Performance.
Precision.
Partnership.

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A TITAN GROUP COMPANY

Quality and Proper Concreting Guide

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Contents

1.0

Introduction

1.1 Building together, with knowledge and trust

Shared goal: to create structures that endure

Knowledge of concrete is the first step towards making the right decisions. The better you know your material, the more reliable the outcome of the project will be.

At INTERBETON, we believe that “working together the right way” means sharing a common goal: to create structures that endure, perform, and inspire trust. Construction is never an individual act; it is the result of collective responsibility, knowledge, and trust. Quality and sustainability are not optional — they are prerequisites for success. And to achieve them, collaboration is required at every stage, from mix design to placing and curing on site.

This technical manual is our way of making every project a success. From the first contact to the final delivery, our purpose is to provide transparency, knowledge, and support, so that each collaboration becomes a stepping stone towards the next, even better project. INTERBETON provides customers with technical assistance, data transparency, and certified procedures. This manual is a practical application guide, but above all, it is a guide to collaboration. We build together in order to create structures that endure.

INTERBETON’s values

INTERBETON, a member of TITAN Group, was founded in 1977 and has firmly established its position in the Greek market, providing ready-mix concrete, aggregates, and high-quality supporting services that meet the needs of the most demanding projects. With an extensive network of 34 ready-mix plants in 14 prefectures and the capability to serve major projects through dedicated on-site batching plants, INTERBETON stands by construction professionals, offering solutions tailored to each project. Its strength lies not only in its infrastructure, but in its distinctive collaboration philosophy: we listen, we guide, we adapt. For the engineer, INTERBETON is a technical advisor; for the contractor, a reliable partner on site; and for the private customer, a guarantee that their project will rest on solid foundations — literally and figuratively. Our philosophy, “It’s worth building together”, reflects our belief that every project is a shared success.

By choosing INTERBETON, you choose consistency, know-how, and responsibility — values that translate into structures that perform, are delivered on time, and are built on strong foundations of trust.

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1.2 The INTERBETON Central Research Laboratory

Where Quality Becomes Science

The INTERBETON Central Research Laboratory, located in Metamorfosi, Attica, is a reference point for technological support and for the development of innovative concrete products, serving the company’s operations across Greece. Equipped with state-of-the-art technology and staffed by highly specialized scientists, the Laboratory provides comprehensive services that enhance the quality, innovation, and sustainability of concrete solutions. It covers the full spectrum of testing and analysis on raw materials, cement, aggregates, concrete, and chemical admixtures, while specializing in the development of concretes for special requirements, the evaluation of alternative raw materials, and environmental compliance.

For the customer, the Laboratory is not just a technical facility but a performance guarantee: every mix is tested, every sample is documented, and every project is monitored with digital traceability, ensuring a fully verified, reliable product is delivered. Leveraging its expertise, the Laboratory supports INTERBETON’s engineers, designers, and partners, contributing substantially to the technical design and success of projects. In parallel, each production unit of the company has a Quality Control Laboratory that ensures compliance with standards and the consistency of the products it produces. Since 2017, within an integrated quality management system, the Betolink Lab program has been operational, connecting all ready-mix plants in Greece in real time. Through this system, tests on raw materials and concrete are recorded and monitored digitally, allowing the specialists of the Concrete Technology Department to continuously control and optimize mixes. With Betolink Lab, quality is not simply controlled — it is documented.

INTERBETON applies the Concrete Technology Regulation (KTS 2016), fully aligned with the European Standard EN 206, and has developed products that exceed the required durability and compliance requirements. The outstanding quality of its products is a benchmark for the sector, thanks to the dedication of its specialized personnel, its own quarries, and its ultra-modern, fully automated production facilities. For more information, interested parties may contact local plants or visit the company’s official website.

2.0

Basic Facts about Concrete

2.1 Quality and proper concrete

Quality is a shared responsibility and a shared benefit

Concrete is the backbone of modern construction. From residential foundations to complex infrastructure, the long-term durability of a structure depends directly on the quality of the concrete and on its placement, compaction, and curing. Experience has shown that errors during concreting — such as adding water on site, insufficient or excessive vibration, and inadequate curing — can lead to cracking, segregation, loss of strength, and ultimately premature deterioration of the structure.

Proper concreting is not just a technical procedure; it is the result of proper design, timely preparation, and coordinated collaboration between the supplier and the site.

With know-how systematically built over decades, INTERBETON invests in the entire production process: from the selection of raw materials and the mixing technology to control standards and on-site support services. The company's plants operate with fully automated production and quality control systems that ensure consistency and accuracy in every batch of concrete.

Quality in concrete is not a luxury — it is an essential condition for safety, functionality, and sustainability. And this quality starts with knowledge and ends with practice. For this reason, INTERBETON provides not only the material but also the technical guidance needed so that every stage, from ordering to the incorporation of the concrete into the structure, is carried out in accordance with best practice.

INTERBETON informs, provides technical support, and stands by every project so that the final result honors both our customer and us. Because truly durable structures are those based on shared responsibility.

2.2 Ready-mix concrete

Technical guidance at every stage

Ready-mix concrete is a predesigned mixture of aggregates, cement, water and chemical admixtures, produced at certified, automated batching plants under controlled conditions and delivered to the site ready for use. INTERBETON operates state-of-the-art production units across Greece and offers high-quality concrete with guaranteed properties in accordance with the Concrete Technology Regulation (KTS 2016) and EN 206.

Compliance is not just an obligation; it is a prerequisite for trust. With INTERBETON, you know that every mix is designed, controlled and certified for you.

Concrete Technology Regulation (KTS 2016)
The Concrete Technology Regulation 2016 (KTS 2016) is the official national framework defining the technical requirements for concrete, as well as the procedures for its production, control, acceptance and use in construction works in Greece. It is based on European Standard EN 206 but incorporates additional requirements, particularities and environmental conditions specific to Greece. It includes detailed guidelines on strength classes, exposure classes, mix design, quality control and certification of production units. It is mandatory for all public and private projects.

EN 206 (Concrete – Specification, performance, production and conformity)
EN 206 is the non-harmonized European standard for concrete. It serves as the basis for defining requirements related to production, properties, and conformity of concrete

Compliance with the Concrete Technology Regulation is not just an obligation; it is a prerequisite for trust. With INTERBETON, you know that every mix is designed, controlled and certified for you.

2.3 Concrete strength and durability

Fundamental properties that determine concrete behaviour

Strength and durability are two fundamental properties of concrete that determine its behaviour both during construction and throughout the service life of the structure.

Strength is the property of concrete to carry loads without cracking or excessive deformation in its mass and is measured in MPa. Strength is a key criterion that guides the designer in engineering the load-bearing structure of each project.

Durability is the property of concrete to resist environmental and chemical actions (moisture, salts, freeze–thaw, chlorides, carbonation, abrasion) throughout the structure's design life, without loss of safety, functionality, or aesthetics.

Durability is not measured directly, but is ensured through an appropriate mix design and correct application.

The durability of concrete depends on several factors, the most important of which are:

- Low porosity.
- Minimum required cement content per m^3.
- Maximum permissible water/cement ratio (w/c): the lower it is, the better the durability.
- Minimum required strength class.
- Minimum reinforcement cover for protection against corrosion.
- Proper curing of concrete at an early age to achieve full cement hydration.
- Use of suitable admixtures — such as superplasticizers, fiber reinforcement, etc.

ANTAEUSHPC
High Performance Concrete

VIRIDIA
High-Durability Concrete

INTERBETON has applied all these provisions since 1/1/2000, fully complying with the requirements of KTS 2016.

At the same time, durability is significantly affected by external factors such as moisture, carbon dioxide, chlorides, sulphates, rapid temperature variations, and frost.

A typical example of highly durable concrete is INTERBETON's **ANTAEUS HPC**, a High Performance Concrete designed for increased durability under harsh environmental conditions, such as chloride exposure. Thanks to its excellent technical performance and very low porosity, it offers extremely low permeability to aggressive agents such as carbon dioxide and chlorides, protecting reinforcement from corrosion and extending the service life of the structure. It is ideal for coastal, urban or industrial environments. ANTAEUS HPC is a strategic choice for projects that seek sustainability through durability, combining long-term performance, minimized maintenance and an enhanced environmental profile.

To ensure the required durability of concrete, it is necessary to select the appropriate exposure class that determines the mix design according to the provisions of the standards (EN 206 and KTS 2016), as well as to ensure high-quality concreting and curing. Adequate durability secures long-term performance, resistance to deterioration and structural safety over time.

In projects where durability is a key requirement, extending the structure's service life, special concrete mixes such as **VIRIDIA** can be used. Such concretes incorporate technologies that enhance low permeability and high resistance to chlorides and carbonation, protecting reinforcement for an additional decade or more without the need for repairs. In this way, sustainable durability is achieved, with reduced environmental and economic footprint of the project.
"Durability = an investment that pays back"

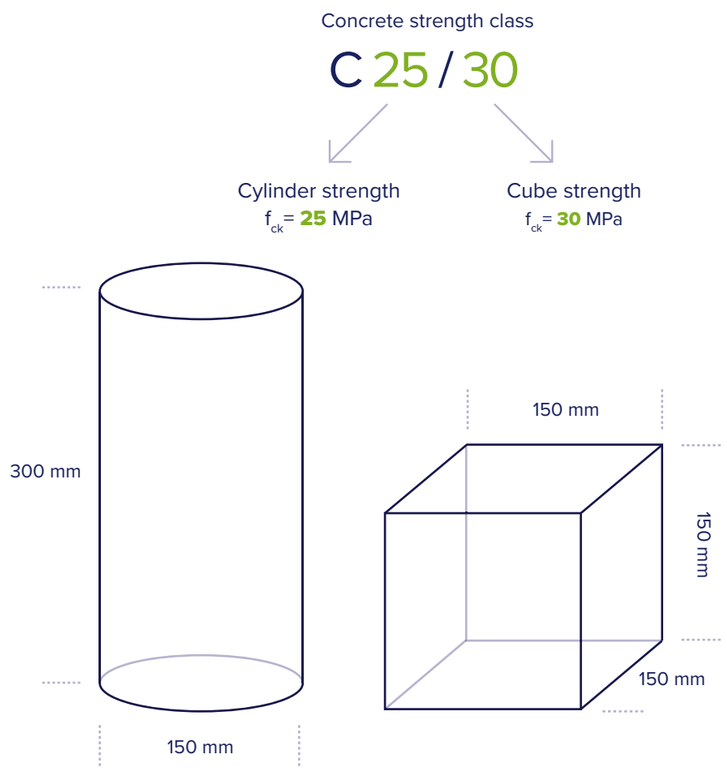
Durability is not only a technical feature. It is a measurable investment: fewer repairs, lower operating costs, higher asset value. For the client, this means long-term performance and reliability that protects their investment.

2.4 Strength and consistency classes

Selecting the appropriate class according to design and project requirements

Concrete strength is defined by its strength class, e.g. C25/30, where the first number indicates the characteristic compressive strength of a cylindrical specimen and the second the corresponding strength of a cube.

Consistency, i.e. concrete workability, is expressed with classes S1 to S5 depending on slump in mm (10–40, 50–90, 100–150, 160–210 and >210).



2.5 Deterioration and environmental exposure classes

Proper matching between exposure class and strength class ensures greater durability and a longer service life.

Long-term deterioration of reinforcement and attack of concrete by environmental or chemical factors directly affect durability, structural integrity and overall performance of the structure. Although concrete provides natural protection for steel due to its alkaline nature, this protection may be lost when the material is exposed to adverse conditions.

Long-term deterioration of concrete may arise from:

- Carbonation (CO_2 ingress and pH reduction).
- Chloride ingress from seawater.
- Chemical attack from acidic or sulphate-bearing effluents.
- Drying shrinkage causes cracking, allowing easier ingress of harmful agents.
- Mechanical abrasion or wear, especially in traffic-bearing slabs or industrial floors.

Selecting the right type of concrete and following proper technical procedures significantly reduces these risks.

To prevent such deterioration, correct classification of the structure into an environmental exposure class, according to the Concrete Technology Regulation (KTS 2016) and EN 206, is critical.

For a detailed presentation of the main corrosion mechanisms and prevention methods, please refer to Annex I: Corrosion and attack of concrete and Annex IV: Concreting in high or low temperatures Appendix IV: Concreting at High or Low Temperatures.

2.6 Concrete Selection Criteria

Characteristic Strength

Concrete Class	f_{ck} (cylinder) MPa	f_{ck} (cube) MPa
C8/10	8	10
C12/15	12	15
C16/20	16	20
C20/25	20	25
C25/30	25	30
C30/37	30	37
C35/45	35	45
C40/50	40	50
C45/55	45	55
C50/60	50	60

Workability (Slump)

Slump Class	Description	Slump (mm)
S1	very low plasticity	10 – 40
S2	low plasticity	50 – 90
S3	plastic	100 – 150
S4	very fluid	160 – 210
S5	flowable	≥ 220

Maximum Aggregate Size

sand	chippings	gravel	stone	coarse

Environmental Exposure Class

	X0	No risk of corrosion or attack
	XC (1-2-3-4)	Corrosion due to carbonation
	XS (1-2-3)	Corrosion from chlorides (sea water)
	XD (1-2-3)	Corrosion from chlorides (not from sea water)
	XF (1-2-3-4)	Freeze–thaw attack
	XA (1-2-3)	Chemical attack
	XM (1-2-3)	Mechanical abrasion (wear – friction)

Chloride Content Class (Maximum Chloride Content)

Use of Concrete	Chloride content class
Concrete that does not contain steel reinforcement or other embedded metallic parts, except for galvanized anchoring systems	Cl 1,5
Concrete containing steel reinforcement or other embedded metallic parts	Cl 0,40
Prestressed concrete	Cl 0,10

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Environmental Exposure Category

Wear / Friction

		Exposure Categories																					
		No risk of corrosion or attack	Corrosion due to carbonation				Corrosion due to chlorides						Corrosion due to chlorides			Freeze/thaw attack				Aggressive chemical environments [b]			Wear / Friction		
							Sea water						Corrosion due to chlorides (not from sea water)											
							Cement II, III, IV (Εκτός CEM II/B-LL + CEM II/B-L)			Cement I (+ CEM II/B-LL + CEM II/B-L)															
	Exposure Category	X0	XC1	XC2	XC3	XC4	XS1	XS2	XS3	XS1	XS2	XS3	XD1	XD2	XD3	XF1	XF2	XF3	XF4	XA1	XA2	XA3	XM1	XM2	XM3
1	max w/c ratio	—	0,65	0,60	0,55	0,50	0,50	0,50	0,45	0,50	0,50	0,45	0,55	0,50	0,45	0,55	0,55	0,55	0,50	0,55	0,50	0,45	0,50	0,45	0,40
2	minimum strength class	C12/15	C20/25	C25/30	C25/30	C30/37	C25/30	C25/30	C30/37	C30/37	C30/37	C35/45	C30/37	C35/45	C35/45	C30/37	C25/30	C25/30	C30/37	C30/37	C30/37	C35/45	C35/45	C40/50	C50/60
3	minimum cement content (kg/m^3)	—	280	300	300	320	330	330	350	330	330	350	330	330	350	320	300	300	320	320	340	360	320	340	360
4	minimum cover for reinforcement [c] (mm)*		25	25	35	35	45	45	50	40	40	50	35	40	50					35	35	35			
5	minimum air content (%)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4,0 [a]	4,0 [a]	4,0 [a]	—	—	—			
6	other requirements	Note: unreinforced concrete					Note: Near coast ≤1.5 km	Note: Permanent contact with sea water	Note: Areas affected by deicing salts							Aggregate in accordance with EN12620 freeze/thaw resistance [d]					Sulfate resisting cement [b]			LA ≤ 27	LA ≤ 25	LA ≤ 22

a. When no air-entraining admixture is used, air content is verified using an appropriate method and comparison with the reference value for the respective exposure class is acceptable.
b. For the exposure classes XA (chemical attack), requirements follow Eurocode EN 206 and standards ΕΛΟΤ EN 197-1. Where SO_4 values exceed KTS limits, the use of sulfate-resistant cement is mandatory.
c. Cover values (*) apply to reinforced concrete.
d. For lightweight aggregate concrete, the provisions of B1.3.3.3 of KTS apply.

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Exposure category to the environment

Inland ← → **Coastal Areas**

XF1 **XC4**

XF1 Freeze–thaw attack.
XC4 Carbonation (wet and dry)

XC1

XC1 Concrete inside buildings with low humidity.

XF3

XF3 Horizontal surfaces exposed to rain and frost.

XC4 Carbonation (wet and dry)

XC4

XO

XO Plain concrete (without corrosion risk)

Reduced water permeability (e.g. tanks, pools)

XC3

XC3 Concrete inside buildings with with moderate to high humidity.

XD2

XD2 Concrete exposed to watercontaining chlorides (swimming pools).

XC2

XC2 Concrete surfaces in contact with water (mainly foundations).

XC4 **XS1** **XF2**

XS1 Structures in coastal zones (distance >5 km from the coast).
XF2 Vertical surfaces exposed to rain and frost.

XC4 **XF2** **XS1** **XD3**

XD3 Structures exposed to chlorides in areas with heavy use of de-icing salts

XM2 **XD3** **XF4**

XM2 Severe mechanical abrasion.
XF4 Structures exposed to heavy saturation with water and freeze–thaw action (e.g. bridge decks and roads).
XA2 Moderate chemical attack from the environment.

XS3 **XF4** **XA2** **XC4**

XS3 Structures exposed to tidal, splash and spray zones (marine works).

2.7 Sustainability at the core of concrete production

VESTA™ – Environmental performance rating system for INTERBETON products

In today's construction sector, the environmental performance of materials plays a decisive role not only in the technical integrity of structures, but also in their compliance with international sustainability standards. INTERBETON has developed the VESTA™ rating system, a tool that enables objective classification of its products according to their environmental footprint.

VESTA™ is INTERBETON's environmental performance rating system for its products, designed to ensure transparency, accuracy and objective sustainability criteria. Since July 2022, the system has operated as a certified internal framework, based on stringent quality management practices and subject to regular audits by the independent body BQV (Business Quality Verification), accredited by the Hellenic Accreditation System (ESYD).

Evaluation is based on critical indicators such as CO_2 emissions, recyclability and use of local raw materials. Concrete mixes are categorized into four classes — U (Ultra), A, B and C — according to their equivalent CO_2 emissions per unit of strength (kg CO_2eq/MPa):

- **U** – Less than 5,5 kg CO_2eq/MPa
- **A** – Less than 7 kg CO_2eq/MPa
- **B** – Between 7 and 8.50 kg CO_2eq/MPa
- **C** – More than 8.50 kg CO_2eq/MPa

VESTA™ actively supports documentation for projects targeting certifications such as LEED, BREEAM, DGNB, LEVEL(s) or ESG ratings, facilitating compliance with international sustainability requirements in the construction sector.

Schemes such as LEED, BREEAM, LEVEL(s) and DGNB assess and recognize buildings that meet high standards of sustainability, energy performance and environmental responsibility. They also emphasize the well-being of building users, promoting health, comfort and quality of life in working and living spaces.

Green is not a trend – it is the new quality benchmark

Responding to the increasing demands of the construction sector for reducing environmental impact, INTERBETON systematically invests in developing concretes with a responsible environmental profile. These products meet the requirements for schemes such as LEED, BREEAM, LEVEL(s) and DGNB, and many are accompanied by Environmental Product Declarations (EPDs) and carry the VESTA label, enhancing both their technical reliability and compliance with international standards.

A central example of this approach is **VELTER**™, an innovative ready-mix concrete from the TITAN Edge product family, which reduces CO_2 emissions by up to 30% compared to conventional products. It is produced exclusively from Greek raw materials bearing CE marking, is 100% recyclable and is accompanied by a Type III EPD certified by Eurocert. Its environmental performance is also documented through the VESTA™ rating system. VELTER™ is classified in the top VESTA™ Ultra Plus tier, representing a benchmark for technically and environmentally advanced choices.

The integration of such products and evaluation tools enables construction professionals to deliver high-quality projects with reduced environmental impact and strong alignment with modern sustainability requirements.

The integration of such products and evaluation tools enables construction professionals to deliver high-quality projects with reduced environmental impact and strong alignment with modern sustainability requirements.

When a client chooses a product with a VESTA™ label or an EPD, they do not just contribute to emissions reduction. They create added value for the project, enhance its potential for LEED, BREEAM, LEVEL(s) or DGNB certification and gain a competitive edge in a real estate market increasingly demanding "green" credentials.

INTERBETON provides its partners with top-performing concretes, along with the necessary sustainability documentation tools that strengthen their business position.

3.0

Design and preparation

3.1 Ordering concrete

Efficient collaboration from the very first step

To ensure correct production and timely delivery of concrete with the right specifications, and to secure a smooth workflow on site, the customer must provide specific technical information when placing the order. INTERBETON provides technical support to customers to ensure proper concrete selection based on project characteristics and regulatory requirements (KTS 2016 and clauses 6.2.3 and 7.1 of EN 206).

In an order for factory-produced ready-mix concrete, additional requirements arising from special concrete uses may also be specified. Such requirements are set out in EN 206, clauses 6.2.3 and 7.1.

A correct order is the foundation of a cooperative relationship free of delays and misunderstandings. With INTERBETON, every step is documented and transparent. Our experience with all types of projects — from small private buildings to large infrastructure works — significantly contributes to the successful completion of your project.

According to INTERBETON, for a correct concrete order, the following must be specified at a minimum:

- Compliance of concrete with the requirements of the Concrete Technology Regulation (KTS 2016), ensuring the product meets minimum regulatory safety and quality requirements.
- Environmental exposure classes to which the structure will be subjected.
- Strength and consistency class or, where applicable, the required slump value.
- Maximum aggregate size (e.g. fine aggregate concrete), appropriate workability or admixtures as needed (e.g. superplasticizer) for elements with small dimensions and/or congested reinforcement.

Discuss with the project engineer to schedule the delivery frequency in line with the placement rate.

Timely supply is a matter of coordination. Define the delivery sequence based on pump capacity and distance from the plant.

Ensuring structured processes, support, and predictability

- Maximum aggregate size of the concrete.
- Chloride content class, according to project requirements.
- Total quantity of concrete required for that day.

In addition, the customer must coordinate with INTERBETON regarding:

- Delivery date and time.
- Delivery rate.
- Unloading speed on site.

The order must be transmitted in good time — at least two (2) working days before the requested delivery date — or earlier, depending on seasonal conditions and project schedule. Early communication facilitates accurate planning and smooth execution by INTERBETON.

For a detailed presentation of the Daily Order Transmission Form, as well as the mandatory information on the Delivery Note, refer to Annex II: Transmission Form and Delivery Note.

INTERBETON's plant network ensures backup coverage for every project. The possibility of an alternative supply reduces delays and risks of interrupted concreting.

3.2 Site preparation for proper concreting

INTERBETON at your project's side

You are not alone on site. Our team is available for on-site support, access evaluation, coordination with the pump or placing crew. For us, successful concreting is a shared effort.

Proper preparation before concrete arrival is a necessary condition for safe, high-quality concreting, ensuring a durable structure. With collaboration between INTERBETON and the customer, mistakes and material losses are avoided, and the full technical advantages of modern concrete are utilized.

According to INTERBETON's guidelines, the customer must ensure the following:

Safety & Infrastructure:
- Site organization so that access routes are clear, obstacles removed and work areas clearly demarcated.
- Safety measures: use of PPE (Personal Protective Equipment), signage, and presence of a responsible person.
- Adequate manpower: the concreting crew must be ready and sufficient in number for the specific order.
- Appropriate lighting for safe conducting of the concreting operations.

Access & Vehicle Circulation:
- Layout and opening of space to allow safe access for truck mixers and unobstructed operation of the pump.
- Check of access points and removal of obstacles (natural or man-made).
- Securing any permits required from the municipality, police or other authorities.
- Provision of designated areas on site for the washout residues from drum and pump cleaning.

Equipment:
- Where required, the concrete pump must be set up and properly positioned in advance.
- Vibrators, trowels and other placing and compaction tools must be available and in proper working order. There must be sufficient equipment so that, even in the event of a breakdown, concreting will not be interrupted and unintended construction joints will be avoided.

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Up to
20%
of total concreting time can be saved by properly preparing the site.

- There must also be a sufficient number of clean cast-iron moulds for sampling test specimens used for compressive strength verification of the concrete delivered, as well as properly trained staff to perform sampling.

Pump Setup & Site Safety:
- Where a pump is required, it must be set on stable, level, clean and slope-free ground.
- A safe distance must be maintained from overhead power lines, and the utility's guidelines must be followed to prevent accidents.
- All safety measures must be implemented by the site's responsible personnel.

Formwork & Reinforcement:
- The goal is to achieve smooth surfaces without discontinuities or defects.
- Proper jointing of forms and clean formwork are required, along with wetting or application of release agents to prevent moisture absorption from the concrete and avoid surface defects and discontinuities.
- Formwork stability and correct reinforcement placement with the required cover distances must be ensured, as they are critical for the strength and durability of the structure over time.

GAIAFILL
CLSM

For structures where fast, reliable filling of voids, trenches, or underground spaces is required, INTERBETON's **GAIAFILL** offers a modern, efficient, and technically safe solution. GAIAFILL is a highly flowable, cementitious fill material designed to be placed without mechanical compaction and to eliminate voids completely. Its special composition ensures full-volume filling without settlement or future subsidence, extremely low shrinkage (<0.08%), and protection of overlying infrastructure and stability even under wet conditions, allowing application in rainy weather without loss of form. It also provides long-term reliability without the need for recompaction or repairs.

GAIAFILL significantly reduces construction time, minimizes environmental impact and protects critical infrastructure such as pipe networks, fiber optic ducts or tanks. It is produced under controlled factory conditions and is accompanied by technical support and consistent quality characteristics.

3.3 Acceptance of concrete

Transparency in practice

The Batch Report is not bureaucracy — it is the proof of our transparency.

The customer knows exactly what they are receiving, with full traceability and quality data available at any time.

Upon arrival of the truck mixer on site, basic acceptance checks must be carried out. The site manager or the person responsible for acceptance must verify the information and proceed to place it if there are no deviations.

This person must check:

That the load is sealed directly from the plant and bears a lead seal on the drum lever. The Delivery Note, verifying that it matches the order.

The Delivery Note must mandatorily include all information required by KTS 2016 (Annex B5.10), such as:

- Declaration of conformity of the concrete with KTS 2016.
- Name and location of the production unit.
- Delivery Note number.
- Vehicle registration number.
- Project name and delivery location.
- Buyer’s name.
- Date and time of loading.
- Time of arrival on site.
- Start and end time of concrete discharge.
- Specimen shape (cylindrical or cubic).
- Whether sampling of test specimens has been carried out.
- Density of fresh compacted concrete, as per mix design.
- Quantity (in m^3 and tonnes).
- Strength class.
- Consistency class.
- Exposure class.
- Chloride content class.
- Maximum aggregate size.
- Cement type/strength class.
- Type of chemical admixtures.
- Any additional required properties due to special use of the concrete.
- Weights of individual constituent materials of the load (batching data).
- Name/mark of the production control certification body for plants with production control certification.
- Certificate number (in a visible place) from the production certification body (where applicable).
- Indication “without production control certification” (if applicable)

Every INTERBETON delivery is accompanied by digital traceability through Betolink Lab, which records mix composition, temperature, loading time and deviation from the reference mix. Thus, full transparency and quality consistency are ensured.

3.4 Batch Report

Complete documentation and production traceability

INTERBETON issues and provides a Batch Report with every load, which forms an integral part of the Delivery Note and includes the official production data for each batch. In essence, it is the technical “identity card” of the concrete delivered to the project.

The Batch Report provides the buyer with a complete and documented picture of the production process and the actual mix of the load. It serves as a tool for traceability, quality control and compliance with KTS 2016 and the approved mix design.

For a detailed presentation, refer to Annex III: Batch Report.

Key elements of the Batch Report

1. Mix composition & quality characteristics
- ➔ Concrete type code and strength class.
- ➔ Density according to mix design.

2. Quantitative data & material proportions
- ➔ Actual weighed quantities of all materials (cement, aggregates, water, admixtures):
  - For the entire load.
  - Per m^3 of concrete.
  - Per mixing cycle.
- ➔ Theoretical material ratios (according to mix design):
  - Per m^3.

3. Production process
- ➔ Quantity of concrete per mixing cycle.
- ➔ Total weight and total volume of the delivered load.
- ➔ Mixing the cycle serial number in the plant mixer for producing the total quantity loaded into the drum.
- ➔ Start time of production for each mixing cycle.
- ➔ Mixing duration after full addition of materials.

4. Adjustments & control
- ➔ Measurement of sand moisture percentage for each mixing cycle.
- ➔ Added or reduced water quantity per cycle (in kg) by the operator.
- ➔ Total amount of water added or removed (including sand moisture).

5. Load identification
- ➔ Delivery Note number.
- ➔ Issue date.
- ➔ Customer code.
- ➔ Project code.
- ➔ Production mixer code.

The Batch Report provides the customer with a complete, detailed picture of each concrete load, including all necessary data for technical verification and quality control. It documents compliance with the mix design specifications, ensures traceability for each batch, and serves as a contractual protection tool, especially during inspections or technical disputes. It is a key technical and legal document that protects both the supplier and the customer, ensuring transparency, accuracy, and reliability at every project stage. It is noted that INTERBETON’s high-value-added products are not accompanied by a Batch Report — they are INTERBETON’s intellectual property, the result of long-term research and innovation.

INTERBETON provides trained personnel and technical support if on-site intervention or reassessment is needed.

3.5 Workability adjustment

Full documentation and production traceability

If it is necessary to modify the workability of the concrete, this may only be done by adding superplasticizer, as defined in the mix design. Mixing is carried out in the truck mixer for:

- At least 1 minute per m^3 of concrete and at least 5 minutes in total.
  For example: 5 m^3 for 5 minutes, 9 m^3 for 9 minutes.
- Maximum drum speed: 10–14 rpm.

The addition of water or any materials not foreseen in the mix design is strictly prohibited.

Discuss with your project's responsible engineer how the choice of consistency class affects porosity and the long-term durability of the structural element.

The correct consistency (slump) ensures uniform placement without segregation or honeycombing.
Do not modify the mix on site.
The addition of water at the site is prohibited—it increases the water/cement ratio, reduces strength, and worsens permeability.

Transport times and load acceptance

According to KTS 2016, under normal temperature conditions:

- With retarder: maximum transport time must not exceed 2 hours.
- Without retarder: maximum transport time must not exceed 1 hour and 30 minutes.

After the above time limits have elapsed, acceptance of the concrete is not permitted.

4.0

Concreting

4.1 Concreting procedure

The moment of truth

Concreting is the moment when the structure takes shape.
It is where the value of collaboration, preparation and the right material becomes evident. With INTERBETON at your side, each concreting operation is a step towards a durable, safe and technically sound structure.

Concrete quality does not depend only on mix design and production, but also on its proper handling on site. From the moment of unloading to final hardening, responsibility lies with the contractor and crews. The following stages are critical for long-term strength and technical performance.

The concreting procedure includes all stages from the receipt of concrete on site to its placement, compaction, and initial curing. Each stage requires accuracy, technical consistency, and close cooperation with the supplier to maintain the material's delivered quality and ensure structural integrity.

OPTIMA
Self Compacting Concrete

In projects where concreting quality is crucial for long-term durability and avoiding failures, the use of self-compacting concrete, such as **OPTIMA**, offers significant benefits. Thanks to its ability to fill any form fully and homogeneously without vibration, OPTIMA eliminates the risk of voids, honeycombing and insufficient reinforcement cover — issues that often undermine structural capacity and service life.

Furthermore, its full and effortless flow enables high-precision applications, improving both technical performance and visual quality, especially in exposed elements and complex geometries. Choosing self-compacting concrete substantially enhances execution quality as a factor of durability.

INTERSTEEL
Powered by Dramix®

In floor applications subject to repeated, dynamic or irregular loads — such as logistics warehouses, industrial centers, loading areas and heavy traffic zones — concrete must maintain its mechanical integrity even after cracking. **INTERSTEEL** is a specialized steel fiber reinforced concrete solution designed to replace or supplement traditional reinforcement.

The steel fibers are uniformly dispersed throughout the concrete mass and act as micro-reinforcement, providing load-carrying capacity and controlling crack development. INTERSTEEL's enhanced post-cracking deformation capacity (e.g. fR3 > 3 MPa) ensures that the floor remains functional and safe even after crack initiation.
In addition, fiber use speeds up construction, reduces the need for mesh placement, and helps optimize manpower and equipment on site.

INTERBETON applies workability control for every batch. Depending on project demand, the laboratory can adjust the mix to ensure stable behaviour without any on-site intervention.

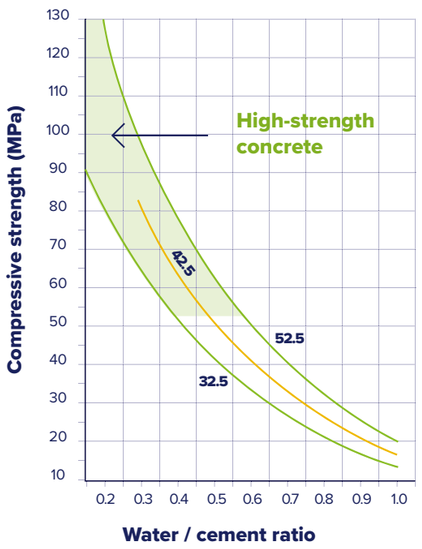
4.2 Avoiding water addition on site

On-site handling determines the outcome

At INTERBETON, quality does not end at the production plant — it continues on site. And this is where collaboration becomes crucial.

Uncontrolled addition of water in the truck mixer or pump to improve workability has immediate and serious consequences:

- ➔ It reduces concrete durability against environmental and mechanical actions.
- ➔ It increases the water/cement ratio over the design value, directly degrading strength.
- ➔ It invalidates the Batch Report, as the material placed in the structure is no longer the one that was produced.
- ➔ It removes responsibility from the supplier and transfers it entirely to the receiver.



Durability reduction
Extra water in the concrete mass increases the water/cement ratio and thus its porosity, resulting in higher permeability and, consequently, a dramatic reduction in durability against environmental effects and aggressive agents.

Strength reduction
Increased water content inevitably leads to a significant reduction in compressive strength.

INTERBETON
A TITAN GROUP COMPANY

4.3 Proper placement

Placing determines long-term behaviour

Placing is a critical stage for concrete's final behaviour, strongly affecting structural integrity and long-term reliability of the structure. Regardless of the mix quality, if placement is not carried out in accordance with correct technical practice, the performance of the element and the structure's long-term behaviour are compromised.

Placing should be carried out in layers with a thickness ≤50 cm, with continuous and uniform vibration. Overlapping of layers must ensure homogeneity. Always use a sufficient number of vibrators in operation and have at least one spare available.

Discuss with your project's responsible engineer the appropriate size and type of vibrator, depending on the geometry of the element and the density of the reinforcement.

4.3 Proper placement

Up to
50%
fewer surface defects and cracks have been recorded in projects that systematically follow these guidelines

Implementation guidelines:

Preparation and equipment:
- If a concrete pump is used, the appropriate boom length must be selected and correctly positioned to avoid blockages, excessive pressures or forced movement of the mix.
- In long pumping lines, lubrication with cement slurry is allowed before the start of concreting.
- The discharge point on the formwork must be as close as possible to the placement area in order to avoid segregation and maintain mix homogeneity.

Workability management:
- Concrete shall be placed with the workability specified in the mix design.
- If it becomes necessary to modify consistency, the supervising engineer may, in cooperation with INTERBETON, increase the slump class by using the same superplasticizer as in the mix design.
- Addition of water on site is prohibited for any reason. Only the superplasticizer used in the mix design may be added. The addition of materials not foreseen in the mix design modifies concrete properties and voids the producer's technical responsibility.

Technical placing rules
- Free fall of concrete from heights >2.5 m in vertical elements is not allowed. A suitable flexible tremie pipe shall be used from the top of the formwork.
- Placing must be carried out in layers of maximum thickness (height) ≤60 cm. For thinner elements, placement can be done in a single layer.
- The top surface of each layer must be kept horizontal and not shaped with the vibrator, as this leads to segregation.
- For elements thicker than 60 cm, the next layer should be placed before the previous one starts to set, to avoid cold joints.
- Movement of concrete by shoveling, raking or using the vibrator for pushing is to be avoided.
- Vibrators must be used exclusively for compaction and not for leveling, as this causes segregation.
- Supply must be continuous. If concrete remains static in the pump hopper, it will start to set.

Dealing with interruptions
- If pump delivery is interrupted long enough for the concrete in the line to lose its workability, this material must be rejected.
- In case of a planned concreting interruption, construction joints must be created and thoroughly cleaned and washed before resuming concreting (in accordance with KTS 2016, Section D2, §D2.1–D2.2).

INTERBETON actively encourages site crews to follow these practices and provides on-site support where needed. It provides technical documentation and site practice guidelines, recognizing that the final product is not just the material delivered, but the correctly placed concrete in the structure.

INTERBETON's technical guidelines are based on laboratory tests and real projects. The goal is to completely avoid honeycombing by properly training placing personnel.

Experience shows that proper concreting and curing practices ensure durability, visual quality and reduced maintenance needs in the early years of service.

4.4 Proper compaction

Implementation guidelines:

Compaction is the final but decisive step in concrete placement. It is essential to ensure the complete removal of trapped air and the proper incorporation of concrete into the formwork. Insufficient or improper compaction leads to voids, poor bond and surface defects.

- The use of a vibrator is mandatory in every concreting operation according to KTS 2016.
- Compaction must be done mechanically, using vibrators, in layers ≤60 cm.
- Vibrator use reduces voids in the concrete mass, expels air and provides full encasement of reinforcement without voids, enhancing the bond between steel and concrete.

Proper compaction ensures:

- Development of specified strength, ensuring there are no voids or trapped air.
- Adequate bond between concrete and reinforcement.
- The vibrator must not be used excessively, as this causes segregation and hence reduced concrete quality. There are two main types of vibrators: internal (poker) and surface vibrators. The choice of type and number depends on many factors: concrete type, reinforcement density, element geometry, concrete volume to be placed, mix workability, maximum aggregate size and overall project requirements.
- Vibration time depends on concrete workability. The higher the workability, the shorter the required compaction time. Excessive compaction leads to segregation.
- The next layer must be placed before the previous one starts to set, to avoid cold joints.

Special concretes such as self-compacting and highly flowable mixes supplied by INTERBETON allow excellent compaction without vibration. Detailed information on compaction is provided in Section D4 of KTS 2016.

Ask your project's engineer to guide you on the correct vibration frequency and duration, in order to achieve full compaction without aggregate segregation.

During technical meetings prior to concreting, INTERBETON's technical team assists in selecting the appropriate consistency and equipment, in order to reduce segregation phenomena and ensure the quality of the final surface.

4.5 Concrete curing

A decisive stage for long-term durability

Curing and protection of young concrete are mandatory and particularly critical for the long-term durability of the structure. Curing begins immediately after compaction and is a fundamental requirement for proper cement hydration, strength development, and the achievement of specified mechanical properties.

Curing must last at least 7 days; under extreme environmental conditions, the curing period and protection intensity must be increased. The goal is to maximize cement hydration in the mix. Preserving surface moisture prevents cracking due to rapid evaporation. Curing can be achieved with coverings (wet burlap, polyethene sheets), water spraying or curing compounds. Maintaining surface moisture during the first hours after concreting and until set is very important because it prevents cracking in the plastic phase due to rapid water evaporation.

Protection from strong winds:

- Curing must start immediately after concreting to avoid cracking, as evaporation of water from the surface is more intense and plastic shrinkage cracking is more likely.
- The use of polypropylene fibers in the mix can limit the width of these cracks.

Protection from high temperatures:

- High temperatures accelerate water evaporation and may result in reduced strength.
- Use of protective measures, such as wet burlap, is recommended.

Protection from low temperatures:

- Low temperatures slow hydration and strength development.
- Measures such as thermal insulation of concrete elements, heating the surrounding area or even postponement of concreting are recommended if concrete temperature is expected to drop below 0°C.

For a detailed presentation, refer to Annex IV: Concreting in high or low temperatures.

Discuss with your project's responsible engineer the duration and curing method that best suit the concrete mix and the climatic conditions of the project.

Curing is the most decisive phase for the durability of the structure. Maintaining moisture and temperature during the first days prevents cracking and increases watertightness.

Proper curing can extend service life by up to

40%

Curing methods and materials:

Curing compounds:
- Must comply with ASTM C309-11 or ASTM C1315-11.
- Cannot be used on surfaces that will receive additional concrete in the future.
- If used outdoors, they must be UV-resistant for at least seven (7) days.

Plastic sheeting:
- Must be well anchored along the boundaries of the pour and prevent evaporation or moisture loss.
- Should have a minimum thickness of 0.3 mm to protect the surface from damage when works resume.

Proper curing of fresh concrete is critical to prevent cracking and achieve final strength. For projects with large exposed surfaces, **INTERBETON offers Devapor™**, an anti-evaporation membrane that is a certified surface protection solution according to EN 1504-2.

Advantages:
- Retains moisture in fresh concrete during setting.
- Reduces cracking in the plastic phase before setting.
- Improves uniformity and visual quality of the final surface.
- Contributes to achieving design strengths and reducing maintenance interventions.

Application:
- The product is applied undiluted by spraying as a fine mist at about 1 atm pressure.
- Consumption: 0.15–0.20 kg/m^2 (depending on wind, temperature and humidity).
- Shake well before use and spray evenly over the entire surface immediately after final finishing.
- Ideal for roofs, industrial floors, pavements and all applications with large exposed surfaces.

Discuss with your project's responsible engineer the integration of Devapor™ into the curing plan, especially for projects with an increased risk of evaporation or cracking.

INTERBETON provides seasonal curing guidelines to document durability, not just theory.

4.6 Formwork striking (stripping)

Form removal determines the safety and quality of the work

The timing, rate and procedure for removing formwork and shoring are defined by the project design and are the responsibility of the supervising engineer. If strength development is not monitored using in-situ test specimens, formwork stripping must follow the minimum times specified for concrete with cement type CEM I 42.5.

Construction Elements	Duration (days)*
Side formwork of beams, slabs, columns, and walls	2
Formwork of slabs and beams with spans less than 5 m	5
Formwork of slabs and beams with spans greater than 5 m, cantilevers	10
Safety shoring of beams, frames, and slabs with spans greater than 5 m, cantilevers	28

*In cases where concrete with strength class 32.5 cement is used, the formwork removal times shall be 3, 8, 16, and 28 days respectively.

Formwork may only be removed when concrete has developed sufficient strength to carry all design loads. Particular care is needed where formwork supports elements above.

- Stripping must be carried out carefully, without impacts or vibrations that may damage the concrete.
- Vertical formwork is removed first, followed by horizontal elements, always taking into account cement type and ambient temperature.

The final result of a project reflects how well we have collaborated. When INTERBETON and the site team work as one, the outcome is always stable and predictable.

4.7 Smart Concrete Monitoring

Real-time data.
Accurate insights.
Documented decisions.

INTERBETON's **Smart Concrete Monitoring** solution, in partnership with the **LumiCon** platform, brings in-place technology to the site. Using wireless sensors and cloud analytics, engineers can monitor concrete temperature, maturity, and strength development in real time — without sampling or delays.

What it offers

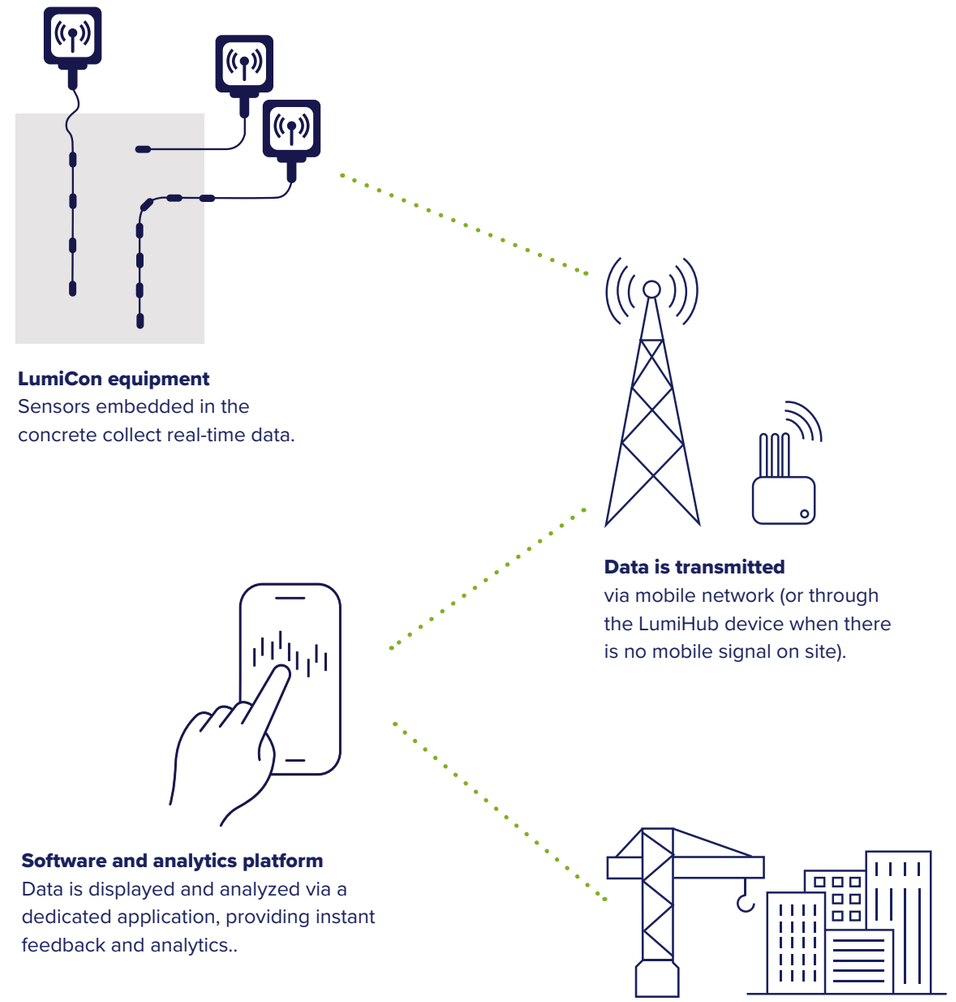
- IP68 smart sensors: measure temperature and, under defined conditions, predict in-place strength (maturity method ASTM C1074).
- LumiCon cloud platform: data logging, alerts, automatic PDF/Excel reporting, access from any device.
- Full traceability: every pour is accompanied by a digital report of temperature curves and in-place strength.
- Applications: mass concrete, foundations, piles, pile caps, large volume elements or cold weather concreting.

Project benefits

- Safer and faster stripping times with documented in-place strength.
- Timely intervention if thermal thresholds are exceeded (e.g. >70 °C or ΔT > 20 °C), via system alerts.
- Minimization of delays and overtime through remote decision-making.
- Compliance with EN 206 and international standards (ASTM C1074, ACI 306R).
- Complete digital documentation for QA/QC and project certification.

With LumiCon powered by INTERBETON, concrete "speaks" — giving engineers the data they need for safer, more efficient and more sustainable decisions on site.

How does the LumiCon concrete monitoring system work?



LumiCon equipment
Sensors embedded in the concrete collect real-time data.

Data is transmitted
via mobile network (or through the LumiHub device when there is no mobile signal on site).

Software and analytics platform
Data is displayed and analyzed via a dedicated application, providing instant feedback and analytics..

Timely and preventive action on-site
Project managers receive alerts and can immediately adjust construction activities based on actual measurements.

5.0

Quality control

5.1 Sampling and quality control tests

Ensuring quality and compliance

Sampling during concrete acceptance is a critical step to ensure quality and compliance with the design specifications and KTS 2016. Particularly in the case of non-certified concrete — as is the case for all concrete currently produced in Greece — sampling is not just an obligation; it is an act of responsibility towards the quality and long-term durability of the structure.

Test specimens are the only objective means to check hardened concrete strength, to provide technical control on site, and to provide documented proof of compliance. In cases of failures or disputes, they can serve as legal evidence to protect the client. At the same time, they allow cross-checking of load characteristics against Batch Report data, offering a complete picture of the concrete used.

The time and place of sampling are mandatorily recorded on the Delivery Note, which is signed both by the producer's representative and the supervising engineer. In addition, all parties involved (producer, supervisor, technical consultant, owner, etc.) have the right to be present during sampling and testing.

KTS 2016 provisions

- For quantities up to 150 m^3, six (6) specimens per batch are required.
- If the daily quantity exceeds 150 m^3, it is divided into equal batches of ≤150 m^3, each with separate sampling.
- Specimens are taken exclusively from the discharge of the truck mixer. Multiple specimens from the same vehicle are not allowed unless the project requires fewer truck mixers. In such a case, at least 1 m^3 must be discharged between successive samplings.
- The supervising engineer is obliged to perform acceptance tests for each batch of non-certified concrete.

Your project engineer can guide you in proper sampling and curing of test specimens to ensure they are representative. Quality control is everyone's responsibility.

INTERBETON supports the customer even after delivery, with monitoring, documentation and technical advice at every control stage.

Quality control is not a compliance procedure; it is a trust mechanism. The more transparent the process, the stronger the collaboration.

INTERBETON
A TITAN GROUP COMPANY

5.2 Sampling and compaction procedure

Concrete test specimens: proof of quality on site

Sampling must be carried out by properly trained personnel using cast-iron molds with dimensions 150 × 150 mm. Specimens are filled in one or two layers, depending on mix consistency, and compacted with 25 blows of a Ø16 mm rod per layer.

If superplasticizer is used on site, sampling takes place after full remixing of the admixture in the load for at least 1 minute per m^3 and a minimum of 5 minutes in total.

Specimens are stored in a location protected from the sun, rain, cold and vibrations until they are transported to the laboratory. Proper storage is essential for valid test results.

Sampling is not a simple routine but a fundamental tool for ensuring quality and accountability, essential for any project that relies on durability, accuracy, and reliability. Combined with proper production documentation (e.g. Batch Report), it ensures full technical transparency and project protection.

Every sample, every measurement, every report is part of the same chain of reliability that links INTERBETON with its customer.

Sampling frequency and execution must be carried out by certified personnel, at a defined frequency depending on the concreting volume.

6.0

Practical guidelines

6.1 Illegal water addition and its consequences

Small intervention, big damage. The risks of water addition

Water addition on site is a practice explicitly prohibited by the Concrete Technology Regulation (KTS 2016), which has the force of law (Government Gazette 1561/B/2.6.2016), as it alters concrete properties. The water/cement ratio (w/c) is critical for final strength and durability.

As stated in KTS 2016:

- Clause D3.5.2: Water addition for the purpose of improving fluidity is prohibited.
- Clauses B3.11 & B3.12: Addition of any material after discharge from the mixer is prohibited, except for a superplasticizer identical to that specified in the mix design, with mandatory remixing for at least 5 minutes.

Illegal water addition has serious technical and economic consequences:

- Degrades concrete strength by reducing compressive strength.
- Increases absorbency and cracking. Extra water increases porosity and permeability, allowing harmful agents (chlorides, CO_2, sulphates) to penetrate, causing reinforcement corrosion and reducing the structure's service life.
- Causes material segregation.
- Invalidates tests and documentation.

Preventing damage to the structure's load-bearing system is much more economical than repair. Indicatively, concrete repair costs €80–150/m^2, strengthening with FRP €300–600/m^3, while full replacement of elements exceeds €1,000. Conversely, using a superplasticizer at only about €3–5/m^3 can prevent such costly interventions.

Our customers' most frequent questions have helped us improve our procedures. Every recommendation here comes from real field experience — so we can prevent mistakes together and grow as a team.

Superplasticizers offer significant advantages: they are safe, permitted under KTS 2016, and easily integrated into the mix design. They improve workability without affecting strength, reduce placement issues in complex sections and are extremely cost-effective relative to the benefit. Preselecting high-workability concrete is a smart, cost-effective choice.

Quality solutions for durable and sustainable projects

INTERBETON offers two advanced solutions that upgrade quality, efficiency and sustainability: INTERFIBER and INTERPUMP. They combine technical reliability, application speed, and long-term durability.

INTERPUMP
High-Pumpability Concrete

INTERPUMP — Pumpability and quality without compromise

INTERPUMP is INTERBETON's high-pumpability solution, specifically designed for projects with increased access, speed and precision requirements. With optimized rheological properties, it ensures homogeneous placement without honeycombing or segregation, improving durability and appearance without compromises such as illegal water addition.

INTERFIBER
Polypropylene Fiber-Reinforced Concrete

INTERFIBER — Fiber technology for preventive durability

Enriched with high-strength polypropylene fibers, INTERFIBER creates a three-dimensional micro-reinforcement mesh within the concrete, limiting plastic shrinkage microcracking and increasing cohesion. The result is a denser, more compact, and longer-lasting structure with reduced maintenance needs and an improved environmental footprint.

Durability, efficiency, sustainability

The two solutions work in complementary ways, enhancing structural sustainability and reducing the project's total life-cycle cost. Whether for industrial floors, slabs, walls or demanding structures, INTERFIBER and INTERPUMP represent the peak of INTERBETON's know-how and reliability.

6.2 Frequent concreting mistakes

Successful concreting does not depend solely on mix quality but also on correct application practices. The most common mistakes include:

- Improper placing (e.g. free fall from excessive height, >2.5 m).
- Shaking or moving the pump hose before discharge, which can cause segregation.
- Absence or improper use of a vibrator, resulting in voids and poor cohesion.
- Combining different concrete types without documentation or approval.
- Inadequate or absent curing.

6.3 Practical tips for effective collaboration

Good communication and adherence to procedures contribute significantly to project success. The following practices are recommended:

- Scheduling concreting operations with timely notification of the supplier regarding the timetable, project characteristics and pump requirements.
- Sending an access plan and organizing the site to avoid delays and bottlenecks.
- Presence of a responsible supervising engineer during acceptance for signing documents, checking the material and sampling.
- Recording all observations in a technical log or on the delivery note.

7.0

Contact details

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Email: kos@interbeton.gr

Kos: Messaria
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Sales Department: +30 2242 441783
Offices: 4th km Kos–Choria Road, PC 85300
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Magnesia: Volos
Ovria Velestinou, PC 37500, Volos
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Sales Department: +30 2421 440795,
+30 2421 440791, +30 2421 440793
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Rhodes: Gennadi
Agios Savvas, PC 85107
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+30 2241 240313, +30 2241 240318
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+30 2241 240313, +30 2241 240318
Sales Department: +30 2241 240310,
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Order Desk: +30 2241 240310,
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Sales Department: +30 2241 240310,
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Offices: Agia Varvara, Koskinou, PC 85100
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Halkidiki: Kassandrino
Kassandra, PC 63077, Halkidiki
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+30 2373 300453, +30 694 828 3986
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Halkidiki: Lakkoma
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Annex I
Corrosion and attack of concrete

Protective role of concrete

Sound concrete protects reinforcement through its alkaline nature, forming a thin passive layer on the steel surface. This layer prevents oxidation unless disturbed by environmental factors. This protection may be lost mainly through two mechanisms: carbonation and chloride ingress.

When the passive layer is destroyed, steel becomes susceptible to oxidation, forming iron oxides (rust) with a volume two to four times greater than the original metal. This expansion creates intense internal stresses in concrete, leading to cracking and spalling of the cover.

These cracks allow faster ingress of harmful agents, accelerating reinforcement corrosion. As a result, the effective steel cross-section is reduced, and the load-bearing capacity of the structural system decreases. Concrete and reinforcement can no longer carry the design loads, potentially jeopardizing the structure's structural safety.

Main corrosion mechanisms:

1. Concrete carbonation
- CO_2 from the atmosphere penetrates concrete pores.
- It reacts with $Ca(OH)_2$, reducing pH below critical levels.
- The passive layer is lost, and corrosion starts.
- Iron oxides (rust) form with a volume 2–4 times larger, causing cracking and spalling of the cover.
- Carbonation is UNAVOIDABLE as long as concrete is exposed to air (indoors or outdoors).

2. Chloride ingress
- Chlorides originate from seawater (exposure classes XD), de-icing salts or industrial pollution.
- They penetrate through pores and, if they exceed critical concentration, destroy the passive layer and corrode steel.
- Corrosion occurs locally and is highly aggressive.
- It is accelerated in coastal or polluted environments.

Influence of extreme temperatures

Low temperatures
- Delay setting and strength development.
- Risk of freezing of fresh concrete: extended cracking may occur throughout the mass, potentially leading to demolition and replacement.
- According to KTS 2016, concreting is prohibited at temperatures below –5°C.

High temperatures
- Accelerate water evaporation.
- Lead to shrinkage, cracking and incomplete surface hydration, reducing durability and protection of reinforcement.

Additional attack mechanisms:

Abrasion and wear
- In high mechanical stress areas (industrial floors, toll stations, etc.).
- Lead to material loss, cracking and surface deterioration.
- Increased surface hardness or protective overlays are recommended.

Chemical attack
- From acids or aggressive chemicals: waste-water, tanks, treatment plants, etc.
- Destroy the cementitious matrix of concrete.
- Require concrete with low permeability and a special mix design.

Applied preventive measures:
- Selection of the appropriate exposure class (e.g. XC, XD, XS according to EN 206).
- Increase in cover thickness and use of durable materials.
- Proper mix design, compaction and curing.
- Limitation of cracking and permeability.

Annex II
Transmission Form, Delivery Note

At INTERBETON, ensuring quality and transparency at every stage of production and delivery is a core principle. Proper completion of the Delivery Note is not a simple formality, but a key tool for traceability, quality control and compliance with specified standards. Through this practice, we ensure that every order meets the project's technical and regulatory requirements, thereby enhancing structural reliability.

Mandatory information on the Delivery Note & rationale

1. Regulatory compliance & certification
Ensures that the concrete meets project requirements and national specifications.

- Declaration of conformity with KTS 2016
  - *Confirms that minimum safety and quality requirements are met.*
- Name and logo of certification body (if applicable)
  - *It should be noted that currently in Greece, there is no accredited body and no certified concrete production plant.*
- Production control certificate number
  - *Enhances transparency and enables verification.*
- Indication “without production certification” where applicable
  - *Mandatory warning of increased responsibility for acceptance and sampling.*

2. Load identity & traceability
Facilitates identification, archiving and monitoring of each order.

- Production plant name and location
  - *Enables traceability in case of inspection.*
- Delivery Note number
  - *Necessary to identify the load.*
- Vehicle registration number
  - *Records the transport means and responsibility for material integrity.*
- Buyer’s name
  - *States who is responsible for acceptance and invoicing.*
- Project name and delivery location
  - *Ensures accurate delivery to the correct place.*

3. Delivery & unloading times
Important for quality control, transport time and acceptance of concrete.

- Date and time of loading
  - *Defines the starting point of the permissible transport time.*
- Time of arrival on site
  - *Checks compliance with transport time limits.*
- Start and end time of discharge
  - *Recorded for control purposes and potential rejection due to delays.*

4. Quantitative & physical characteristics
Document the quantity and quality of concrete delivered.

- Quantity of concrete (m^3 and tonnes)
  - *Necessary to certify delivered volume and billing.*
- Density of fresh concrete
  - *Indicator for mix composition evaluation.*
- Weights of constituent materials
  - *Allow documentation of the mix and proof of production quality control.*

5. Technical characteristics of concrete
Define performance and compatibility with project requirements.

- Strength class (e.g. C25/30)
  - *Defines required mechanical performance.*
- Consistency class (e.g. S1–S5 or slump value)
  - *Affects workability, essential for proper placing.*
- Exposure class (e.g. XC2, XS3)
  - *Indicates environmental conditions and durability requirements.*
- Chloride content class (e.g. Cl 0.40)
  - *Critical for reinforcement protection.*
- Maximum aggregate size (e.g. 31.5 mm)
  - *Relates to suitability for specific elements.*
- Cement type and strength class
  - *Affects strength and setting rate.*
- Type of chemical admixtures (e.g. superplasticizer, retarder)
  - *Necessary to understand concrete behaviour on site.*
- Other properties due to special use (e.g. self-compacting)
  - *Ensures special requirements are considered.*
- Specimen shape & sampling (cylindrical or cubic)
  - *Documents sampling and quality verification.*

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INTERBETON CONSTRUCTION MATERIALS S.A.
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DAILY ORDER REQUEST FORM FOR READY-MIX CONCRETE PRODUCT ACCORDING TO KTS 2016 AND THE CLIENT–SUPPLIER AGREEMENT

DATE: ORDER NO.:

ORDERING PARTY DETAILS — Billed Party | Contractor | Engineer
Company Name: Telephone:
Name: Mobile:

PROJECT DETAILS — Type of Project: Residential | Infrastructure | Commercial | Other
Project Description: City / Area:
Project Address (Street No.): Building Permit No.:

APPLICATION / USE OF CONCRETE
Foundations | Columns | Beams | Slabs | Surrounding Area | Other

CLIENT / INVOICE RECIPIENT DETAILS
Company Name: Telephone: Mobile:
Address: City / Area:
Tax ID No. (VAT): Tax Office:

ORDER DETAILS

Desired Date of Concrete Placement	Desired Time of Concrete Placement	Total Quantity (m^3)

Desired Supply Rate — Mixers per Hour: — m^3 per Hour:
Minimum Interval Between Mixers at Site ____ min — Unloading Time per Mixer at Site ____ min

Exposure Class	Without Risk of Corrosion / Damage	Carbonation-Induced Corrosion			Chloride-Induced Corrosion: Sea Water			Chloride-Induced Corrosion: Other than Sea Water		
	X0	XC1	XC2	XC3	XC4	XS1	XS2	XS3	XD1	XD2	XD3
	Freeze/Thaw Attack			Chemical Attack				Wear / Abrasion			
	XF1	XF2	XF3	XF4	XA1	XA2	XA3	XM1	XM2	XM3	

Requested Strength Class	C8/10	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60

Maximum Aggregate Size	31,5mm	16mm	8mm	4mm

Concrete Use Parameters		Chloride Content Class	
	Without Reinforcement:		Cl 1,5
	With Reinforcement:		Cl 0,40
	Sulphate Resistance:		Cl 0,10

Consistency – Categories

Slump Class (mm)	VEBE Time (sec)	Flow Class	Flow Diameter (mm)
S1 (Ελάχιστα Πλαστικό: 10–40mm)	V0 (≥ 31sec)	C0 (≥1,46)	F1 (≤340mm)
S2 (Μέτρια Πλαστικό: 50–90mm)	V1 (30–21sec)	C1 (1,45–1,26)	F2 (350–410mm)
S3 (Πλαστικό: 100–150mm)	V2 (20–11sec)		F3 (420–480mm)
S4 (Ημίρρευστο: 160–210mm)	V3 (10–6sec)	C2 (1,25–1,11)	F4 (490–550mm)
S5 (Ρευστό: >220mm)	V4 (5–3sec)	C3 (1,10–1,04)	F5 (560–620mm)
			F6 (≥630mm)

ON-SITE TESTING / USE OF SUPERPLASTICIZER / SAMPLING

Use of Pump:	YES	NO	Sampling Height (m):	Specimen Shape:	Cubes
Use of Network Pump:	YES		Sampling Location:		
On-Site Superplasticizer Addition:	Supplier		Client		

OBSERVATIONS – ADDITIONAL CHARACTERISTICS – SPECIAL REQUIREMENTS

Annex III
Batch Report

INTERBETON issues a detailed Batch Report, which is an integral part of the Delivery Note. Through the Batch Report, the company provides the buyer with official production data for each load (a “scan” of the product):

1 Concrete strength class
2 Concrete type code
3 Theoretical material ratio per m^3 of concrete according to the mix design
4 Concrete quantity per mixing cycle
5 Theoretical material ratio per m^3 of concrete according to the mix design per cycle
6 Concrete density according to mix design
7a Total weight of delivered load
7b Total volume of delivered load
8a Actual weighed quantities of each material for the total concrete volume delivered
8b Actual weighed quantities of each material per m^3 of concrete
9 Mixing cycle serial number in the production plant mixer for the total quantity loaded into the drum
10 Start time of each mixing cycle.
11 Mixing time after completion of material loading into the mixer
12 Actual weighed quantities per material and per mixing cycle
13 Sand moisture percentage corresponding to each cycle
14 Added or subtracted water quantity (kg) per cycle by the operator
15 Total water quantity (kg) added or removed per cycle, including sand moisture.
16 Delivery Note number
17 Issue date
18 Customer code
19 Customer project code
20 Production mixer code

INTERBETON
METHODOLOGY COMPANY

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DELIVERY DOCUMENT

DELIVERY NOTE No.: 288841
03/04/2018 12:54

PURPOSE OF DISPATCH: SALE

CUSTOMER RECIPIENT

CUSTOMER CODE : 01.A5.31027
COMPANY NAME : MENEXIS GEORGIOS & CO.
ADDRESS : SOURI 6 KALAMARIA–THESSALONIKI-55134
WORK DESCRIPTION : Technical Construction Tax ID No. (VAT): 999431027

PROJECT No. : 01.A5.47937
ADDRESS : FLEMINGK 11–13
KALAMARIA – THESSALONIKI PROJECT ZONE : 23 ΖΩΝΗ
PROJECT NAME :

CUSTOMER ORDER DETAILS

ORDER NUMBER : 01.A5.276575
CONCRETE TECHNOLOGY REGULATION : ΚΤΣ 2016
COMPOSITION : Product Characterization Summary
STRENGTH CLASS : C25/30
EXPOSURE CLASS : XC2
MAXIMUM AGGREGATE SIZE (mm) : 31.5
CONSISTENCY CLASS : S4
CHLORIDE CONTENT : CL 0,4
SPECIAL REQUIREMENTS : NO
ORDER DATE :
ORDERED QUANTITY (m^3) : 150.00

DETAILS OF DELIVERED READY-MIX CONCRETE

PRODUCT CODE : 2523C001 (2)
CONCRETE TYPE :C25/30, XC2,S4,31.5,CL0.40

QUANTITY (m^3) / (tn) : 8.00 (7b) 18.958 EIGHT (7a)

STRENGTH/EXPOSURE CLASS : C25/30 / XC2
CEMENT TYPE : CEM II/A-M (P-LL) 42.5 N
CEM II/B-M (W-P-LL) 32.5 N
CONSISTENCY CLASS : S4 CHLORIDE CONTENT : CL 0.4
MAXIMUM AGGREGATE SIZE (mm) : 31.5
CONCRETE DENSITY : 2.396 (kg/m^3) (6)
TYPE OF CHEMICAL ADMIXTURES : High-range water reducers/ superplasticizers

DELIVERY LOAD DETAILS

DISPATCH TIME TO PROJECT :
UNLOADING : START FINISH
RETURN TO PLANT:

ISSUED/DRIVER : MAKOUSIS F.
DELIVERED BY : INTERBETON
DELIVERY RECIPIENT :
(SIGNATURE) :
(NAME/SURNAME) :

ADDITIONAL DETAILS

DRIVER : GEORGIADIS APOSTOLOS
TRUCK No : P017 EKB4200
PUMP : LN LOGOTHETIS NIKOLAOS

CUSTOMER/RECIPIENT ORDERS AT THE PROJECT

TEST SPECIMENS: TIME SHAPE: CUBIC SPECIMENS 15 cm EDGE LENGTH: No.:

The concrete complies with the Concrete (16) blogy Regulation 20 (17) 2016). The addition of water to t (2) ete is STRICTLY PROHIBITED. (18) d workability is achieved only thro (19) addition of superpl (20)

DELIVERY NOTE No. 288841 (02) 03/04/2018 Product: 2523COO1 Customer: 31027 Project: 47937 Mix No.: 1

(1) C25/30					(3)	640	500	435	325	250	50	187	0,6	2,7	Total Weight		
MIX : 2,66 m3 (4)					(5)	1702	1330	1157	864	665	133	497	1,6	7,18	2.390,3Kg/m³ (6)		
	(10) MIX	(11)		HYGROMETER		AGGREGATES					CEMENTS		WATER	ADDITIVES			
No	TIME	MIXER	% Mes	SAND	SAND	SAND	SAND2	COARSE SAND	GRAVEL (12)	II32,5	II42,5	WATER	CHEM1	CHEM2	+/-	Comp.	
(9) 1	11:47	50s	(13)	0,9%	0,0%	1.710	1.287	1.083	855	680	137	458	1,59	7,19	-26	-41	
2	11:49	50s	%	1,0%	0,0%	1.723	1.392	1.313	896	647	129	457	1,61	7,19	-26	-42	
3	11:51	50s	%	1,0%	0,0%	1.697	1.315	1.058	831	673	134	457	1,63	7,19	-26	-42	
(7a) 18958/8 n (7b)					(8a)	5.130	3.994	3.454	2.582	2.000	400	1.372	4,83	21,57	-78	-125	
Average					(8b)	641	499	432	323	250	50	172	0,60	2,70	(14)	(15)	

Annex IV
Concreting in high or low environmental temperatures

According to the Concrete Technology Regulation (KTS 2016, Annex D6.1.2), concrete temperature during placing must not exceed 32°C, regardless of ambient temperature. Compliance with this limit is critical for quality and long-term durability.

Factors affecting concrete temperature
- Ambient temperature at the time of concreting.
- Temperature of raw materials (aggregates, water, cement).
- Heat released during cement hydration.
- Distance and transport conditions from plant to site.
- Site conditions during placing (time of day, area, etc.).

Effects of high temperature
Concreting in hot weather carries significant risks for concrete quality:
- Rapid evaporation of water leading to increased plastic shrinkage cracking.
- Reduced surface hydration, causing loss of strength and inadequate protection of reinforcement.
- Accelerated setting resulting in lower final strength.

Effects of low temperature
Low ambient temperature is considered to be below 5°C during placing, compaction, curing or thermal protection. When the temperature falls below 0°C, concreting should be postponed, and it is strictly prohibited below –5°C.

Cold weather concreting carries serious risks:
- Delayed setting and slow strength gain, extending the required stripping time.
- Freezing of fresh concrete (if necessary measures are not taken to maintain concrete temperature within KTS 2016 limits), causing cracking and sudden strength loss to the extent that demolition may be required.

Indicative preventive measures are provided in KTS 2016 (Annex PD7) and by the Hellenic Society of Civil Engineers (Technical Guideline 1 “Concrete in low ambient temperature”).

Indicative protection measures
According to Technical Guideline 2 of the Hellenic Society of Civil Engineers and Annex PD6 of KTS 2016, the following are recommended:
- Shortening of the time between production and placing. This requires well-planned ordering and proper management of delivery schedules.
- Use of light-coloured vehicles to avoid excessive heating of concrete during transport.

- Prohibition of water addition on site and exclusive use of approved superplasticizers.
- Concreting during cooler times of the day (night or early morning).
- Spraying/wetting of formwork before placing without creating standing water.
- Minimization of construction joints.
- Systematic curing with wet burlap for shading and keeping the surface moist.

Applying the above measures is critical to avoid premature deterioration and ensure compliance with KTS 2016.

Transport and placement
- Must be carried out as soon as possible after production.
- Avoid late afternoon concreting due to sudden temperature changes at the end of the day.
- Concreting is prohibited if the ambient temperature is < –5°C or if snow or ice is present on reinforcement, formwork or subgrade.
- Minimum temperature of fresh concrete: 10°C (for maximum aggregate size 31.5 mm).

Thermal protection and curing
- Protection of exposed surfaces and insulation of side faces using materials such as plastic sheets, insulation boards, bituminous membranes, fibrous or granular insulation, etc.
- In very low temperatures, the space around the structure must be heated with heaters or steam. Combustion gases must not come into contact with fresh concrete.
- Water curing is prohibited during frost periods.
- Protection duration and concrete strength must be verified using in-situ test specimens.

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