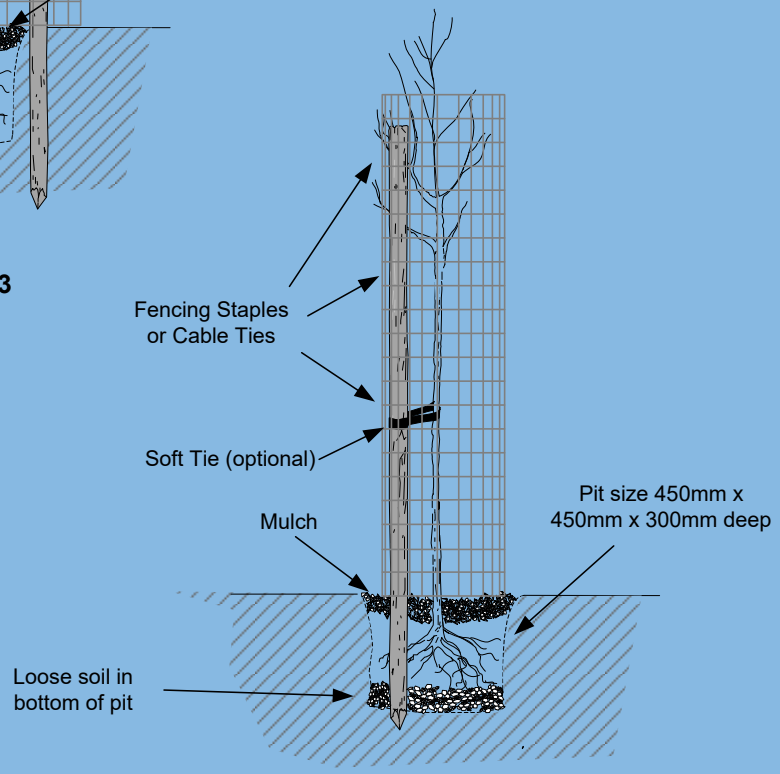


Notes
Protect from drying out in summer
Protect from damage by strimmers

FIGURE 15/5 - TREE PLANTING DETAIL
(Methods 3 & 4) Mesh Supported Trees

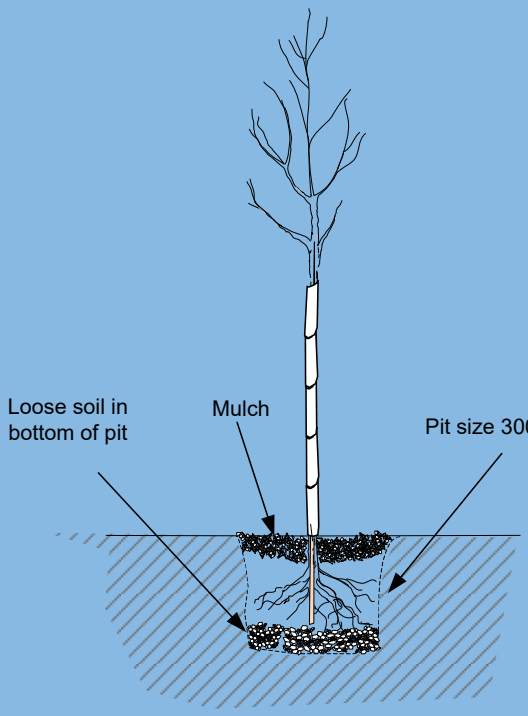


Method 3

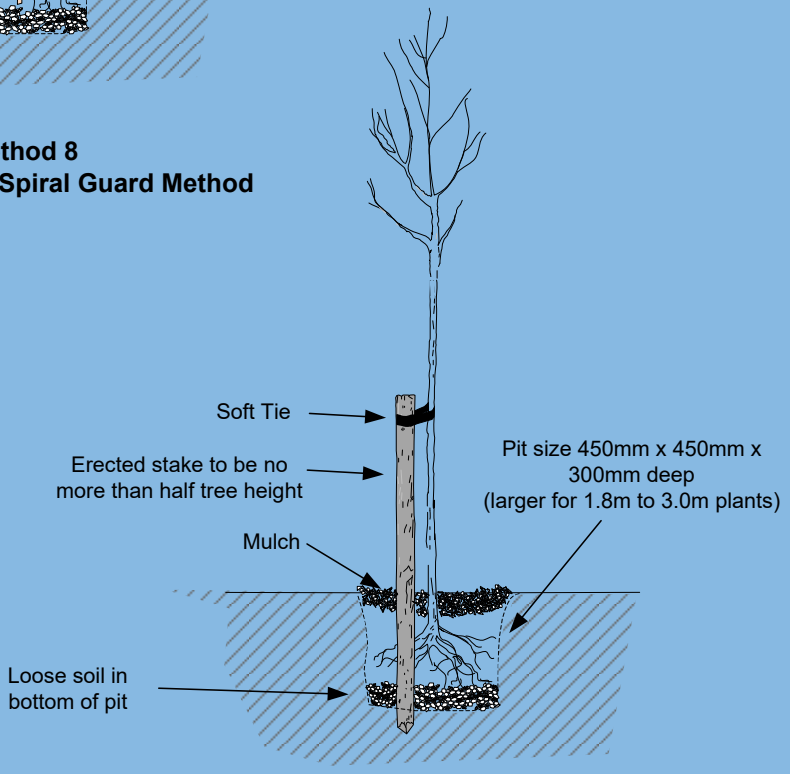


Method 4

FIGURE 15/6 - TREE PLANTING DETAIL
(Methods 7 & 8) Spiral Guard Methods



Method 8
Bamboo Cane & Spiral Guard Method



Method 8
Single Stake & Spiral Guard Method

EXAMPLE – APPENDICES 7/1

APPENDIX 7/1 – PERMITTED PAVEMENT OPTIONS – FLEXIBLE CONSTRUCTION

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

THIS APPENDIX COMPRISES 5 SCHEDULES:

SCHEDULE 1 THIS DEFINES THE EXTENT OF VARIOUS PAVEMENT OPTIONS. ON MANY SMALLER SCHEMES ONLY ONE OPTION WILL BE CHOSEN BY THE DESIGNER.

INSERT THE FOLLOWING:-

DRAWING REF - SCHEME DRAWING NUMBER

SECTION - NORMALLY DEFINED BY CHAINAGES

GENERAL REQUIREMENT- SELECT APPROPRIATE FROM SCHEDULE 2 TO SUIT SECTION IN QUESTION

PERMITTED PAVEMENT OPTION – SELECT APPROPRIATE FROM SCHEDULE 3 TO SUIT SECTION IN QUESTION.

SCHEDULE 1

Schedule 1: Permitted Pavement Options			
Drawing Ref	**Section**	**General Requirements**	**Permitted Pavement Option**

APPENDIX 7/1 – PERMITTED PAVEMENT OPTIONS –GENERAL REQUIREMENTS

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

SCHEDULE 2 GENERAL REQUIREMENTS

Insert the Following:-

Insert sections as "described" or "ch from & ch to" for each section

Category of Road	***Category of road is determined from Appendix 1.4B Code of Practice Highway Works: Standards, Materials and Testing as follows:-***
	The category of each section of road shall be
	(a) Category A shall be applied to all Section 278 works
Interval of Measurement - of transverse regularity	***Usually 10 m intervals but may very according to location ie. Belmouths etc.***
Surface texture Required Clause 921SR	***Surface texture is required for Hot Rolled Asphalt (HRA)surfacing that includes coated chippings and Stone Mastic Asphalt (SMA) surface courses If Yes – complete and compile Schedule 5 If No – ignore***

SCHEDULE 2

Schedule 2: General Requirements			
	Sections/ Chainage from		
	Chainage to		
Grid for checking surface levels of pavement courses	Machine Lay	Longitudinal dimension	10 metres
		Transverse dimension	2 metres
	Hand Lay	Longitudinal dimensions	5 metres
		Transverse dimensions	1 metre
Surface regularity: Clause 702.7 Table 7/2		Category of Road	.....
Interval for measurement of longitudinal regularity:			All lengths
Interval of measurement of transverse regularity:			.....
Surface texture required: Clause 921SR			Yes/No

APPENDIX 7/1: PERMITTED CONSTRUCTION MATERIALS –CONVENTIONAL CONSTRUCTION

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

SCHEDULE 3: PERMITTED ALTERNATIVE COMBINATIONS OF CONSTRUCTION

PAVEMENT LAYER - For given section in Schedule 1 select appropriate Pavement Option A, B, or C etc (or another agreed with the Highway and Flood Authority)

Note: For key to Material References (HRASC etc) – See Schedule 5

CONVENTIONAL CONSTRUCTION (UNREINFORCED)

Base:- For new works insert required thickness from Section 2.0

Sub-base:- For new works insert required thickness from Section 2.0

CONVENTIONAL CONSTRUCTION (REINFORCED)

Base and sub-base as the Unreinforced Construction above.

Asphalt reinforcing Grid – Refer to notes below:-

Geosynthetic Asphalt Reinforcing Grids (GARG) shall be considered where the new construction abuts the existing construction. Seek advice from the Highway and Flood Authority.

Insert depth below carriageway surface at which grid reinforcement is required.

Insert depth below carriageway surface at which grid reinforcement is required

Insert "total thickness" – dependant on figures preceding.

SCHEDULE 3

CONVENTIONAL CONSTRUCTION (UNREINFORCED)

Pavement Layer	Pavement Option A		Pavement Option B	
	Material Reference	Thickness	Material Reference	Thickness
Surface Course	HRASC LCCSPM	40 mm	HRASC LCCST	40 mm
Binder Course	DBMBC	60 mm	DBMBC	60 mm
Base	DBMBC	.....mm	DBMBC	.....mm
Sub-base	GSB1	.....mm	GSB1	.....mm
Total Thickness		**.....mm**		**.....mm**

Pavement Layer	Pavement Option C	
	Material Reference	Thickness
Surface Course	CGMSC	40 mm
Binder Course	DBMBC	60 mm
Base	DBMBC	.....mm
Sub-base	GSB1	.....mm
Total Thickness		**.....mm**

APPENDIX 7/1: PERMITTED CONSTRUCTION MATERIALS –CONVENTIONAL CONSTRUCTION

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

SCHEDULE 3: PERMITTED ALTERNATIVE COMBINATIONS OF CONSTRUCTION

PAVEMENT LAYER - For given section in Schedule 1 select appropriate Pavement Option A, B, or C etc (or another agreed with the Highway and Flood Authority)

Note: For key to Material References (HRASC etc) – See Schedule 5

CONVENTIONAL CONSTRUCTION (UNREINFORCED)

Base:- For new works insert required thickness from Section 2.0

Sub-base:- For new works insert required thickness from Section 2.0

CONVENTIONAL CONSTRUCTION (REINFORCED)

Base and sub-base as the Unreinforced Construction above.

Asphalt reinforcing Grid – Refer to notes below:-

Geosynthetic Asphalt Reinforcing Grids (GARG) shall be considered where the existing surface is cracked, crazed concrete or in other exceptional circumstances. In such cases it may also be appropriate to use a rubber based surface and/or binder course in accordance with Clause 931SR. Alternatively a polymer modified binder may be appropriate, seek advice from Lincs Laboratory. When placed under a surface course a GARG requires the surface course to have a minimum compacted thickness of 40mm.

Advice shall be sought from Lincs Laboratory prior to using this technique and completing Appendix 7/1.

Insert depth below carriageway surface at which grid reinforcement is required.

Insert depth below carriageway surface at which grid reinforcement is required

Insert "total thickness" – dependant on figures preceding.

SCHEDULE 3 Continued

CONVENTIONAL CONSTRUCTION (REINFORCED)

Pavement Layer	Pavement Option AR			Pavement Option BR		
	Material Reference	Thickness	Installation Depth Below Carriageway surface	Material Reference	Thickness	Installation Depth Below Carriageway surface
Surface Course	HRASC LCCSPM	40 mm		HRASC LCCST	40 mm	
Asphalt Reinforcing Grid	GARG		.....mm	GARG		.....mm
Binder Course	DBMBC	60 mm or 100 mm	.....mm	DBMBC	60 mm or 100 mm	.....mm
Asphalt Reinforcing Grid	GARG or SARG		.....mm	GARG or SARG		.....mm
Base	DBMBC	.....mm		DBMBC	.....mm	
Sub-base	GSB1	.....mm		GSB1	.....mm	
Total Thickness		.....mm			.....mm	

Pavement Layer	Pavement Option CR		
	Material Reference	Thickness	Installation Depth Below Carriageway surface
Surface Course	CGMSC	40 mm	
Asphalt Reinforcing Grid	GARG		.....mm
Binder Course	DBMBC	60 mm or 100 mm	.....mm
Asphalt Reinforcing Grid	GARG or SARG		.....mm
Base	DBMBC	.....mm	
Sub-base	GSB1	.....mm	
Total Thickness		.....mm	

APPENDIX 7/1: PERMITTED CONSTRUCTION MATERIALS – HIGH FRICTION

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

PAVEMENT LAYER - For given section in Schedule 1 select appropriate pavement option.

Note: For key to Material References (HFS etc) – See Schedule 5

HIGH FRICTION CONSTRUCTION (UNREINFORCED)

The suitability for use of High Friction surfaces is determined from Table 4 of Section 1.4 of the Code of Practice Highway Works: Standards, Materials and Testing.

Binder course:- see note above.

Base:- For new works insert required thickness from Section 2.0

Sub-base:- For new works insert required thickness from Section 2.0

HIGH FRICTION CONSTRUCTION (REINFORCED)

Base and sub-base as the Unreinforced Construction above.

Asphalt reinforcing Grid – Refer to notes below:-

Geosynthetic Asphalt Reinforcing Grids (GARG) shall be considered where the existing surface is cracked, crazed concrete or in other exceptional circumstances. In such cases it may also be appropriate to use a rubber based surface and/or binder course in accordance with Clause 931SR. Alternatively, a polymer modified binder may be appropriate seek advice from Lincs Laboratory. When placed under a surface course a FARG requires the surface course to have a minimum compaction of thickness of 40mm.

Advice should be sought from Lincs Laboratory prior to using this technique and completing Appendix 7/1.

Insert depth below carriageway surface at which grid reinforcement is required.

Insert depth below carriageway surface at which grid reinforcement is required
Insert "total thickness" – dependant on figures preceding.

SCHEDULE 3 (continued)

HIGH FRICTION CONSTRUCTION (UNREINFORCED)

Schedule 3: Permitted Construction Materials (continued)						
Pavement Layer	**Pavement Option HFA**		**Pavement Option HFB**		**Pavement Option HFC**	
	Material Reference	**Thickness**	**Material Reference**	**Thickness**	**Material Reference**	**Thickness**
Surfacing Treatment	HFS		HFS		HFS	
Surfacing Treatment Substrate	HRA HFS	40 mm	TSCS	40 mm	SMASC	40 mm
Binder Course	DBMBC	60 mm	DBMBC	60 mm	DBMBC	60 mm
Base	DBMBC	.....mm	DBMBC	.....mm	DBMBC	……mm
Sub-base	GSB1	.....mm	GSB1	.....mm	GSB1	.....mm
Total Thickness		**.....mm**		**.....mm**		**.....mm**

HIGH FRICTION CONSTRUCTION (REINFORCED)

Schedule 3: Permitted Construction Materials									
Pavement Layer	**Pavement Option HFRD**			**Pavement Option HFR E**			**Pavement Option HFR F**		
	Material Reference	**Thickness**	**Installation Depth Below Cgway surface**	**Material Reference**	**Thickness**	**Installation Depth Below Cgway surface**	**Material Reference**	**Thickness**	**Installation Depth Below Cgway surface**
Surfacing Treatment	HFS			HFS			HFS		
Surfacing Treatment Substrate	HRA HFS	40 mm		TSCS	40 mm		SMASC	40 mm	
Binder Course	DBMBC	60 mm or 100 mm	.....mm	DBMBC	60 mm or 100 mm		DBMBC	60 mm or 100 mm	
Asphalt Reinforcing Grid	GARG or SARG			GARG or SARG			GARG or SARG		
Base	DBMBC	.....mm		DBMBC	.....mm		DBMBC	.....mm	
Sub-base	GSB1	.....mm		GSB1	.....mm		GSB1	.....mm	
Total Thickness		.....mm			.....mm			.....mm	

APPENDIX 7/1: PERMITTED FOR CONSTRUCTION MATERIALS

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

SCHEDULE 4

Clause 801.7	***All materials within 450 mm of finished carriageway level shall be not Frost susceptible.***
Clause 802.7	***Compacted Layer thicknesses must comply with Clause 802.7***
Clause 901.6, 901.9 & 942.5	***See Lincolnshire Clauses.***
Clause 903.15	***See Lincolnshire Clauses***
Clause 903.39	***If there is the likelihood that areas of the works will be used for temporary trafficking prior to the surface course being laid, then application of PSV values for such intermediate layers shall be imposed. A minimum PSV_{55} shall be specified unless advised otherwise by Lincs Laboratory's consultancy section.***

SCHEDULE 4

Schedule 4: General Requirements for Construction Materials	
Clause	**Requirement**
801.7	Clause 801.7 Applies
901.6, 901.7, 901.8, 902.2, 903.28, 903.29, 903.30, 903.31 & 942.5	Clause 901, 902, 903SR, 942SR and 978AR Apply
903.39SR	Minimum PSV to temporary running surface is: 55

APPENDIX 7/1: PERMITTED FOR CONSTRUCTION MATERIALS

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

SCHEDULE 5

Note: ***The suitability of these construction types is determined from the Code of Practice for Highway Works: Standards Materials and Testing. Material Reference used in Schedule 3 of Appendix 7/1.***

Dense Asphalt Concrete Binder Course

Only crushed slag or crushed rock aggregate as both coarse and fine aggregate is permitted in the binder course in roads with a Wheel Tracking Classification of 1 or 2 as given in Table 2E of Departmental Document, The Code of Practice Highway Works Standards, Material and Testing. Also see LCC Appendix 1.1A of the Code. Consult Lincs Laboratory.

If the binder course is to be used as a temporary running surface a minimum PSV_{55} shall be specified for the course aggregate unless otherwise advised by Lincs Laboratory.

Asphalt Reinforcing Grid – Refer to notes below:-

Geosynthetic Asphalt Reinforcing Grids (GARG) shall be considered where the existing surface is cracked, crazed concrete or in other exceptional circumstances. In such cases it may also be appropriate to use a rubber based surface and/or binder course in accordance with Clause 931SR. Alternatively a polymer modified binder may be appropriate. Seek advice from Lincs Laboratory. When placed under a surface course a GARG requires the surface course to have a minimum compacted thickness of 40mm.

Advice should be sought from Lincs Laboratory prior to using this technique and completing Appendix 7/1.

For PSV and AAV value refer to Tables 4 and 5 of the Code of Practice Highway Works: Standards, Materials and Testing.

For nominal layer thickness refer to notes for Schedule 3

For CGMSC the BS 594987 traffic category is 'A' for all sites in Lincolnshire

For PSV and AAV refer to Tables 4 and 5 of the Code of Practice Highway Works: Standards, Materials and Testing.

70/100 grade binder may be used in CGMSC where a close graded surface course material with enhanced surface durability is desirable. Advice should be sought from Lincs Laboratory when considering the use of this grade of binder.

Exceptionally 70/100 grade binder may be deployed in DBMD(S)C where some movement in the underlying materials is anticipated. Lincs Laboratory shall be consulted in such circumstances.

SCHEDULE 5

Schedule 5: Requirements for Construction Materials			
Material Reference	**Clause**	**Description**	**Requirement**
GSB 1	803	Granular Sub base Material Type 1	Minimum in-situ CBR 30% or more when tested by Plate Bearing Test
GARG	770AR	Geosynthetic Asphalt Reinforcing Grid	See facing note for when to use this grid and its location
DBMBC	934	Dense Asphalt Concrete Binder Course	BS EN 13108-1 and 0975AR LCC Annex B AC 20 Dense bin 40/60 Recipe mixture Bitumen Grade 40/60 pen 20 mm size dense binder course Coarse aggregate: Crushed rock or slag, Gravel is .... (not) permitted Fine aggregate: Crushed rock or slag. Natural sand is... (not) permitted. If to be used as a running surface minimum PSV ….. Bond and air void requirements to Clause 903SR
CGMSC	912	Close Graded Asphalt Concrete Surface Course	BS EN 13108-1 and 0975AR LCC Annex B AC 10 Close surf 100/150 or 70/100. Aggregate Types: Crushed rock or slag 10 mm size close graded surface course Traffic category: A Minimum PSV ..... Maximum AAV ..... Bitumen Grade (100/150 pen or 70/100 pen).....pen Bond and air void requirements to Clause 903SR Minimum air temperature for laying Surface course: -1^{o}C
DBMBSC	934	Dense Asphalt Concrete Binder Course as Surface Course	BS EN 13108-1 and 0975AR LCC Annex B AC20 Dense Bin 40/60 Recipe mixture Bitumen Grade 40/60 pen 20 mm size dense binder course Coarse aggregate, Crushed rock or slag only Fine aggregate: Crushed rock or slag. Natural sand is... (not) permitted. Minimum PSV of coarse aggregate ..... Maximum AAV of coarse aggregate ..... Bond and air void requirements to clause 901SR.

SCHEDULE 5 CONTINUED

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

Note: ***The suitability of these construction types is determined from the Code of Practice for Highway Works: Standards Materials and Testing. Material Reference used in Schedule 3 of Appendix 7/1.***

For selection ***If LCC SPECIAL MIX (HRASC LCC SPM) or HIGH STIFFNESS MIX (HRASC LCC SPM WT2) see section 1.3 and Table 2 of the Code of Practice for Highway Works: Standards Materials and Testing.***

For PSV and AAV refer to Tables 4 and 5 of the Code of Practice for Highway Works: Standards Materials and Testing.

For PSV and AAV refer to Tables 4 and 5 of the Code of Practice for Highway Works: Standards Materials and Testing.

High Friction Surfacing type (HFS) as determined from Section 1.3 and Table 2 of the Code of Practice for Highway Works: Standards Materials and Testing.

APPENDIX 7/1

REQUIREMENTS FOR CONSTRUCTION MATERIALS
SCHEDULE 5 (CONTINUED)

Schedule 5:Requirements for Construction Materials			
Material Reference	**Clause**	**Description**	**Requirement**
HRASC LCCSPM	911SR	Hot Rolled Asphalt Surface Course (Design Mix)	**LCC SPECIAL MIX** BS EN 13108-4 and 0976AR LCC Annex C HRA 30/14 F surf 40/60 des Wheel tracking (Clause 911SR) and 2 mm/hr, 4 mm max @ 45.^{o}C (BS598 Part 110) or $WTR_{AIR\ 5,0}$ and $RD_{AIR\ 3,0}$ to BS EN12697-22: 2003 small device procedure A at 45^{o}C. Alternatively if wheel tracking results are not available the following applies: Marshall Stability 6 kN to 10 kN Marshall Flow: (Clause 911SR) 5 mm Aggregate Types: Crushed rock or slag Designation: 30/14F Bitumen Grade: 40/60 pen Minimum PSV: 45 Maximum AAV: 16 Bond and air void requirements to Clause 901SR Minimum air temperature for laying Surface course: 5^{o}C Coated chippings (Clause 915):- 14/20 mm size Minimum PSV: ..... Maximum AAV:..... Texture Depth (Clause 921SR) 0.75 mm - 1.30 mm TM2.
HRASC LCCSPM WT2	911 SR	Rolled Asphalt Surface Course (Design Mix). LCC High Stiffness Mix Wheel Tracking Class 2.	**LCC HIGH STIFFNESS MIX** BS EN 13108-4 and 0976AR LCC Annex C HRA 30/14 F Surf pmb des. Wheel Tracking (Clause 911 SR) 5 mm/hr, 7 mm max @ 60°C to BS 598 Part 110 or $WTR_{AIR15,0}$ $RD_{AIR7,0}$ to BS EN 12697-22:2003 small device procedure at 60°C. Aggregate Types: Crushed rock or slag Designation: 30/14F Bitumen Grade: Polymer Modified Minimum PSV: 45 Maximum AAV: 16 Bond and air void requirements to Clause 903 SR. Minimum air temperature for laying Surface course: 5°C Coated Chippings (Clause 915):- 14/20 mm size Minimum PSV: ……. Maximum AAV: …… Texture Depth (Clause 921 SR) 0.75 mm – 1.30 mm TM2

SCHEDULE 5 CONTINUED

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

Note: ***The suitability of these construction types is determined from the Code of Practice for Highway Works: Standards Materials and Testing.***

Material Reference used in Schedule 3 of Appendix 7/1.

For selection if LCC SPECIAL MIX or STANDARD MIX see Section 1.3 and Table 2 of the Code of Practice for Highway Works: Standards Materials and Testing.

High Friction Surfacing Type (HFS) as determined from Section 1.3 and Table 2 of the Code of Practice: Highway Works for Standards Materials and Testing.

HRASC LCCST	911SR	Hot Rolled Asphalt Surface Course (Design Mix)	**LCC STANDARD MIX** BS EN13108-4 and 0976AR LCC Annex C HRA 30/14 F surf 40/60 des Marshall Stability Target: 4 kN to 8 kN Marshall Flow: (Clause 911SR) 5 mm Aggregate Types: Crushed rock or slag Designation: 30/14F Bitumen Grade: 40/60 pen Minimum PSV: 45 Maximum AAV: 16 Minimum air temperature for laying Surface course: 5°C Coated Chippings (Clause 915):- 14/20 mm size Minimum PSV: ..... Maximum AAV: ..... Bond and air void requirements to Clause 901SR Texture Depth (Clause 921SR) 0.75 mm - 1.30 mm MTM. For Texture Meter 2 (TM 2) equivalent values apply
HFS	924	High Friction Surface Treatment	H.F.S. Type ..... Minimum PSV 70 Certification required to demonstrate the system has current HAPAS certificate

SCHEDULE 5 CONTINUED

DESCRIPTION IN ACCORDANCE WITH BS EN TITLES

Note: ***The suitability of these construction types is determined from the Code of Practice for Highway Works: Standards Materials and Testing.***

Material Reference used in Schedule 3 of Appendix 7/1.

HRAHFS – For use only as a substrate for High Friction Surfacing (HFS) or as a patching material for small areas or as a pot hole reinstatement material. Material with 40/60 binder is used as a substrate to HFS. 100/150 binder is used for patching or reinstatement materials. See Section 1.3 and Table 2 of the Code of Practice for Highway Works: Standards Materials and Testing.

(Advice should be sought from Lincs Laboratory prior to specifying this mix).

APPENDIX 7/1

REQUIREMENTS FOR CONSTRUCTION MATERIALS
SCHEDULE 5 (CONTINUED)

Schedule 5:Requirements for Construction Materials			
Material Reference	**Clause**	**Description**	**Requirement**
HRAHFS	911SR	Rolled Asphalt Surface Course Design Mix (H.F.S. Substrate and patching material)	BS EN 13108-4 and 0976 AR LCC Annex C HRA 55/10 F or C surf 40/60 Wheel tracking (Clause 911SR) 5 mm/hr,7 mm max @ 60°C to BS 598 Part 110 or $WTR_{AIR15,0}$ $RD_{AIR7,0}$ to BS EN 12697-22:2003 small device procedure A at 60°C. Alternatively if wheel tracking results are not available the following applies; Marshall Stability Range: 8 kN to 16 kN Marshall Flow: (Clause 911SR) Maximum 5 mm Aggregate Types: Crushed rock or slag Designation: 55/10 F or C Bitumen Grade: 40/60 pen Minimum PSV: 55 Maximum AAV: 16 Minimum air temperature for laying Surface course: 5°C Bond and air void requirements to Clause 903SR

SCHEDULE 5 CONTINUED

For Minimum Polished Paviour Value see Table 4 of the Code of Practice for Highway Works: Standards Materials and Testing.

See Clause 772AR for requirement of Laying Course Sand and category.

16. PUBLICATIONS

All publications listed are the current editions unless otherwise specified.

16.1 BRITISH STANDARDS

Published by British Standards Institution, 389 Chiswick High Road, London, W4, 4AL.

BS	Title
65	Vitrified clay pipes and joints
EN124	Manhole covers, road gully gratings and frames for drainage purposes
EN206	Concrete, specification, performance, production and conformity
EN295	Vitrified clay pipes
EN317	Particleboards and fibreboards
434	Bitumen road emulsions
437	Cast iron spigot and socket drain pipes and fittings
EN545	Ductile iron pipes, fittings, accessories and their joints for water pipelines
EN598	Ductile iron pipes, fittings, accessories and their joints for sewerage
598	Sampling and examination of bituminous mixtures for roads and other
743	Specification for materials for damp-proof courses
EN752	Drain and sewer systems outside buildings planning
EN771-1	Specification for masonry units. Clay masonry units
EN771-3	Specification for masonry units. Aggregate concrete masonry units
EN772	Methods of test for masonry units
812	Testing aggregates
EN1097	Tests for mechanical and physical properties of aggregates
1247	Manhole step irons
EN1338	Concrete Paving Blocks. Requirements and Test Material.
EN1295-1	Structural design of buried pipelines under various conditions of loading
EN1339	Concrete paving blocks. Requirements and Test Material
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EN1344	Clay pavers. Requirements and Test Methods
1377	Methods of test for soils for civil engineering purposes
EN1388	Concrete paving blocks. Requirements and test methods
EN1401	Plastic piping systems for non-pressure underground drainage and sewerage
EN1436	Road Marking materials – Road marking performance for road users
EN1452	Joints and fittings for use with Unplasticised PVC pressure pipes
EN ISO 1461	Specification for hot dip galvanised coatings on iron and steel articles
EN1744	Tests for chemical properties of aggregates
EN1996	Design of Masonry Structures
ISO 2602	Guide to statistical interpretation of data. Estimation of mean: confidence
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3882	Specification for Topsoil
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5178	Prestressed concrete pipes for drainage and sewage
5489	Road lighting (Part 1-10)
5911	Precast concrete pipes and fittings for drainage and sewage
5930	Site investigation
6398	Specification for bitumen damp-proof courses for masonry
6515	Specification for polyethylene damp-proof courses for masonry
7533	Guide for structural design of pavements constructed with clay or concrete block pavers

7533-3	Code of Practice for laying precast concrete paving blocks and clay pavers for flexible pavements.
7533-13	Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers.
7671	Requirements for electrical installations
8204-2	Screeds, bases and in situ floorings concrete wearing surfaces. Code of Practice
8215	Code of Practice for the Design and Installation in damp-proof courses in masonry construction
8420	Methods of measuring irregularities on surfaces of roads, footways and other paved areas using straight edges and wedges
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8515	Rainwater harvesting systems. Code of Practice
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EN ISO 9004	Quality management systems, Guidelines for performance improvements
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EN ISO 10319	Geotextiles. Wide width tensile test
EN ISO 11058	Geotextiles and geotextile related products : determination of water permeability
EN ISO 12460-5	Wood based panels
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EN12620	Aggregates for concrete
EN 12697	Bituminous mixtures. Test methods for hot mix asphalt
EN 1S0 12956	Geotextiles and geotextile related products. Determination of the characteristic
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EN13043	Aggregates for bituminous mixtures and surface treatments for roads, airfields
EN13101	Steps for underground man entry chambers
EN 13108	Bituminous mixtures. Material specifications
EN13139	Aggregates. Aggregates for mortar
EN13201	Road Lighting
EN13242	Aggregates for unbound and hydraulically bound materials for use in civil
EN13285	Unbound mixtures. Specification
EN13286	Unbound and hydraulically bound mixtures
EN 13808	Bitumen and bituminous binders. Framework for specifying cationic bituminous
EN14364	Plastic piping systems for drainage and sewerage with or without pressure
EN ISO / ICC 17021	Conformity assessment - Requirements for bodies providing audit and certification of management systems
EN 1S0 / IEC 17025	General requirements for the competence of testing and calibration laboratories
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PD	**Title**
6678	Guide to the specification of masonry mortar – Possible BS EN998
6682	Aggregates. Guidance on their use
6691	Guidance on the use of BS EN 13108 Bituminous mixtures – Material
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CEN/TR 15019	Geotextiles and geotextile – related products – on site quality control

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Lincolnshire Development Roads and Sustainability Drainage Design Approach

A Guide to Parking Provision

Maintenance Design Manual

Published by Water Research Centre, Frankland Road, Blagrove, Swindon, Wiltshire SN5 8YF

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Managing Reclaimed Asphalt – Highways and Pavements.

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Published by CIRIA (Construction Industry Research and Information Association), Griffon Court, 15 Long Lane, London EC1A 9PN

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SW1H 0BH

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