CONSTRUCTION HEIGHT SPECIAL PROVISIONS

Introduction

This standard has been adopted by the Standards Committee for NOC*NSF Quality Care System. This standard has been created by taskforce 4 “minerals”, taskforce 5 “plastics” and taskforce 6 “artificial turf”, all of which are associated with this standards committee.

This standard concerns special provisions for construction heights determined for operation-specific constructions. These operation-specific constructions must be assessed and approved in conformity with one of the protocols described in this standard. There are protocols for unbound, partially bound and bound constructions. All of which may feature either horizonal or vertical draining.

This standard has been created as a supplement to existing standards CONSTR 2 and CONSTR 2.1.

Products which need to be certified using CONSTR 3, must be subjected to an assessment process by the supplier in conformity with one of the six protocols which make up this standard, CONSTR 3, and the results of this assessment must be submitted to an assessment institute recognised by NOC*NSF. This institute will determine whether or not the construction is sufficient.

If the construction is deemed sufficient, then the materials standards shall determine which demands will be made of the materials used.

The options, as listed in CONSTR 3, are not exhaustive. New, innovative ideas may present themselves and these may involve new computation systems. New ideas, using new computation systems, must be submitted to NOC*NSF. NOC*NSF can, at the petitioner’s expense, invite experts to assess new ideas and computation systems. If these experts approve the new ideas/computation systems, then NOC*NSF may add them to CONSTR 3.

Reference
A special provision for construction height is a construction height which is intended for an operation-specific construction, as described in the accompanying operation-specific standard.

Characteristics
The thickness of a special provision for construction height is described in the accompanying operation-specific standard. This operation-specific construction standard must be assessed and approved in conformity with one of the protocols described in the following pages of this standard sheet.
There are protocols for:

1. unbound vertical draining constructions
2. unbound horizontal draining constructions
3. partially bound vertical draining construction
4. partially bound horizontal draining constructions
5. bound vertical draining constructions
6. bound horizontal draining constructions.

Unbound constructions are constructions where the substructure, the foundation and the top layer consist of unbound materials.

Partially bound constructions are constructions where the substructure and the foundation consist of unbound materials and the top layer consists of both unbound and bound materials.

Bound constructions are constructions where the substructure, and/or the foundation, and/or the top layer consist of bound materials.

Definitions
Normative precipitation:
Normative precipitation is the precipitation which can be expected 1x every 10 years according to: T.A. Buishand and C.A. Velds (KNMI 1980; Precipitation and Evaporation, chapter 8), increased with a 10% climate allowance. See table D1

Time (min)	Precipitation (mm)	Time (min)	Precipitation (mm)	Time (min)	Precipitation (mm)	Time (min)	Precipitation (mm)
5	10.89	180	37.73	840	50.60	2160	62.59
15	19.58	240	40.04	960	52.03	2400	64.57
30	25.30	300	41.69	1080	53.24	2640	66.55
45	28.16	360	42.90	1200	54.67	2880	68.42
60	30.03	480	45.43	1440	56.54	3360	71.39
90	32.67	600	47.41	1680	58.63	3840	74.47
120	34.32	720	48.84	1920	60.61	4320	77.44

Table D1: Normative Precipitation T=10 years (incl. 10% climate allowance)

Ponding:
Ponding occurs when the (apparent) groundwater level rises above the ground level

Damage
Damage is understood to mean a permanent deviation from the technical specifications, including, but not limited to height and flatness

Frost-resistant
Parts of a construction are frost-resistant if no damage occurs when the part in question is exposed to temperatures under 0 degrees Celsius.

Generally accepted literature
- Scientific publications, research etc., as well as research findings published by recognised laboratories are viewed as generally accepted literature. The use of these items within the context of this standard is subject to approval by or on behalf of NOC*NSF.

Horizontal drain capacity
The amount of water which can be horizontally disposed of by a draining layer of one meter wide per time unit (l/m.s)
The horizontal drain capacity is determined in conformity with EN ISO 12958, using the following specification:
- A superimposed load of 2 kPa.
- The water level on one side is equal to the top of the sample
- Unhindered outflow on the other side
- The design gradient must fall within the technical standards for the application.
- This gradient can be determined by:
  - Adjusting the gradient in the test chamber where the sample is located, or
  - The test chamber is configured horizontally and the gradient is achieved by adjusting the water level at the front of the sample.
- The sample size must be at least 300 mm long and 200 mm wide (NB: we recommend using a sample size of 300 mm by 200 mm for comparisons with international institutes).

Table D2 indicates what the horizontal drain capacity needs to be, depending on the construction's storage and the half width of the sports field (W in m). The drain capacity is calculated using the normative precipitation.

		The requisite drain capacity (l/m.s) for the design gradient for half width W			
		W = 1 m	W = 12 m (korfball)	W = 29.5 m (hockey)	W = 36 m (football)
Storage*) (mm)	Draining (mm/day)				
5	1800	0.021000	0.252000	0.619500	0.756000
10	900	0.010500	0.126000	0.309750	0.378000
15	480	0.005600	0.067200	0.165200	0.201600
20	275	0.003208	0.038500	0.094646	0.115500
25	130	0.001512	0.018144	0.044604	0.054432
30	65	0.000756	0.009072	0.022302	0.027216
40	19	0.000224	0.002688	0.006608	0.008064
50	10	0.000112	0.001344	0.003304	0.004032

Table D2 Drain capacity in relation to storage and half field width
**) This concerns the storage for the total construction, including, for example, the artificial turf's storage.*

Design gradient
The sports field's slope as required for the construction in question (m/m). An assessment of the actual gradient realised is part of the practical assessment of the field/foundation. A gradient which is smaller than the design gradient will result in the field/foundation being rejected. The design gradient must fall within the technical standards for the application.

Horizontal dispersion
System which ensures that the total drainage discharge resulting from the horizontal dispersion of water is disposed of via the sides of the field. A drainage ditch for example. The horizontal dispersion system must be described in the corporate standard and must feature a calculation which proves the system possesses sufficient capacity. The inspection of this system is part of the practical assessment of a field. The field will be rejected if it is not constructed in conformity with the corporate standard.

Equivalent calculation model
A calculation model is equivalent to another model if the same input, yields the same output. The equivalence of the model will be assessed by or on behalf of NOC*NSF.

Linear Elastic Multi-layer model
A calculation model where the construction layers are fully bound and infinitely stretched horizontally in the model. The materials per construction layer are modelled for linear elasticity, this means prescribed loading conditions are used that are directly proportional to the tension applied.

Elongation at break
Elongation in a bound material under one-off failure load. This can be calculated as follows if no data is available:

- NEN-EN 13286-40 (direct tension test) OR
- NEN-EN 13286-42 (indirect tension test) OR
- NEN-EN 12697-26 Annex B (bending test)

Saturated water permeability
Water permeability at full saturation. To be determined in conformity with accepted data. This can be calculated as follows if no data is available;

- NEN-EN 5123 or 5124 (soil, sand, etc.) or
- NEN-EN 12616 (sports floors) or
- NEN-EN 12697-19 (rigid, permeable materials).

Hollow space (%)
The space between the parts of a construction material expressed as a percentage of the total volume the material takes up. To be determined in conformity with accepted data. If no data is available, then the hollow space percentage, n, can be determined as follows: n = 100 * (1 - pd / dd) where pd = particle density and dd is reference dry bulk density

Particle density
Mass per unit of particle volume, including the non-accessible pores in particles and excluding the liquids in the open pores. This can be determined in conformity with NEN-EN 1097-6 (Determining particle density and water absorption) if no data is available.

Reference dry bulk density
Mass per unit of volume for granular materials, including the pares in and hollow space between the granules and excluding the liquids in the open pores. The reference dry bulk density can be calculated as follows:

- NEN-EN 13286-2 article 7.1 (unbound, fine-grained, mineral aggregates) OR
- NEN-EN 13286-2 Annex B (unbound, coarse-grained, mineral aggregates) OR
- NEN-EN 12697-6 (bound materials)

Compressive strength
The strength of a bound material; determined in conformity with NEN-EN-13286-41 (compressive strength)

Free lime content
Mass percentage $CaCO_3$, to be determined following the removal of shell particles, and to then be calculated in conformity with DIN 18129.

Mud/clay content
Mass percentage of particles < 2 µm, to be determined in conformity with NEN 5753:2006+C1:2009
Namely:
1. Carbonates are removed using acid
2. Organic materials are removed using peroxide
3. Peptising agents are added (particles fall apart)
4. Filtered using a 32 µm sieve
5. Transfer of a fraction smaller than 32 µm to a measuring cylinder
6. Sedimentation: an assumption is made that mud/clay will collect at a certain height, at a certain time, following which pipetting will take place
7. Drying and the mud/clay content will be determined by weighing

A simplified method is permitted if:
1. The same preparation (points 1 up to and including 3) takes place
2. Filtered using a 90 µm sieve
3. It is then transferred to a measuring cell in what is known as a sedigraph, the refraction is then measured at various heights and at various times by means of x-ray. Calculations will be made to determine the mud/clay content.

Particle content < 63 µm
Mass percentage of particles < 63 µm, to be determined in conformity with NEN 933-1.

Conduction
A material's ability to conduct heat. To be determined in conformity with accepted data. This can be calculated using NEN-EN 12664 following preparation in conformity with EN 12087, if no data is available.
In deviation to EN 12087, the material sample must be left to drain for 30 minutes instead of 10 following it being wetted. Measurements are carried out at a temperature of 20 degrees Celsius.

Thermal capacity
A material's ability to retain heat. To be determined in conformity with accepted data. A worst-case scenario should be leading if the data lists different values. This can be calculated in conformity with NEN 12667, if no data is available.

Stiffness modulus natural foundation
Resistance to distortion expressed as the relationship between a material's load and elastic distortion; the characteristic value of the stiffness modulus should be divided by a partial factor of 1.1. This can be calculated as follows if no data is available:
- In the event that bound materials are used: NEN-EN 12697-26 Annex B
- In the event unbound or self-binding materials are used: like those used in road construction data.

Poisson's ratio
The ratio between the specific elongation change perpendicular to and in the direction of the given axial strain change in a material; also referred to as the lateral contraction coefficient. The calculation assumes a value of 0.20 for cement bound materials, 0.50 for rubber and 0.35 for all other materials.

Partial factor
Factor for the material property, strength or load in which the potential for adverse deviations of the characteristic value of the material property, strength or load have been discounted.

Stiffness moduli natural foundation
Parameter which indicates the connection between the vertical tension under a load plate and the sinking of the base as a function of the form and size of the loaded surface. The calculation is based on a value which matches the bearing strength of the natural foundation/foundations on which the construction will be used. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

1. Protocol for assessing the acceptance of an unbound, vertically draining construction.

1A. Main demands

The field must be playable under the following criteria:

Drainage
No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

Frost-resistance
The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction. A normative period of frost is frost which may be expected to occur 1x every 10 years. This is a consecutive period of frost lasting 15 days with a daily temperature of -4 degrees Celsius.

Bearing strength
The design load is the characteristic wheel load of a maintenance vehicle. The use of a maintenance vehicle may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for a maintenance vehicle are:

Characteristic axle load 2.5 kN * partial factor 1.35	F	3.4 kN
Tyre pressure, equal to the internal load distribution	σ	0.1 MPa (1 bar)

1B. Research protocols

Research protocol drainage

The quality of the drainage must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model for vertically draining sports field construction as created by KIWA-ISA-Sport: *“Dimensioning water draining sports field model version5.xls”*
Or by means of a comparable calculation model.

Input parameters in the calculation model:

- Saturated water permeability
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Construction elements consisting of unbound materials are considered frost-resistant if the hollow space percentage is >32% (volume) AND the percentage of fine particles (< 63 µm) is not higher than 5% (mass) AND the mud/clay content (< 2 µm) is not higher than 2% AND if the free lime content (mass percentage) is lower than:
  - With a D50 <180 µm < 1%
  - With a D50 180 - 250 µm < 3%
  - With a D50 > 250 µm < 5%
- Standardised materials like equestrian sand, sport sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *"Warmth insulation calculation model version5.xls"* as created by KIWA-ISA-Sport. Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model. The highest elastic vertical distortion calculated plus the surface may not exceed -350 µm/m.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson's ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

2. Protocol for assessing the acceptance of an unbound, horizontally draining construction

2A. Main demands

The field must be playable under the following criteria:

<u>Drainage</u>
No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

<u>Frost-resistance</u>
The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction. A normative period of frost is frost which may be expected to occur 1x every 10 years. This is a consecutive period of frost lasting 15 days with a daily temperature of -4 degrees Celsius.

<u>Bearing strength</u>
The design load is the characteristic wheel load of a maintenance vehicle. The use of a maintenance vehicle may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for a maintenance vehicle are:

Characteristic axle load 2.5 kN * partial factor 1.35	F	3.4 kN
Tyre pressure, equal to the internal load distribution	σ	0.1 MPa (1 bar)

2B. Research protocols

<u>Research protocol drainage</u>
The quality of the drainage must be proven mathematically. This calculation must prove that the horizontal drain capacity, which is part of the construction's design gradient, is related to the construction's storage capacity, and, at the very least, conforms with the values in table D2. Furthermore, it must be mathematically proven that the horizontal dispersion possesses sufficient capacity to process the total drainage discharge even in the event of a calamity.

Input for the calculation:
- Horizontal drain capacity (l/m.s)
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Construction elements consisting of unbound materials are considered frost-resistant if the hollow space percentage is >32% (volume) AND the percentage of fine particles (< 63 µm) is not higher than 5% (mass) AND the mud/clay content (< 2 µm) is not higher than 2% AND if the free lime content (mass percentage) is lower than:
  - With a D50 <180 µm   < 1%
  - With a D50 180 - 250 µm   < 3%
  - With a D50 > 250 µm   < 5%

- Standardised materials like equestrian sand, sport sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *"Warmth insulation calculation model version5.xls"* as created by KIWA-ISA-Sport. Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model. The highest elastic vertical distortion calculated plus the surface may not exceed -350 µm/m.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson's ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

3. Protocol for assessing the acceptance of a partially bound, vertically draining construction

3A. Main demands

The field must be playable under the following criteria:

Drainage

No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

Frost-resistance

The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction. A normative period of frost is frost which may be expected to occur 1x every 25 years. This is a consecutive period of frost lasting 25 days with a daily temperature of -4 degrees Celsius.

Bearing strength

The design load is the characteristic wheel load of an ambulance. The use of an ambulance may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for an ambulance are:

Characteristic axle load 10 kN * partial factor 1.35.	F	13.5 kN
Tyre pressure, equal to the internal load distribution	σ	0.4 MPa (4 bar)

3B. Research protocols

Research protocol drainage

The quality of the drainage must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model for vertically draining sports field construction as created by KIWA-ISA-Sport: *“Dimensioning water draining sports field model version5.xls”*
Or by means of a comparable calculation model.

Input parameters in the calculation model:

- Saturated water permeability
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Construction elements consisting of unbound materials are considered frost-resistant if the hollow space percentage is >32% (volume) AND the percentage of fine particles (< 63 µm) is not higher than 5% (mass) AND the mud/clay content (< 2 µm) is not higher than 2% AND if the free lime content (mass percentage) is lower than:
  - With a D50 <180 µm < 1%
  - With a D50 180 - 250 µm < 3%
  - With a D50 > 250 µm < 5%
- Standardised materials like equestrian sand, sport sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *"Warmth insulation calculation model version5.xls"* as created by KIWA-ISA-Sport. Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model. The highest elastic vertical distortion calculated plus the surface may not exceed - 1,000 µm/m.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson's ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

4. Protocol for assessing the acceptance of a partially bound, horizontally draining construction

4A. Main demands

The field must be playable under the following criteria.

Drainage
No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

Frost-resistance
The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction. A normative period of frost is frost which may be expected to occur 1x every 25 years. This is a consecutive period of frost lasting 25 days with a daily temperature of -4 degrees Celsius.

Bearing strength
The design load is the characteristic wheel load of an ambulance. The use of an ambulance may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for an ambulance are:

Characteristic axle load 10 kN * partial factor 1.35.	F	13.5 kN
Tyre pressure, equal to the internal load distribution	σ	0.4 MPa (4 bar)

4B. Research protocols

Research protocol drainage
The quality of the drainage must be proven mathematically. This calculation must prove that the horizontal drain capacity, which is part of the construction's design gradient, is related to the construction's storage capacity, and, at the very least, conforms with the values in table D2. Furthermore, it must be mathematically proven that the horizontal dispersion possesses sufficient capacity to process the total drainage discharge even in the event of a calamity.

Input for the calculation:
- Horizontal drain capacity (l/m.s)
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Construction elements consisting of unbound materials are considered frost-resistant if the hollow space percentage is >32% (volume) AND the percentage of fine particles (< 63 µm) is not higher than 5% (mass) AND the mud/clay content (< 2 µm) is not higher than 2% AND if the free lime content (mass percentage) is lower than:
  - With a D50 <180 µm < 1%
  - With a D50 180 - 250 µm < 3%
  - With a D50 > 250 µm < 5%
- Standardised materials like equestrian sand, sports sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *“Warmth insulation calculation model version5.xls”* as created by KIWA-ISA-Sport. Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model. The highest elastic vertical distortion calculated plus the surface may not exceed - 1,000 µm/m.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson’s ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

5. Protocol for assessing the acceptance of a bound, vertically draining construction

5A. Main demands

The field must be playable under the following criteria:

Drainage

No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

Frost-resistance

The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction. A normative period of frost is frost which may be expected to occur 1x every 50 years. This is a consecutive period of frost lasting 30 days with a daily temperature of -4 degrees Celsius.

Bearing strength

The design load is the characteristic wheel load of an ambulance. The use of an ambulance may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for an ambulance are:

Characteristic axle load 10 kN * partial factor 1.35.	F	13.5 kN
Tyre pressure, equal to the internal load distribution	σ	0.4 MPa (4 bar)

5B. Research protocols

Research protocol drainage

The quality of the drainage must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model for vertically draining sports field construction as created by KIWA-ISA-Sport: *“Dimensioning water draining sports field model version5.xls”*
Or by means of a comparable calculation model.

Input parameters in the calculation model:

- Saturated water permeability
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Water permeable, bound materials are considered frost-resistant if there is no visible damage following the freeze-thaw test carried out in conformity with EN 1367
- Construction elements consisting of unbound materials are considered frost-resistant if the hollow space percentage is >32% (volume) AND the percentage of fine particles (< 63 µm) is not higher than 5% (mass) AND the mud/clay content (< 2 µm) is not higher than 2% AND if the free lime content (mass percentage) is lower than:
  - With a D50 <180 µm < 1%
  - With a D50 180 - 250 µm < 3%
  - With a D50 > 250 µm < 5%
- Standardised materials like equestrian sand, sports sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *“Warmth insulation calculation model version5.xls”* as created by KIWA-ISA-Sport. Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model.

- The highest elastic vertical distortion calculated plus the surface may not exceed - 1,000 µm/m;
- The largest elastic horizontal distortion calculated at the bottom of the bound foundation may not exceed the characteristic elongation at break for the foundation material.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson’s ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

6. Protocol for assessing the acceptance of a bound, horizontally draining construction.

6A. Main demands

The field must be playable under the following criteria:

Drainage
No ponding should occur during normative precipitation AND the average highest ground water level may not be shallower than 0.50 m under the ground level.

Frost-resistance
The construction must consist of frost-resistant parts.
And:
A normative period of frost may not result in permanent damage to the construction.
A normative period of frost is frost which may be expected to occur 1x every 50 years. This is a consecutive period of frost lasting 30 days with a daily temperature of -4 degrees Celsius.

Bearing strength
The design load is the characteristic wheel load of an ambulance. The use of an ambulance may not damage the construction. The bearing strength is subject to a partial factor of 1.35.

Calculation parameters for an ambulance are:

Characteristic axle load 10 kN * partial factor 1.35.	F	13.5 kN
Tyre pressure, equal to the internal load distribution	σ	0.4 MPa (4 bar)

6B. Research protocols

Research protocol drainage
The quality of the drainage must be proven mathematically. This calculation must prove that the horizontal drain capacity, which is part of the construction's design gradient, is related to the construction's storage capacity, and, at the very least, conforms with the values in table D2.
Furthermore, it must be mathematically proven that the horizontal dispersion possesses sufficient capacity to process the total drainage discharge even in the event of a calamity.

Input for the calculation:
- Horizontal drain capacity (l/m.s)
- Hollow space (%). The storage potential is determined as a percentage of the hollow space.

Research protocol frost-resistance:

The construction must consist of frost-resistant parts.

- Impermeable, bound materials with a volumetric mass < 1,000 kg/m^3 are considered frost-resistant if the compressive strength exceeds 1.5 MPa.
- Impermeable, bound materials with a volumetric mass > 1,000 kg/m^3 are considered frost-resistant if the compressive strength exceeds 3 MPa.
- Water permeable, bound materials are considered frost-resistant if there is no visible damage following the freeze-thaw test carried out in conformity with EN 1367

Construction elements consisting of unbound materials will be considered frost-resistant if the hollow space percentage >32% (volume) AND the percentage of fine particles (< 63 µm) does not exceed 5% (mass) AND the mud/clay content (< 2 µm) is lower than 2% AND the free lime content (mass percentage) is lower than:

- With a D50 <180 µm < 1%
- With a D50 180 - 250 µm < 3%
- With a D50 > 250 µm < 5%

- Standardised materials like equestrian sand, sports sand, lava, etc. are considered frost-resistant.

A normative period of frost may not result in permanent damage to the construction.

One way to prevent damage is to ensure that the natural surface does not freeze. This must be proven mathematically. This could be, for example, by means of a calculation created using the calculation model *"Warmth insulation calculation model version5.xls"* as created by KIWA-ISA-Sport.
Or by means of a comparable model.

Input parameters in the calculation model:

- Conduction
- Thermal capacity.

Research protocol bearing load

The bearing load must be proven mathematically. This could be, for example, by means of an assessment of the design load in a Linear Elastic Multi-layer model, or in a comparable model.

- The highest elastic vertical distortion calculated plus the surface may not exceed
  - 1,000 µm/m;
- The largest elastic horizontal distortion calculated at the bottom of the bound foundation may not exceed the characteristic elongation at break for the foundation material.

Input parameters in the calculation model:

- Stiffness moduli construction elements
- Poisson's ratio
- Stiffness modulus natural foundation. To be determined in conformity with the work method which has been included as an appendix to this standard sheet.

APPENDIX TO NOC*NSF-CONSTR.3
WORK METHOD FOR DETERMINING THE BEARING LOAD OF THE EXISTING SURFACE

1 Introduction

This appendix contains the work method for determining the bearing load of the surface on which a sports accommodation may be constructed.
The assessment is limited to the top meter of a construction. The bearing load for a deeper surface must be determined by means of a geotechnical assessment if there is a reason to do so. The results of this type of a geotechnical assessment may result in special measures needing to be implemented (stabilizers, pre-loading, construction using piles, etc.).

The basis is a tiered approach. An office assessment is the departure point. This result then needs to be verified by means of compaction measurements and soil drilling. The stiffness of a surface is determined by means of a Light Weight Deflectometer (LWD). This instrument will provide a value for the stiffness modulus in situ during the measurement process.

The measurement may only be carried out by organisations which have been recognised by NOC*NSF in the Procedures Manual.

2 Measurement and analysis methods

2.1 Office assessment

A general overview of the conditions under which the sports accommodation will be constructed should be created by means of an office assessment. This assessment should focus on excavations, attenuation and elevations. This can be done, for example, by consulting De Bodemkaart van Nederland [Soil Map of the Netherlands] issued by StiBoKa. Internet sites like “beeldbank.cultureelerfgoed.nl” and “Dinoloket.nl” may be consulted. The measurement should be adjusted in conformity with these results if necessary. This is at the testing institute’s discretion.

2.2 Drilling

Soil drilling needs to take place, once the office assessment has been completed. The analysis of the drilling and the classification of the soil types must take place in conformity with the soil classification system for the Netherlands (StiBoKa 1966). The results of the drilling may only be used as a tool to help gain insight into the surface.

1. Determine the number of drilling sites. Take a sample every 750 m_2, evenly distributed over the site, with a least 6 samples taken.
2. If, based on the results of the office assessment, there is cause to assess certain areas in more depth, then the numbers under 1 should be adjusted accordingly.
3. The depth of the drilling sample is 1 m with regards to the ground level.
4. The data can be interpreted in conformity with StiBoKa
5. Normative is the lowest load bearing soil with a thickness of > 0.3 m.

2.3 Stiffness measurement

The stiffness of the site is determined by means of a Light Weight Deflectometer (LWD). The measurements must be carried out under adequate soil conditions; the soil may not be dry.

1. Determine the number of measurement points for determining the subsoil's stiffness. Take one measurement per 500 m² with a minimum of 12 measurement points.
2. Divide the measurement points, using a regular measurements pattern, over the area in question.
3. If, based on the results of the office assessment, there is reason to do so, subsections should be used. Each subsection should contain at least 6 measurement points.
4. The existing ground level is the departure point for measurements. Measurements should be taken at both ground level and at 0.20 m depth at 6 measurement points. The measurements should be repeated using additional measurement points and should be recorded if significant differences are noted.
5. Use an LWD with a 300 mm diameter base plate and a load weight of 10 kg.
6. Set the load weight to a height where the load force reaches 100 ± 10 kPa during a drop.
7. Execute a measurement beforehand using a randomly selected measurement point which may expected to be one of the locations which has a lower load bearing capacity. Carry out six drops.
8. If the deflections exceed 1500 µm, then the fall height needs to be adjusted downwards so that the deflections no longer exceed 1500 µm (the measuring sensors have a range up to 2000 µm).
9. Carry out 6 drops at each measurement point and record the following for each measurement point:
   a. measurement point designation
   b. GPS coordinates
   c. any particulars
10. Record the drop size (in kPa or kN) and the deflection (in µm) for each drop
11. Determine the surface modulus (in MPa) with a value of 0.35 for the Poisson's ratio for each drop.
12. Determine the average of the surface moduli for drops 4, 5 and 6. This value is known as the measurement point stiffness modulus.
13. Analyse the measurement point stiffness moduli for both positive and negative outliers (statistical tests are available for this purpose) for each subsection if used. Try to explain the low outliers. Remove the low and the high outliers from the population of measurement values, but make sure that sufficient measures are implemented to help improve the local quality of the surface over an area of at least 50 m² per outlier in areas where low outliers are identified.
14. Analyse the measurement point stiffness moduli as follows:
   a. If the area has not been divided into subsections and the variation in the measurement point stiffness moduli is not linked to a particular location on site, all measurement point values, excluding the outliers, must be analysed to determine the design stiffness of the entire area.
   b. If the area has been divided into subsections and the variation in the measurement point stiffness moduli is not linked to a particular location in a subsection, all measurement points for each subsection, excluding the outliers, must be analysed to determine the design stiffness of each subsection.

c. If the area has not been divided into subsections and the variation of the measurement point stiffness moduli is clearly localised (example: the measurement point stiffness modulus decreases from west to east, or a curve is evident featuring systematically lower or higher values), then the area needs to be divided into subsections (and then analysed in conformity with 14b) or the quarter of the site with the lowest measurement point stiffness moduli needs to be analysed to help determine the design stiffness of the entire area.

15. For each subsection, determine the characteristic value of the stiffness modulus for the surface based on the average and the standard deviation of the measurement point stiffness moduli. Apply a reliability level of 85%.
16. Determine which surface class an area or a subsection is part of (see table 1).
17. Merge subsections which are part of the same surface class.

3 Soil classification

The surface stiffness should be classified in conformity with table 1 which is featured below.

Class	Indicative Description	Stiffness Modulus
0	Sapric peat	Project-specific building methods required
1	Peat, loamy sand, loam, extremely humic clay, mucky clay/loam/loess	20 MPa
2	Non-mucky clay, loam loess, sandy clay, extremely silty sand	32 MPa
3	Silty sand, humic sand	48 MPa
4	Slightly silty sand, somewhat humic sand	64 MPa
5	Low-loam sand, low-humus sand, gravel	80 MPa