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ESSENTIAL CHARACTERISTICS OF EXPOSED CONCRETE NOWADAYS

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Abstract. The future of concrete utilization has to be centered on its sustainability perspective, influence on environment, but also from expressivity point of view as a finite material. Nowadays, a large and spectacular range of colours, textures and concrete shapes became easy accessible to architects.

Exposed concrete use will emphasize in the near future all aspects of concrete influences on environment, visual aspect of buildings but also their effects on macro climate.

Key words: exposed concrete; environment protection; finishes; aesthetics; durability.

1. Introductions

Construction materials as steel or reinforced concrete, has been introduced, initially, in civil engineering area, with the only purpose of solving technical problems, and not to create artistic shapes.

In the field of water and industrial constructions or bridge works, on which exterior shape was determined by constructive system, these materials became in the meantime a way of expression. If protection layers on the wood or steel didn't mask them, the external surface of concrete wasn't exposed from

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the beginning, trying to take advantage only of its strength. Thereby concrete was clad with plaster, stone flags or ceramic plates.

When concrete has achieved a regular composition, in order to have a surface expressing the homogeneous interior texture, it was admitted without any protection or coating. In this way *exposed concrete* (Fig. 1) was born, and carrying structure of a building wasn't hidden no more, but integrated into work ensemble, expressing even courage.



Fig. 1 – Exposed concrete facade - Everson Museum of Art, Syracuse, New York.

Multiple transformations which were transited by exposed concrete, from the first works till contemporary ones, are huge and attributed to technology development and its technique, but also to architecture aesthetic reformation.

Nowadays exposed concrete substitutes by its new applications – expensive finishing materials – which demand for their placement high qualification workmanship and a long execution time.

2. Component Materials. Exposed Concrete Mixing Conditions

Concrete is a composite construction material, composed of cement (commonly Portland cement) and other cementitious materials such as fly ash and slag cement, aggregate (generally a coarse aggregate made of gravel or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand), water and chemical admixtures.

Exposed concrete represents the use of concrete as not simply a utilitarian medium for construction but as an aesthetic enhancement to a structure, while still serving its function as an integral part of the building itself such as floors, walls, driveways and patios. Conversion of concrete into exposed concrete is achieved by using a large variety of materials and admixtures which are added when preparing the concrete mix, when pouring it or by different methods of treatment after hardening process has stopped.

For exposed concrete is imposed same suit of technical conditions as in case of usual concrete which is subsequent covered (minimal strength class, maximum W/C ratio, minimum dosage of cement). Beside technical restrictions, from aesthetic point of view, has to be fulfilled a set of conditions regarding colour (tonality, uniformity), structure (absence of cracks, pores and segregation), resistance to water flow and environment aggressiveness.

Achievement of a durable and aesthetic surface depends on two sets of conditions which refer to concrete as a construction material, respectively to execution technology of the element which gets exposed. When preparing an exposed concrete mix, further conditions are imposed, related to its compounds, recipe, quality control or transport.

2.1. Conditions Imposed to Concrete Compounds

- a) During execution it is not allowed changing cement type, factory producer, source and type of aggregates.
- b) Has to be used only clean aggregates, adequately washed.
- c) In the concreting plant has to be used only potable water (recycled or residual waters are forbidden in concrete composition which became exposed).

2.2. Conditions Imposed to Concrete Recipe

- a) The presence of large diameter aggregates is limited.
- b) Usage of a cement dosage between 300 kg/m^3 and 400 kg/m^3 .
- c) Minimum concrete class C30/37 for concrete exposed to wet-dry alternance.
- d) Maximum W/C ratio equal to 0,5.
- e) It is recommended a lower dosage of water.
- f) Has to be avoided concrete bleeding by strictly respecting consistency class of fresh concrete.

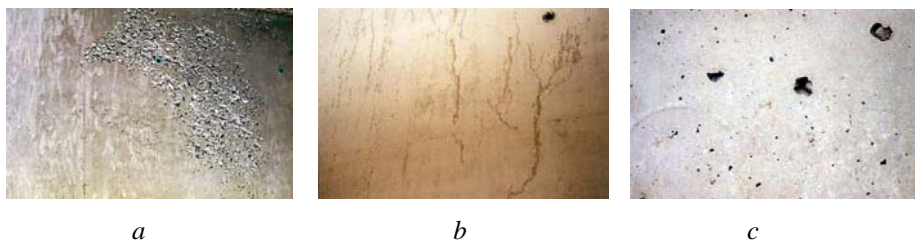


Fig. 2 – Exposed concrete faults: *a* – honeycombing; *b* – sand scouring; *c* – blow holes.

In the case of using pigments, supplementary conditions are imposed to concrete recipe, like using of a single type of pigment acquired from a single quarry and strictly respecting its dosage. Pigments have to be insoluble in

water, keeping their colour in the strong alkaline medium given by concrete and stable in exploitation conditions of the respective work.

Non-compliance with mix conditions mentioned above can have undesired influences from durability and aesthetic point of view (Fig. 2).

3. Aesthetic Aspects. Particularities of Used Technologies

Development of finishing possibilities for concrete can influence the environment from visual-aesthetic point of view and excite the interest of the new generation of designers. Because environment protection represents a priority goal for the new generation of engineers, the trust of information validity regarding concrete finishes characteristics it is extremely important.

The most popular finishing forms are represented by: integrally pigmentation of concrete, architectural curing of concrete faces or surfaces with protection role. In Figs. 3 and 4 are presented a set of colours and textures for exposed concrete.



Fig. 3 - Coloured concrete.

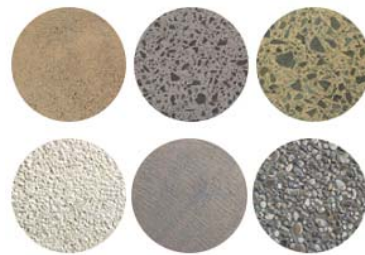


Fig. 4 – Exposed concrete textures.

Generally the public has quickly agreed coloured concrete utilization for walls and boarding, patios, pavements and other construction elements. This fact is due to its incontestable aspect better than the bleak one of simple concrete, grey.

Pigments based on oxides used at concrete colouring are available in three shapes: fine dry powders, liquids/dispersions, granulated powder. Most frequent shape for pigments using is the dry powder which can be directly mixed with cement or fresh concrete.

The main finishing techniques for architectural exposed concrete curing are presented in the scheme from Fig. 5. Other combinations of these procedures are possible on different areas of concrete, in order to obtain different models and characteristics (door and window frames, straps and flutes on wall surface).

Besides casting of finishing, the other procedures are about brushing excessive hardened cement paste, if we talk about exposed aggregate concrete.

Their acquiring is relatively simple, by different methods from using retarders, polishing, chemical treatment or sandblasting.

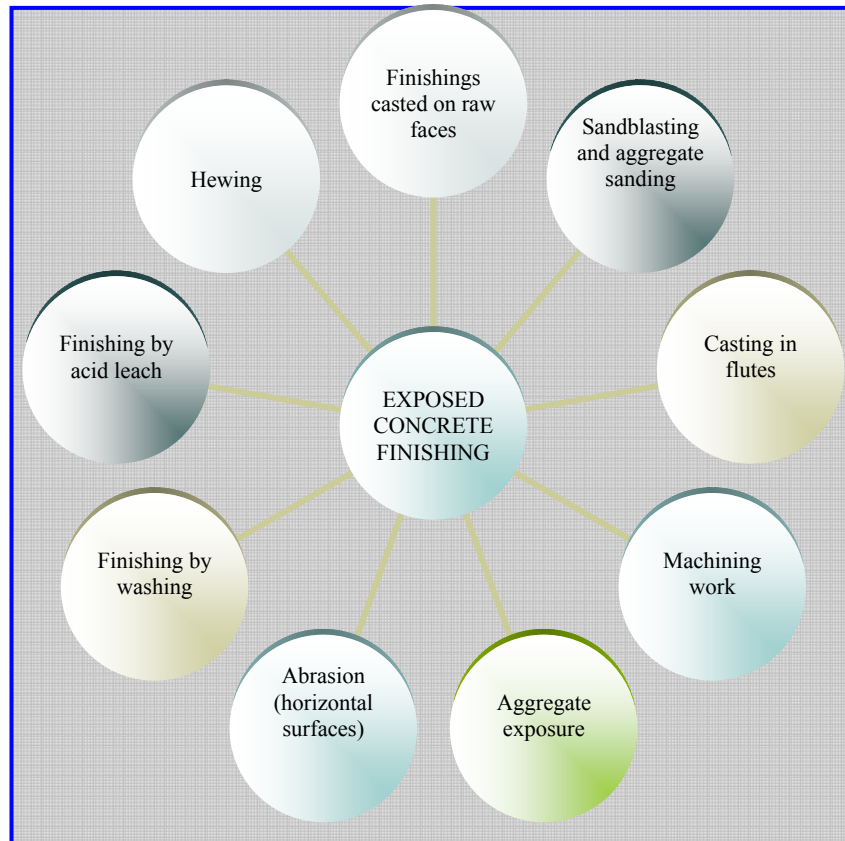


Fig. 5 - Procedures for exposed concrete finishings achievement

Aggregate exposure for supine cast panels is realized by washing the surface. This process offers a very attractive finishing at a cheap price, and selected aggregates have to be uniform in size, for example from 10 to 14 mm or larger and uniformly distributed on concrete element surface, immediately after casting. Hereafter the aggregate is incorporated into concrete surface through a coarse-mesh. When is sufficiently hardened (to keep the aggregates bonded) the aggregate is exposed simultaneous by brushing and washing.

Protection surfaces can offer to exposed concrete a particular and aesthetic aspect, by using some high standard materials like opaque cement pigmented with mineral oxides, resistant acrylic paints or stains.

In order to reach high resistance to bleaching those one can contain UV resistant pigments (inorganic). Using of organic pigments will carry out to bleaching or blackening the concrete surface. On the other hand, for achieving

different effects on exposed concrete surfaces, a large set of formworks with plastic properties are available in a large field of models and profiles, permitting concrete surfaces casting with shape of linear plates. Those can imitate timber, brick or even stone and slate. Linear models of formworks are including

- a) flexible PVC lamellas, in multiple models (up to 40 times reusable);
- b) PVC lamellas with rigid fins, with different widths (up to 10 times reusable);
- c) single use polystyrene with impressed models.

The consequences of poisonous weather on finishing, has to be taken into account from the early design stage. For example, pollution or pluvial water draining from the bounds of the buildings could cause permanent spot of surfaces, thus degradation of the entire composition.

4. Conclusions

Perception of the built environment quality is in relation with well being and comfort feeling, as an aesthetic satisfaction. Many times has been showed the fact that perception and built environment evaluation is different from those who are responsible with design – architects and designers – on the one hand, and those who occupy them on the other.

Concrete benefits by its natural advantages, which will be desired in the future if we talk about the possibility of thermal energy storage, durability, recyclability and chemical products avoidance which are harmful for the environment. Many states governs are aligned to the new changing attitude of the community, with an increasing interest for environment protection. On this line the choice of concrete as a construction material has to be encouraged, taking into account all its positive attributes.

The positive visual impact of concrete, same as the effects on entire environment, will be improved in the future, and the opportunity of those concerned by producing and processing concrete is highly real.

REFERENCES

- Thrane L.N., *Form Filling with Self-Compacting Concrete*. Ph.D. Diss, Danish Technol. Inst., Dept. of Civil Engng., Techn. Univ. of Denmark, 2007.
- Snyder M.B., *Pavement Surface Characteristics – A Synthesis and Guide*. Amer. Concr. Paving Assoc. ACPA, Skokie, Illinois, US, 2006.
- Cleaver J., *Surface and Textured Finishes for Concrete and their Impact upon the Environment*. Steel Reinf. Inst. of Australia, NSW, Australia, 2005.
- * * *Tolerances for Concrete Surfaces*. Cement Concrete & Aggregates, Australia, 2005.
- * * *Guide to Off-form Concrete Finishes*. Cement Concrete & Aggregates, Australia, 2006.

CARACTERISTICI ESENȚIALE ALE BETOANELOR APARENTE FOLOSITE ÎN
ETAPA ACTUALĂ

(Rezumat)

Viitorul utilizării betonului trebuie privit din perspectiva sustenabilității sale, a influenței asupra mediului, dar și din punct de vedere al expresivității ca material finit. În prezent, un spectru larg și spectaculos de culori, texturi și forme ale betonului au devenit ușor accesibile arhitecților.

Utilizarea betoanelor aparente va pune accent, în viitorul apropiat, pe toate aspectele influenței betonului asupra mediului înconjurător, pe aspectul vizual al clădirilor dar și pe efectul acestora asupra macroclimatului.