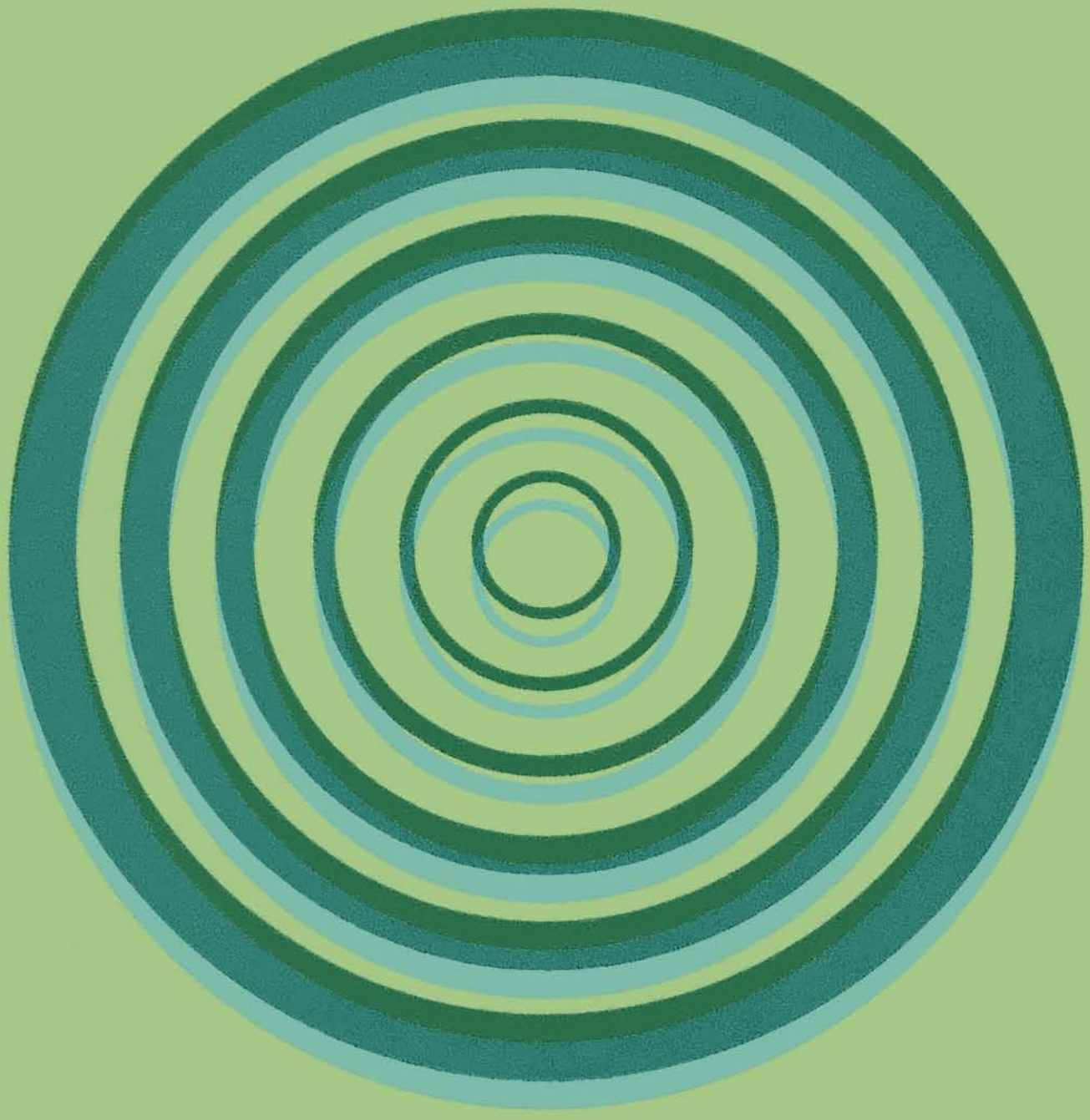
CIB

Report No. 24

TOLERANCES ON BLEMISHES OF CONCRETE

Report prepared by CIB Working Commission W 29 "Concrete Surface Finishings"



CIB Report n° 24

Concrete finishes —

Tolerances for blemishes

This document has been prepared by the CIB Commission W 29 on the basis of a report by Dr. Rolf SCHJODT, of the Norwegian Building Research Institute, OSLO

Text

Comments

PREAMBLE

The ultimate standard of perfection is not attainable and a method of defining the quality of a surface is therefore necessary to facilitate communication between those responsible for specification, supervision and excution.

A cursory inspection of the document may convey the impression that it is unrealistic and of little practical value. It is considered, however, that it provides a significant advance on the present situation in which it is not possible to define the required quality.

The appearance of concrete is often of major importance and a range of finishes is available. The aesthetic impact of a surface depends, however, not only on the type of finish but also on its quality.

At present, contractors differ in their interpretation of the designer's requirements and prices, to some extent, reflect differences in the standard of finish being offered. The proposals are intended, however, to facilitate communications in general, in addition to specifications.

This document presents a method whereby the quality of a surface can be expressed in quantitive terms. In some cases, limits are given on the *magnitude* of a blemish; in others, it is considered more appropriate to set a limit to the *variations* between one part of a surface and another.

The values given are based upon measurements and observation but are provisional. It is hoped that the technique will be applied during the three years following publication and that, during this period, comments and suggestions for improvement will be sent to the Co-ordinator of Working Group W 29 - c/o the CIB Secretariat - Postbus 299 - Weena 700 - Rotterdam (The Netherlands)

TABLE OF TOLERANCES

The table of tolerances divides surfaces into four classes:

— a *ROUGH class* is provided for surfaces where there is no special requirement for finish;

— an *ORDINARY class* applies to surfaces where appearance, whilst a minor factor, is still of some importance;

— an *ELABORATE class* applies to those with definite requirements for visual appearance;

— a *SPECIAL class* applies to those calling for the highest standards of appearance.

It will rarely be possible to justify the high cost of obtaining a finish in the *SPECIAL* class except on buildings and other structures where the appearance is of unusual importance.

The standard required may depend not only upon the character and position of the building but upon the distance from which the surface is viewed. A surface may be classed differently according to the type of blemish under consideration.

The classification of the concrete finishes into four classes has been choosen after many hesitations, for each class corresponds to an amount of prescriptions which in total are difficult to comply with.

ORDINARY class is appropriate when the concrete surfaces are to be visible but when it is not considered necessary to incur the expense of achieving the superior quality of an ELABORATE class finish.

For example, the first floor of a building should be finished to a higher standard than the other floors. However, the effect of holes in the surface diminishes more rapidly with distance than the effect of colour variations, so consequently a wall may be classed more strictly on colour variations than on local surface defects if it may be viewed from a long distance.

For instance, concerning blow-holes, there are two possibilities:

— blow-holes are grouped together in small areas (3, 1) and these groups are considered as local defects which will be treated as in point 2;

— blow-holes are distributed all over the concerned surface and, in this case, one has to follow the reference scale photographs to appreciate the importance of blow-holes, but referring to the full surface of the concerned element. Nevertheless, to be in agreement with the principle given in the document, which consists in considering not absolute values but variations, it is quite possible to admit in the SPECIAL class (the strictest one) a finish corresponding to the photograph no. 6 provided that such a finish will be uniform all over the element.

In the same way, for the colours, one cannot normally specify the shade no 2 or 4 but one has to appreciate if, when the concerned work or part of work is achieved, the variations between the lightest and the darkest zones are of 2, 3, ... points. The colour scale is given only in grays, for the colour range is too wide to be easily used in such a document, but the present scale can be easily used with coloured concrete by photographing this scale on the element in accordance with the indications of table point 4 and taking a black and white film.

The document relates specifically to plane surfaces produced direct from the form or mould, but may, at least in part, be used in conjunction with other finishes. The table is restricted to faults which are apparent upon striking the form, or soon after; thus, it does not include blemishes associated with weathering or exposure to aggressive agencies.

MEASUREMENTS

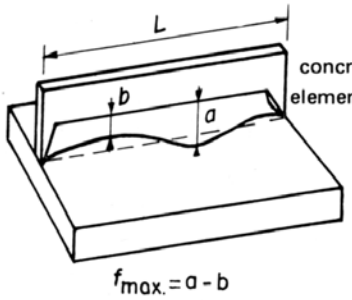
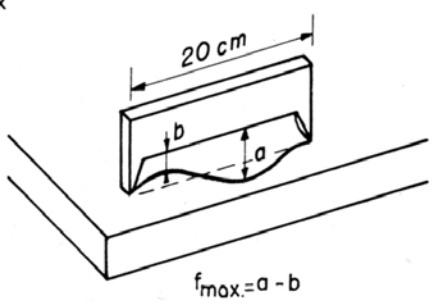
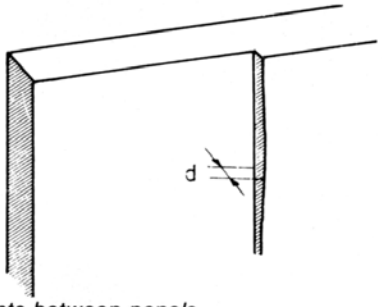
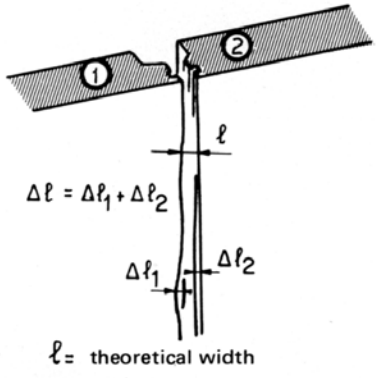
The numerical values in the table should be treated with some discretion as absolute limits cannot be set. This is in line with current philosophy applied, for example, when specifying characteristic values for compressive strength although it will be difficult to apply similar statistical techniques when using this document. So it is fruitless to satisfy any specification for 100%. It could be permissible to satisfy the specifications for:

95% for special class
80% for elaborate class
70% for ordinary class

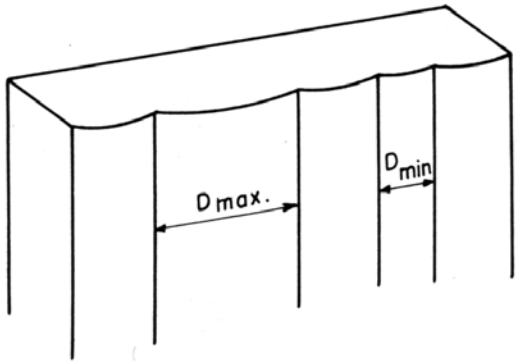
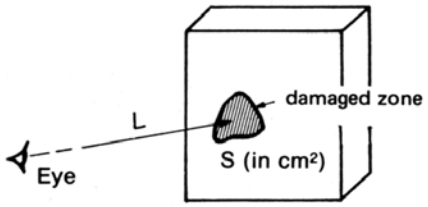
It is not intended that reference to this document in a specification should necessitate making many measurements. Numerous tests should only be necessary when doubt arises as to whether the required standard is being achieved. The specification might state that the cost of tests should be borne by the contractor if the standard is found to be below that required and, conversely, by the client if the standard is found to be satisfactory.

MODELS

In some cases, it may be found useful to supplement the document with sample surfaces. If precast concrete elements are being produced, for example, one or two of the elements produced at the beginning of the production run might be retained for reference purposes. If these are stored in the open, allowance will need to be made for the effect of weathering on their appearance.

BLEMISHES CONSIDERED Relative position of the concerned elements	CLASSES						
	SPECIAL		ELABORATE		ORDINARY		ROUGH
	Adjacent	Distant	Adjacent	Distant	Adjacent	Distant	
1. VARIATIONS OF SHAPE.							
1.1 *Departure from a plane surface*							
1.11. of whole element (compared to largest dimension of the element). f max ≤	0,4%		0,6%		1,0%		
							
1.12. local - within 200 mm (only for plane surfaces). f max	3 mm		6 mm		10 mm		
							
1.13. Steps discontinuities: accidental discontinuities should not exceed the dimensions given (the values indicated are for variations from a given dimension "d" and d = 0 for a plane surface). d ≤	3 mm		6 mm		10 mm		
							
1.2 *Joints between panels.* The lesser of the two values (ℓ = width of joint).	±8 mm or 0,3 ℓ		±10 mm or 0,5 ℓ		±15 mm or (-0,7 ℓ (+ ℓ		
							

NO REQUIREMENT

BLEMISHES CONSIDERED	CLASSES						
	SPECIAL		ELABORANTE		ORDINARY		ROUGH
Relative position of the concerned elements	Adjacent	Distant	Adjacent	Distant	Adjacent	Distant	
1.3 *Acutal distance between patterns* compared with the theoretical distance D (1) $R = \frac{D\ actual}{D}$	1.1>R>0.9		1.3>R>0.7		1.5>R>0.5		
Special tolerances for variations concerning large patterns may be specified if the standard tolerances are inappropriate.							
							
2. STAINS & LOCAL SURFACE DEFECTS							
							
2.1 Maximum area of faulty surface in cm² related to the distance L in meters from which the surface is viewed. S≦	3L		4L		5L		NO REQUIREMENT
2.2 Blemishes which are regularly spaced can be considered as patterns as in 1.3. In this case the theoretical distance D is the average distance between blemishes.							
3. BLOW HOLES.							
3.1. *Groups of holes:* groups of holes are considered as local defects (see § 2).							
3.2. *Distributed holes:* maximum allowable variation between the different zones on the scale indicated by the attached photographs.	2	4	4	6	6	–	
4. COLOUR VARIATION							
Maximum allowable difference using the enclosed "grey scale" (to be used when the concrete is dry and in the shade, viewed from at least 3 m from the surface, with the scale fixed to the surface).	2	2	2	3	3	4	

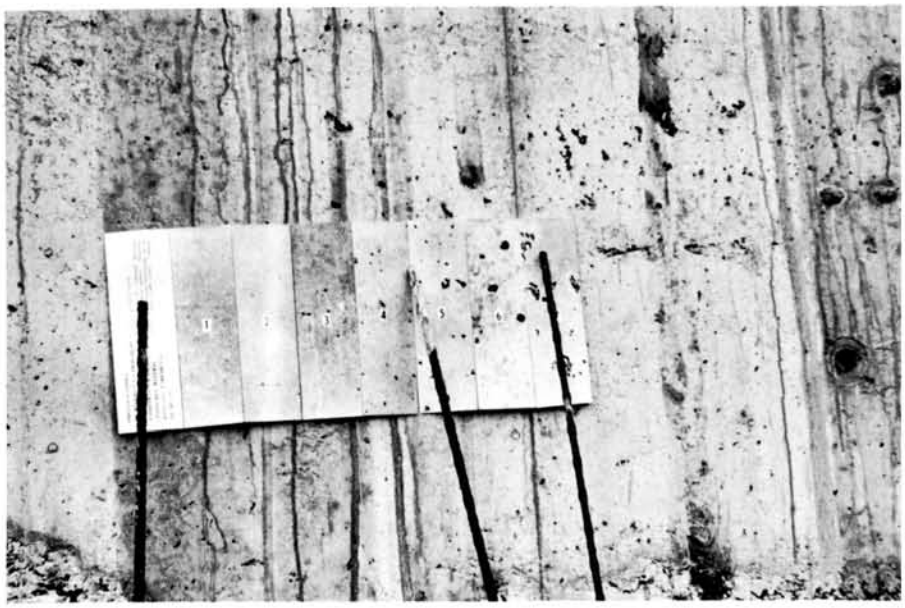
Small stains are considered as holes (see § 3)

(1) Patterns may be related to a profile or associated with the construction method, e.g. widths or formwork elements.

Annexe 1: **Some examples of application**

Figure 1

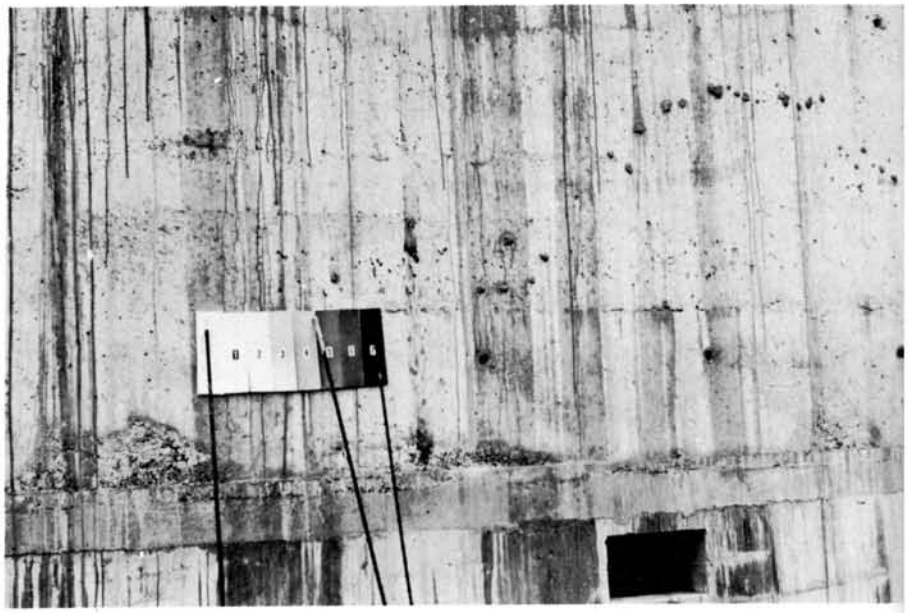
The blowholes in this wall are such that the upper part is class 7, the remainder being class 3. The difference, 7 — 3 = 4, indicates an ***ordinary*** *class of blemishes.*



1

Figure 2

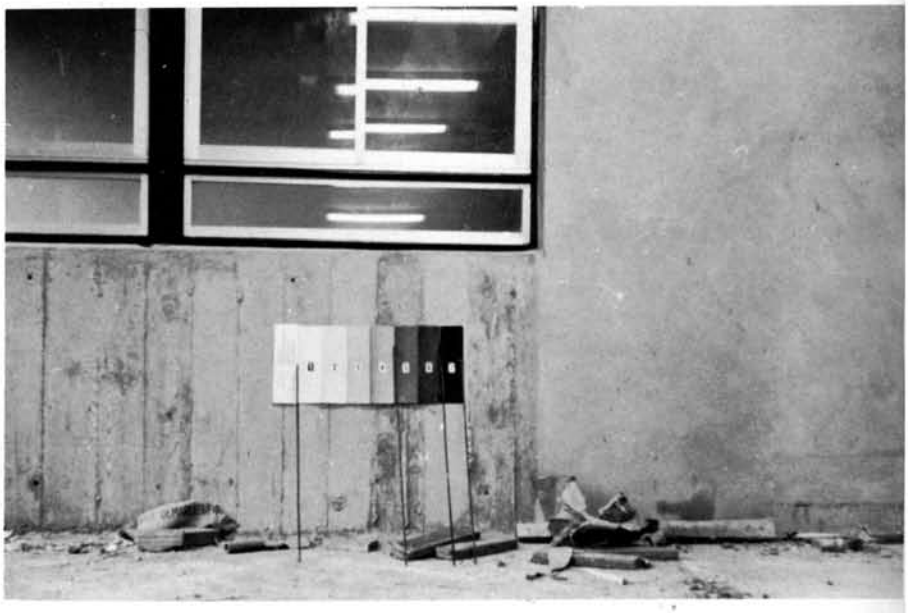
The colour variations extend from n° 6 to lighter than n° 3. The difference is more than 3 and so the finish is designated ***rough.***



2

Figures 3 and 4

These views of the façade of the same building show colour variation from n° 3 to lighter than n° 5. The difference is less than 2 indicating an ***elaborate*** *standard of finish.*



3

4

5

Figures 5 and 6

Colour variations in a single precast element generally vary between 2 and 6 (elements 1A3—1A5) but in element 1A2, the variation is only 5 — 6. This can be classed in ***special,*** *the remainder being* ***rough.***

If the panels are close together in one façade, the overall standard is classed as ***rough.*** *If the panels are not close to each other, the façade will be classed as* ***ordinary.***

6

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ANNEXES

Annexe 1 - **Some examples of application**

Annexe 2 - **Reference photographs illustration level of the incidence of blowholes in surfaces**

Annexe 3 - **Grey scale for use when assessing the colour variation of concrete finishes.**

annexe 2

D'après M.S. Thompson
"Blowholes in concrete surfaces"

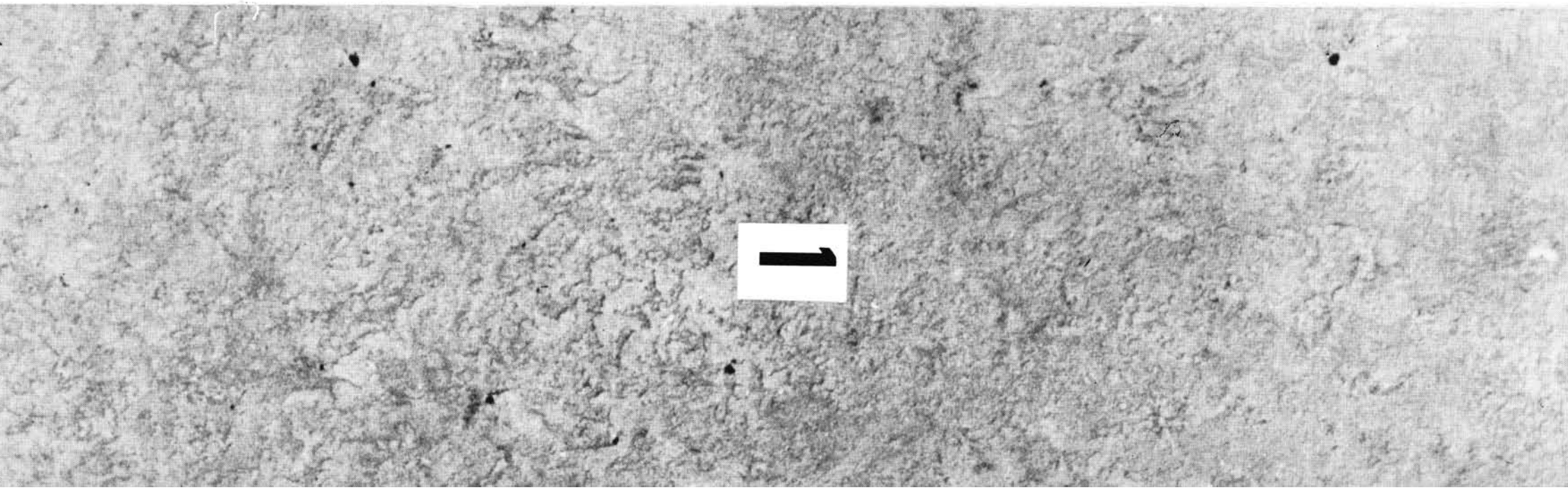
(Documents aimablement communiqués par la Société John Laing (R et S) Ltd, Londres)

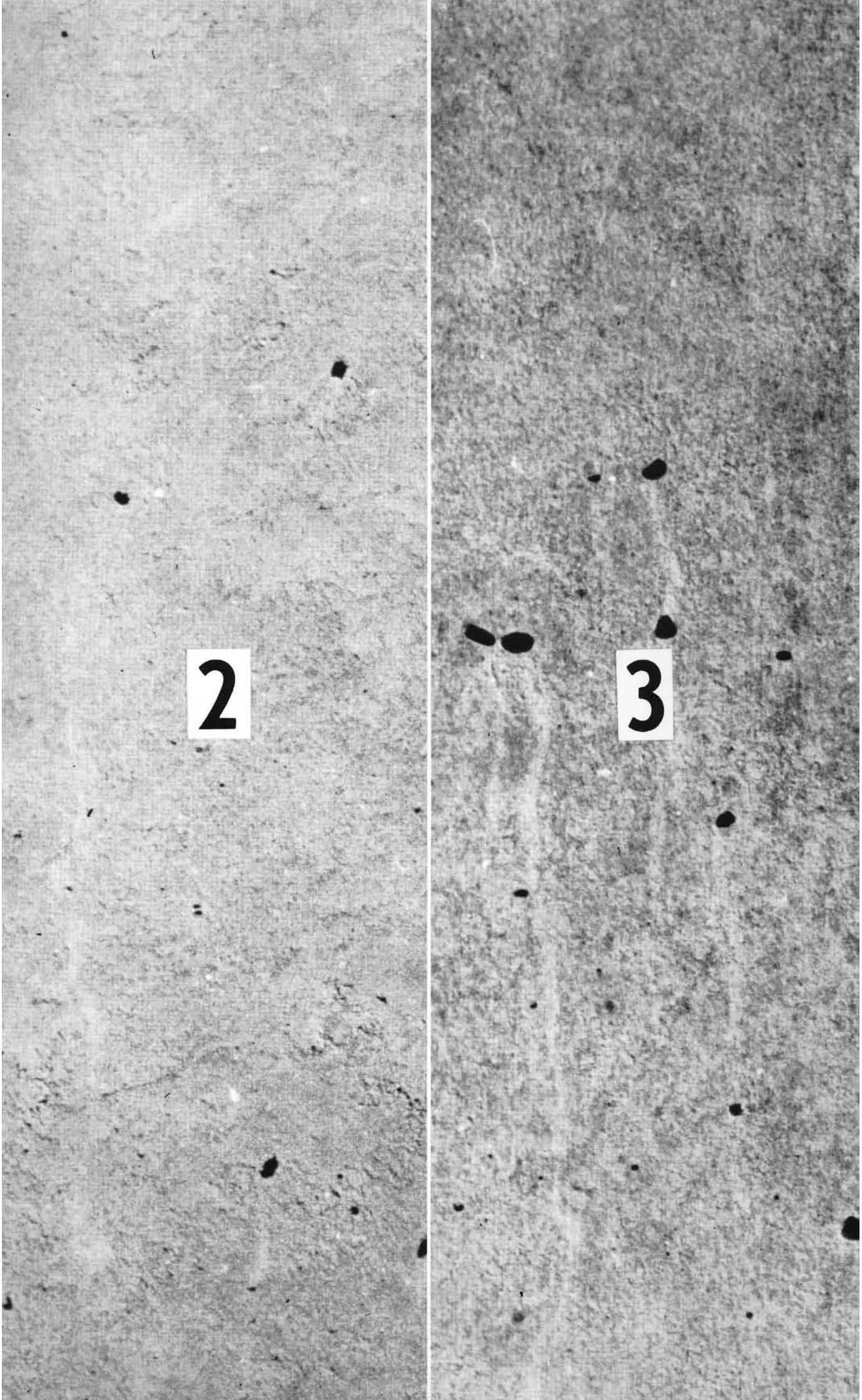
Photographies de référence utilisables pour apprécier l'importance des trous (tassures, bulles) dans les parements de béton

Reference photographs illustration level of the incidence of blow-holes in surfaces

Vergleichsbilder für die Bestimmung der Auswirkung von Luftblasen und anderen Vertiefungen in der Betonoberfläche

ÉCHELLE GRANDEUR NATURE FULL SCALE REPRODUCTION MASSSTAB 1 : 1

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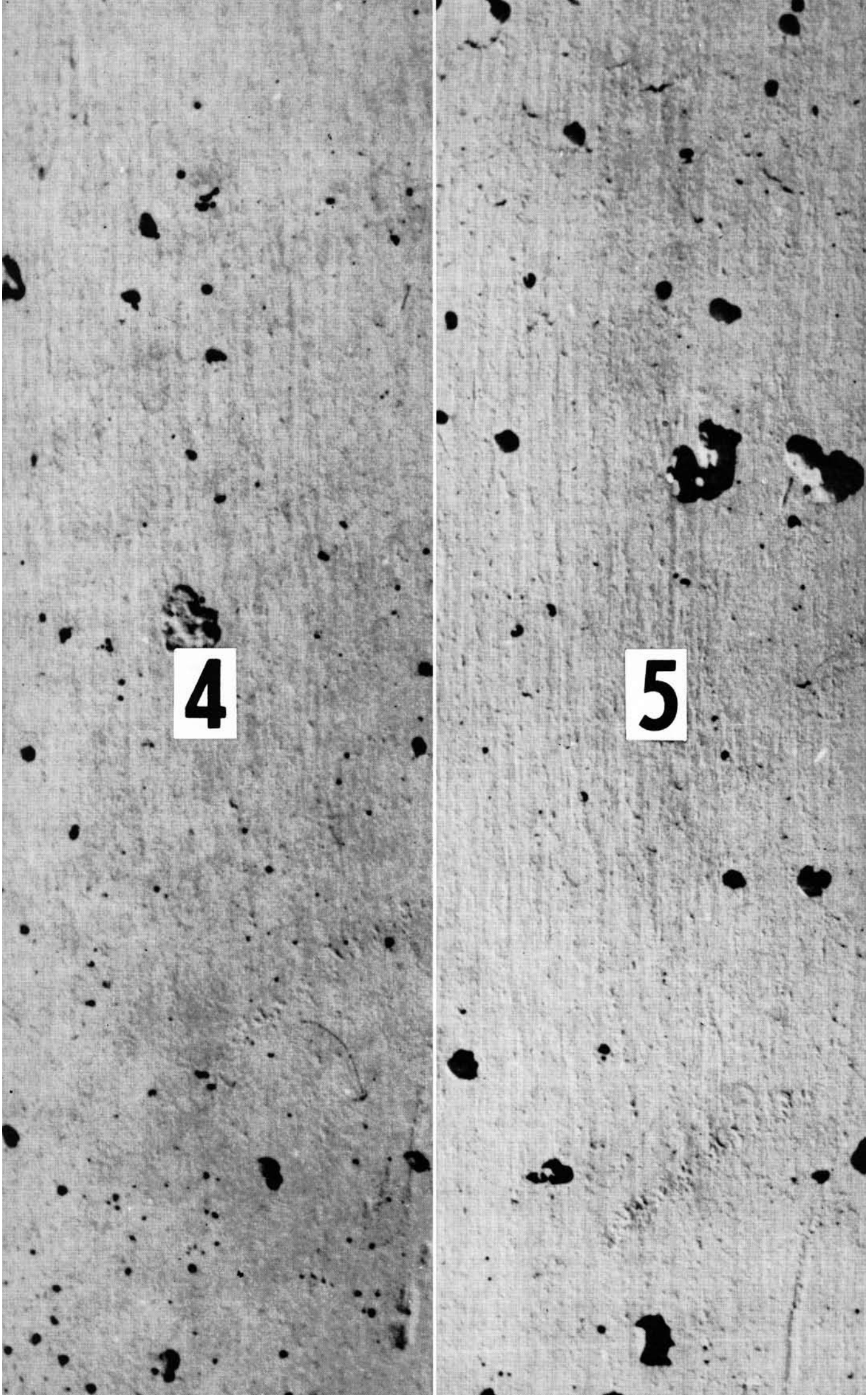
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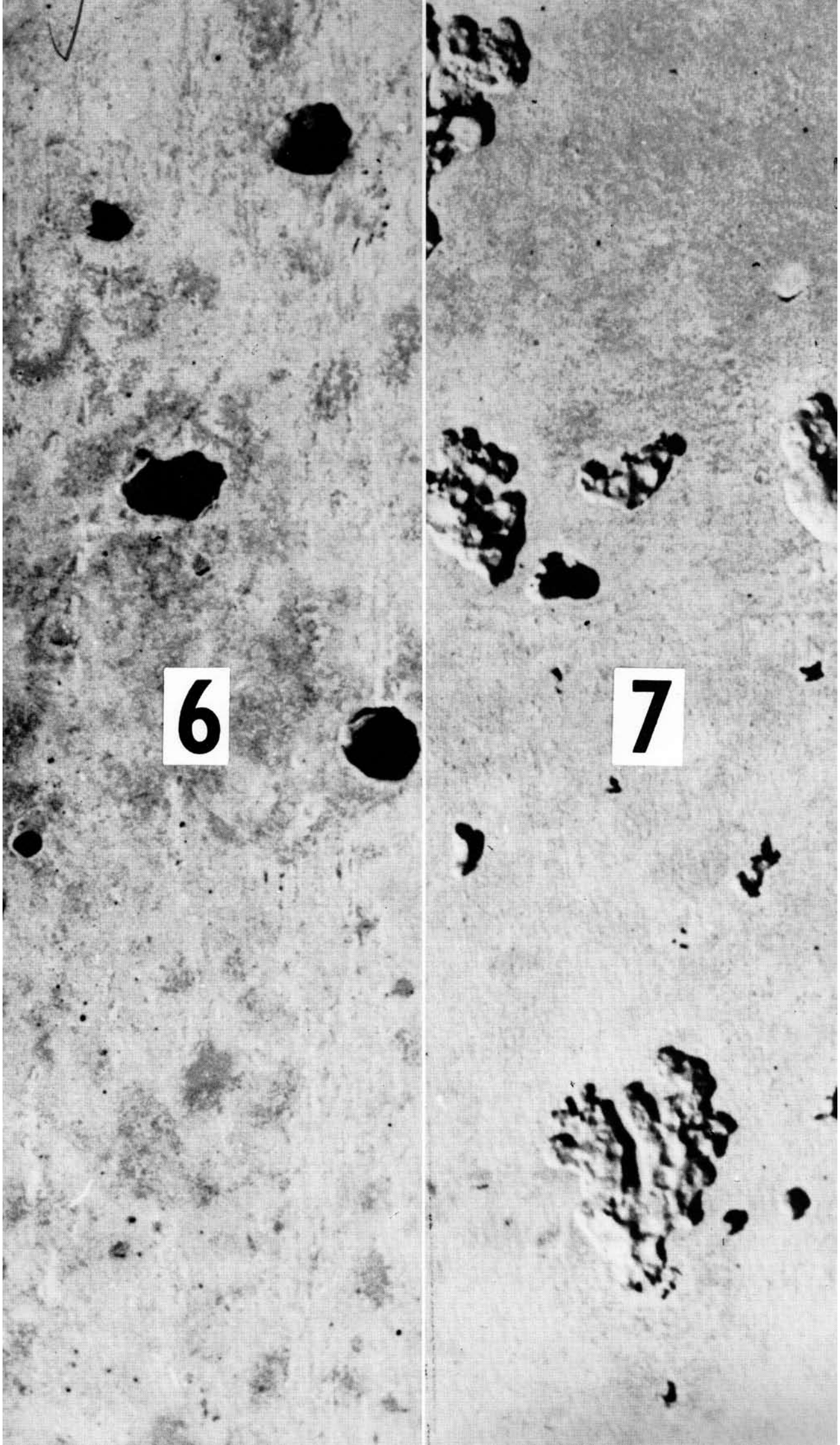
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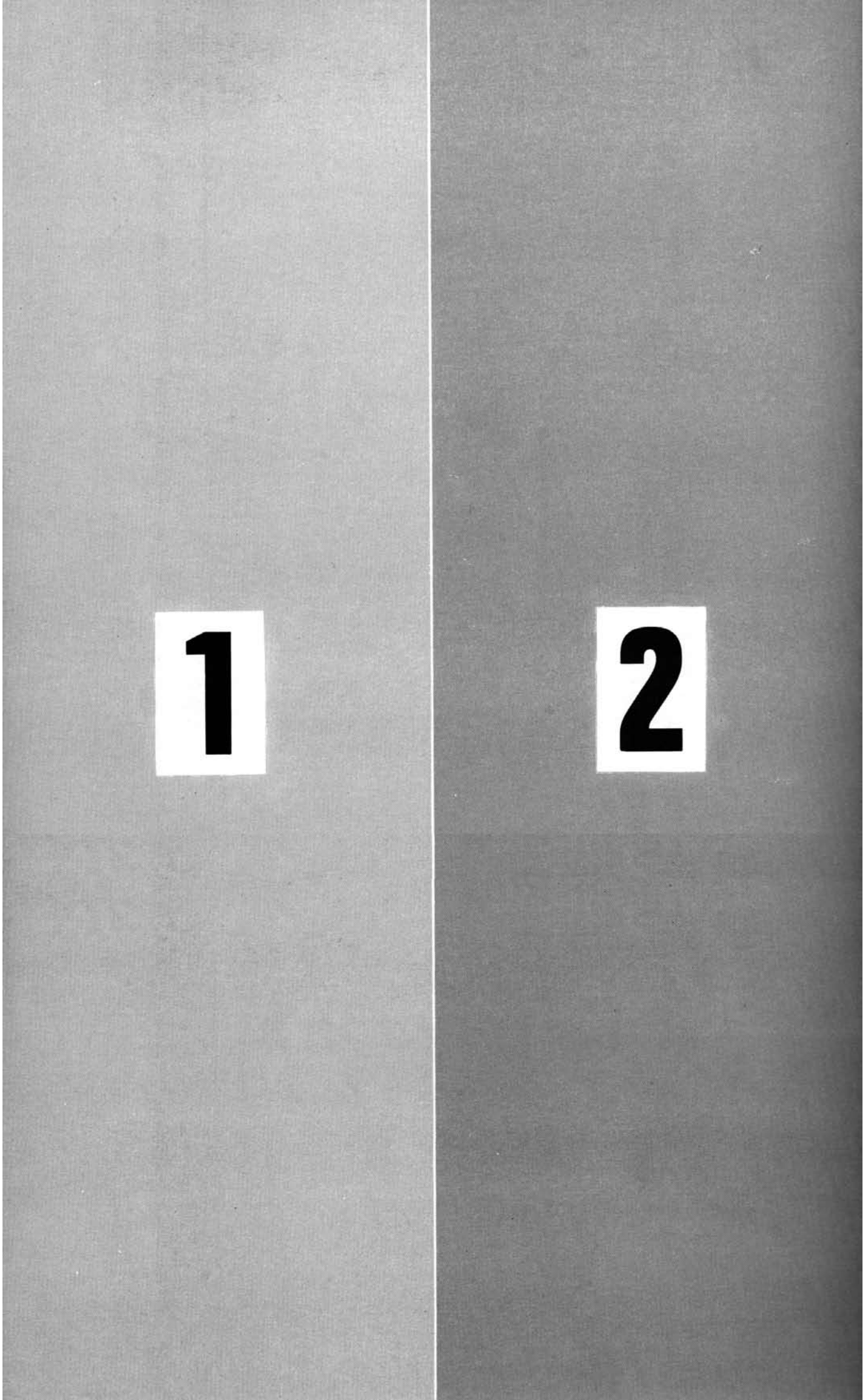
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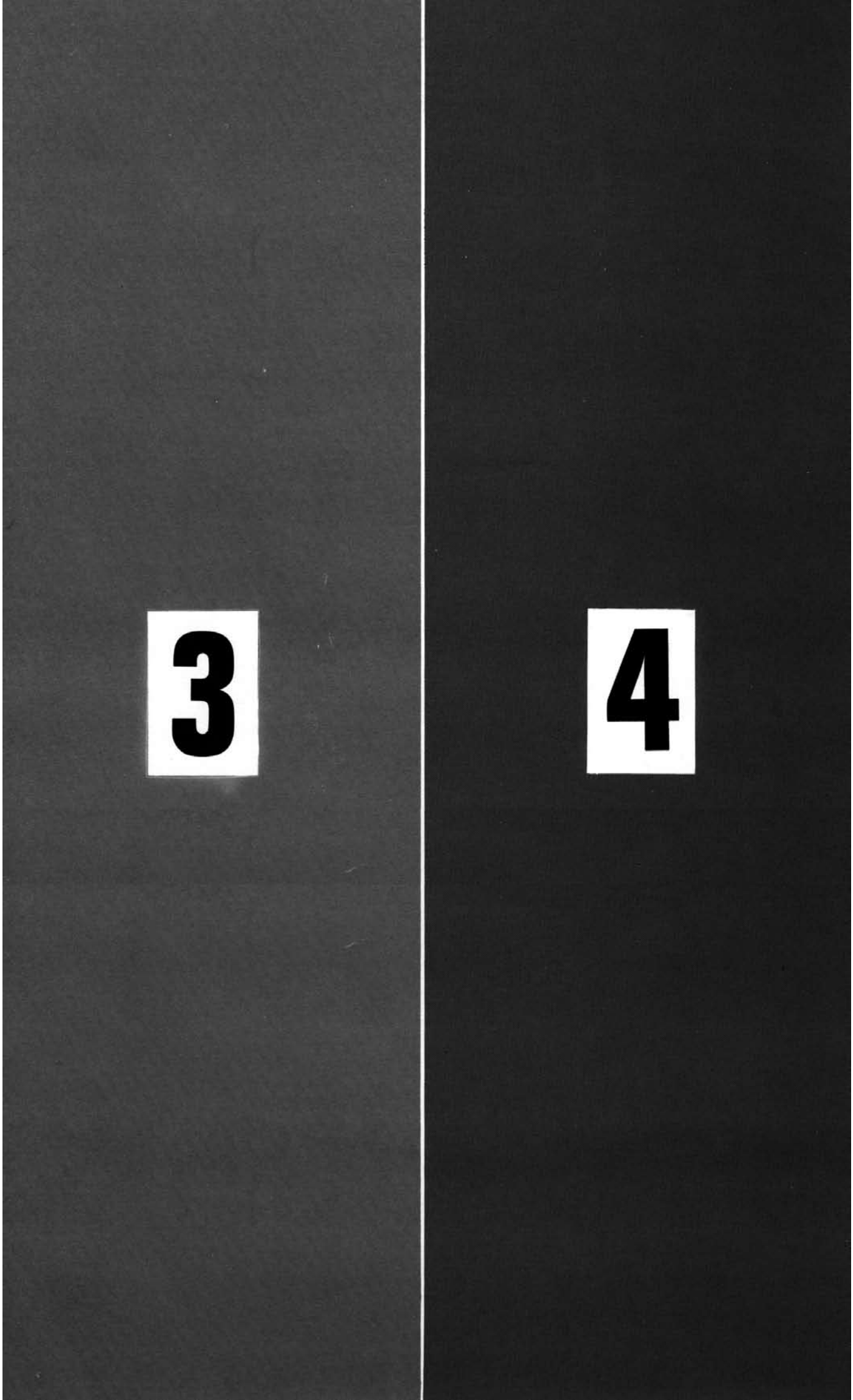
2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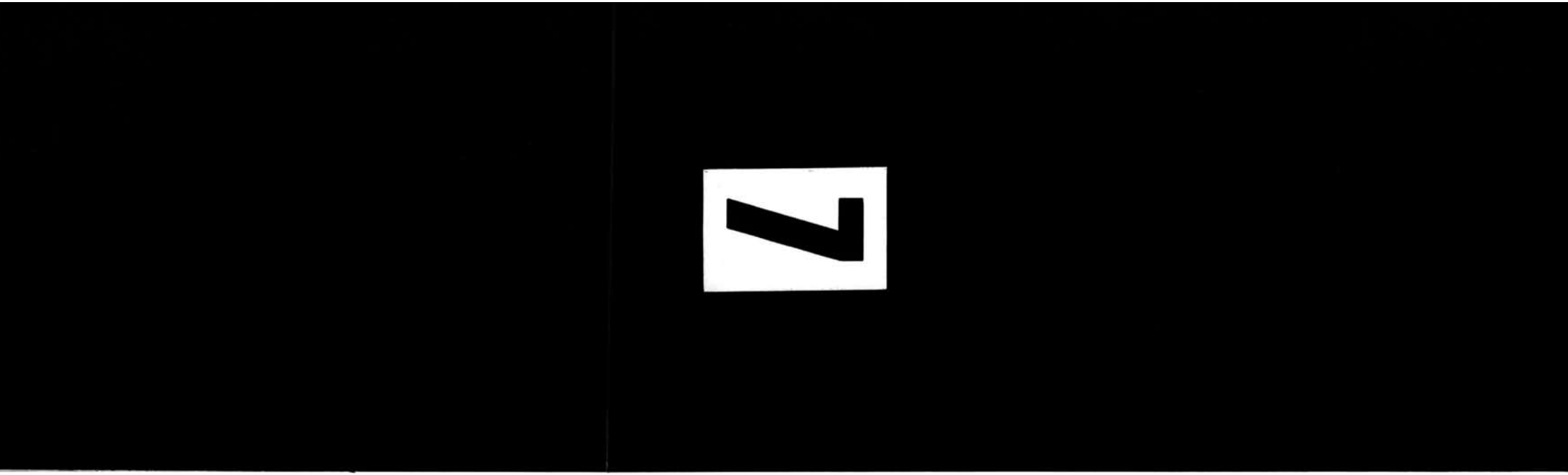

annexe 3

Échelle des gris utilisable pour contrôler la régularité de teinte des bétons

Grey scale for use when assessing the colour variation of concrete finishes

Grautonskala für die Prüfung der Regelmässigkeit der Farbtönung des Betons