Israeli Standard SI 118
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**Concrete: specifications, performance, and production**

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**Notice of revision**

This standard supersedes these Israeli standards:

Israeli Standard SI 118 from December 1986

Amendment edition no. 1 from July 1992

Israeli Standard SI 601 from November 1984

Amendment edition no. 1 from June 1989

Amendment edition no. 2 from March 1990

Amendment edition no. 3 from June 1991

Amendment correction from July 1992

**Descriptors**

Concretes, cement and concrete technology, performance, performance testing, conformity, production, aggregates, construction materials, curing (concrete), quality control, inspection, verification, compression strength, concrete mixers, ready-mixed materials, concrete mixes, composition, delivery, transport, building sites, grades (quality), consumer-supplier relations, tests

**Updatedness of the standard**

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**Table of Contents**

# Preamble

1. This standard supersedes Israeli Standards SI 118 and SI 601, and it includes the specifications for concrete and its components, the production process, and the process for determining compliance with the standards.
2. The standard is based on European Standard EN 206-1 from 2000. The structure of the standard is the same as the structure of the European standard, but some of the specifications are adjusted to the concrete production conditions and uses in Israeli conditions.
3. The main difference between the two standards is in the control and evaluation process of concrete conformity (see definition 3.35), as mentioned hereinbelow:

(a) In the European standard, the concrete conformity evaluation process is performed by the manufacturer and includes concrete production control (section 9 of the European standard), and the use of statistical methods to control the mixes (section 8 of the European standard). By request or pursuant to the laws of the country, it is possible to require that a certified laboratory review the manufacturer’s tests and evaluate the concrete conformity (section 10 of the European standard).

(b) Under the Israeli standard, the concrete conformity is determined to the standard in a process that includes:

 - Concrete production control by the manufacturer ((section 9 of this standard), in which the authorized certifying entity (see note to definition 3.32) evaluates and confirms that the production process conforms to the standard;

 - A pressure strength test of the concrete supplied to the site was performed by a certified laboratory (as required under the Planning and Building Regulations)

 The process is similar to the process currently undertaken by the construction industry in Israel.

**Note**:
A revision of the standard is scheduled approximately two years following its publication, and the new version shall include statistical methods for concrete mix control by the manufacturer, similar to what is mentioned in the European standard. A certified laboratory shall review, evaluate, and approve the concrete conformity. For the purpose of said change, the option of applying statistical methods at Israeli plants shall be considered in the interim, and, if necessary, appropriate amendments shall be made.

1. Applicability of the Standard
	1. This standard shall apply to brought concrete, plants for the production of prefabricated elements, and any other concrete of ordinary weight (see definition 3.4) intended for the manufacture of elements and structures pursuant to Israeli Standard SI 466 and its sections.
	The standard states specifications for:
* Concrete mixes;
* Marginal values for concrete mix;
* Fresh concrete and hardened concrete properties and methods for testing them;
* Specifications for concrete (see definition 3.28);
* The supply of fresh concrete;
* The production control process;
* Conformity to the standard;
* Conformity to the specifications.
	1. If there is a contradiction between the specifications mentioned in this Standard and the specifications stated in Israeli Standard SI 466 Part 1, the specifications stated in Israeli Standard SI 466 Part 1 shall apply to the concrete.
1. References
The standards and documents mentioned in this Standard (undated standards and documents – the latest version is the determining version)

**Israeli standards**

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| --- | --- |
| SI 1 Part 1 | Cement: ordinary cement |
| SI 1 Part 2 | Cement: sulfate-resistant Portland cement |
| SI 1 Part 3 | Cement: ordinary cement with low hydration heat |
| SI 3 | Natural mineral aggregates |
| SI 26 Part 1 | Concrete testing methods: taking samples from fresh concrete |
| SI 26 Part 2.1 | Concrete tests: fresh concrete – reliance - shrinkage test  |
| SI 26 Part 2.2 | Concrete tests: fresh concrete – reliance – Vee-Bee method test  |
| SI 26 Part 2.3 | Concrete tests: fresh concrete – reliance - cohesion test  |
| SI 26 Part 2.4 | Concrete tests: fresh concrete – reliance – flow table test  |
| SI 26 Part 2.5 | Concrete tests: fresh concrete – reliance – density test  |
| SI 26 Part 2.6 | Concrete tests: fresh concrete – reliance – air content test  |
| SI 26 Part 3 | Concrete testing methods: preparation of samples for testing and curing (1985, with its amendment editions) |
| SI 26 Part 3(1) | Concrete tests: preparation of samples for strength test – form, dimensions, preparation, and curing |
| SI 26 Part 4 | Concrete testing methods: hardened concrete properties – strength (1985, with its amendment editions) |
| SI 26 Part 4.1(1) | Concrete tests: hardened concrete strength – compressive strength |
| SI 26 Part 4.2(1) | Concrete tests: hardened concrete strength – bending strength |
| SI 26 Part 4.3(1) | Concrete tests: hardened concrete strength – indirect tension strength |
| SI 26 Part 5 | Concrete testing methods: hardened concrete properties, except for strength (1995)  |
| SI 26 Part 5.1(1) | Concrete tests: hardened concrete – density |
| SI 26 Part 5.2(1) | Concrete tests: hardened concrete – dampness properties in dry conditions in air |
| SI 26 Part 5.3(1) | Concrete tests: hardened concrete – absorbency |
| SI 26 Part 5.4(1) | Concrete tests: hardened concrete – penetration depth of water under pressure |
| SI 26 Part 5.5(1) | Concrete tests: hardened concrete – fiber absorbency |
| SI 26 Part 5.6(1) | Concrete tests: hardened concrete – cement properties |
| SI 26 Part 5.7(1) | Concrete tests: hardened concrete – erosion resistance |
| SI 26 Part 5.8(1) | Concrete tests: hardened concrete – modulus elasticity model  |
| SI 26 Part 6 | Concrete testing methods: acceptance, preparation, compressive strength test of hardened concrete samples in a structure (1985 with its amendment editions) |
| SI 26 Part 6(1) | Concrete tests: hardened concrete in a structure - acceptance, preparation of samples and compressive strength test |
| SI 466 Part 1 | Concrete code: general principles |
| SI 466 Part 2 | Concrete code: elements and systems of reinforced concrete and non-reinforced concrete |
| SI 466 Part 3 | Concrete code: compressed concrete |
| SI 466 Part 4 | Concrete code: precast concrete |
| SI 466 Part 5 | Concrete code: Hollow pre-stressed concrete |
| SI 755 | Fire responses of building materials – testing methods and classification |
| SI 896 Part 1 | Concrete additives: concrete additives |
| SI 1209 | Floating coal ash on concrete |
| SI 1225 Part 1 | Steel Building Code: general |
| SI 1865 Part 2 | Test methods for paving: tests of aggregates |
| SI 1923 | Concrete casting work on site |

(1) Standards in preparation. Until they are published, tests shall be performed pursuant to the standards mentioned hereinbelow, as applicable:
- SI 26 Part 3 from 1985 and its amendment versions;
- SI 26 Part 4 from 1985 and its amendment version;
- SI 26 Part 5 from 1995;
SI 26 Part 6 from 1985 and its amendment version;

**Israeli laws, regulations, and documents**Planning and Building Regulations (Application for a Permit, its Conditions and Fees), 5730-1970, and updates
Public Health Regulations (Sanitary Quality of Drinking Water), 5734-1974, and updates

**International standards**ISO 9001:2000 Quality management systems – specifications
**European standards**

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| --- | --- |
| EN 206-1:2000 | Concrete: specifications, performance, production and conformity |
| EN 1008:2002 | Mixing water for concrete: specification for sampling testing and assessing the suitability of water, including water recovered from processes in the concrete industry as mixing water for concrete |
| EN 12878:2005 | Pigments for the coloring of building materials based on cements and/or lime: specifications and methods of testing |
| EN 13263-1: 2005 | Silica fume for concrete: definitions, specifications and conformity criteria |

**National standards**

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| --- | --- |
| DIN 4030-2:2008 | Assessment of water, soil and gases for their aggressiveness to concrete: sampling and analysis of water and soil samples |
| ASTM A 820:2001 | Standard specification for steel fibers for fiber-reinforced concrete |
| ASMT C 1152:2004 | Standard test method for acid-soluble chloride in mortar and concrete |

1. **Definitions**
	1. **Concrete**These definitions are valid in these regulations:
	Material obtained by mixing cement, rough aggregates, fine aggregates, and water, which can include additions, supplements, and fibers, and the formula of its properties by hydration of the cement.
	2. **Fresh cement**
	Concrete following completion of the mixing process and is still in a condition that allows compression.
	3. **Hardened concrete**
	Concrete in a solid state, which has developed strength.
	4. **Ordinary weight concrete**
	Concrete with specific spatial weight, when dried in a kiln, is greater than 2,000 kg. per cu.m., but is less than 2,600 kg. per cu.m.
	5. **Reinforced concrete**
	Concrete with reinforcement that is not less than the minimum reinforcement state in the different parts of Israeli Standard SI 466, as applicable (the definition is taken from Israeli Standard SI 466 Part 1 from June 2003).
	6. **High-strength concrete**
	Concrete with strength properties at pressure is greater than 60 megapascals.
	7. **Concrete mix components** (hereinafter: admixture)
	Concrete for which additional mixes and properties have been defined.
	8. **Prescription concrete mix**
	Concrete for which the constituents and composition have been defined.
	9. **Cement mixer truck**
	A vehicle on which a cement mixer has been installed to mix and supply homogenous concrete.
	10. **Transport vehicle**A vehicle without a cement mixer used to transport concrete.
	11. **Production unit**
	The quantity of mixed concrete in a single action of the mixer.
	12. **Batch**A quantity of concrete mixed by a mixer as defined in sections 3.9 and 3.10, which include one production unit or several production units.
	13. **Supply**
	The process of supplying fresh cement by the manufacturer.
	14. **Additives**
	As defined in Israeli Standard SI 896 Part 1.
	15. **Admixture**
	Fine material, which can be added to the concrete composition to improve particular properties or to achieve special properties. The admixtures are of the following kinds:
* Almost inert mineral additive (type 1)
* Pozzolanic or latent hydraulic admixture (type II)
(see details in section 5.1.6)
	1. **Aggregate**
	As defined Israeli Standard SI 3.
	2. **Ordinary weight aggregate**
	Aggregate the grain density of which in dry conditions is greater than 2,000 and less than 3,000, pursuant to what is stated in Israeli Standard SI 1865 Part 2.
	3. **Recovered aggregate**(2)
	Aggregates which have been separated from the wash water of mixers that included concrete prepared under the specifications of this standard, or which were separated from fresh concrete pursuant to the specifications of this standard.
	(2) [translator’s note: explanation of the Hebrew term]
	4. **Cement**
	As described in Israeli Standard SI 1 Part 1.
	5. **Recycled water**
	Water obtained from recycling facilities at concrete production plants, which originates from:
* Water that was part of any surplus concrete mix; or
* Water used to wash the internal parts of a mobile or fixed mixer or of concrete pumps, which included concrete as defined in this tender; or
* Water pumped from fresh concrete during its production.
	1. **Included quantity of water**
	The quantity of water in concrete: mix water, water included in aggregates and on their surfaces, water included in admixtures and liquid admixtures, and water created from addition of ice or from heating in a kiln.
	2. **Effective quantity of water** The difference between the included quantity of water found in fresh concrete and the quantity of water absorbed by the aggregates.
	3. **Water ratio: cement**
	The weight ratio in fresh concrete between the effective quantity of water and the quantity of the cement.
	4. **Compressive strength of a test sample (fci)**
	The compressive strength of any test sample from the samples tested (in megapascals).
	5. **Mean concrete compressive strength (fcm)**
	The mean compressive strength (in megapascals) of all the samples tested, referring to the continuous solidity of that part of the structure on one day.
	6. **Confined characteristic compressive strength (fck)**
	The compressive strength (in megapascals) of concrete after 28 days on which the structure or composition property is based.
	7. **Building site (**hereinafter: the site)
	The site where construction work is underway.
	8. **Specifications**
	A document that includes the technical specifications and test specifications (see definition 3.29) for them. The specifications are defined from the function aspect of the concrete and/or from the composition aspect of the concrete.
	9. **Test specifications**
	Part of a document that includes the specifications (see definition 3.28), including the test methods, number of samples to be tested, the test times, and their frequencies (everything as applicable).
	10. **Building skeleton planner** (hereinafter: the planner)
	As defined in the Planning and Building Regulations.
	11. **Manufacturer**
	A person or entity which produces brought concrete, concrete for the production of prefabricated elements, or any other concrete.
	12. **Certified manufacturer**
	A manufacturer whose production process has been inspected and certified by an authorized certification agency.
	**Note**: when this standard was published, the authorized certification agency was the Standard Label system.
	13. **User**
	A person or entity which uses the fresh concrete to produce a structure or structure element.
	14. **Preliminary tests**
	Tests intended to determine the composition of new concrete before the start of its production, in order to ensure that it complies with all the specifications mentioned for the concrete in fresh state or in hardened state.
	15. **Conformity control**
	Tests conducted by the manufacturer for determining concreate conformity(see section 8)
	**Note**: this edition of the standard does not include concrete match control specifications.
	16. **Environmental conditions**
	Chemical and physical actions by environmental factors that affect the concrete, concrete reinforcement, and metals included in concreate are not expressed in the load calculations of the structure properties.
1. **Classification**
	1. **Classification of environmental conditions of structures and elements – exposure grades**
	Classification of the environmental conditions, to which structures and structure elements are exposures as mentioned in section 4.1.2. This classification is intended to define the specifications that apply to the production of the concrete and the concrete mix for different exposure conditions. For the purposes of determining the exposure grades, the chemical aggressiveness of the soil and the water are classified as mentioned in section 4.1.1.
		1. **Classification of the soil and water chemical aggressiveness**
		The classification of the chemical aggressiveness of the soil and water that come into contact with structures and structure elements are detailed in Tables 1 and 2.
		When two or more aggressive factors act together, the class of aggressiveness is determined by the factor with the higher class of action.
		The classification in Tables 1 and 2 are suited for the average summer temperature of up to 30° C. In areas with a higher average summer temperature (the Jordan Valley, the Arava, and the southern Negev), and/ or when there are two or more aggressive factors of the same class, the aggressiveness class shall be stricter by one grade. Additional conditions that will result in a stricter aggressiveness class, on the basis of an expert consultant, are:
* Fast flowing water;
* Frequent dampness and dryness cycles;
* Soil contaminated with aggressive chemical substances;
* Structures for the aggressive chemicals industry

**Table 1 – Chemical aggressiveness classification of a damp environment (including damp soil)**

|  |  |  |
| --- | --- | --- |
| **Serial no.** | **Description of the aggressiveness criterion** | **Aggressiveness class** |
| **Low** | **Medium** | **High** |
| 1 | pH value | 5.5-6.5 | 4.5-5.5 | 4.0-4.5 |
| 2 | CO2 solubility (mg/liter) | 15-40 | 40-100 | >100 |
| 3 | NH4+ (mg/liter)  | 15-30 | 30-60 | 60-100 |
| 4 | Mg++ (mg/liter) | 300-1000 | 1000-3000 | >3000 |
| 5 | SO4 ­--(mg/liter) | 300-600 | 600-3000 | 3000-6000 |

* **Table 1 – Chemical aggressiveness classification of a dry soil environment**

|  |  |  |
| --- | --- | --- |
| **Serial no.** | **Description of the aggressiveness criterion** | **Aggressiveness class** |
| **Low** | **Medium** | **High** |
| 11 | Acidity (ml/kg) (Baumann Gully test in DIN 4030-2:200) | >200 | Nonexistent in reality | Nonexistent in reality |
| 12 | SO4 ­--(mg/kg) | 1000-3000 | 3000-12000 | 12000-24000 |

* + 1. **Exposure classes of structures and their elements to environmental conditions**
		Classification of the environmental conditions to exposure classes in accordance with their effect on structures and elements, as mentioned in Table 3.

**Table 3 – Exposure classes**

|  |  |
| --- | --- |
| Exposure class | Description of the environmental conditions of the structure or structure element(a) |
| 1 | Interior element – in “ordinary air” conditions, orExterior element – in a desert area, at least 2 m above the ground |
| 2 | Exterior element | When R > 2, at least 2 m above the ground |
| 3 | Element surface | In contact with non-aggressive water, or with non-aggressive ground (up to 2 m above it) |
| 4 | Exterior element | If 1 < R < 0.2, at least 2 m above the ground |
| 5 | Marine environment (Mediterranean) | If 1 < R < 2, exposure to sea wind or if R < 0.2, more than 30 m above the surface |
| 6 | If R < 0.2, up to 30 m above the surface, or not exposed to direct seawater spray |
| 7 | Marine construction (Red Sea) | In the water, at a depth of over 2 m |
| 8 | In the sea spray zone or in the water at a depth of up to 2 m |
| 9 | Aggressive environment or sea class (b) | Low aggression |
| 10 | Medium aggression |
| 11 | Severe aggression (the element must have a separation protection coating in such an environment |
| Notes to the table:(a) R states the element’s distance from the closet Mediterranean shoreline, in km.(b) Aggressiveness class shall be determined in accordance to what is mentioned in Tables 1 and 2. |

The left-hand column of Table 3 lists the classes of exposure, and the right-hand column states the environment conditions to which the structure or its elements are exposed.

This table refers to the concept of “ordinary air” for the interior space in which the average humidity is not higher than 60%. If the average humidity is higher, the interior element will be considered as an “exterior element”.

“Desert area” is a site where there average humidity is 30-50%.

An interior element exposed to outside air (a shed, open parking garage, etc.) is considered as an exterior element.

Exposure class 3 includes unsealed foundations and platforms, air-raid shelters, and fresh water pools.

Exposure classes 7 and 8 include structure elements that are in contact with brackish water or seawater groundwater at the applicable depths.

The exposure class will be **stricter** if, during construction, the structure or element is exposed to worse conditions for a period exceeding six months (such as a structure that is not plastered or covered during this period).

* 1. **Fresh concrete classification**
		1. **Viscosity classes**
		Classifications of fresh concrete, based on its viscosity, to concrete with a viscosity class as stated in Tables 4, 5, 6, and 7.
		**Notes**:
1. The viscosity classes mentioned in Tables 4 through 7 were established by different test methods, which are not directly related to each other.
2. See the additional guidelines for applying the viscosity class methods in section 5.4.1.
3. The viscosity class is not classified for concrete, which will have a greater density by special means, such as compressing for earthworks.

**Table 4 – Viscosity classes by shrinkage test(3)**

|  |  |
| --- | --- |
| **Viscosity class** | **Concrete shrinkage (mm)** |
| S1 | 1-40 |
| S2 | 41-65 |
| S3 | 66-90 |
| S4 | 91-115 |
| S5 | 116-140 |
| S6 | 141-165 |
| S7 | 166-190 |
| S8 | 191-215 |
| **Note to table:**Even though the viscosity class names (S1-S5) are the same as the viscosity classes in European Standard EN 206-1, the shrinkage classes of the concrete are different for the corresponding classes. |

**Table 5 – Viscosity classes by Vee-Bee test**

|  |  |
| --- | --- |
| **Viscosity class** | **Vee-Bee time (seconds)** |
| V0 | ≥ 31 |
| V1 | 21-30 |
| V2 | 11-20 |
| V3 | 6-10 |
| V4 | 3-5 |

(3) [Translator’s note; the text is an explanation of the translation into Hebrew]

**Table 6 – Viscosity classes by compactness classes**

|  |  |
| --- | --- |
| **Viscosity class** | **Compactness classes** |
| C0 | ≥ 1.46 |
| C1 | 1.45-1.26 |
| C2 | 1.11-1.25 |
| C3 | 1.04-1.10 |

**Table 7 – Viscosity classes by flow table test**

|  |  |
| --- | --- |
| **Viscosity class** | **Flow diameter (mm)** |
| F1 | < 340 |
| F2 | 350-410 |
| F3 | 420-480 |
| F4 | 490-550 |
| F5 | 560-620 |
| F6  | > 630 |

* + 1. **Classification by maximum aggregate grain size in the concrete**
		Classifications of concrete by the maximum grain size of the aggregate in it (see section 5.4.4)
		**Note:** “Maximum aggregate grain size” is defined in Israeli Standard S! 3.
	1. **Hardened concrete classification**
		1. **Compressive strength grade es**
		The concrete is classified according to its characteristic compressive strength (fck) (see definition 3.26) for concrete with strength grade es as mentioned in Table 8.

**Table 8 – Strength grades by characteristic compressive strength**

|  |  |
| --- | --- |
| **Strength grade (type of concrete) (a)** | **Characteristic compressive strength (megapascals)** |
| B-15 (b) | 15 |
| B-20 | 20 |
| B-25 | 25 |
| B-30 | 30 |
| B-40 | 40 |
| B-50 | 50 |
| B-60 | 60 |
| Types of high strength concrete (see definition 3.6) | To be determined by the planner(c) |
| **Notes to the table**:(a) Concrete with a strength grade of up and including 60 is used to produce elements as stated in Israeli Standard SI 466 and its parts. Concrete with a higher strength grade (see definition 3.6) is used to produce special elements. High-strength concrete has different mechanical properties from the mechanical properties described in Israeli Standard SI 466 Part 1 for concrete with a class strength of up to 60. These properties are not linearly greater with the increase in compressive strength.(b) Concrete B-15 is only intended for non-reinforced concrete elements.(c) Adaptation specifications to the concrete compressive strength standard for high-strength concrete shall be determined by the planner (see also section 10.3.2) |

* + 1. **Chloride content class**
		The cement and its mixes are classified in accordance with its chloride content (see section 5.2.7), as mentioned hereinbelow:
* Concrete with 0.80 chloride content, called Cl 0.80;
* Concrete with 0.20 chloride content, called Cl 0.20;
* Concrete with 0.10 chloride content, called Cl 0.10.
1. **Concrete testing specifications and methods**
	1. **Basic specifications for concrete components**
		1. **General**
		The concrete components will conform to the concrete’s designation.
		The components will not include materials that damage the concrete or cause the reinforcement to corrode.
		The concrete components will conform to the applicable Israeli standards, or, alternatively, to the applicable foreign standards, as mentioned in sections 5.1.2-5.1.7.
		2. **Cement**
		The cement used for the production of concrete will conform to Israeli Standard SI 1 and all its parts.
		It is prohibited to use cement with a compressive strength of 32.5 for concrete for structural elements (see also section 1.2).
		Israeli Standard SI 1 Part 1 discusses 27 kinds of cement in Table 1: The 27 products in the family of common cements, of which types of cement for which there is experience in their use in Israel are mentioned below
* Portland cement (CEM 1)
* Portland cement types-clinker (CEM II/A-S), which includes only up to 10% clinker;
* Portland cement – fly coal clinker (CEM II/A-V, CEM II/A-W) ), which includes only up to 10% fly coal clinker;
* Portland cement – mixed (CEM II/A-M (S-L-V)), ), which includes only up to 10% fly coal clinker and up to 10% clinker.
As for the other kinds of cement mentioned in Table 1 in SI 1 Part 1, there is no experience of use in Israel. Before using any kind of cement for which there is no experience of use in Israel, check and confirm confirming the cement for the production of concrete, the conforming the concrete for the production of elements, the concrete durability, the concrete strength, and its mechanical and other physical properties, and the concrete testing methods.
	+ 1. **Aggregates**
		The aggregates used for the production of the concrete will be natural aggregates of ordinary weight, which conform to Israeli Standard SI 3.
		It is also permitted to use recovered aggregates (see definition 3.18) at the conditions mentioned in section 5.2.3.2.
		2. **Mixing water**
		The water for the production of the concrete will conform to the specifications of the standard with respect to drinking water sanitary quality or any other law that supersedes it. It is also permitted to use ice.
		**Note:** make sure that the ice has melted in full during the mixing of the concrete.
		Notwithstanding what is mentioned hereinabove, it is permitted to recycled water (see definition 3.20) on the condition that the recycled water conforms with what is mentioned in Annex A of European Standard EN 1008:2002.
		3. **Additives**
		The admixtures used for the production of concrete will conform to Israeli Standard SI 896 Part 1.
		Notwithstanding what is mentioned hereinabove, it is permitted to use other additives on the condition that their compliance under the equivalent function principle mentioned in section 5.2.5.3.
		4. **Admixtures** (see definition 3.15)
1. Type I additives used for the production of concrete will be one of the following:
* Mineral fillers that conform to Israeli Standard SI 3;
* Pigments that conform to European Standard EN 12878: 2005.
1. Type II additives used for the production of concrete will be one of the following:
* Coal ash that conforms with Israeli Standard SI 1209
* Microsilica that conforms with European Standard EN 13263-1: 2005.

Notwithstanding what is mentioned hereinabove, it is permitted to use other admixtures on the condition that their compliance under the equivalent function principle mentioned in section 5.2.5.3.

* + 1. **Fibers**
		It is possible to use steel fibers, polymer fibers, and other fibers, if necessary, in the specifications (see definition 3.28). Steel fibers will conform to the American Society for Testing Materials ASTM A 820:2001.
		Use of fibers is only permitted with approval of the planner (see definition 3.30), at the conditions and quantities tested in prior trials (see definition 3.34) and found that they do not adversely affect the mechanical properties and durability of the concrete.
	1. **Basic specifications for the concrete composition**
		1. **General**
		The composition of the concrete mix and its components will be determined both for the mix components (see definition 3.7) and for prescription concrete mix components (see definition 3.8), so that the fresh concrete and the hardened concrete will conform to the specifications, *inter alia*, the viscosity, density, strength, durability, and protection of the steel against corrosion, and taking into account the concrete production methods and the method for executing the concrete work.
		If the components are not mentioned in the specifications, the manufacturer (see definition 3.31) will choose the dosages and types of components from among those mentioned in sections 5.1.2-5.1.7.
		**Note 1:** The concrete will be planned in a way that will allow the achievement of a uniform and homogeneous mix, reducing the tendency for water to extrude from the fresh concrete.
		**Note 2:** The mix required for concrete in a structure will only be achieved if the application of the fresh concrete is undertaken by suitable processes. Therefore, when planning the concrete, it is also necessary to take into account the additives specifications beyond what is mentioned in this standard, such as specifications with respect to transport, placement, density, curing, and additional handling (see Israeli Standard SI 1923 and other standards relevant to the subject).
		These specifications are usually interdependent. If all these specifications are fulfilled, then any change in the quality of the concrete in the structure and the results obtained in the standard’s sample test will be “covered” by the appropriate part of the partial safety coefficient of the material (see Israeli Standards SI 466 Part 1, SI 1225 Part 1, or other relevant standards.
		2. **Cement selection**The following will be taken into account when selecting the cement:
* The final use of the concrete;
* Curing conditions (such as thermal curing);
* The structure’s dimensions (the developing heat);
* Exposure class (see section 4.1.2);
* The possibility of an aggregate-climate reaction response in the concrete components;
* Prior experience in using the cement.
	+ 1. **Use of aggregates**
			1. **General**
			When choosing the type and kind of aggregate, its class, form of the grains (for example: flatness), the aggregate’s resistance to freezing and thawing, resistance to corrosion, and its clinker properties, the following shall be taken into account:
* Executing the work;
* The final use of the concrete;
* Exposure classes (see section 4.1.2)
* Any exposure requirement of the aggregate or tooled concrete finishes;

When choosing the maximum grain size in the aggregate, the following considerations shall be taken into account, *inter alia*, the concrete reinforcement cover, the distance between the reinforcement bars, the minimum size of the cross-section (see the chapter which discusses composition in borderline service conditions in Israeli Standard SI 466 Part 1).
Do not use type B aggregates in B-40 or higher strength grade concrete, as stated in Israeli Standard SI 3.
The maximum grain size in aggregate will not be larger than the smaller of these values:

* 1/5 of the minimum dimension between the formwork surface;
* 1/3 of the thickness of all types of hardened ceilings;
* 3/4 of the available distance between single reinforcement bars or between groups of bars in reinforced concrete, or between chords and pace lengths in compressed concrete
* Lateral concrete cover thickness for reinforcement.

**Note:** When determining the maximum grain size, also take into account the transport technology taking the concrete to the site, such as transportation by pump. At the permission of the planner, it is possible for maximum aggregate grain size to exceed the limits in this section, on the condition that the pouring and density method prevent flaws in the concrete, such as spaces and gravel nests.
The maximum aggregate grain size will be stated in the plans or content documents, as required by Israeli Standard SI 466 Part 1.

* + - 1. **Recovered aggregates**(2) (see definition 3.18)
			Aggregates recovered from wash water or fresh concrete may be used for the production of concrete under these conditions:
			The recovered aggregates, which are not separated into crude and fine aggregates, will not be used for the production of concrete in quantities that exceed 5% of the total aggregates.
			When the quantity of recovered aggregates is greater than 5% of the total aggregates, they will be from the same source and the same kind of the main aggregate and separated into crude and find sections as defined in Israeli Standard SI 3.
			2. **Alkaline-silica reaction resistance**
			When the aggregates contain types of silica, which are sensitive to alkaline aggression (Na2O and K2O originating in the cement or other sources) and the concrete is exposed to a humid environment, measures shall be taken to prevent harmful alkaline-silica reaction, based on processes with proven effectiveness.
			**Note:** Use appropriate caution with respect to the geologic original of the aggregate, and take into account prior long-term experience with respect to particular cement-aggregate mixes. A review of these cautionary means, which are accepted in various European countries is found in CEN Report CR 1901.
		1. **Use of recycled water** (see definition 3.20)
		Recycled water may be used to produce concrete if it conforms with the relevant specifications mentioned in section 5.1.4
		2. **Use of admixtures**
			1. **General**The quantity of type 1 and type II admixture will match the quantity determined in preliminary trials (see definition 3.34 and Appendix A).
			**Note:** Take into account the effect of high content of admixtures on the concrete properties, except for strength.
			For type II admixtures, take into effect the concrete composition, with reference to the cement’s properties and water-cement ratio. It is possible to use the k-value concept for coal ash and for microsilica pursuant to the guidelines mentioned in section 5.2.5.2.
			Use of other principles (for example, the equivalent function concept [see section 5.2.5.3], changes in the k-value concept, use of higher k-values from what is mentioned in sections 5.2.5.2 b and 5.2.5.2 c, or use of other admixtures (including type I) or a combination of admixtures require approval of the planner.
			2. **K-value principle** (see also section 1.2)
1. **General**
The k-value concept makes it possible to determine the quantity of the equivalent type II admixture for replacement of the quantity of cement, so that the minimum quantity of cement in the concrete and the maximum water-cement ratio will conform to the specifications in Table 11. The “quantity of cement” expressed in the minimum quantity of cement calculation in the concrete and the maximum water-cement ration calculation will be determined by the quantity of cement in the concrete after the k + the replacement x quantity of the admixture. In sections 5.2.5.2 b and 5.2.5.2 c, the k-value is expressed for the coal ash that conforms with Israeli Standard SI 1209, and for microsilica that conforms with European Standard EN 13263-1: 2005.
The k-value for the other admixtures, or for a combination of an additive with different cement from the cement mentioned in said sections, will be determined according to the equivalent function concept (see section 5.2.5.3).
2. **The k-value concept for coal ash that conforms to Israeli Standard SI 1209**
The k-value described hereinbelow may by applied for a quantity of coal ash that is not greater than the quantity of cement after the replacement x 0.33. If the concrete contains a larger quantity of coal ash, do not take into account the rest of the minimum quantity of cement and maximum water-cement ratio calculations.
The minimum quantity of cement required in accordance with the exposure class (see section 5.3.2) may be reduced if all these conditions are present:
* The quantity of cement (∆c), which can be replaced with the equivalent quantity of coal ash (∆f) will not be greater than what is mentioned in Table 9;
* The quantity of coal ash that is equivalent for replacing a quantity of cement will be calculated according to the formula: ∆f = ∆c/k;
* The k-value will conform with what is mentioned in Table 9 for exposure classes 1-4 (see section 4.1.2) and for CEM 1 cement or CEM II/A-V or CEM II/A-W, which contains up to 10% coal ash with a strength grade of at last 42.5, in compliance with Israeli Standard 1 Part 1.
For other exposure classes, the k-value will be determined according to the equivalent function concept (see section 5.2.5.3); for concrete that hardened in water or in a slurry solution, see the k-value specifications in section 5.3.2.4.
* (Quantity of cement after k + replacement x quantity of coal ash) will not be less than the quantity of cement required in accordance with the exposure class as mentioned in section 5.3.2;
* The water-(quantity of cement after k + replacement x quantity of coal ash) will not be greater than the water-cement ratio required in accordance with the exposure class as mentioned in section 5.3.2.

**Table 9 – k-value for coal ash**

|  |  |  |  |
| --- | --- | --- | --- |
| k-value | Maximum quantity of cement (∆c) which can be replaced by coal ash (kg per cu.m) | Minimum quantity of cement required in accordance to Table 11 (kg per cu.m) | Exposure class under section 4.1.2(a) |
| 0.5 | 30(b) | 230 | 1(b) |
| 0.5 | 40 | 270 | 2 |
| 0.5 | 40 | 270 | 3 |
| 0.4 | 30 | 270 | 4 |
| **Notes to table:**(a) The k-value may be used for exposure classes 5 through 11 if the k-value itself is determined in accordance with the equivalent function concept as required in section 5.2.5.3.(b) For reinforced concrete with exposure class 1, reducing the quantity of cement is only allowed for concrete with a strength grade of B-30 or higher. |

1. **The k-value concept for microsilica conforming to European Standard EN 13263-1: 2005**
The k-value concept described hereinbelow is applicable for a quantity of microsilica that is not greater than the quantity of cement after replacement x 0.11. If the concrete contains a larger quantity of microsilica, do not take into account the balance in the minimum quantity of cement and maximum water-cement ratio calculation. The minimum quantity of cement required in accordance with the exposure class (see Table 11) may be reduced if all of these conditions are present:
* The quantity of microsilica (∆s) equivalent to the quantity of cement (∆c) will be calculated according to the formula ∆s = ∆c/k;
* The k-value for CEM 1 cement conforming to Israeli Standard SI 1 Part 1 will be as follows:
	+ - K = 2.0, when the cement-water ratio in the concrete is equal or less than 0.45;
		- K = 1.0, when the cement-water ratio in the concrete is greater than 0.45
* (Quantity of cement after the replacement + k x quantity of microsilica) will not be less than the quantity of cement required in accordance with the exposure class as mentioned in Table 11;
* The water-(quantity of cement after the replacement + k x quantity of microsilica) will not be greater than the quantity of cement required in accordance with the exposure class as mentioned in Table 11;
* For exposure classes 1-4 only, the quantity of cement (∆c) that may be replaced by the quantity of microsilica (∆s) will not be greater than 30 kg per cu.m of concrete.
	+ 1. **Equivalent function concept**
		The equivalent function concept allows deviating from the specifications for the minimum quantity of cement and the maximum water-cement ratio mentioned in this standard, by use of the combination of the specific admixture and the specific cement for which the original manufacture and properties are known and documents.

		Under the specifications in section 5.2.5.1, it is proved that concrete has an equivalent function, especially with respect to its reaction to environmental influences and its durability, compared with reference concrete, which conform with the specifications in section 5.3.2 for the relevant exposure class and which was prepared with CEM 1 cement that conforms to Israeli Standard SI 1 Part 1. Appendix B states the principles for determining the equivalent function. When the concrete is produced in accordance with these processes, it will be under continuous control, which takes into account changes in the cement composition and the admixture.
		2. **Chloride properties**The American Society for Testing Materials ASTM C 1152: 1997 test examines the general properties of soluble chloride ions in acid of all concrete admixture components together, expressed as a percentage of the quantity of the cement in the mixture, which will not exceed the values mentioned in Table 10, according to the chloride property class.

**Table 10 – Maximum chloride content in concrete**

|  |  |  |
| --- | --- | --- |
| The concrete | chloride property class (Cl) | Maximum chloride content relative to the cement mass(a) |
| Does not contain steel rebar or other metal (except for corrosion-resistant lifting facilities) | Cl 0.80 | 0.80% |
| Contains steel rebar or other metal | Cl 0.20 | 0.20% |
| Contains compressed steel | Cl 0.10 | 0.10% |
| **Notes to table:**(a) When type II admixtures are used, which take the cement properties into account, the chloride properties will be expressed as a percentage of the Cl ion of the mass of the cement + the total mass of the admixtures that are taken into account. |

 Do not use chemical admixtures based on calcium chloride or other chlorides in reinforced concrete (see definition 3.5) and compressive concrete.

* + 1. **Concrete temperature**
		Unless decided otherwise between the user and the manufacturer, the temperature of the concrete during its production will not be higher than 40° Celsius and will not be lower than 5° Celsius. If it is necessary to decide a different minimum and maximum temperature specification for the concrete, it is also necessary to determine the permissible deviation.

		If artificial heating or cooling is necessary before supplying the concrete, the heating or cooling method will be decided between the user and the manufacturer.
	1. **Specifications related to environmental conditions**
		1. **General**
		The concrete resistance specifications to environmental effects as marginal values of the concrete composition and its properties (see section 5.3.2) or, alternatively, as specifications derived from the functional planning methods relative to the durability (see section 5.3.3).
		2. **Marginal values for the concrete composition**
			1. **General**
			In the absence of standards for testing the absolute functioning of the concrete, the specifications for resistance to environmental conditions are expressed in terms of the marginal values of the mixture.
			2. **Concrete composition margin values, except for concrete conforming to sections 5.3.2.3 and 5.3.2.4**
			The maximum water-cement ratio and the minimum cement content in concrete will conform to what is mentioned in Table 11.
			3. **Concrete composition margin values for concrete without any steel**
			There are no specifications for the minimum quantity of cement in concrete that does not contain steel reinforcement bars and/or steel accessories (see also section 1.2).
			The maximum water-cement ratio will conform to what is mentioned in Table 11 for exposure classes 1, 7, 8, 9, 10, 11.
			4. **Concrete composition margin values for concrete that hardens in water or slurry solution**
			Concrete which is hardened in water or a slurry solution (such as pilings or slurry walls) will have a minimum cement content of 400 kg per cu.m. Users of coal ash or other mineral admixture may reduce the quantity of cement to 260 kg per cu.m. The quantity of the admixture will be determined in accordance with section 5.2.5 at k-value = 0.4.
			The maximum water-cement ratio will be as mentioned hereinbelow:
* Concrete which hardens in a non-aggressive environment (as defined in section 4.1.1.: 0.50;
* Concrete which hardens in an aggressive environment (as defined in section 4.1.1.: 0.45.

**Table 11 - Maximum water-cement ratio and the minimum cement content in accordance with exposure class(a)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Exposure class** | **Description of the environmental conditions of the structure or structure elements(b)** | **Maximum water-cement ratio(c)** | **Minimum cement content (kg per cu.m.)** | **Strength grade (type of cement)(d)** |
| 1 | **Interior element** in “ordinary atmosphere”, or**Exterior element** in desert area, at least 2 m above the ground | 0.70 | 230 | B-20 |
| 2 | **Exterior element** | If R > 2, at least 2 m above the ground | 0.60 | 270 | B-30 |
| 3 | **Element surface** (interior or exterior) | In contact with non-aggressive water or non-aggressive ground (and up to m above it), or in humid air |
| 4 | **Exterior element** | If 1 < R < 2, , at least 2 m above the ground |
| 5 | **Marine element** (Mediterranean) | If 0.2 < R < 2, exposed to sea wind | 0.55 | 320 | B-30 |
| 6 | If R < 0.2, up to a height of 30 m – exposed to sea wind, but not to direct seawater spray | 0.45 | B-40 |
| 7 | **Marine element** (Mediterranean and Red Sea) | In the water, at a depth greater than 2 m | 0.45 | 350 | B-40 |
| 8 | In area of sea spray, or in the water at a depth of up to 2 m | 0.45 | 320 | B-40 |
| 9 | **Aggressive soil or environment** (see Tables 1, 2) | Light aggression | 0.50 | 320 | B-40 |
| 10 | Moderate aggression | 0.45 | B-40 |
| 11 | Severe aggression (requires separating protective cover) | 0.45 | 350 | B-40 |
| **Notes to table:**(a) The planner may consider tightening the specifications mentioned in the table.(b) R in this table indicates the distance of the element from the closest Mediterranean shore in km.(c) The minimum cement properties suited for use in the kinds of cement for which their experience in its use in Israel are mentioned in section 5.1.2. For other cements, the minimum properties will be determined on the basis of the equivalent function (see section 5.2.5.3).(d) The compressive strength grade mentioned in this column are solely for information, and is the lowest strength grade which can be obtained from the cement composition that conform to the maximum water-cement ratio and the minimum cement content. Compliance with the maximum water-cement ratio and the minimum cement content may usually result in a type of concrete that has a higher strength grade than what is mentioned in this column. |

* + 1. **Functional planning methods**
		Functional planning methods may be used with respect to durability, for the purpose of determining specifications that refer to the environmental conditions in terms of functional criteria.
		The guidelines for using an alternative functional planning method with reference to durability are given in Appendix C.
	1. **Testing methods and specifications for fresh concrete**
	When it is necessary to determine the properties of the fresh cement, they will be determined as mentioned in sections 5.4.1-5.4.4 hereinbelow.
		1. **Viscosity**
		The concrete viscosity is determined by one of these methods:
		2. **Cement, additives, admixtures properties and the water-cement ratio**
		The properties of the cement, additives, and admixtures are determined in accordance to what is stated in the manufacturer’s records. The water-cement ration will be in accordance to the manufacturer’s records, taking into account the dampness condition of the aggregates.
		3. **Air properties**
		The air properties in concrete are determined in a test under Israeli Standard SI 26 Part 2.6. The air properties in concrete requirement will be determined as a minimum value. The maximum air properties in concrete value will be minimum value plus 4% (percentage of the volume of the concrete).
		4. **Maximum aggregate grain size**
		The maximum aggregate grain size in fresh concrete, as defined in Israeli Standard SI 3, is determined by the test under Israeli Standard 1865 Part 2.
		A test sample obtained from the residual concrete through a 4.75 type sieve, after it was washed. The test sample weight will 2 x (the test sample weight specification in Israeli Standard 1865 Part 2 in the chapter which discusses the aggregate class by sifting.

		The maximum grain size will not be larger than the specifications (see definition 3.28).\
	2. **Test methods and specifications for hardened concrete**
	When it is necessary to determine hardened concrete properties, they will be determined as mentioned in sections 5.5.1-5.5.5 hereinbelow.
		1. **Compressive strength**
			1. **Taking and preparing a fresh concrete test sample**
			Take the concrete as required in Israeli Standard SI 26 Part 1. Prepare the test samples and cure them as required in Israeli Standard SI 26 Part 3(1).
			2. **Take and prepare test samples from concrete that hardened in a structure**
			If samples were not taken from fresh concrete as required in Israeli Standard SI 26 Part 1, or if the compressive strength of the samples taken from the fresh concrete do not conform to the standard, or when it is impossible to prepare the test samples in a laboratory (for example, sprayed concrete or compressed concrete in a press), it is possible to take from the same part of the structure representative blocks as described in Israeli Standard SI 26 Part 6(1).
			The representative blocks are only removed from the structure in coordination with and approval of the planner (see definition 3.30) as stated in Israeli Standard 466 Part 1.
			3. **Number of test samples, sampling, and the representative blocks**
			At each of the test dates, one test sample from each representative sampling and each representative block will be tested. The number of representative samples will be as required in Israeli Standard SI 26 Part 1. The number of representative blocks will be as required described in Israeli Standard SI 26 Part 6(1).
			4. **Age of the concrete at the time of the test**
			For the purpose of determining that any concrete conforms to the compressive strength mentioned in this standard, the concrete will be tested at an age of 28 days.

			If it is impossible to test the compressive strength at an age of 28 days (because of the Sabbath, holiday, etc.), the concrete conformity test will be carried out in accordance with the pressure strength specifications mentioned in this standard on the closest workday following the 28-day age.
			**Note**: In addition to the compressive strength test at the age of 28 days, it is possible to test the compressive strength of the concrete at other ages, but, in any case, the type of concrete will only be determined by the test at the age of 28 days.
			5. **Compressive strength test**
* The compressive strength of the concrete samples prepared from fresh concrete are tested as stated in Israeli Standard 26 Part 4.1(1).
* The compressive strength of the concrete samples prepared from hardened concrete are tested as stated in Israeli Standard 26 Part 6(1).

**Note**: If no samples were taken from fresh concrete, the compressive strength of concrete samples taken from concrete which has hardened in the structure shall be used to estimate the compressive strength of the hardened concrete in the part of the structure, but they will not be used to determine conformity to the compressive strength standard of the fresh concrete that was supplied to the site.

* + 1. **Tensile strength**
		The tensile strength of the concrete will be determined by an indirect tensile test (in a crack) or bending strength test, as required by the planner, using the method described in Israeli Standard 26 Part 4.3(1) or Part 4.2(1) as applicable. The tensile strength will be determined by testing concrete at an age of 28 days. The tensile strength will be equal to or greater than the strength stated in the specifications.
		2. **Density (specific spatial mass)**
		The concrete density is the density in dry condition in the kiln, determined by the method stated in Israeli Standard 26 Part 5.1(1). The density in dry condition in the kiln of concrete of ordinary weight will be greater than 2,000 kg. per cu.m., but less than 2,600 kg. per cu.m.
		3. **Water penetration resistance**
		The resistance to water penetration will be determined by the test under Israeli Standard 26 Part 5.4(1).
		4. **Reaction to fire**
		Concrete made from natural aggregates conforming to section 5.1.3, from cement conforming to section 5.1.2, from admixtures confirming to section 5.1.5, from additives conforming to section 5.1.6, or from other inorganic components conforming to section 5.1.1 is defined as inflammable material (fire classification V1.4.4) under Israeli Standard SI 755.
1. **Concrete specifications** (see definition 3.28)
	1. **General**
	The planner (see definition 3.30) will include all the specifications related to the concrete properties and/or the test specifications (see definition 3.29) for each of the specifications, except for the concrete strength grade .
	**Note**: The concrete strength grade in accordance with its compressive strength will be examined as required in this standard.
	The planner will also state all the specifications for the concrete properties needed for its transportation, placement, density, curing, and any other treatment. The specifications will include, as needed, special specifications (such as specifications for achieving architectural finishing).
	The planner will taking these data into account when determining the specifications:
* The application of the fresh concrete and the purpose of the hardened concrete;
* The curing conditions;
* The component dimensions (heat development);
* Influence of environmental conditions;
* Specifications related to the finishing of the concrete;
* Specifications related to the thickness of the steel reinforcement cover or the minimal cross-section width, such as maximum grain size.

The specifications for the concrete will be determined in one of the following ways:

1. Mix content specifications (see definition 3.7 and section 6.2). The planner will determine the concrete properties in accordance with the classification given in section 4 and the specifications stated in section 5.3 through 5.5.
2. Prescription mix content specifications see definition 3.8 and section 6.3). The planner will determine the mix composition.

The basis for planning the concrete and determining its composition will be the result of early trials (see Appendix A) or information obtained from long-term trials with similar concrete. Take into account the basic specifications for the concrete components (see section 5.1) and its composition (see section 5.2 and 5.3.2).

When determining the specifications for prescription concrete mix, the planner is responsible for ensuring that the concrete components conform to this standard and that the required composition will be able to achieve the intended function of the concrete, both in fresh condition and in hardened condition. The planner will possess the up-to-date documents proving the link between the composition and the required function.

* 1. **Content mix specifications**
		1. **General**
		The content mix will be defined by means of the basic specifications stated in section 6.2.2, which shall be mentioned any case, and the additional specifications mentioned in section 6.2.3, which shall be mentioned as needed.
		2. **Basic specifications**
		The specifications will include:
1. Specifications to conform to this standard;
2. Exposure class;
3. Strength grade ;
4. Viscosity class;
5. Maximum aggregate grain size.
	* 1. **Additional specifications**
		As necessary, on the basis of the functional specifications, data, such as the following, will be defined and mentioned:
* Types of cement;
* Additional properties of the aggregates;
* Chloride properties class in the concrete, as stated in Table 10;
* Properties to resist freezing and thawing damage; for example, air properties (see section 5.4.3);
* Fresh concrete temperature specifications, if they are different from what in mentioned in section 5.2.8;
* Strength development (see Table 12);
* Hydration heat development;
* Delay in concrete bonding;
* Resistance to water penetration;
* Corrosion resistance;
* Indirect tensile strength (shrinkage) (see section 5.5.2);
* Other technical specifications (such as specifications related to finishing which must be met, or special placement method).

**Note**: for additional data, see Israeli Standard SI 466 Part 1 in the section which discusses concrete for special needs.

* 1. **Prescription concrete mix specifications**
		1. **General**
		Prescription concrete mix will be defined by the basic specifications stated in section 6.3.2, which shall be mentioned in any case, and the additional specifications stated in section 6.3.3., which shall be mentioned as necessary.
		2. **Basic specifications**
		The specifications will include:
1. Specifications to conform to this standard;
2. The cement properties;
3. The type of cement according to the composition and kind of cement by strength;
4. Water-cement ratio, or viscosity expressed as viscosity class;
5. Type and kinds of aggregates;
6. Maximum aggregate grain size, the composition of the aggregates in the concrete mix, and any restriction in its class;
7. Kinds and quantities of admixtures and additives, if relevant;
8. If admixtures and additives are used, which cannot be defined by accepted means (standards), state the origin and kind of cement to be used;
9. Compressive strength grade.
	* 1. **Additional specifications**
		The planner will mention additional specifications, if necessary.
10. **Ordering the concrete and the supply of fresh concrete** (see definition 3.13)
	1. **Ordering the concrete**
	Concrete will be ordered in writing. The order will include, at least:
* The particulars mentioned in section 6.2 or in section 6.3, as applicable;
* The quantity of cement ordered.
	1. **Transportation time**
	The transportation time and unloading of the concrete will not exceed 90 minutes from the time the water is added in the production process. If the concrete is supply by non-motorized means, the delivery and unloading time will not exceed 45 minutes from the time the water is added in the production process.
	Notwithstanding what is mentioned hereinabove, with agreement between the manufacturer and the user, and with the approval of the planner, the delivery and unloading time may be extended.
	2. **Information from the user to the manufacturer**
	The user (see definition 3.33) will determine, in agreement with the manufacture, these details:
* Supply date, supply time, and pace of the supply;

If relevant, the user will notify the manufacturer about:

* Special means of transportation at the site;
* Special casting methods;
* Transport vehicle restrictions, such as cement mixer (see definition 3.9) or transport vehicle (see definition 3.10), vehicle size, height, and total weight;
* Information about the cast, such as pillars, beams, ceilings, walls.
	1. **Information from the manufacturer to the user**
	The user may request from the manufacturer proper fresh concrete casting and curing information and an estimate for the concrete strength development. The manufacturer shall provide this information upon request, before the concrete is supplied.
	If necessary, the information about the mix content shall be provided, as mentioned hereinbelow:
1. Type of cement by its composition and strength, and the type of aggregates;
2. Types and admixtures and types of additives, if any, and their quantities;
3. Results of previous relevant tests on the same concrete, such as results obtained from production control or preliminary trials;
4. Strength development;
5. The sources of the materials which comprise the concrete.

It is possible to provide information about the estimated development of the compressive strength in accordance with the data stated in Table 12 or by the strength development cure at 20° Celsius from day 2 through day 28.
**Note**: the rate of concrete tensile strength development is different from the rate of concrete compressive strength development.

**Table 12 - estimated concrete compressive strength development at 20° Celsius**

|  |  |
| --- | --- |
| **Strength development** | **Estimate strength ratio**fcm.2/fcm.28 |
| Rapid | 0.5 ≤ |
| Moderate | 0.5 > through 0.3 ≤ |
| Slow | 0.3 > through 0.15 ≤ |
| Very slow | 0.15 > |

The strength development is determined on the basis of the ratio between the average compressive strength after 2 days (fcm.2) and the average compressive strength after 28 days (fcm.28), as determined in preliminary trials or on the basis of the known functional properties of concrete with a similar composition. The preliminary trials are supposed to be carried out on test samples taken as mentioned in Israeli Standard SI 26 Part 1, and prepared and cured as mentioned in Israeli Standard SI 26 Part 3(1), and tested under Israeli Standard SI 26 Part 4.1(1).

The manufacturer shall notify the user about the health risks involved in handling the fresh concrete, as required under regulations and laws of the relevant agencies, such as the Ministry of Health and the Ministry of Environmental Protection.

* 1. **Bill of lading**
	The manufacturer will provide the user a bill of lading when supplying each batch of concrete (definition 3.12), which will be printed and include at least the following details:
* Name of production plant of the brought concrete;
* The serial number of the bill of lading;
* The time and date of the loading; i.e. the time of the first contact of the cement and the water;
* The number or identification mark of each transport vehicle;
* The name of the client;
* Order identification particulars, such as name and location of the site, the specifications number, code, or order number.
* The quantity of the concrete ordered;
* The quantity of the concrete in the batch (see also section 7.7);
* The cumulative (total) quantity of the concrete supplied;
* A declaration that the manufacturer is certified (see definition 3.32);
* Arrival time of the concrete at the site;
* The permissible quantity of water to add at the site (see definition 3.27) before unloading the concrete (if relevant);
* The type and quantity of the additives permitted to add at the site, before unloading the concrete (if relevant);
* The quantity of water added in practice at the site, before unloading the concrete;
* The quantity of additives added in practice at the site, before unloading the concrete;
* The starting time of unloading the concrete;
* The time the samples are taken for testing, and the name of the sampler (if relevant);
* The time the unloading was completed.

The following will also be mentioned:

1. For the content mix:
* The exposure class (according to Table 3) to which the concrete conforms;
* The compressive strength grade ;
* The viscosity class;
* The maximum aggregate grain size;
* The chloride properties class (if mentioned in the specifications);
* Special properties, if required (see section 6.2.3).
1. For the prescription concrete mix
* All the particulars mentioned in the specifications that the customer demanded to be recorded.

**Note**: it is possible to use a code agreed between the customer and the manufacture to state all the special properties.

* 1. **Concrete viscosity at delivery**
	Do not add water or any additives when supplying the concrete, unless it is necessary to adjust the viscosity of the concrete the viscosity ordered (as required in the specifications). The quantity of the water that may be added are recorded in the bill of lading. The manufacturer shall perform this action at its responsibility, while preserving the concrete properties recorded in the bill of lading.
	Any quantity of water or additives added to the concrete in the cement mixer will be recorded in the bill of lading. See section 9.8 for the mixing instructions.
	2. **Quantity of concrete delivered**
	Check the quantity of concrete (cu.m. of fresh concrete) per the specifications of one of the pertinent parties.
	A sample of the batch number is tested to determine the total quantity of concrete supplied, as mentioned in Table 13, and the total quantity of concrete is calculated as mentioned in Appendix D.
	**Note**: do not determine the quantity of concrete supplied on the basis of a theoretical calculation of the volume of the platforms in which the concrete was hardened.
	The total quantity of concrete supplied to the site will not be less than the quantity ordered as stated in the bill of lading. If the quantity of concrete supplied to the site is in two or more batches, the quantity of concrete in one batch will not be less than 1.5% of the quantity stated in the bill of lading.

**Table 13 – Number of batches tested**

|  |  |
| --- | --- |
| **Number of batches supplied to the site** | **number of batches for testing** |
| 1 | 1 |
| 2 to 8 | 3 |
| More than 8 | 2 + an additional batch for every four additional batches or part thereof |

1. **Conformity control** (see definition 3.35)
This section will include the methods and specifications for conformity control of the concrete by the manufacturer using statistical methods. The methods and specifications are not included in this edition of the standard. They will be included in the future, after the options for implementing them are examined and validated.
**Note**: said statistical methods will be based on what is mentioned in section 8 of European Standard EN 206-1:2000.
2. **Production control**
The 1986 edition of Israeli Standard SI 118, which is superseded by this edition, defined the different classes of concrete production control conditions. This edition of the standard defines uniform control conditions, equivalent to the “good control conditions” in the 1986 edition of the standard.
	1. **General**
	All the concrete production will be under production control at the responsibility of the manufacturer.
	Production control includes all the means needed to guarantee that the concrete properties will conform to the specifications.
	The production control includes:
* Selection of the concrete components;
* The concrete mix content;
* The concrete production;
* Supervision and testing;
* Use of the test results of the component materials, the fresh concrete properties, and the hardening, and the equipment;
* Supervision of the equipment used to transport the fresh concrete;
* Conformity control pursuant to section 8 (this specification is not applicable in the present edition of the standard).

Specifications about other aspects of the production control are mentioned in the sections hereinbelow.

Additional specifications will be defined for special circumstances.

**Note**: section 9 takes into account the principles of the international standard ISO 9001: 2000.

* 1. **Production control system**
	The responsibility and functions of all the employees engaged in the management, production, and control, and the reciprocal relations between them will be defined in the quality assurance handbook.
	This issue mainly affects workers whose job requires freedom of action and authority to ensure the quality of the concrete. The production control system will be reviewed at least once a year and ensure conformity and effectiveness of the system.
	Documentation of a review will be saved for at least three years.
	The production control system will include work procedures and instructions, which will be based on the control specifications mentioned in Tables 16, 17, 18, as applicable.
	The program and frequency of the manufacturer’s audits will be documented.
	The results of the audits will be documented.
	2. **Documented information and additional documents**
	All relevant information about the production control will be documented. See Table 14.
	The production control documentation will be saved for several years, as required by the Planning and Building Regulations for the saving of construction documents, and for not less than three years.

**Table 14 – Documented information and additional documents (as applicable)**

|  |  |
| --- | --- |
| Subject | **Documented information and additional documents** |
| Specifications | The specifications stated in the specifications |
| Cements, aggregates, additives, admixtures | Names of the suppliers and sources |
| Mix water tests (not required for drinking water) | Date and location where taken, test results |
| Concrete components tests | Date and results of the tests |
| Concrete mix | * Description of the concrete
* Documentation of the quantities of the components in the batch or production portion (for example: cement content)
* Water-cement ration
* Chloride content (if required)
 |
| Fresh concrete tests | * Date and location taken
* Location of the structure, if known (part of the structure)
* Viscosity (test method and results)
* Density (specific spatial mass) (if required)
* Concrete temperature (if required)
* Air content (if required)
* Production portion volume or tested batch volume
* Serial number (code) of the test samples
* Water-cement ratio (if required)
 |
| Hardened cement tests | * Test date
* Serial number (code) of the test samples
* Density test results (if required)
* Strength test results
* Special comments (for example: extraordinary failures)
 |
| Conformity assessment | Conforms/does not conform to specifications  |
| Other issues related to brought concrete | * Customer name (order)
* Site address
* Numbers and dates of the bills of lading belonging to the tests
* Bills of lading
 |
| Other issues related to prefabricated concrete | Additional or different information as required by Israeli Standard SI 466 Part 4 |

* 1. **Tests**
	The tests will be conducted by the test methods mentioned in this standard.
	2. **Preliminary trials and the concrete mix**
		1. **Preliminary trials**
		Before starting production of concrete with a new mix, preliminary trials will be carried out as mentioned in Appendix A, to ensure that the required properties of functionality are achieved.
		There is no need for preliminary trials in these cases:
* Using concrete with a new composition when there is long-term experience using similar concrete;
* Using concrete with a new composition when it is possible to determine the concrete composition by interpolation between known concrete compositions, or by extrapolation the compressive strength, which is not greater than 5 megapascals.

	+ 1. **Concrete composition**
		Concrete compositions will be rested periodically to verify that they conform to the composition determined in the preliminary trials.
	1. **Personnel, equipment and facilities**
		1. **Personnel**
		Concrete manufacture will be performed under the supervision of a person (the concrete supervisor) whose expertise is suited for the carrying out of all the tests mentioned in section 9.9.
		2. **Equipment and facilities**
			1. **Storage and transport of materials**
			The materials will be stored and transported in a way that will ensure that no significant change occurs in the properties of the materials, for example, due to climate factors, or the mixing or contamination of materials. The same applies to transportation to and storage in relevant Israeli facilities.
			Storage conditions will be clearly marked to prevent mistakes in the use of concrete components.
			Special instructions of the components’ suppliers will be taken into account.
			Facilities will be found which will allow the taking of representative samples from the silos, material acceptance vessels, and storage vessels.
			2. **Sorting systems**
			The sorting systems will be two-stage.
			The systems will be equipped in silos and separate chambers large enough to store the fine aggregates and each of the crude aggregate sections.
			The shape of the chamber and its operation will allow to be efficiently emptied in full, without segregation into the weighing chambers.
			To ensure accurate weighing, control mechanisms will be installed to provide full control of the material flow into the weighing chambers.
			Each weighing chamber will be designed to prevent the accumulation of residual material and allow to be emptied in full.
			All the gauges will clearly visible to the operator when filling the weighing chamber.
			The operator will have easy access to the control mechanisms.
			The sorting system will ensure conformity to the tolerances as mentioned in section 9.7. The sorting systems will have computerized recording methods. The sorting systems will have the capabilities specified in Table 17.
			3. **Mixers**
			The mixers installed on cement mixers and fixed mixers will have mixing capacity to achieve uniform concrete (with a uniform viscosity) within the specified mixing time.
			The cement mixers will also be equipped with mechanisms for measuring the addition of water, if it needs to be added on the site at the responsibility of the concrete manufacturer.
			4. **Testing equipment**
			All testing equipment, testing facilities, and use instructions will be available for the audits and testing of the equipment, concrete components, and the concrete itself. The testing equipment will conform to the specifications in the Israeli Standards which discuss testing methods, *inter alia,* calibration specifications and testing equipment auditing specifications. See Table 17.
	2. **Sorting materials**
	The sorting facility will have written instructions detailing the sorting, classification, and quantity of the concrete components. The sorting tolerances of the concrete components will conform to what is stated in Table 15.
	When the batches include several production portions, the tolerances will apply to the batch.

**Table 15 – Sorting tolerances of the concrete components**

|  |  |
| --- | --- |
| Component | Tolerance |
| Total quantity of aggregates | ± 3% of the required quantity |
| Water | ± 3% of the required quantity |
| Cement | ± 1% of the required quantity |
| Additives in an amount greater than 5% of the quantity of cement | ± 3% of the required quantity |
| Admixtures and additives in an amount equal or smaller than 5% of the quantity of cement | ± 5% of the required quantity |

 All the powder and liquid components of the concrete, such as aggregate, cement, additives, and admixtures will be weighed. The quantity of the components in a portion will be registered by computer in real team.

* 1. **Concrete mixing process**
		1. **Mixing the concrete**
		The components will be mixed in a cement mixer or fixed mixer that conform to the specifications in section 9.6.2.3. The mixing will continue until uniform concrete is obtained as mentioned in Appendix E.
		The mixers will not be loaded beyond their maximum capacity.
		Before unloading the concrete at the site, it will undergo an additional mixing for 30 seconds per cu.m. of concrete, and not less than three minutes altogether, at the main mixing speed as stated in Appendix E.
		2. **Mixing after completing the water and/or additives dose at the site, before unloading the concrete**
		It is only permitted to add water and/or additives to the mixer on site, before unloading the concrete, if this is explicitly stated in the bill of lading. Water will be added with a water gauge. To ensure concrete uniformity after adding the water and/or additives, mix concrete for 30 seconds per cu.m. of concrete, and not less than three minutes altogether, at the main mixing speed as stated in Appendix E-2 (E).
	2. **Production control process**
	The conformity of the components, equipment, production processes, and the concrete are checked against the specifications and the specifications of this standard. The control will be performed so that any significant changes that affect the properties will be distinguishable and appropriate corrective action can be taken.
	Control of the concrete components will be undertaken as mentioned in Table 16.
	**Note**: Table 16 is based on the assumption that the components manufacturer will perform appropriate production control at the place of production, and that the components are transported (deliveries) with a bill of lading, which states that they conform to the relevant specifications. If not, the concrete manufacturer will conduct a conduct a test that the components conform to the relevant standard.
	Equipment control will ensure that the means of storage, the weighing and measuring equipment, the mixer, and the control equipment (i.e. the means for measuring aggregate dampness) are in working order and conform to the specifications of this standard.
	The control of equipment (which is in use) will be performed as stated in Table 17.
	The control of the concrete production and its properties will be performed as stated in Table 18.
	The plant, equipment, and the means of transportation will be maintained in accordance with the maintenance planning system and will be in good condition to prevent damaging the concrete properties.
	The ratio of the components in prescription concrete mix, viscosity, and temperature, per the specifications, will be controlled pursuant to the specifications mentioned in Table 18 (lines 2 through 5 and 8 through 13).
	The control will include production, transportation, and unloading.
	Additional specifications, which are not expressed in this standard, will be prepared for the production control of particular types of concrete, such as high-strength concrete.
	If the specifications define special specifications for concrete, the production control will include the additional necessary actions to those mentioned in Tables 16 through 18.

**Table 16 – Concrete components control(a)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serial no. | **Component** | **The test or control** | **Objective** | **Minimum frequency** |
| 1 | Cement | Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Every delivery |
| Test per Israeli Standard SI 1 (the relevant section) and all its sections | Verify conformity to the standard specifications | * Twice a year, every type and kind of cement from each separate source
* First delivery from a new source
* If there is concern of non-conformity
 |
| 2 | Aggregates | Before unloading: visual check of the aggregates | Verify that the aggregates appear normal in terms of class, form, and that harmful materials are not present | Every delivery |
| Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Five times a year |
| Inspection pursuant to Israeli Standard 3 and all its sections | Verify conformity to the specifications of the standard | * Four times a year
* First delivery from a new source
* If there is concern of non-conformity
 |
| Test for water absorption by the method stated in Israeli Standard 1865 Part 2 | Verify conformity with Israeli Standard SI 3 | * Once a month
* First delivery from a new source
* If there is concern of non-conformity
 |
| Check aggregate class by the method stated in Israeli Standard 1865 Part 2 | Verify conformity with Israeli Standard SI 3 | * Once a month
* First delivery from a new source
* If there is concern of non-conformity
 |
| 3 | Admixtures | Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Every delivery |
| Inspection pursuant to Israeli Standard SI 896 Part 1 and all its sections | Verify conformity to the specifications of the standard | * Once a year for each additive
* First delivery from a new source
* If there is concern of non-conformity
 |
| Inspection pursuant to Israeli Standard SI 896 Part 4.2 (the tests apply on every additive by class) | Verify conformity to the specifications of the standard | Five times a year |
| Test the density of a liquid additive as mentioned in Israeli Standard SI 896 Part 1  | Verify conformity to the specifications of the standard | Every delivery |
| 4 | Recycled water (see definition 3.20) | Inspection pursuant to all sections of Annex A of European Standard EN 1008: 2002 (see action 5.1.4 of this standard) | Verify conformity to the specifications of the standard | If there is concern of non-conformity |
| Test density, color, odor, and acidity pursuant to European Standard EN 1008: 2002 | Verify conformity to the specifications of the standard | Once a day |
| 5 | Coal ash | Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Every delivery |
| Loss of ignition (LOI) by the method stated in Israeli Standard SI 1209 | Verify conformity to the specifications of the standard | Every delivery |
| Inspection pursuant to Israeli Standard SI 1209 and all its sections | Verify conformity to the specifications of the standard | * Before using the coal ash
* Four times a year
* If there is concern of non-conformity
 |
| 5 | Microsilica | Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Every delivery |
| Inspection pursuant to European Standard EN 13263-1: 2005 | Verify conformity to the specifications of the standard | If there is concern of non-conformity |
| 6 | Powdered mineral additives (Type 1 0 see definition 3.15) | Before unloading: check the bill of lading | Verify that the delivery conforms to the order | Every delivery |

**Table 17 – Equipment control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serial no. | **Equipment** | **The test or control** | **Objective** | **Minimum frequency** |
| 1 | Storage and transportation facilities | Visual inspection of the conditions specified in section 9.6.2.1 | Verify conformity to the specifications in section 9.6.2.1 | Every delivery |
| 2 | Sorting system: scales for aggregates, cement, admixtures, water | * Visual inspection of the conditions specified in section 9.6.2.2
* Calibrate the scales
 | Verify that the scales are operating properly | * Every day
* If there is concern of non-conformity
 |
| Validate the calibration of the scales | Verify that the scales are operating properly | * Every three months by the manufacturer
* If there is concern of non-conformity
 |
| Calibration of the scales | Verify that the scales are operating properly | * Once a year by the manufacturer
* If there is concern of non-conformity
 |
| 3 | Water gauges for mixers | Test that the operation is in working order | Verify that the water gauge is in working order | * Once a month
* If there is concern of non-conformity
 |
| 4 | Testing equipment | * Test the conformity to the specifications for the testing equipment in the relevant standards for the testing methods
* Test that the equipment is calibrated
 | Verify conformity to the specifications in section 9.6.2.4 | * If there is concern of non-conformity
* Strength testing equipment will be tested once a year by an authorized calibration laboratory
 |
| 5 | Cement mixer, fixed mixer | Test the uniformity of the mixing pursuant to the method described in Appendix E | Verify the ability of the mixer to produce uniform concrete | * Once a year for each mixer
* Before using a repaired mixer
* If there is concern of non-conformity
 |

**Table 18 – Concrete production process and properties control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serial no. | **Property tested** | **The test or control** | **Objective** | **Minimum frequency** |
| 1 | Determining the concrete mix | Preliminary trials (see Appendix A) | To determine that the composition of the concrete mix (hereinbelow: “the planned mix”) conforms to the function or properties specifications | Before using a new concrete mix |
| 2 | Dampness in fine aggregate | Measure the continuity or test the dryness in the kiln or check the weight | To determine the quantity of water in the fresh concrete | * Once a day
* If there is concern of non-conformity
 |
| 3 | Dampness in coarse aggregate | Test the dryness in the kiln or check the weigh | To determine the quantity of water in the fresh concrete | In case of* Changes in weather conditions
* Change in the aggregate source
 |
| 4 | Quantity of water in fresh concrete | To determine that the quantity of water conforms to what is recorded in the dosage system | To determine the quantity of water in the fresh concrete | Every production portion |
| 5 | Viscosity | Test the viscosity pursuant to the standards mentioned in section 5.4.1 | Verify that the viscosity conforms to the specifications for the planned mixes | * Every day of production
* If there is concern of non-conformity
 |
| Visual inspection or weight test | Verify that the appearance of the concrete conforms to the ordinary appearance for the required viscosity | Each production portion |
| 6 | Fresh concrete density | Density test pursuant to Israeli Standard SI 26 Part 2.5 | Test the uniformity of the mix | Twice a month |
| 7 | Quantity of concrete in a batch | Pursuant to Appendix D of this standard | To determine the quantity of concrete in a batch | Twice a month for each batch |
| 8 | Quantity of cement in fresh concrete | Determine that the quantity of cement conforms to what is recorded in the dosage system | * To determine the quantity of the cement
* To provide data for calculating the water-cement ratio
* To verify that the quantity of cement conforms to the specifications for the planned mix
 | Each production portion |
| 9 | Additives content in the fresh concrete | Determine that the quantity of additives conforms to what is recorded in the dosage system | * To determine the additives properties
* To provide data for calculating the water-cement ratio
 | Each production portion |
| 10 | Admixture content in the fresh concrete | Determine that the quantity of admixtures conforms to what is recorded in the dosage system | * To determine the admixture properties
* To provide data for calculating the water-cement ratio
 | Each production portion |
| 11 | Water-cement ration in the fresh concrete | According to the calculation (see section 5.4.2) | Verify that the water-cement ratio conforms to the specifications of the planned mix | Once a day |
| 12 | Air content in the fresh cement | Pursuant to Israeli Standard SI 26 Part 2.6 or the calculation method | Verify that the air content conforms to the specifications of the planned mix | Twice a month |
| 13 | Fresh concrete temperature | Use a thermometer with a precision of ± 1° C | Verify that the temperature conforms to the specifications or, in the absence of specifications, to section 5.2.8 | Once a day |
| 14 | Compressive strength of the concrete | Pursuant to Israeli Standard SI 26 Part 4.1(1) | Verify that the compressive strength conforms to the specifications of the planned mix | Test one sample from each kind of concrete (as defined in Israeli Standard 26 Part 1) every two production days, but not less than ten samples from each type of concrete during one month |

1. **Conforming to the standard**
	1. **General**What is written in this section applies to both the mix content and the prescription concrete mix.
	When evaluating if the concrete conforms to the standard, refer to its production process and compressive strength as defined in the bill of lading.
	**Note**: for the purpose of evaluating that the properties of the concrete supplied to the site conform to the standard, use test samples prepared from samples taken during the unloading of the concrete from the mixer at the site.
	2. **The production process**
		1. **Tests**
		A certified entity (see the note to definition 3.32) will check and evaluate that the production process conforms to the standard.
		2. **Specifications**The concrete conforms to the standard if it is produced at the conditions hereinbelow:
			* 1. **Preliminary trials**The concrete is tested in preliminary trials as defined in section 9.5.1 and in Appendix A (if relevant) and found to conform to the applicable specifications;
				2. **Production control**
				The concrete is produced at a plant with production controls that conform to the specifications in section 9.

If the manufacturer is certified (see definition 3.32) and the bill of lading states that the manufacturer is certified, the concrete will be considered as complying with the specifications mentioned in sections a) and b) hereinabove.

* 1. **Compressive strength**
		1. **Tests**
		The compressive strength is as stated in section 5.5.1
		2. **Specifications**
		Concrete of a particular type conforms to the standard if its average compressive strength (fcm) (see definition 3.25) and compressive strength of concrete of a test sample (fci) (see definition 3.24) are not less than what is stated in Table 19, in accordance with the kind of concrete.

**Table 19 – compressive strength of the sample (**fci) **of the concrete**

|  |  |
| --- | --- |
| Type of concrete | Compressive strength (megapascals) |
| Of the sample **(**fci) | Average **(**fcm) |
| Increase or decrease of the characteristic strength (megapascals) |
| -3 | +3 |
| B-15 | 12 | 18 |
| B-20 | 17 | 23 |
| B-25 | 22 | 28 |
| B-30 | 27 | 33 |
| B-40 | 37 | 43 |
| B-50 | 47 | 53 |
| B-60 | 57 | 63 |

 **Note:**
(a) The planner will determine the specifications of high-strength concrete (see definition 3,6) to conform to the standard
(b) For concrete which does not conform to the specifications stated in section 10.2, do not determine the type of concrete based on the compressive strength.

* + 1. **Repeat test**
		If the concrete does not conform to the specifications mentioned in section 10.3.2, the test may be repeated as described hereinbelow (see also the note in section 5.5.1.5).
		From concrete which has been hardened in a structure, take representative blocks, the taking of which and the number will conform to what is mentioned in Israeli Standard 26 Part 6(1), and test the compressive strength of the sample pursuant to what is mentioned in Israeli Standard 26 Part 6(1) no later than 90 days from the day the concrete was poured.
		The concrete conforms to the standard if the average compressive strength and compressive strength of the sample obtained in the repeat test are not less than what is stated in Table 19, depending on the type of concrete. Do not take into account the results of previous tests in the repeat test.
		**Note:** The results of a repeat test of concrete from blocks taken later than 90 days from the date of the pouring may only be used for expressly evaluating the compressive strength of the concrete, but not for classification of the concrete as mentioned in Table 19.
	1. **Notification that the concrete conforms to the standard**
	The report that the concrete conforms to the standard will include at least the following details:
		1. The details required in Israeli Standard 26 Part 1;
		2. The details required in Israeli Standard 26 Part 4 and all its sections(1), except for what is required in section 4.4.7 therein (the concrete conforms to SI 118);
		3. The details required in Israeli Standard 26 Part 3(1);
		4. The details required in Israeli Standard 26 Part 6(1) if relevant;
		5. Notification that the concrete conforms to Israeli Standard SI 118, which will include:
* Conformity of the production process (section 10.2);
* Conformity of the compressive strength by type of concrete stated in the bill of lading (section 10.3).
1. **Conforming to the specifications**
	1. **General**
	What is written in this section applies to both the mix content and the prescription concrete mix.
	When evaluating that the concrete conforms to the specifications, refer to its properties (except for the compressive strength) and/or its composition as defined in the specifications.
	**Note:** For the purpose of evaluating that the properties of the concrete supplied to the site conform to the specifications, use the test sample prepared from the samples taken during the unloading of the concrete at the site.
	2. **Tests**
	Test every property and/or component as defined in its specifications.
	3. **Specifications**
	The concrete conforms to the specifications if all its properties and/or components conform to what is stated therein.
	4. **Notification that the concrete conforms to the specifications**
	Separate reports that each of the properties and/or the components of the concrete conform to the specifications. The report that the concrete conforms to the specifications will be appended to the report that the concrete conforms to the standard (section 10.4).

**Appendix A – Preliminary trials**

(normative)

**A1 General**

 This appendix discusses preliminary trials, as required in sections 5.2.51., 6.1, and 9.5.1.
Preliminary trials will determine that the concrete mix complies with all the applicable specifications of the fresh concrete and the hardened concrete defined in the specifications.

**A2 The party responsible for the preliminary trials**
The preliminary trials are under the responsibility of the manufacturer for the mix content, and under the responsibility of the writer of the specifications for prescription concrete mix.

**A3 Frequency of the preliminary trials**
The preliminary trials will be performed before using concrete with a new mix, under the conditions in section 9.5.1. Repeat the preliminary trials as required in section 9.5.2.

**A4 Trial conditions**
The preliminary trials will be performed in a laboratory. They will be performed on fresh concrete at a temperature of the concrete between 15° C and 26° C.
**Note**: If the concrete is intended for pouring at the site at a much different temperature, or if it is handled in heat, notify the manufacture of this fact so it can examine the effects on the concrete and the need for additional tests.
At least three different production portions will be tested in each preliminary trial, and each portion will comprise three samples.
The compressive strength of the production portion is the average results of the test of the samples. The result of the preliminary trial for the concrete tested is the average compressive strength of the portions.
All the results of the tests of fresh concrete and the hardened concrete will be documented.

**A5 Criteria for approving the preliminary trials**
The mixes prepared and tested in the laboratory in the preliminary trials, pursuant to Israeli Standards 26 Part 3(1) and Part 4(1) will be considered as complying with the strength and average compressive strength specifications of the portion if they are at least 10% higher than the fcm strength required in section 10.3 for concrete with the same strength grade .
The concrete viscosity will be within the range of limits for the viscosity grade when the concrete is due to be placed or when the brought concrete is supplied.
Other properties appearing in the specifications will conform to the defined values within the appropriate limits.

**Appendix B – Guidelines for implementing the equivalent functionality principle of the concrete with additives properties**

(for information only)

This appendix presents the details for the alternative mentioned in section 5.2.5.3.

It is necessary to demonstrate, through tests, that the functionality of the concrete with an additive will be at least equivalent to that of the reference concrete.

The reference concrete will be prepared with CEM I cement that conforms to Israeli Standard SI 1 Part 1, and the composition of which conforms to the specifications in section 5.3.2 for the relevant exposure class.

The tests will be performed at the same time in the same laboratory. The laboratory will have experience in and be certified for the relevant tests. The function test results of the concrete tested (which contains additives) will indicate a similar level of reliability of the function of the reference concrete.

The range of components for which this method is suited will be limited as follows:

* The mix containing the additive, included the additive that is found as a component in the cement, will be within the permitted limits in Israeli Standard SI 1 and all its parts for the type of cement.
* The amount of cement mix and the additive will be at least equal to the cement content required in section 5.3.2 for the relevant exposure class.

The water-(cement + additive) ratio will not be higher than the specifications in section 5.3.2 with respect to the maximum water-cement ration for the relevant exposure class.

**Appendix B – Concrete planning methods based on functionality approach with respect to what exists**

(for information only)

**C1 General**
This appendix includes details pertaining to the functionality planning methods with respect to what exists as mentioned in paragraph 5.3.3.

**C2 Definition**
The planning method based on the functionality approach takes into account every relevant destruction mechanism, the lifespan of the component or structure, and the criterion that defines the end of the lifespan quantitatively.
Such a method may be based on sufficient experience of the accepted practices in the local environment, data obtained from a functionality test based on the relevant mechanism, or use of models with a proven predictive power.

**C3 Implementation and general guidelines**

A. Particular aggressive actions, which can be best handled by defining the prescription concrete mix. For example, when concrete without an alkaline-silica reaction, concrete resistant to sulfate, or erosion-resistant concrete is needed.

B. Functionality planning methods are more relevant for corrosion resistance, and possibly also for freezing-thawing resistance.

 This approach is appropriate when:

* A lifespan of more than the usual 50 years;
* The structure is “special” and requires a small failure probability;
* The environmental conditions are particularly aggressive, or well defined;
* A high quality of construction is expected;
* There is a maintenance and management strategy, and possibly a planned upgrade;
* A large number of similar structures or components are planned;
* New or different materials will be used.
* Review of case in which the planning was by the standard method (section 5.3.2) or there was a failure.

C. In reality, the current level achieved depends on integrating the planning, materials, and building processes.

D. The sensitivity of the planning approach, structure system, form of the components, and the structural and architectural items are important parameters in all the functionality planning methods.

E. Conformity of the materials and construction methods, quality of implementation, and the level of quality assurance are important parameters in all the functionality planning methods.

F. The functionality required to exist depends on the necessary lifespan, the future use of the structure, appropriate protective systems, maintenance planning, and the results of failure in the local environmental conditions.

G. For each required functional grade, an alternative solution is possible from the other planning elements, materials, and construction processes.

H. The level of knowledge about the local environmental and microclimate conditions is important in order to determine the reliability level of the functionality planning methods.

**C4 Planning methods based on the functionality approach compared with what exists**
When implementing the alternative methods mentioned hereinbelow, it is important to define the following issues in advance:

* Type of structure;
* Local environmental conditions;
* Level of construction;
* The required lifespan;

These issues usually involve several consideration and guidelines to bring the chosen method to a level that will be usable.

The alternative methods include:

A. Improving the method of the standard (section 5.3.2), based on long-term experience with local materials and local methods, and detailed information about the local climate.

B. Methods based on approved and proven tests, which represent the local conditions and which have approved functionality criteria.

C. Methods based on analytic models, which have been calibrated against data representing conditions of use in the field.

Accurately define the concrete composition and its components in order to protect the functionality level.

**Appendix D – Determining the quantity of concrete supplied in a batch**

(normative)

This appendix describes the method for determining the quantity of concrete supplied as required in section 7.7.

**D1 Measuring the quantity of concrete in a tested batch**
 The quantity of concrete in a tested batch is calculated by the formula:

 Vi = Wi/Pi

 In which:
 Vi – quantity of concrete in a batch
 Wi – weight of concrete in a batch
 Pi – the specific spatial mass of the concrete in the batch

 The specific spatial mass is calculated as follows:
Take from the batch three representative samples as required in Israeli Standard 26 Part 1. For each representative sample, test the density of the concrete using the method described in Israeli Standard 26 Part 2.5.
The average specific spatial mass of the three representative samples is the specific spatial mass of the concrete in the batch.

Calculate the weight of the concrete in the batch using one of these methods:

1. The weight of the concrete in the tank is the total weight of the components put in the batch, including water and cement.
2. The weight of the concrete is the difference between the weight of the mixer when full and the weight of the mixer when empty, as measured on properly calibrated bridge scales.

**D2 Calculating the total weight of the concrete supplied**
The total weight of the concrete supplied is calculated by the formula:

[insert the formula]

In which:
n – Batch number tested
Vt – Total quantity of concrete supplied
Vd - Total quantity of concrete supplied, as declared by the supplier
nΣ Vti – Total quantities calculated of the concrete in the batch testedi=l
nΣ Vdi – Total quantities calculated of the concrete in the batch tested, as declared i=l by the supplier

**Appendix E – The mixing process and mixing uniformity**

(normative)

**E1 General**This appendix describes the concrete mixing process and test of its uniformity, as required in section 9.8

**E1.1** The mixing process will include:

* Primary mixing to obtain uniform concrete;
* Secondary (rocking) mixing to prevent separation of the components and to protect the concrete uniformity;
* Additional mixing before unloading the concrete from a cement mixer.

**H1.2** The concrete uniformity after the mixing will be tested as mentioned in section H3.

**H2 The mixing process**
The mixing speed and time, measured from when all the components (including the water) are put into the mixer will be as follows:

**(a) Primary mixing in a cement mixer**
The mixer will be set at a speed of at least ten rounds per minute up to the completion of 100 rounds.

**(b) Primary mixing in a fixed cement mixer**
The mixer will be set at the speed and time defined by the concrete manufacturer. The mixing will not be less than 30 seconds per concrete portion.

**(c) Secondary (rocking) mixing**
The secondary mixing will take place throughout the transportation and waiting process at speeds of (1-4) rounds per minute.

**(d) Additional mixing before unloading the concrete**
Completion of the mixing will last for 30 seconds per cu.m. of concrete, and no less than two minutes at the mixing speeds stated in paragraph (a) or (b), as applicable.

**€ Mixing after adding components to the concrete mix**
If components are added (such as water, admixtures, additives) after the primary mixing is completed, additional mixing time of 30 seconds per cu.m. of concrete, but no less than three minutes, is needed at the mixing speeds stated in paragraph (a) or (b), as applicable.

**(f)** Notwithstanding what is mentioned in paragraphs (a)-(e), if is demonstrated that the concrete uniformity during the mixing process is different from what is required hereinabove, it is possible to shorten the mixing time accordingly.

**H3 Concrete uniformity**
Test the uniformity of the concrete in order to determine the mixer’s ability to produce uniform concrete. Test the concrete uniformity at these times:

* Concrete produced in a cement mixer: when the mixing is completed, before the concrete is unloaded;
* Concrete produced in a fixed mixer: when the primary mixing is completed.

Take from the mixer two representative samples of the concrete, each with a volume of at least 25 liters. The samples will be taken during the continuous unloading of the concrete at the times mentioned hereinabove.
The first representative sample of concrete is taken during the unloading of 15% to 30% of the volume of concrete in the mixer.
The second representative sample of concrete is taken during the unloading of 75% to 80% of the volume of concrete in the mixer.
Each of the two samples is remixed, and each is divided into three parts. One part is used to test the concrete viscosity; the second is used to test the specific spatial mass of the concrete and the crude aggregate content of the concrete; and the third part is used to test the concrete strength.
**Note**: for special properties concrete, such as SCC or trapped air concrete, adjust the properties to determine uniformity.

The tests are conducted as mentioned hereinbelow:

* Test the concrete viscosity using the shrinkage method(3) as described in Israeli Standard SI 26 Part 2.1;
* Test the density as described in Israeli Standard SI 26 Part 2.5;
* Test the crude aggregate content in the concrete mix as mentioned hereinbelow:
* Weigh the concrete (W1 weight).
* Wash the concrete through a 4.75 mm sieve.
* Dry the residual crude aggregate on the screen at a temperature of 105° C until the fixed weight and determine its weight (W2). Calculate the weight, A, of the crude aggregate as a percentage of the concrete weight, by the formula:

[insert formula]

* Test the concrete compressive strength as described in Israeli Standard SI 26 Part 4.1(1). For the purpose of the test, prepare six standard cubes as required in Israeli Standard SI 26 Part 3: three cubes for testing at aged 7 days and three cubes for testing at age 28 days.

The concrete is uniform if the tests described hereinabove conformed to the specifications in Table H1.

**Table H1 – concrete uniformity specifications**

|  |  |
| --- | --- |
| **Description of the test** | **Maximum difference between the two representative samples** |
| The concrete in the shrinkage method viscosity test * To S1-S3 class concrete
* To S4 or higher class concrete
 | 20 mm30 mm |
| Specific spatial mass of the fresh concrete | 25 kg per cu.m. |
| The crude aggregate content in a percentage of the total weight of the concrete | 6% |
| Average compressive strength of each sample at age 7 days | ±7.5% of the average of the 2 samples |
| Average compressive strength of each sample at age 28 days | ±7.5% of the average of the 2 samples |

If the concrete conforms to the strength uniformity at aged 7 days specifications, do not test the strength uniformity at aged 28 days.

If the concrete does not conform to the strength uniformity at aged 7 days specifications, test the strength uniformity at aged 28 days.

Concrete which conforms to the strength uniformity at aged 28 days conforms to the strength uniformity specifications.

If the concrete does not conform to one or more of the specifications mentioned in Table H1, it is possible to retest its conformity to the same specifications to which it did not conform, except for the compressive strength.

Concrete which conforms to these specifications in a repeat test conforms to the concrete uniformity specifications.

Israeli Standard SI 118
September 2008
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**Concrete: specifications, performance, and production**

Israeli Standard SI 118
September 2008
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**Concrete: specifications, performance, and production**

Israeli Standard SI 118
**Amendment No. 1**

May 2010

**Concrete: specifications, performance, and production**

This amendment was prepared by Expert Committee 10605 – Concrete – Specifications comprising:

Gideon Irus, Mony Ben-Bassat (chairman), Amnon Katz, Yehoshua Miller, Menachem Koenigsberg, Albert Rahamim

Gil Ashuach, Yossi Sinkoler and Ronen Cohen also contributed to the preparation of the amendment.

This amendment was approved by the Technical Committee 106 – Materials and products for contract, comprising as follows:

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| Technion, Faculty of Civil Engineering | Amnon Katz (chairman), Constantine Kolber |
| Association of Contractors and Builders in Israel  | Haim Lev |
| Manufacturers Association of Israel | Albert Rahamim, Yehuda Turgeman |
| Organization of Engineers and Architects | Shmuel Engel |
| Standards Institution of Israel – Construction Department | Danny Schneider |
| Ministry of Defense | Lev Michaels |
| Ministry of Construction and Housing | Nahum Manchikovsky |

Leah Fischer organized the preparation work for the standard.

**Notice of revision**

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**Updatedness of the standard**

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**2. Mentions
Israeli Standards**
Add to the list:
SI 5098 – Natural Radioactive Elements Content in Construction Products

**5. Concrete testing specifications and methods**

**5.1 Basic specifications for the concrete components**

**5.1.4 Mixing water**
What is written in the last sentence in the section will be deleted and replaced by: Notwithstanding what is written hereinabove, it is permitted to use recycled water (see definition 3.20) on the condition that the recycled water conforms to what is written in Annex A of European Standard EN 1008: 2002, with this change:

What is written in the section “General” – A.4.1 of the European standard does not apply, and the following will apply instead:
A visual examination that shows no change in the color of the water compared with the color seen in the previous tests.

**5.3 Specifications related to environmental conditions**

**5.3.2 Marginal values for the concrete composition**

**5.3.2.2 Concrete composition margin values, except for concrete conforming to sections 5.3.2.3 and 5.3.2.4**

 **Table 11 - Maximum water-cement ratio and the minimum cement content in accordance with exposure class(a)**

* Right-hand column (strength grade (type of concrete(d)” will be deleted
* Note (d) of the table will be deleted.

**5.5 Testing methods and specifications for hardened concrete**

**5.5.1 Compressive strength**

**5.5.1.4 Age of the concrete at the time of the test**

 The note at the end of the section will be deleted and replaced by:

 **Note 1**: Notwithstanding what is mentioned hereinabove, if the concrete samples tested at age 28 days do not conform to the specifications (as mentioned in section 10.3.2), it is possible to carry out a repeat test at the conditions mentioned in section 10.3.3.

**Note 2**: In addition to a compressive strength test at age 28 days, it is also possible to test the compressive strength of the concrete at other ages, but in any event, the type of concrete will only be determined by the 28-day test or by the repeat test as mentioned in note 1 hereinabove.

**5.5.1.5 Compressive strength test**

 The note at the end of the section will be deleted.

 After section 5.5.5, add section 5.5.6 as written hereinbelow:

**5.5.6 Natural radioactive elements content in concrete**

 Radiation measures of the concrete will conform to the specifications in Israeli Standard SI 5098.

**6. Concrete specifications** (see definition 3.28)

 **6.1 General**

 On line 6 from the end of the section, after the words “see Appendix A”, add: (see also the notes to sections 9.5.1 and 9.5.2 in this amendment).

**7. Ordering the concrete and the supply of fresh concrete** (see definition 3.13)

**7.1 Ordering the concrete**

 - What is written in the first line of the section will be deleted and replaced by: The customer will provide the manufacturer with a written order.

 - At the end of the section, add a note as follows:

 **Note 1**: Notwithstanding what is mentioned hereinabove, by the end of one year from the date this amendment is published, it is possible not to record these particulars in the bill of lading:

* The quantity of water added in practice at the site, before unloading the concrete;
* The quantity of additives added in practice at the site, before unloading the concrete;

**Note 2**: Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published, it is possible not to record in the bill of lading the exposure class to which the concrete conforms (under Table 3).

**7**.6 **Concrete viscosity at the time of delivery**

 Add the following text at the start of the section:

 Test the viscosity per the specifications of one of the relevant parties.

 Use one of the methods mentioned in section 5.4.1, as applicable, for the test.

 The viscosity grade will conform to what is written in the order, within the limits mentioned in section 4.2.1, in Tables 4 through 7, as applicable.

 Notwithstanding what is mentioned hereinabove, for viscosity that conforms to concrete shrinkage S3 or higher, a deviation of ± 10 mm from the shrinkage limits mentioned in Table 4 is permitted

**9. Production control**

**9.2 Production control system**
 At the end of the section, add the following:

 **Note:** Notwithstanding what is mentioned hereinabove, by the end of one year from the date this amendment is published, it is possible to use quality handbooks, procedures, and the manufacturer’s work instructions that are not pursuant to this standard, such as those used to certify the manufacturer under Process Label 12.

**9.3 Documented information and additional documents**

**Table 14 – Documented information and additional documents (as applicable)**

 The row stating “Hardened concrete test”, right-hand column “Documented information and additional documents”, after the first line, add:

* Location of the structure
* At the end of the section, add the following note:

**Note:** Notwithstanding what is mentioned hereinabove, by the end of one year from the date this amendment is published, it is possible to use existing documentation of the manufacturer, which are not pursuant to this standard, such as those used to certify the manufacturer under Process Label 12.

**9.5 Preliminary trials and the concrete mix**

**9.5.1 Preliminary trials**
At the end of the section, add the following note:

 **Note:** What is written in this section will come into effect at the end of two years from the date this amendment is published.

**9.**5.2 **Concrete composition**

 At the end of the section, add the following note:

 **Note:** What is written in this section will come into effect at the end of two years from the date this amendment is published.

**9.6 Personnel, equipment and facilities**

**9.6.1 Equipment and facilities**

**9.6.2.2 Sorting systems**

At the end of the section, add the following note:

 **Note:** Notwithstanding what is mentioned hereinabove, by the end of three years from the date this amendment is published, it is possible to use sorting systems that do not have computerized recording means.

**9.**6.2.3 **Mixers**

At the end of the section, add:

 Cement mixers will be equipment with tables on which the following particulars will be permanently marked:

* Maximum capacity (cu.m. of fresh cement)
* Minimum and maximum mixing speed of the mixer and the movement.

**9.7 Sorting materials**
At the end of the section, add the following notes:

 **Note 1:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published, it is possible to use sorting systems that do not have computerized recording means.

**Note 2:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published, it is possible to measure in volume units the liquid components of the concrete, such as water, admixtures, and additives.

**9.**9 **Production control process**

**Table 16 – Concrete components control(a)**

Serial no. 4 – Recycled water (see definition 3.20)

What is written in this row in the table is deleted and instead write:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serial no. | Component | Test or control | Objective | Minimum frequency |
| 4 | Recycled water (see definition 3.20) | Test pursuant to what is stated in section 5.1.4 of this standard | Verify the conformity to the specifications of the standard | If there is concern of non-conformity |
| Visual test | Verify that the color of the water has not changed compared with the color seen in previous tests | Regularly, but not less than twice a day |

**Table 18 – Concrete production process and properties control**

Serial no. 1 – Determining the concrete mix

Add the following note to this row:

**Note**: The specifications recorded in this row will come into effect at the end of two years from the date this amendment is published.

Serial no. 2 – Dampness in the fine aggregate

In this row, in the right-hand column (minimum frequency) add the following note:\

**Note:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published, it is possible to carry out the test if there is only concern.

Serial no. 3 – Dampness in the crude aggregate

In this row, in the right-hand column (minimum frequency) add the following note:\

**Note:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published, it is possible to carry out the test if there is only concern.

Serial no. 11 – Water-cement ratio in fresh concrete

In this row, in the right-hand column (minimum frequency) add the following note:\

**Note:** The production control specifications recorded in this row will come into effect at the end of two years from the date this amendment is published.

Serial no. 12 – Air content in fresh concrete

In this row, in the right-hand column (minimum frequency) add the following note:\

**Note:** The production control specifications recorded in this row will come into effect at the end of two years from the date this amendment is published.

Serial no. 14 – Compressive concrete strength

In this row, in the right-hand column (minimum frequency) add the following note, delete the first words “of any kind of concrete will be tested” and write instead, “of any kind of concrete produced at a frequency of at least twice a week (the relevant frequency for the production period) will be tested.”

After the row Serial no. 14, add the row Serial no. 15, as mentioned hereinbelow:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serial no. | Component | Test or control method | Objective | Minimum frequency |
| 15 | Radiation measurements | Pursuant to Israeli Standard SI 5098 | Verify that the radiation of the concrete conforms to the specifications in Israeli Standard SI 5098 | Pursuant to Israeli Standard SI 5098, Appendix B, which discusses the frequency of the tests |

**10. Conformity to the standard**

**10.1 General**

 The note at the end of the section will be deleted.

10.2 **The production process**

**10.2.2 Specifications**

 **(a) Preliminary trials**

 After item (a), add the following note:

 **Note:** What is mentioned in this item will come into effect at the end of two years from the date this amendment is published.

**10.3 Compressive strength**

**10.3.3 Repeat test**

 What is written in the first sentence will be deleted and replaced by:

 If the concrete sample tested at the age of 28 days (samples prepared from fresh concrete (section 5.5.1.1) or samples which were prepared from hardened concrete in the structure (section 5.5.1.2) do not conform to the specifications mentioned in section 10.3.2, it is possible to carry out a repeat test as described hereinbelow.

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**Concrete: specifications, performance, and production**

This amendment was prepared by Expert Committee 10605 – Concrete – Specifications comprising:

Gideon Irus, Mony Ben-Bassat (chairman), Amnon Katz, Yehoshua Miller, Menachem Koenigsberg, Albert Rahamim

Yossi Sinkoler and Ronen Cohen also contributed to the preparation of the amendment.

This amendment was approved by the Technical Committee 106 – Materials and products for contract, comprising as follows:

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| Concrete Manufacturers Association | Gil Ashuah |
| Federation of Israeli Chambers of Commerce | Shlomi Rosenberg |
| Technion, Faculty of Civil Engineering | Amnon Katz (chairman), Constantine Kolber |
| Israeli Consumer Council | Moshe Weider |
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| Organization of Engineers and Architects | Shmuel Engel |
| Standards Institution of Israel – Construction Department | Danny Schneider |
| Ministry of Defense | Lev Michaels |
| Ministry of Construction and Housing | Nahum Manchikovsky |

Leah Fischer organized the preparation work for the standard.

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**Updatedness of the standard**

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**5.2 Basic specifications for the concrete composition**

**5.2.5 Use of admixtures**

**5.2.5.1 General**

 After the third sentence, which begins with the words “Type II additives” and ends with the words “the water-cement ratio”, add this sentence:

 The total quantity of the coal ash in the concrete will not be greater than 160 kg. per cu.m. of fresh concrete.

**Appendix E -** **The mixing process and mixing uniformity**

**H2 The mixing process**

**(d) Additional mixing before unloading the concrete**

 The words “but not less than two minutes” will be deleted and replaced with:

 but not less than three minutes

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This amendment was prepared by Expert Committee 10605 – Concrete – Specifications comprising:

Gideon Irus, Mony Ben-Bassat (chairman), Amnon Katz, Yehoshua Miller, Menachem Koenigsberg, Albert Rahamim

Gil Ashuach, Yossi Sinkoler also contributed to the preparation of the amendment.

This amendment was approved by the Technical Committee 106 – Materials and products for contract, comprising as follows:

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Leah Fischer organized the preparation work for the standard.

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**7. Ordering the concrete and the supply of fresh concrete** (see definition 3.13)

**7.1 Ordering the concrete**

 At the end of the section, add the note as mentioned hereinbelow:

 **Note:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published in the Records, it is possible:

* Not to deliver the order in writing;
* Not to mention in the order items A and B mentioned in section 6.2.2

**7.5 Bill of lading**

 At the end of the section, add Note 3 as mentioned hereinbelow:

 **Note 3:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published in the Records, it is possible not to record in the bill of lading the exposure class to which the concrete conforms (pursuant to Table 3).

**9. Production control**

**9.3 Documented information and additional documents**

At the end of the section, add a note as mentioned hereinbelow:

**Note:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published in the Records, it is possible to use the existing documentation of the manufacturers, which are not pursuant to this standard, such as those used to certify the manufacturer under Process Label 12.

**9.6 Personnel, equipment and facilities**

**9.6.2 Equipment and facilities**

**9.6.2.2 Sorting systems**

At the end of the section, add the note as mentioned hereinbelow:

 **Note:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published in the Records, it is possible to use sorting systems that do not have computerized recording means; when it is not possible to make computerized records, the recording will be done manually.

**9.7 Sorting materials**

At the end of the section, add Note 3 as mentioned hereinbelow:

 **Note 3:** Notwithstanding what is mentioned hereinabove, by the end of two years from the date this amendment is published in the Records, it is possible to use sorting systems that do not have computerized recording means; when it is not possible to make computerized records, the recording will be done manually.

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Gideon Irus, Mony Ben-Bassat (chairman), Amnon Katz, Yehoshua Miller, Nechemia Masuri, Yossi Sinkoler, Menachem Koenigsberg, Albert Rahamim

Gil Ashuach and Ami Moses also contributed to the preparation of the amendment.

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| Ministry of Defense | Lev Michaels |
| Ministry of Construction and Housing | Claudia Reinhorn |
| Ministry of National Infrastructure, Energy and Water | Sharbel Shehada |

George Numa organized the preparation work for the standard.

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**4. Classification**

**4.2 Classification of fresh concrete**

**4.2.1 Viscosity classes**

 - The first row in the section will be deleted and replaced with:
 The fresh concrete is classified, in accordance with its viscosity, as concrete with a viscosity class as mentioned in Tables 4, 5, 6, 7, 7A.

 - In note 1, the words “Tables 4 through 7” will be deleted and replaced with:
as in Table 4 or 7A

 - After Table 7, add Table 7A, as follows:

**Table 7A – Viscosity ratings according the shrinkage-flow test**

|  |  |
| --- | --- |
| **Viscosity rating** | **Shrinkage-flow** (mm) |
| SF1 | 440-650 |
| SF2 | 660-750 |
| SF3 | 760-850 |
| **Note:** The viscosity class for SCC concrete |

**5. Concrete tests specifications and methods**

**5.1 Basic specifications for concrete components**

**5.1.2 Cement**

 After the eighth row, beginning with the words “Portland cement – slag”, add:

* Slag cement (CEM III/B) (which will be used in accordance with the planner’s guidelines)

5.2 **Basic specifications for the concrete composition**

**5.2.3 Use of aggregates**

**5.2.3.1 General**

The line before the note in the section, “Lateral concrete cover thickness for reinforcement” will be deleted and replaced with:

 ¾ lateral concrete cover thickness for reinforcement

**5.2.5 Use of admixtures**

**5.2.5.2 k-value principle**

**B. The k-value concept for coal ash that conforms to Israeli Standard SI 1209**

 After the first sentence, “The k-value principle described hereinbelow is applicable for a quantity of coal ash that is not greater than x 0.33 of the quantity of concrete after the replacement,” add:

 For CEM 1 type cement and x 0.25, the quantity of concrete after the replacement – for CEM II type cement.

**Table 9 – k-value for coal ash**

 The table will be deleted and replaced with the following Table 9:

**Table 9 – k-value for coal ash**

|  |  |  |  |
| --- | --- | --- | --- |
| k-value | Maximum quantity of cement (∆c) which can be replaced by coal ash (kg per cu.m) | Minimum quantity of cement required in accordance to Table 11 (kg per cu.m) | Exposure class under section 4.1.2(a) |
| 0.5 | CEM I  | CEM II | 230 | 1 |
| 30  | 25 |
| 0.5 | 30  | 25 | 230 | 2 |
| 0.5 | 30  | 25 | 230 | 3 |
| 0.4 | 25 | 20 | 230 | 4 |
| **Notes to table:**(a) The k-value may be used for exposure classes 5 through 11 if the k-value itself is determined in accordance with the equivalent function concept as required in section 5.2.5.3. |

**5.3 Specifications related to environmental conditions**

**5.3.2 Marginal values for the concrete composition**

**Table 11 - Maximum water-cement ratio and the minimum cement content in accordance with exposure class**

The values in the column entitled Minimum cement content (kg per cu.m.) will be replaced with the following values:

 The value “270” will be deleted and replaced with the value 230

 The value “320” will be deleted wherever it appears and replaced with the value 270

 The value “350” will be deleted wherever it appears and replaced with the value 320

**5.5 Testing methods and specifications for hardened concrete**

**5.5.1 Compressive strength**

**5.5.1.5 Compressive strength test**

 At the end of the section, write:

* If no samples are taken from the fresh concrete, the compressive strength of the concrete samples taken from the hardened concrete in the structure will be used to estimate the compressive strength of the hardened concrete in the same section of the structure, but will not be used to determine the conformity to the standard of the compressive strength of the fresh concrete supplied to the site.