Guide to Formed Concrete Surfaces
Presented by Technical Committee 347

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Scope of the Guide:

Why do we need a guide for Formed Concrete Surfaces although various descriptions, interpretations and methods exist to achieve as cast concrete surfaces?

None of them do offer a comprehensive guidance and understanding to its production and evaluation.

The scope of this guide is:

- to solve the lack of uniformity in the appearance criteria of concrete surfaces,
- to provide definitions for the various levels of formed concrete surfaces, and
- to give objective evaluation.
Current documents

Let us have a look to the current documents
Current documents to reference concrete surface quality:

- ACI 301-10 specifies three categories of surface finishes
- ACI 117 Tolerances, describes four categories for Form offsets
- ACI 347R-14 describes four categories of formed concrete surfaces, same as in ACI 117-Tolerances
- ACI 303R-12 addresses architectural concrete
- ASCC Educational and Training Committee uses samples to illustrate expectations (no longer available)
- ACI 309R-05 provides information on consolidation of concrete and visible effects
- These references do not provide uniform appearance criteria
301 currently specifies three categories of surface finish. These categories only consider:

- Voids
- Projections
- Tie holes
- Tolerances and Mockups on basis of ACI 117 Tolerances

5.3.3.3 As-cast finishes—Use form-facing materials meeting the requirements of 2.2.1.1. Produce as-cast formed finishes in accordance with Contract Documents and 5.3.3.3.a through 5.3.3.3.c.

5.3.3.3.a Surface finish-1.0 (SF-1.0):
- No formwork facing material is specified;
- Patch voids larger than 1-1/2 in. wide or 1/2 in. deep;
- Remove projections larger than 1 in.;
- Tie holes need not be patched;
- Surface tolerance Class D as specified in ACI 117; and
- Mockup not required.

5.3.3.3.b Surface finish-2.0 (SF-2.0):
- Patch voids larger than 3/4 in. wide or 1/2 in. deep;
- Remove projections larger than 1/4 in.;
- Patch tie holes;
- Surface tolerance Class B as specified in ACI 117; and
- Unless otherwise specified, provide mockup of concrete surface appearance and texture.

5.3.3.3.c Surface finish-3.0 (SF-3.0):
- Patch voids larger than 3/4 in. wide or 1/2 in. deep;
- Remove projections larger than 1/8 in.;
- Patch tie holes;
- Surface tolerance Class A as specified in ACI 117; and
- Provide mockup of concrete surface appearance and texture.
The way how to create the specified appearance and texture with different formwork and form facing, new and used, premanufactured and job-built concrete, is described in the

new ACI 347.3R-13

Guide to Formed Concrete Surfaces
The contents of the documents 301 Specifications and 347 Formwork is based on the Form offsets categories Class A, B, C and D, as described in 117.

The new “Guide for Formed Concrete Surfaces” 347.3R-13 describes the intended concrete surface, and deriving from that all further appearance criteria and understanding of its production and evaluation.
Current document 347R-14
Formwork for Concrete

347 only provides permitted tolerances of formed concrete surfaces as described in 117 Tolerances.

<table>
<thead>
<tr>
<th>Class of surface</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 in. (3 mm)</td>
<td>1/4 in. (6 mm)</td>
<td>1/2 in. (13 mm)</td>
<td>1 in. (25 mm)</td>
<td></td>
</tr>
</tbody>
</table>

Class A is suggested for surfaces prominently exposed to public view where appearance is of special importance. Class B is intended for coarse-textured, concrete-formed surfaces intended to receive plaster, stucco, or wainscoting. Class C is a general standard for permanently exposed surfaces where other finishes are not specified. Class D is a minimum-quality requirement for surfaces where roughness is not objectionable, usually applied where surfaces will be permanently concealed.
Let us have a look to the new
Guide to Formed Concrete Surfaces
Contents of the new Guide for Formed Concrete Surfaces, 347.3R-13

- Chapter 1 – INTRODUCTION
- Chapter 2 – DEFINITIONS
- Chapter 3 – FORMED CONCRETE SURFACE DESCRIPTIONS
- Chapter 4 – BASICS OF LAYOUT AND DESIGN
- Chapter 5 – SPECIFICATIONS
- Chapter 6 – CONSTRUCTION
- Chapter 7 – EVALUATION OF FORMED CONCRETE SURFACES
- Chapter 8 – REFERENCES
Formed Concrete Surfaces Descriptions

• Four concrete surface categories (CSCs) are defined.
  • CSC 1 has the lowest classifications and CSC 4 has the highest classifications for a finished concrete surface.

• Concrete surface levels are planned for individual parts of the structure or the entire surfaces to reflect owners’ needs, desires and budget.

Possible examples include:

• Basement walls: CSC 1
• Industrial structures: CSC 1 or CSC 2
• Electrical and mechanical rooms: CSC 1 or CSC 2
• Stairwalls: CSC 1, CSC 2 or CSC 3
• Commercial building exteriors: CSC 3 or CSC 4
Formed Concrete Surfaces Descriptions

- High-End commercial building exteriors: CSC 3 or CSC 4
- Religious structures or museums: CSC 3 or CSC 4
- Monumental or landmark structures: CSC 4
Formed Concrete Surface Descriptions

Tables are used to define measurable properties pertaining to formed concrete surfaces.

Table 3.1a—Description of formed concrete surface categories (CSC)

<table>
<thead>
<tr>
<th>Formed concrete surface category</th>
<th>Description</th>
<th>CSC requirements</th>
<th>Additional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC1</td>
<td>Concrete surfaces in areas with low visibility or of limited importance with regard to formed concrete surface requirements, used or covered with subsequent finish materials.</td>
<td>T1   SVR1  SVR1  CU1  CU1  SI1  CJ1  Optional  FC1  Low</td>
<td></td>
</tr>
<tr>
<td>CSC2</td>
<td>Concrete surfaces where visual appearance is of moderate importance.</td>
<td>T2   SVR2  SVR1  CU1  CU1  SI2  CJ2  Optional  FC1  Average</td>
<td></td>
</tr>
<tr>
<td>CSC3</td>
<td>Concrete surfaces that are in public view or where appearance is important, such as exterior or interior exposed building elements.</td>
<td>T3   SVR3  SVR2  CU2  CU2  SI3  CJ3  Highly recommended  FC2  High</td>
<td></td>
</tr>
<tr>
<td>CSC4</td>
<td>Concrete surfaces where the exposed concrete is a prominent feature of the completed structure or visual appearance is important.</td>
<td>T4   SVR4  SVR3  CU2  CU3  SI4  CJ4  Should be required  FC3  Very high</td>
<td></td>
</tr>
</tbody>
</table>
Formed Concrete Surfaces Descriptions

The deriving features and requirements are further described in:

- Table 3.1.b Visible effects
- Table 3.1.c Form facing categories
- Table 3.1.d Concrete surface void ratio on as cast formed concrete surfaces
- Table 4.6.4 Characteristics of various form facing materials
- Table 7.3.3 Examples of common concrete surfaces deviations and common repair techniques

I will explain the basic table 3.1.a- Description of formed concrete surface categories CSC1-CSC4 with all further related information, using examples
Concrete Surface Classification

This entire building was intended and designed for concrete surface classification of CSC4.

To understand the intention and the built up of the new guide we are using an example for concrete surface requirements CSC4 and the deriving characteristics.
Table 3.1.b  Description of visible effects on as cast formed concrete surfaces

Each criterion has its own classification:

- **Texture**: T1 – T4
  - Acceptable **gaps** in adjacent formwork components
  - Acceptable **depth** of mortar loss
  - Acceptable **surface offsets** of panel joints (117-10 reference)
  - Allowable **projections** (301-10 reference)
  - **Imprints** of modular panel frames
Table 3.1.b Description of visible effects on as cast formed concrete surfaces

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Classification</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>(Table 4.6.4)</td>
<td>- Acceptable gaps in adjacent formwork components ≤ 3/4 in. (19 mm) (6.1 h).&lt;br&gt;- Acceptable depth of mortar loss ≤ 1/2 in. (13 mm).&lt;br&gt;- Acceptable surface offsets of panel joints up to 1 in. (25 mm). (ACI 117-10, Section 4.8.3, Class D).&lt;br&gt;- Allowable projections 1 in. (25 mm) from adjacent surface. (ACI 301-10, Section 5.3.3.3.a).&lt;br&gt;- Form-facing material examples: Rough sawn lumber, CDX plywood, and particle board.&lt;br&gt;- Imprints of modular panel frames are acceptable.</td>
</tr>
</tbody>
</table>

| T2        | (Table 4.6.4)  | - Acceptable gaps in adjacent formwork components ≤ 1/2 in. (13 mm) (6.1 i).<br>- Acceptable depth of mortar loss ≤ 3/8 in. (10 mm).<br>- Acceptable surface offsets of panel joints up to 1/2 in. (13 mm) (ACI 117-10, Section 4.8.3, Class C).<br>- Allowable projections 1/2 in. (13 mm) from adjacent surface.<br>- Form-facing material examples: Class BBOES plywood, MDO plywood.<br>- Imprints of modular panel frames are acceptable. |

| Texture, panel-joint* | T3 (Table 4.6.4) | - Acceptable gaps in adjacent formwork components ≤ 1/4 in. (6 mm) (6.1 i).<br>- Acceptable depth of mortar loss ≤ 1/4 in. (6 mm).<br>- Acceptable surface offsets of panel joints up to 1/4 in. (6 mm) (ACI 117-10, Section 4.8.3, Class B).<br>- Allowable projections 1/4 in. (6 mm) from adjacent surface (ACI 301-10, Section 5.3.3.3.b).<br>- Form-facing material examples: HDO plywood, phenolic surface film, plastic, or steel.<br>- Imprints of modular panel frames are acceptable. |

| T4        | (Table 4.6.4)  | - Formwork should be grout tight. Avoid grout/mortar leakage and correct where occurs.<br>- Permissible surface offsets of panel joints up to 1/8 in. (3 mm) (ACI 117-10, Section 4.8.3, Class A).<br>- Form-facing material examples: HDO plywood, PSF plywood, full plastic, steel, and fiberglass.<br>- Imprints of modular panel frames are unacceptable unless demonstrated and approved in the mockup. |
Used wooden facing with damaged surface is not useable for CSC-3 and CSC4
Table 3.1.b Description of visible effects on as cast formed concrete surfaces

- **Surface void ratio:** SVR1 – SVR4
  - Void area of pores of surface occurring within a 24 in. x 24 in. square
  - Allowable percentage of voids in test area from 1.2% to 0.3%
  - Suggested concrete placement practices, use of release agent, vibration, concrete mixture consistency and mockups
<table>
<thead>
<tr>
<th>Surface void ratio</th>
<th>SVR1</th>
<th>SVR2</th>
<th>SVR3</th>
<th>SVR4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Void area of pores of surface occurring within a 24 in. x 24 in. square (610 x 610 mm)*</td>
<td>6.9 in.² (4452 mm²); $D_{\text{max}} = \frac{3}{4}$ in. (19 mm)</td>
<td>5.8 in.² (3742 mm²); $D_{\text{max}} = \frac{5}{8}$ in. (16 mm)</td>
<td>3.5 in.² (2258 mm²); $D_{\text{max}} = \frac{3}{8}$ in. (9.5 mm)</td>
<td>1.7 in.² (1095 mm²); $D_{\text{max}} = \frac{1}{4}$ in. (6 mm)</td>
</tr>
<tr>
<td>Suggested concrete placement practices to yield desired results</td>
<td>- Void area not to exceed 1.2 percent of the test area.</td>
<td>- Void area not to exceed 1 percent of the test area.</td>
<td>- Void area not to exceed 0.6 percent of the test area.</td>
<td>- Void area not to exceed 0.3 percent of the test area.</td>
</tr>
<tr>
<td>- Standard formwork and placement practices should yield these results without any special effort.</td>
<td>- Release agent should be compatible with the form-facing material.</td>
<td>In addition to the efforts described for the SVR2 category:</td>
<td></td>
<td>- In addition to the efforts described for the SVR2 and SVR3 categories:</td>
</tr>
<tr>
<td>- This surface void ratio category limitation should not apply to permanently concealed concrete surfaces.</td>
<td>- Formwork should be cleaned before the application of release agent.</td>
<td>- Adequate vibration should be provided especially at features, openings, and embeds.</td>
<td></td>
<td>- Concrete design and formwork should eliminate surfaces that inhibit the upward movement of entrapped air.</td>
</tr>
<tr>
<td></td>
<td>- Apply release agent thinly and uniformly.</td>
<td>- Concrete mixture consistency is important in achieving reproducible results.</td>
<td></td>
<td>- Placement rate should consider vertical ascent rate of entrapped air during consolidation.</td>
</tr>
<tr>
<td></td>
<td>- A mockup might be beneficial.</td>
<td>- Use vibration method at top lift.</td>
<td></td>
<td>- Use methods of deposition that minimize agitation at the surface that introduces entrapped air.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Mockups are recommended.</td>
<td></td>
<td>- Mockups are required.</td>
</tr>
</tbody>
</table>
Surface void ratio

Summation of surface voids in a small area

The surface void ratio is only required to be determined if the entire impression of the surface does not meet the contract expectation.
Entire impression
Table 3.1.b  Description of visible effects on as cast formed concrete surfaces

- **Color uniformity:** CU1 – CU3
  - Light and dark color variations
  - Color variations between adjacent concrete placement and layer lines
  - Rust and dirt stains
  - Concrete source materials and form facing materials (see Table 4.6.4 characteristics of various form facing materials)

| CU3 | - Discolorations caused by concrete source material of different type and origin; different types or treatments of facing materials; or inconsistent treatment of concrete surfaces are unacceptable. 
|     | - Rust stains, dirt stains and visible pouring layers are unacceptable. |
Color uniformity, examples

Pouring layers not mostly uniform as required by CU2 and CU3

Form facing material should be of consistent type, grade and source

Phenolic decay of plywood
Color deviation and clarification

Color deviations with black spots, resulting of cement water flowing through nail holes. If only seen in some areas, acceptable for CSC 3 and CSC4 (CU2 and CU3). If seen over the whole surface only acceptable for CSC2 and less. (CU1)

Color uniformity deviations resulting of used and repaired plywood facing and imprints of modular frames. Surface can be considered as CSC1 (CU1) inconsistent, (lowest surface category). See table 3.1.c too, Form facing categories (FC1)
## Form facing categories

### Table 3.1c—Form-facing categories

<table>
<thead>
<tr>
<th>Criterion</th>
<th>FC1</th>
<th>FC2</th>
<th>FC3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holes, greater than 3/16 in. (5 mm)</td>
<td>Plug or disk covers are acceptable</td>
<td>Acceptable if patched sanded and sealed or ground to match adjacent form surface</td>
<td>Visible filling is unacceptable</td>
</tr>
<tr>
<td>Holes, 3/16 in. (5 mm) or less</td>
<td>Acceptable</td>
<td>Acceptable without patching, provided form surface is not damaged or torn around hole(s)</td>
<td>Acceptable if patched, sanded, and sealed or ground to match adjacent form surface</td>
</tr>
<tr>
<td>Vibrator burns</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Scratches/dents</td>
<td>Acceptable</td>
<td>Acceptable if patched, sanded, and sealed or ground to match adjacent form surface</td>
<td>Unacceptable unless otherwise approved</td>
</tr>
<tr>
<td>Concrete remnants*</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Cement residue†</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Should not affect finished concrete surface</td>
</tr>
<tr>
<td>Swelling of facing at fastener or tie holes</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Patching‡</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Should not affect finished concrete surface</td>
</tr>
</tbody>
</table>

**FC 1 is accepted for the concrete surface categories CSC1 and CSC2**
Color deviation

Too much release agent remained on form facing

Rust stains on concrete surface, resulting of formwork
Concrete Surface, Color deviations

Color deviations resulting of plywood and pouring of concrete

Color deviations resulting of cold aggregates when pouring at cold temperature

Aggregates heated to appr. 60 ° F

Aggregates unheated
### Table 3.1.b Description of visible effects on as cast formed concrete surfaces

- **Surface irregularities:** SI1 – SI4
  - Surface classes A-D (ACI 117-10 reference)
  - Maximum gradual deviation over a distance
  - Allowable deflections

*SI4*
- ACI 117-10, Section 4.8.3, Class A-Surface.
- Maximum gradual deviation over a distance of 5 ft. (152 cm), or abrupt deviation is 1/8 in. (3 mm).
- Limit deflection of formwork structure to $L/400$.
- ACI 117-10, Section 4.8.2 does apply.
4.8.2 *Formed surfaces over distances of 10 ft (3 m)*

All conditions, unless noted otherwise in this section……………………………………±0.3%

Outside corner of exposed corner column……………………………………………±0.2%

Contraction joint grooves in concrete exposed to view…………………………………±0.2%
Table 3.1.b Description of visible effects on ascast formed surfaces

- Construction and facing joints: CJ1 – CJ4
  - Offsets of surfaces between two adjacent placements
  - Use of chamfer strips or other reveals
  - Construction joint locations

<table>
<thead>
<tr>
<th>Construction and facing joints*</th>
<th>CJ1</th>
<th>CJ2</th>
<th>CJ3</th>
<th>CJ4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acceptable offset of surfaces between two adjacent placements ≤ 1 in. (25 mm).</td>
<td>Acceptable offset of surfaces between two adjacent placements ≤ 1/2 in. (13 mm). - The use of chamfer strips or similar reveals are recommended at construction joints.</td>
<td>Acceptable offset of surfaces between two adjacent placements ≤ 1/4 in. (6 mm). - The use of chamfer strips or similar reveals are recommended at construction joints. - Construction joint locations should be coordinated with architectural design.</td>
<td>Acceptable offset of surfaces between two adjacent placements ≤ 1/8 in. (3 mm). Offsets less than 1/8 in. (3 mm) should be specified in design documents. - The use of chamfer strips or similar reveals are recommended at construction joints. - Construction joint locations should be coordinated with architectural design and approved by architect or engineer. - The mockup should contain all features representative to the finished product.</td>
</tr>
</tbody>
</table>

* Construction and facing joints: CJ1 – CJ4

- Offsets of surfaces between two adjacent placements
- Use of chamfer strips or other reveals
- Construction joint locations
Construction and facing joints

......arranged as per surface appearance drawing and per architectural design
Kind of Formwork to be used

Job-built gang form with wood facing, facing with different source material!

Premanufactured panelized formwork with all plastic facing
Formwork and facing joints

Premanufactured panelized forms with its imprint at the concrete surface, CSC3 (FC2 and T3), and even panel joint.

deepened panel joint depends on architect if accepted as CSC3 or only as CSC2.
Formwork and facing joints

Concrete surfaces of job-built gang form with its imprint of facing joints, CSC3 , (FC2 and T3) and CSC4 with (FC3 and T4)
Example for a wall elevation using panelized formwork

Fig. 4.1a—Panelized formwork, plan view example. Elevation A: Use of panels 8 x 8 ft (2.4 x 2.4 m), and form face appearance elevation.

Fig. 4.1b—Panelized formwork, plan view example.
Intended concrete surface

- Formed surface appearance drawings help convey desired features and appearance
Intended concrete surface

Single structures or whole elevations should be clarified by a surface appearance drawing, mentioning the intended concrete surface including joints and tie-hole locations. The contractor will choose the accordingly needed material and the work process.
Form facing Categories: FC1 – FC3

- Allowable hole sizes
- Scratches, remnants, vibrator burns, swelling
- Acceptance for patching

<table>
<thead>
<tr>
<th>Criterion</th>
<th>FC1</th>
<th>FC2</th>
<th>FC3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holes, greater than 3/16 in. (5 mm)</td>
<td>Plug or disk covers are acceptable</td>
<td>Acceptable if patched sanded and sealed or ground to match adjacent form surface</td>
<td>Visible filling is unacceptable</td>
</tr>
<tr>
<td>Holes, 3/16 in. (5 mm) or less</td>
<td>Acceptable</td>
<td>Acceptable without patching, provided form surface is not damaged or torn around hole(s)</td>
<td>Acceptable if patched, sanded, and sealed or grounded to match adjacent form surface</td>
</tr>
<tr>
<td>Vibrator burns</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Scratches/dents</td>
<td>Acceptable</td>
<td>Acceptable if patched, sanded, and sealed or grounded to match adjacent form surface</td>
<td>Unacceptable unless otherwise approved</td>
</tr>
<tr>
<td>Concrete remnants*</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Cement residue†</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Should not affect finished concrete surface</td>
</tr>
<tr>
<td>Swelling of facing at fastener or tie holes</td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Patching‡</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Should not affect finished concrete surface</td>
</tr>
</tbody>
</table>
Table 3.1.b Description of visible effects on as cast formed concrete surfaces

### Summary

- **Texture:** T1 – T4
- **Surface void ratio:** SVR1 – SVR4
- **Color uniformity:** CU1 – CU3
- **Surface irregularities:** SI1 – SI4
- **Construction and facing joints:** CJ1 – CJ4
- **Form facing categories:** FC1 – FC 3

The failure of one agreed criterion according to this guide should not result in the obligation to repair deviations, if the overall positive image of the structure of the building is not disturbed.
Basics for layout and design:

The concrete surface reflects the texture and other properties of the formwork. Based on the selected CSC (Concrete surface category) the following features should be considered for the formwork design:

- Formwork to be used (panelized or job-built), stiffness, new or used
- Number of reuses
- Form facing material
- Form face joints and joint locations
- Form tie locations
- Reveals (size, shape, pattern)
- Properties of the concrete mixture, estimated concrete pressure and pouring time
Form facing, Example

Examples with all plastic facing and finished wall with curved end as CSC4 classification
General considerations/ recommendations

- Number, size and position of pouring windows (not recommended for CSC4)
- Consideration of other compacting methods (internal and external)
- Mixture design modifications (SCC)
- Installation of rebar (minimum clearance)
- Stripping methods (protection of sharp edges)
- Availability and properties of used (rented) formwork systems
- Form-facing materials may have limitations in dimensional size
- Number of possible reuses (absorbent or nonabsorbent facing material)
- Use of release agent
General considerations

Cleaning of facing and preparation for use with release agent is important to create the required concrete surface.
General considerations/recommendations

Guide offers description, considerations and advantages for ‘premanufactured, panelized formwork’ as well as for ‘job-built formwork’.

Table 4.6.4 describes currently available form-facing materials and their characteristics for use.
### Table 4.6.4—Characteristics of various form-facing materials

<table>
<thead>
<tr>
<th>Type of facing</th>
<th>Texture of formed concrete surface</th>
<th>Advantages</th>
<th>Other considerations</th>
<th>Approximate number of reuses’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsanded plywood (CDX) or plywood with similar properties</td>
<td>Rough, wood grain, and defects visible</td>
<td>- Easy to work with including cutting, trimming, nails, and screws &lt;br&gt; - High availability</td>
<td>- Saccharide from wood may cause dusting and sanding, non-uniform color&lt;br&gt; - Sensitive to moisture, resulting in strength loss, swelling and warping, edges swelling quickly&lt;br&gt; - Coarse wood grain and defects visible&lt;br&gt; - Bleeding at seams unless tongue and groove&lt;br&gt; - Declining absorbency with reuse</td>
<td>2-3</td>
</tr>
<tr>
<td>Rough sawn lumber</td>
<td>Rough, wood grain and defects visible</td>
<td>- Easy to work with including cutting, trimming, nails, and screws &lt;br&gt; - High availability</td>
<td>- Saccharide from wood may cause dusting and sanding, non-uniform color&lt;br&gt; - Very sensitive to moisture; loss in strength; swelling and warping&lt;br&gt; - Coarse wood grain and defects visible&lt;br&gt; - Bleeding at seams, unless tongue and groove&lt;br&gt; - Declining absorbency with reuse</td>
<td>Up to 3</td>
</tr>
<tr>
<td>Surfaced lumber</td>
<td>Grain and defects visible</td>
<td>- Easy to work with including cutting, trimming, nails, and screws &lt;br&gt; - High availability &lt;br&gt; - Can be milled for creating formwork features</td>
<td>- Saccharide from wood may cause dusting and sanding, non-uniform color&lt;br&gt; - Very sensitive to moisture; loss in strength; swelling and warping&lt;br&gt; - Wood grain and defects visible&lt;br&gt; - Bleeding at seams, unless tongue and groove&lt;br&gt; - Declining absorbency with reuse</td>
<td>Up to 5</td>
</tr>
</tbody>
</table>
Form facing material

Further types of facing, described in Table 4.6.4

- Sanded and oiled plywood
- Painted or liquid coated plywood
- MDO plywood
- HDO plywood
- PSF plywood
- Full plastic
- Fiberglass forms
- Laminated paper tubes
- Metal faced forms
- Drainage fleece
Form facing material

Partly absorbent and partly non-absorbent

Swelling of plywood

Form facing not cleaned from cement residue
Important notes

- Establish a ‘Concrete surface team’ for production of CSC3 and CSC4 surfaces
  - Owner, licensed design professional
  - General contractor/construction manager
  - Concrete contractor, special consultants
  - Formwork supplier

- Tasks
  - Identify mockup requirement
  - Clarify surface appearance drawings
  - Clarify surface evaluation
  - Clarify methods and decisions about corrective work
Evaluation of formed concrete surfaces

The **OVERALL IMPRESSION** of the concrete surface appearance is the basic acceptance criteria for the agreed upon CSC.

(Concrete surface category)

If mockups were used they should be used for the evaluation process and in addition for eventual repair procedures

- Appropriate viewing distance of minimum 20 ft (6m) depending on structure
- Distance that allows the entire building to be viewed in its entirety
- Avoid sunlight striking at an acute angle during evaluation
Procedure in case of deviations

Removal of defects

Areas with removed defects remain recognizable.

- Parties agree on techniques for removing defects
- Develop step-by-step work plan
- Identify the defect
  - Determine the correct repair process
  - Evaluate repair materials
  - A mockup with repair possibilities maybe required
  - Perform final inspection

The guide provides an example for common defects and repair methods.
Summary

The new Guide to Formed Concrete Surfaces 347.3R-13 primarily considers the expected concrete surface of either single structures of a building or a concrete building as a whole. (categories CSC1 – CSC4)

Deriving from that surface intention of the owner/architect, the guide provides comprehensive information regarding the process and materials involved.

It will lead to a transparent and common understanding between all parties involved, from the first idea of the architect until the final outcome.
The calculation process and final cost for the structure will be clearer than before.

The guide will help make all parties aware of what is realistically achievable in as cast concrete and finally will help to reduce disputes and misunderstandings.
Thank you

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