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DECORATIVE CONCRETE SURFACE DESIGN

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Abstract

Buildings are created as a result of the combination and interaction of various materials. The appearance, finish, and plasticity of materials are essential for providing a general impression. Each material has a special formal language to be used by the designer. The form of concrete/cast stone is determined by formwork. Plastic concrete can take almost any shapes before solidification. Work with this material requires the architect to have high-level professional skills and imagination as well as self-control at the same time since this versatile material has practically unlimited possibilities for use.

The design of decorative concrete surfaces involves the exploitation of both the constructive (structural) features and the variations of shaping the material. Surface structures – shiny/dull, smooth/coarse, rough/fine, just to mention some of the endless line of variations – all depend on the material concerned. These structures result from the interaction of different materials or show certain components of the same type of material.

Structures may strengthen or weaken the formal language of buildings, but they certainly interact with each other, determining the optical impression, which can be further refined by using various colours. Surface embossment endows façades with interesting light and shade effects.

Surface structures can also be created by the extraordinary shaping of certain architectural details (e.g. joints). The selected component structure should always harmonize with the immediate surroundings of the building; and what is even more important, with the impact of urban design.

Keywords: concrete, façade

1. Concrete Surfaces and Formwork Structures

Concrete consists of cement, aggregates, and water. After solidification, it assumes the properties, looks, and appearance of rocks. Fresh concrete is poured into a formwork structure and gets consolidated there. The surface of hard concrete shows the imprint of the formwork. This surface may be shaped by a coarse or smooth structure.

Many optical impressions can be created by imprinting concrete using the pattern of the formwork or by placing patterns into the formwork. A well-known optical effect is that façades with close vertical lining are perceived to be taller and narrower. On the other hand, widely arranged horizontal lines tend to reduce height, therefore the building appears to be broader. Structures of irregular directions result in flat patterns similar to wallpaper and material structures may lead to associations for various materials (e.g. wood patterns). Some line patterns put a surface into

perspective or a flat surface may seem to be embossed by varying the closeness of lines.

2. Decoration and Embossment

Besides material-dependent surface structures, façades may be decorated as well, whereby considerable architectural (aesthetic) impacts can be achieved. By implementing the third dimension, decorative forms will turn into reliefs. In order to shape reliefs, a component containing one or more negative moulds should be placed in the formwork, which will determine the future forms of embossment. Decoration enables the architect to break up the surface and dissolve the compact form of a building façade. Reliefs can divide and revive large unbroken surfaces, providing buildings with an unmistakable, unique exterior.

3. Stone-Cutting and Other Working Methods

By working methods similar to stone-cutting (e.g. coarsing, roughening, and pelleting), the topmost cement layer of concrete is removed, resulting in a coarse surface showing the partly fractured aggregates. White cement, coloured aggregates or colour paint can be used to achieve peculiar effects, to be supplemented by light and shade effects.

Other working methods for concrete surfaces include etching, sand blasting, and flame spraying. In these cases, the topmost cement layer is again removed and aggregates act more effectively as shaping elements. As regards etching, aggregate grains are exposed and cleaned. Coarse surfaces are produced as a result of sand blasting, while flame spraying produces ragged surfaces where the topmost aggregate grains are exploded by heat. The aggregate structure can also be made visible by grinding and polishing concrete surfaces. Concrete stones wrought like this can be used in many ways, e.g. for façades, walls, and window panes as well.

4. Washed Concrete and Finely Washed Concrete Surfaces

The most frequently applied technique for fashioning surfaces is washing out the topmost cement layer. Various effects can be achieved by aggregates of diverse characteristics. The appearance of concrete is always different depending on the kind of stones added to the aggregate, let them be square or round, light or dark, of a single or multiple colours. Another procedure consists in the application of surface inhibitors by covering the inside of the framework. This ensures that only the topmost one millimeter is washed out. This is what we call fine washing, whereby, interestingly enough, the concrete is made to look very much like sandstone and can be further coloured by proper aggregates and coloured paints.

5. Coloured Concrete and Coloured Cover

Very interesting shaping effects can be achieved by applying coloured concrete. In this case coloured paint is added to the the concrete mixture. Iron oxide pigment is mainly used for the tones of red, yellow, brown, and black; chromium oxide and chromium oxide hydrate pigment for the shades of green, and mixed crystal based pigment – e.g. cobalt-aluminum-chromium oxide – for the shades of blue. Concrete colouring is durable and weather-proof. Tones are darker when grey cement is used and lighter and clearer when white cement is used. Colours are enhanced by refined surface subdivisions.

Concrete surfaces may be coloured in order to emphasize major building surfaces, ensembles of similar surface parts, or separate building components. However, the paint used should always harmonize with the characteristics of concrete.

Concrete fronts can be directly painted as well. Paints for coating concrete surfaces should comply with the following requirements:

- resistance to alkali action coming from the concrete;
- proper adhesion to concrete;
- proper bonding within the coating system;
- possibility for repeated painting with the same paint;
- weathering quality;
- resistance to industrial environments and/or water-soluble substances;
- photostability and UV resistance;
- low predisposition for pollution;
- satisfactory ability for letting through vapour;
- resistance to running water;
- resistance to washing or scrubbing.

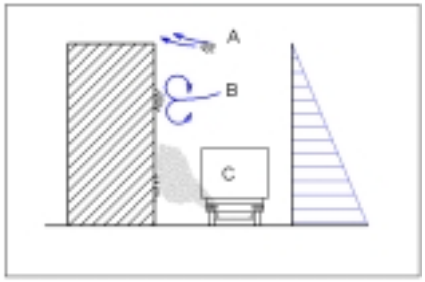

Fig. 1. Dust settlement on façades (A – high winds – low levels of dust settlement; B – lower dust settlement by turbulence; C – transport, traffic)

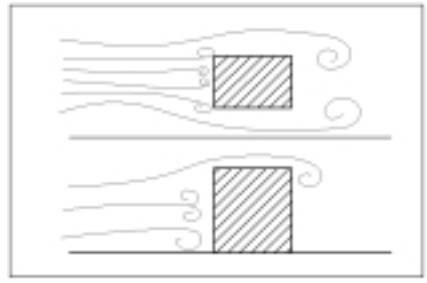

Fig. 2. Air flow on buildings

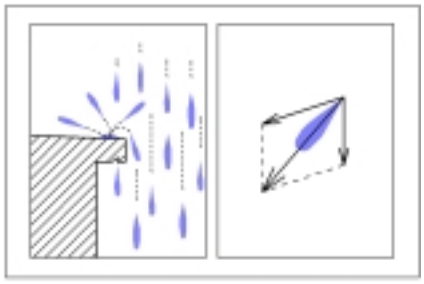

Fig. 3. Rain on buildings (*d* – rain direction; *V* – wind force; *P* – raindrop weight)

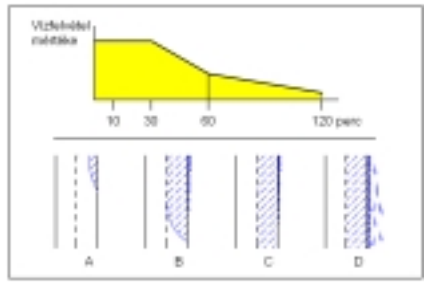

Fig. 4. Downpour on façades (A – absorption; B – start of downpour and absorption;
C – saturated ground and downpour;
D – downpour and drying)

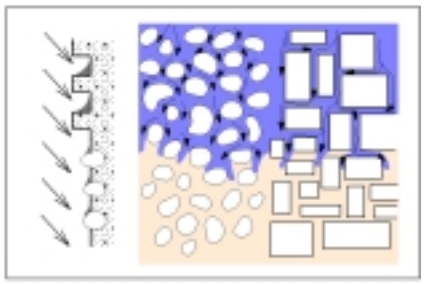

Fig. 5. Deep structures result in dusty holes (A), but they regulate water flow as well (B)

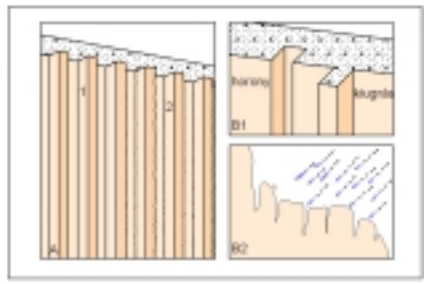

Fig. 6. Horizontal recesses and laid lines result in dusty holes (A 1,2,3), but they also regulate water distribution (B)

Such types of paint primarily include mineral or silicate based paint solidified by air or hydraulically; plastic based dispersion paint; and polymerized resin based paint. It should be taken into consideration when selecting the type of paint that painting should be repeated from time to time. Colours cannot make up for deficient architectural design; however, they can be properly used for enhancement and supplementation. The method of colouring may or may not depend on the material. Either some semantic impacts or the integration into a wider context may be sought for. Façade colour design plans should be indispensable attachments to any building drawings and licensing plans.

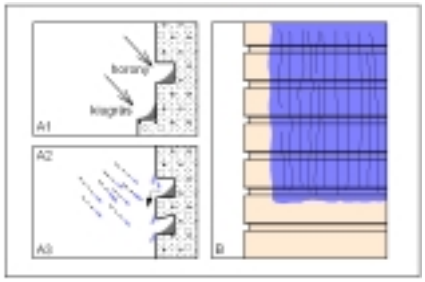

Fig. 7. Vertical recesses and laid lines (A1,2 and B1) prevent uneven rain inflow by side wind (B2)

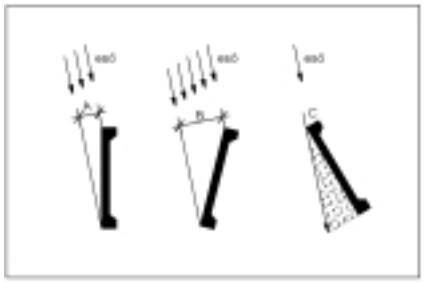

Fig. 8. Different quantities of rainwater on various inclined surfaces (A,B,C)

6. Pollution and Weathering Resistance

In order to produce a durable high-quality building front, pollution – a normal phenomenon in the course of time – should be abated and rainwater should be drained properly from the façade.

The quantity of water accumulated at certain places and the location of pollution deposits is determined by wind direction and no-wind conditions. The flow pattern of water is particularly important as it may wash pollutants away from the surface of the façade and those pollutants may be deposited elsewhere again (*Figs.1* to *6*).

The slope and inclination of concrete surfaces are also very important factors. Vertical surfaces are relatively less exposed to water and get cleaned easily. The quantity of rain falling on surfaces leaning backwards is much larger; however, the ability of autocleaning is somewhat lower.

Pollutants are frequently deposited at lower edges in particular. Surfaces leaning forward remain dry in general and are polluted the least. The upper part should be designed in a way that water cannot flow on the surface, otherwise the flow pattern appears very soon and may spoil the appearance of the façade (*Figs.7* to *8*).

These factors should be taken into consideration when applying concrete for façade design. Façade pollution can be permanently prevented by properly designed components.