ROADS

PAVING WORK

General Work Specification – GWS

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Replaces
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Danish Road Standards Committee

Vejdirektoratet

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1. GENERAL

"General Work Specification (GWS) for paving works" includes execution of paving works of concrete and natural stone as well slabs on a solid base. The GWS contains functional requirements for the finished pavement and requirements for materials, execution and control. The material requirements and characteristics specified are consistent with:

- DS/EN 1338	Concrete paving blocks – Requirements and test methods
- DS/EN 1339	Concrete paving flags - Requirements and test methods
- DS/EN 1340	Concrete kerb units - Requirements and test methods
- DS/EN 1341	Slabs of natural stone for external paving - Requirements and test methods
- DS/EN 1342	Setts of natural stone for external paving - Requirements and test methods
- DS/EN 1343	Kerbs of natural stone for external paving - Requirements and test methods
- DS/EN 1344	Clay pavers - Requirements and test methods

with related test methods

- DS/EN 1926	Natural stone test methods. Determination of uniaxial compressive strength
- DS/EN 12371	Natural stone test methods - Determination of frost resistance
- DS/EN 12407	Natural stone test methods - Petrographic examination
- DS/EN 13242	Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
- DS/EN 933-1	Determination of particle sizedistribution - Sieving method
- DS/EN 933-5	Determination of percentage of crushed and broken surfaces in coarse aggregate particles

-DS/EN 933-8	Annex A Procedure for the determination of the sand equivalent value

The work specification also incorporates relevant provisions from

- DS 1136	Paving works
- DS/INF 156	Guidance paper - Application of the standards for concrete paving blocks, flags and kerb units

1.1 Services provided by the Contractor

The Contractor shall perform all work that is necessary for the completion of the facility.

1.2 Functional requirements

The final result shall appear as an aesthetical whole adapted to fixed objects with even surfaces, cambers and slopes as well as straight alignment and heights, and thus provide a pleasing visual impression and the desired function.

2. MATERIALS

2.1 General requirements

2.1.1 New materials

All new materials shall be provided in accordance with applicable Danish standards, including European standards approved as Danish standards (DS/EN standards); see, e.g. requirement for CE marking.

2.1.2 New concrete products

All concrete products shall be controlled and marked by the supplier to comply with the requirements specified in Danish standards, including the national annexes to DS/EN 1338, -39 and -40.

Resistance to frost/thaw with deicing salt shall be ≤ 1.0 kg/m^2 determined in accordance with Annex D in DS/INF 156, and no single value shall be > 1.5 kg/m^2.

Wearing resistance shall be ≤ 23 mm determined in accordance with Annex G in DS/INF 156.

Friction coefficient shall be declared according to Annex I in DS/EN 1338, DS/EN 1339 and DS/EN 1340.

2.1.3 Recycled materials

Used materials should not be expected to comply with the material standards. Such materials can only be used if they comply with agreed/defined alternative material requirements.

2.2 Laying and setting materials

Laying and setting materials (paving gravel) consists of material with particle size 0-8. The requirements are:

Mesh size (mm)	**Passing fraction (mass percentage)**
11.2	100
8	85 - 99
0.25	0 - 25
0.063	0 - 9

- Sand equivalent SE ≥ 30
- Uniformity coefficient U ≥ 3
- Content of uncrushed particles (round grains) shall not exceed 30%
- Normative reference DS/EN 13242: All-in, D = 8 mm, G_A 85, f_9

For laying and setting material of cement bound gravel the mass ratio (cement:paving gravel) 1:4 or 1:5 shall be used.

For setting of concrete kerbstones and facing and infilling, soil-moist concrete with strength 16 MPa shall be used.

2.3 Paving stones, granite setts and mosaics

New paving stones (carriageway stones) and granite setts (pavement stones) of natural stone shall be made of granite, see DS/EN 1342 and DS/EN 12407.

Mosaics shall be granite or other natural stone, see DS/EN 12407, and be 50-70 mm or 50-90 mm in width/length/depth.

2.4 Cobblestones/fieldstones

For cobblestone paving/fieldstone paving, hand sorted, mainly rounded fieldstones, gravel pit stones or marine rubble, see DS/EN 12407; possibly cut.

2.5 Kerbstones

Concrete kerbstones shall observe the following requirements:

- Pavement edge supports and verge edge supports in accordance with DS/EN 1340.
- Kerbstones that can be nailed and glued in accordance with DS/EN 1340 and the supplier's instructions

New kerbstones of natural stone shall be made of granite, see DS/EN 1343 and DS/EN 12407.

2.6 Gutter

New concrete gutters shall observe the requirements of DS/EN 1340.

2.7 Slabs

Natural stone slabs shall be of granite or other natural stone, see DS/EN 1341 and DS/EN 12407.

Concrete slabs shall observe the requirements of DS/EN 1339.

2.8 Concrete paving stones

Concrete paving stones shall observe the requirements of DS/EN 1338.

2.9 Tiles

Hard-fired tiles shall observe the requirements of DS/EN 1344.

2.10 Joint filler

Materials for joint filling (grain size 0-2) shall, in respect of 2-5 mm joints, observe the requirements

Mesh width	**Passing fraction**

(mm)	(mass percentage)
4	100
2	80 - 99
0.25	4 - 30
0.063	0 - 10

Normative reference DS/EN 13242: Fine, D = 2 mm, G_F 80, f_{10}

The aim is to have a fines content (< 0.063 mm) between 4 and 10%.

For joints greater than 5 mm, paving gravel with an intended fines content (< 0.063 mm) between 5 and 9% shall be used.

3. EXECUTION

3.1 General requirements

3.1.1 Base

Base means the layer under the laying and setting material or the regulating course.

Prior to the paving work, the Contractor shall perform a supervision to ensure that the base is suitable for proper application and inform the Employer of any visible, lacking preconditions for performing the work according to the requirements.

If a surfacing and its base are laid out under the same contract, the Contractor cannot claim any defects vis-à-vis the Employer that can be ascribed to performance of the base.

In connection with paving works on existing surfacing, it is assumed that any grass and weeds have been removed by the Employer.

The work shall be performed on a finished and approved base. Paving works shall not be performed on frozen base or with frozen laying and setting materials.

3.1.2 The final result

Paving shall have a superelevation of approx. 5 mm against cover slabs and other fixed objects at paving level.

In respect of the overall visual impression, it will, in order to avoid that the paved area appears hollow,

be necessary to camber the area at approx. 1/8 of the cross fall.

3.2 Laying and setting materials

In respect of laying of setting and regulating courses, the layer thickness should be uniform and as close as possible to lower tolerance for the layer thickness. For concrete paving stones and slabs, the levelling course is compressed before levelling to ensure the evenness of the paving. Small concrete paving stones may also be laid on a loose, i.e. non-compressed levelling course.

3.3 Edge limits

Kerbstones are set according to specified levels and alignment, both in straight lines as in curves and shall appear as a coherent unit.

In curves with radius ≤ 12 m, curved stones shall be used. In the curves with radius > 12 m, 0.5-1 m straight stones shall be used.

Kerbstones are usually set vertically or sloping in the cross fall direction.

In pedestrian crossings, crossings, etc., measures shall be made to ensure accessibility subject to agreement with the Employer.

Concrete kerbstones shall be set with a joint width of 2-5 mm.

Where kerbstones need to be cut, this is done manually or by cutting. Kerbstones shall be cut perpendicular on the main surface.

No cut kerbstones may be shorter than 0.5 m.

Unless otherwise stated on the drawings or in SWS, kerbstones are set as follows:

- Evenness shall generally be 0-5 mm when digging from a 3 m straightedge
- Evenness of cut kerbstones shall be 0-25 mm when digging from a 3 m straightedge
- There shall be no gaps between kerbstone edges.

Facing and infilling

On kerbstones in the road cadastral, infilling shall always as a minimum consist of a 150×150 mm triangular casting.

Unless otherwise stated on the drawings, facing is made as 100×100 mm.

In order to prevent sand from flowing out, the back joints on granite kerbstones are made with gravel concrete.

3.3.1 Kerbstones set in gravel

Kerbstones that cannot be set in the road base course shall be set on a compacted gravel base with a thickness of at least 100 mm. The gravel shall observe the requirements in the Tender Specification for Stable Gravel for quality II. On top of the base, kerbstones shall be set on 30-50 mm paving gravel.

3.3.2 Kerbstones set in concrete

Kerbstones shall be set on a layer of soil-moist concrete with a thickness of no less than 100 mm and a width of no less than 300 mm. However, the width shall at least correspond to the width of the kerbstone as well as the required infilling and facing.

At kerbstones along bus bays, in turn lanes and similar places where the load is particularly high, the concrete layer shall be made with a thickness of at least 150 mm.

In connection with casting, the concrete shall be protected against mixing with soil and other impurities. After casting, the concrete shall be protected until it has achieved an equivalent hardening of at least 3 days at 20°C.

3.4 Gutter works

Gutters shall be set in 30-50 mm paving gravel or 100 mm soil-moist concrete.

The gutter shall be established with specified levels and alignment and appear without any depressions. Minimum gutter gradient shall be 5‰ (0.5%). Outer edges shall be straight or follow the curves of the pavement.

3.5 Carriageway paving, granite sett paving and mosaic paving

For areas to be made of granite materials, the stones shall generally be set closely together, but in a manner that takes due regard to the aesthetic whole depending on variations in stone size etc.

3.5.1 Carriageway paving

The stones shall be set in 20-50 mm paving gravel, with a superelevation of 30-40 mm in case of heavy traffic and 10-30 mm in case of light traffic.

The paving shall be rammed with a pneumatic rammer or vibrating plate on carriageways, but may be rammed manually on pavements.

The area shall appear as an even surface without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving will have:

- a minimum gradient of 30‰ (3%)on lanes and 25‰ (2.5%) on pavements
- evenness: 0-15 mm measured by digging from a 3 m straight edge
- stones standing closely together in a straight course with the same stone width
- bond made with at least $^1/_3$ of the stone length
- horizontal adjustment (joint) against cover slabs and other fixed objects in the pavement.

3.5.2 Granite sett paving

Stones shall be set in 20-50 mm paving gravel, with a superelevation of 10-30 mm.

The paving shall be rammed with a hand rammer or be vibrated in place using a vibrating plate.

The area shall appear as an even surface without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving will have:

- minimum gradient 30‰ (3%)on lanes, squares and 25‰ (2.5%)on pavements
- evenness: The 0-10 mm measured by digging from a 3 m straightedge.

Granite sett paving set in a straight course and pavement paving

- stones shall be placed close together in a straight course with the same stone width
- bond shall be made with at least $^1/_3$ of the stone length.

Granite sett set in arc

- the chord of the arc shall be at least 1.0 m and no more than 2.3 m
- arc rise: $^1/_5$ of the chord
- arc length shall be the quarter of a circle

- the arcs shall intersect each other under a right angle (90°)
- bond shall be made with at least $^1/_5$ of the stone length
- for straight edge limit shall be finished with a semicircle.

3.5.3 Mosaic paving

Stones shall be set in 20-50 mm paving gravel, with a superelevation of 10-20 mm. On carriageways, stones shall be set in concrete.

The paving shall be rammed using a hand rammer, vibrating plate or roller.

The area shall appear as an even surface without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving will have:

- a minimum gradient of 25‰ (2.5%)on lanes and pavements
- evenness: 0-10 mm measured by digging from a 3 m straight edge
- bond shall be made with at least $^1/_3$ of the stone length.

3.6 Cobblestone paving/fieldstone paving

The stones shall be set in 70-120 mm paving gravel, with a superelevation of 30-40 mm in case of heavy traffic and 10-30 mm in case of light traffic.

The paving shall be rammed using a hand rammer, vibrating plate or roller.

The area shall appear as a compact, even surface without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving shall have no visible lines on the surface and with:

- a minimum gradient of 35‰ (3.5%)on lanes and pavements
- evenness: 0-20 mm measured by digging from a 3 m straight edge
- stones set on the root face (the most level upward facing surface)
- stones set closely together.

3.7 Slab paving

Slabs in uniform thickness shall be laid on 20-40 mm compacted paving gravel with a superelevation of 5-10 mm and be rammed/vibrated in place. The slab area shall appear as an even surface without depressions without height deviations between adjoining slabs and with dense and filled joints.

Slabs in varying thickness shall be laid on 20-100 mm individually levelled paving gravel and be rammed in place.

Unless otherwise specified on the drawings and plans, paving will have:

- a minimum gradient of 25‰ (2.5%)on lanes and pavements
- evenness: The 0-10 mm measured by digging from a 3 m straightedge.
- joint width 2-5 mm

Slabs which are cut shall for the sake of durability not be less than 30% of the normal size. However, this does not apply to bevelled tiles.

3.8 Concrete paving stones

Concrete paving stones shall be laid on either 20-40 mm compacted and levelled paving gravel with a superelevation of 5-15 mm and be compacted to a final height with a vibrating plate or on non-compacted paving gravel with a superelevation of 15-25 mm.

In connection with laying of paving stones, a uniform, aesthetic appearance shall be used by using stones from several pallets at the same time. The area shall appear as an even surface without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving will have:

- a minimum gradient of 25‰ (2.5%)on lanes and pavements
- evenness: 0-10 mm measured by digging from a 3 m straight edge
- joint width 2-5 mm.

Connecting stones shall be used against cover slabs and edge limits. Where this is not possible, the stones shall be adjusted. Adjusted stones against solid limitations shall be larger than 30% of a whole stone. Adjusted stones against soil shall be at least 50% of a whole stone.

3.8.1 Stone with dense surface

The joints shall be filled with joint filler before the paving is compacted in place.

3.8.2 Grass pavers

The holes in the pavers shall be filled with a mix of 50% coarse gravel 0-4/0-8 and 50% topsoil depending on volume, before the pavers are compacted in place. The above mixture with grass seeds is used as topping. The holes shall be filled to approx. 10 mm below upper edge of the pavers.

3.9 Tile paving

Tiles shall be laid on either 20-40 mm compacted and levelled paving gravel with a superelevation of 5-10 mm and be levelled to a final height by light ramming or vibration using a rubber roller or on non-compacted paving gravel with a superelevation of 15-25 mm.

Tiles shall be laid in the pattern illustrated in on the drawings. The tile paving shall be framed by a runner where other natural limitation does not exist.

The area shall appear as an even surface with as small joints as possible, without depressions and with dense and filled joints.

Unless otherwise specified on the drawings and plans, paving will have:

- a minimum gradient of 25‰ (2.5%) on lanes and pavements
- evenness: The 0-10 mm measured by digging from a 3 m straightedge
- joint width 2-5 mm.

Tiles shall be cut by cover slabs and other fixed objects. Adjusted tiles shall be larger than 30% of a whole stone.

3.10 Joint sealing

Joints should be established continuously as the paving work progresses. Joint gravel shall be swept into the joints not late than on the same day when the paving has been set, the paving shall be swept clean.

For concrete paving stones, a vibrating plate shall be run across the paving once. Additional joint gravel shall be added, and a vibrating plate shall be run across the paving once. If necessary, more joint gravel shall be added. The runs shall have 50% overlap so that all stones are vibrated twice in each direction.

No later than the day after the paving has been set, additional joint gravel shall be added, and the paving shall be watered until the joints are completely filled and compact. Watering shall be done carefully so as not to wash away the joint material. The stones shall be cleaned thoroughly for joint material so that they appear completely clean.

4. CONTROL

4.1 General

The paving shall be divided into control sections.

4.2 Materials

The Contractor shall submit EC declaration(s) related to the CE marking for the delivered construction products.

The Contractor shall carry out handover inspection for natural stone and brick in accordance with applicable product standards.

The Contractor shall carry out handover inspection for purchased concrete products in accordance with Annex B of DS/EN 1338, DS/EN 1339 and DS/EN 1340.

The quality of the gravel materials shall be controlled regularly. At least one material analysis shall be made, comprising a determination of the particle size distribution via the sieving method and the sand equivalent for each 100 m^3 or fraction thereof.

The degree of fragmentation shall be documented at the beginning of the delivery.

In the course of the work, a new test shall be made if

a) gravel from a new production site is used

b) great variation is seen in the materials used or in the composition of the materials which might affect the material properties.

The result of the new test shall be documented as the control of the original supply.

Samples to be taken from the production site.

4.3 Execution

For each control section, the Contractor shall document the paving:

- Heights
- Alignment
- Evenness
- Camber/gradient
- Bond/pattern
- Arc rise and uniformity (at arched paving)
- Joints
- Anti-knock value in gravel (stone set in gravel are stable without vibration)
- Delivered materials, by declaration and documentation water absorption and frost resistance (where required).
- For kerbstones, also a visual supervision of

- Alignment/curves and edges
- Facing and infilling
- Joint width and filling.

COLOPHON:

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