

Specifications Guidelines for UHPC

UHPC 规范指南

INTRODUCTION - ULTRA-HIGH PERFORMANCE FIBRE-REINFORCED CONCRETE

简介-超高性能混凝土

The material used can be defined as follows:

材料定义如下

1. The UHPC used will be reinforced by Organic Fibers exclusively

UHPC内掺纤维仅能使用有机纤维

2. it will have a technical assessment drawn up by an independent third party laboratory (Exp: CSTB in France, or equivalent)

必须通过第三方研究试验机构的技术评估（例如法国CSTB, 或者同等机构）

3. it will be characterised by:

材料特性参数应符合

a. a characteristic compressive strength higher than 100 MPa at 28 days

28天养护抗压强度应高于100MPa

b. a characteristic tensile strength higher than 6 MPa at 28 days

28天养护抗拉强度应高于6Mpa

c. a ductile behaviour (ie. strain hardening) under flexural stress: Modulus of Rupture (MOR) higher than Limit of Proportionality (LOP)

在挠曲应力下须具备塑形性能：断裂模量需高于比例限度

d. a very high durability with: low water porosity (<12%) and maintenance MOR in flexure and Young modulus after accelerated ageing tests (HRT cycle type)

须具备高耐久性能：低水孔隙率（小于12%）并在加速老化测试中维持挠曲断裂模量和弹性模量（HRT循环）

The final profile and section of the UHPC elements must be validated by a design office which will accept the task of designing the elements, and will take liability for this.

UHPC产品的断面必须通过设计确认

The definitive colour of the elements must be established from a sample produced by the precaster. Similarly, the final texture may be specified.

大货的最终表面效果和颜色或者表面肌理必须以加工厂商的样本为准

EXAMPLE OF SPECIFICATIONS

DESCRIPTION OF THE MATERIAL

材料叙述

The material used can be defined as follows:

材料定义如下

1. the UHPC used will be reinforced by Organic Fibers exclusively
UHPC内掺纤维仅能使用有机纤维
2. it will have a technical assessment drawn up by an independent third party laboratory (Exp: CSTB in France, or equivalent)
必须通过第三方研究试验机构的技术评估（例如法国CSTB, 或者同等机构）
3. it will be characterised by:
材料特性参数应符合
 - a. a characteristic compressive strength higher than 100 MPa at 28 days
28天养护抗压强度应高于100MPa
 - b. a characteristic tensile strength higher than 6 MPa at 28 days
28天养护抗拉强度应高于6Mpa
 - c. a ductile behaviour (ie. strain hardening) under flexural stress: Modulus of Rupture (MOR) higher than Limit of Proportionality (LOP)
在挠曲应力下须具备塑形性能：断裂模量需高于比例限度
 - d. a very high durability with: low water porosity (<12%) and maintenance MOR in flexure and Young modulus after accelerated ageing tests (HRT cycle type)
须具备高耐久性能：低水孔隙率（小于12%）并在加速老化测试中维持挠曲断裂模量和弹性模量（HRT循环）

The principles for obtaining this performance are based notably on a high binder content and a low water/cement ratio (W/C=0.26). A full technical assessment from an independent third party laboratory should be available to state all material properties, including durability indicators."
透过使用高效胶凝剂以及低水灰比（水灰比0.26）方能达到这样的强度规范，需使用第三方技术机构提供的技术评估具体规范所有的材料参数，包括耐久性能指数。

UHPC SUPPLIERS

UHPC 材料供应商

UHPC are to be supplied by the following UHPC Suppliers; for alternate suppliers, the Façade Contractor to submit information to the satisfaction of the Project Manager. The nominated UHPC Contractor is to provide full evidence of experience, license and factory capability prior to confirmation as the nominated UHPC Contractor.

UHPC 须由以下品牌提供。如考虑承包商其他品牌，承包商需提供该品牌资料供业主审批。承包商建议的 UHPC 厂家必须於被选定前提供所有相关的经验、证书以及工厂生产能力。 _

1. Ductal France
2. HiCON Denmark
3. TATKL U.S.A

The UHPC Supplier brand shall have at least 10 years of UHPC supply on projects of over 10000 meter square equivalent quality and size in China and overseas. The technical personnel assigned to the project by the UHPC Supplier shall have sufficient experience on similar projects, and be subject to the Project Manager's review and approval prior to the commencement of the project. The supplier shall not sub-contract the scope stated in the Contractor Document to 3rd parties. The Supplier is required to fabricate all GRC products at its own plant. UHPC contractor using imported UHPC should provide the UHPC authorized document for the project from the UHPC supplier.

UHPC材料供应品牌应在过去10年中在国外与中国具有超过10000平方米幕墙工程的供应经验和实绩。承包方及有关厂家所派遣之技术人员应满足业主要求，具有充分的经验年数及类似经历，并须经事先审查及业主认可。另外供货商不得向第三者发包，供货商必须在自家工厂进行生产。使用进口UHPC材料之UHPC承包商须具备UHPC材料供应商之原厂项目授权证明书。

REFERENCE STANDARDS

参考标准

The following describes the China and International standards and codes of practice that are deemed acceptable in this Tender Document. The Façade Contractor shall be responsible for ensuring that all works comply with the following standards and codes of practice.

以下部分略述了招标文件中要求符合的中国国家标准以及国际规范、标准和规定。外墙承包商要负责确保所有的工作都遵守以下所述和本规范中其他标准、规范。

1. CSTB Technical Assessment_
2. GB/T 15231-2008 玻璃纤维增强水泥性能试验方法 _

The Façade Contractor shall be responsible for ensuring that all works comply with the local government's requirements. Should there be inconsistencies among different standards, the most stringent requirements shall apply.

外墙承包商应负责确认所有的工作都符合建委当地政府的要求。如不同规范间有冲突，使用要求较严谨的。

UHPC FABRICATION

1. Equipment required

The conditions required for pouring UHPC are as follows

- a. an enclosed building protected from frost
- b. ambient and mould temperatures between 5° and 35°C._

设备需求

浇筑UHPC 的需求条件如下:

- a. 封闭式建筑保护霜的产生,
- b. 环境和模具温度在5°,到35°,C。 _

2. Mixes

The UHPC concretes are prepared by mixing the constituents for one of the 2 "Full premix". The water has to comply with standard EP1008. Mixing and batching plants should never use recycled water.

The proportions of the mixes shall satisfy the following conditions:

proportion of plasticizer F2 or F3 between 0.9 and 2.5% by weight of cement,
proportion of accelerator A1 or A2 between 0 and 2% by weight of cement,
proportion of organic fibres: 3% by volume.

The respective quantities are given in a fabrication procedure supplied by the Lafarge Cements technical assistant at the end of his inspection.

预拌混凝土

UHPC制作为搅拌其预混料。水必须遵守EP1008标准。搅拌站千万不能使用回收水。搅拌比例要满足以下条件：

减水剂 F2 or F3的比例在 水泥重量的 0.9 and 2.5%。

速凝剂 A1 or A2 的比例在 水泥重量的0 and 2%

有机纤维的比例占水泥体积的3%

3. Mixing

The mixer used to mix the UHPFRC Na-FO concrete must not contain any residual water before loading. The weigh hopper, the mixer and its discharge hopper shall be completely cleaned to avoid cross contamination.

The organic fibres are gradually introduced into the mix (either manually or using a vibrating conveyor belt in order to prevent lumps from forming).
Mixing times (t1 to t10) are determined by a technical assistant at the preliminary inspection stage. These times are determined based on the production equipment so as to ensure compliance with the slump requirements for the Lafarge UHPFRC concrete using the ASTM cone of between 260 mm and 320 mm, 3 minutes after lifting the cone.

搅拌

搅拌机用于搅拌 UHPFRC Na-FO 混凝土在投料前千万不能含有剩余的水分。计量斗，搅拌机和卸料斗要完全清洗干净避免交叉污染。

有机纤维逐渐地加入到浆料中 (手动或是使用震动传输带避免堆积形成坨状。)

搅拌时间 (t1 to t10) 由技术人员在初步检验阶段决定。这些时间根据生产设备确保符合 Na-F 的坍落度要求，使用ASTM 坍落度桶，3 分钟拿起坍落度桶在260mm 到 320 mm间。

浇筑模具

在一般平均的温度状态， UHPC 需要在最多一个小时内浇筑到模具里。浇筑从模具的一边开始为了在浇筑的过程中提供轻微连续的震动使其逐渐地驱除气泡。养护状态和热处理

UHPC在模具里的养护状态必须保护它干燥直到完全固化。这可能涉及塑料膜盖在制品上或是喷上养护剂防止它水分蒸发。空气越干燥，越重要观察且持续养护过程。温度千万不能高于40°C。在30°C到40°C, F2 or F3 减水剂的剂量可以调整为了遵守新搅拌的料在加入纤维前的流变特性。UHPC在固化后，必须防止雨水和阳光直射48小时。

板块的表面处理，如果需要，应在脱模之后根据UHPC厂家的建议操作。

a. Panels shall be handled, stored and transported in a manner to avoid damage or marking to the exposed outside surface and to avoid overstressing.

板块的处理、储存和运输要避免受到损伤或暴露在外的表面有标记或过度受压。

b. The UHPC supplier should provide on-site supervision in order to ensure that the installation and adjustment is carried out in accordance with the UHPC supplier's recommendations. The UHPC supplier to provide on-site instruction and assistance during the installation of the first panel of each UHPC panel system.

UHPC 厂家必须提供现场监督以确保 UHPC 板块顺利安装及调位。在安装每一系统的第一块板块时，UHPC 厂家必须到现场指导及协助。 _

c. Making good of the exposed outside surface shall only be permitted subject to the consent of the Client and the Architect. Any such making good shall be submitted to the Client and Architect for review and approval before the works are carried out. The making good works shall provide a long-lasting effect without deterioration.

只有在业主及建筑师同意的情况下，才允许对外露表面进行修补。任何修补程序、方法、用料等必须预先提交审批。修补应为持久性的，并满足原设计的外观及性能要求，而且不会变质。

d. Upon completion, the Façade Contractor shall carry out final cleaning of all GRC panels according to the GRC supplier's suggested procedures and instructions.

完成安装后，外墙承包商需根据 UHPC 厂家的建议程序及指示清洗所有 UHPC 装饰板

Materials GRC产品的原材料

Water 水

The water shall be clean and free from deleterious matter that may interfere with the colour, setting, or strength of concrete. Refer BS EN 1008, Mixing water for concrete.

生产UHPC的用水必须清洁、没有杂质、无毒，并遵照BS 3148。

Demoulding agent 脱模剂

The use of water based mould release agent will be permitted provided it is compatible with the mould lining material and the finish required, subject to the review and approval of the Client and the Architect. Any residue shall be removed from the finished product so that this does not interfere with any interfaces or applied finishes.

脱模剂须由分包商提议，由业主及建筑师批准。须符合产品表面未层的要求。UHPC 生产商必须清除所有遗留在UHPC完成品上残余，以免影响其接口的密封处理或其表面处理。脱模剂的使用应根据生产商的指导或建议。

Pigments 染料

Any pigments used shall conform to BS EN 12878: 1999. These shall be:

所有染料需按照 _BS EN 12878:1999, 并满足以下条件:

a. Harmless to the UHPC's set and strength. 不对UHPC的强度构成影响

b. Stable at high temperature. 高温时保持稳定 _

c. UV-resistant and alkali-resistant. 具抗紫外线及耐碱 _

It is understood that there will be some minor colour variation, therefore samples showing extreme colour range (max and min) shall be submitted to the Client, prior to commencing manufacture.

小量色差属可接受。所以承包商需於批量生产前提供一个颜色范围的样品供业主审批。

UHPC加工產品

Alignment 平整和对齐

The design, fabrication and installation of UHPC products shall be as such that UHPC products would align accurately on site. Cutting of UHPC products after casting is not allowed unless otherwise approved by Project Manager.

组件的设计、制作及安装程序均需保持高水平，使连接处平滑笔直及板面接驳准确等。除非业主批准，已成型的 UHPC 产品不准切割。

Maintenance Requirements 维护要求

Damages 损坏 UHPC products located on or near horizontal surfaces, such as UHPC coping, transom/ beam cladding and stiffeners and all components that may be susceptible to damages due to maintenance loading shall be designed to withstand such loading.

当 UHPC 装饰板系统部件如顶盖、横梁包面、肋板等安装在水平或靠近水平面时，该板块必须在设计师考虑维修人员的活荷载，以防止板块损坏。

Self- cleaning

UHPC products stated in this project shall be designed to suit the products' self-cleaning properties. Appropriate drainage fall, flashing, drip detail and self-cleaning joint design should be accommodated in the design of the UHPC systems.

本项目的 UHPC 板块系统应备自身清洁的功能。设计必须考虑板块表面的排水、反水般的应用、滴水槽设计和自洁缝设计。

Panel replacement 板块的更换 UHPC products installed on site shall be designed as such that they can be replaced and touched-up. The Façade Contractor shall submit, with the endorsement from the UHPC supplier, panel replacement and on-site touch-up procedures and maintenance plan for review and approval prior to carrying out the replacement works. UHPC 的设计要允许今后单独板块的替换及现场修补。外墙承包商需於进行板块更换或修补前递交 UHPC 厂家同意的更换损坏板块的详细资料和步骤。

Fabrication Tolerances 生产允许误差

Tolerances at joints and points of convergence shall have priority over panel and component tolerance. Tolerances includes but not limited to:

外墙承包商需优先处理接缝和接点处之间的容差，及后至面板和主要部件之间的容差。容差一般包括：

Edge dimensions 边长 $\pm 3.0\text{mm} / \text{m}$

Diagonal 对角线的长度 $\pm 5.0\text{mm} / \text{m}$

Panel thickness 板厚 $\pm 2.0\text{mm} / \text{m}$

Warp 扭曲、翘曲 $\pm 5.0\text{mm}$ 弯曲 $\pm 3.0\text{mm} / \text{m}$

Surface Smoothness 表面凹凸 $\pm 3.0\text{mm} / \text{m}$

Location of cast-in hardware 预埋五金件的位置 $\pm 5.0\text{mm} / \text{m}$

The overall tolerance should not exceed 5mm.

整体误差不应超过 5mm