CONCRETE BLOCK PAVING FOR THE CIVIC CENTRE OF BUCHAREST

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SUMMARY

Coloured concrete block paving was first used in Romania in 1989 for easy traffic purpose in the Civic center of Bucharest. The paper presents the mix proportions, the properties of component materials and the physical-mechanical characteristics of the concrete for CBP. The paper also presents details on the CBP manufacturing process in a precast concrete plant, details on the statistical interpreting for the evaluation of laboratory and site tests.

INTRODUCTION

The Civic center project was meant to provide easy traffic routs, concerning a total surface of 105,000 mp with coloured blocks.

The necessary number of concrete blocks for covering the entire surface was of 3,000,000 pieces with 198x198 mm plane dimensions and a 98 mm height.

QUALITY OF CONCRETE

The technical requirements of the concrete for CBP specified in the design were:

-strength class of concrete B 40
-the greatest depth of water penetration in testing with STAS 3591-76(1); (average of three test specimens) does not exceed 25 mm
-the greatest loss of compressive strength in testing in accordance with 3518-88(2) after 150 cycles of freezing and thawing does not exceed 25 %.
-the wearing resistance in terms of height reduction of the test specimens in accordance with STAS 5501-81(3) does not exceed 1.3 mm.

-strength for forms removal	min 27 N/mm^2
-delevry strength	min 32 N/mm^2

The design activity for concrete proportions was based on the research carried out along the years within the Concrete Laboratory of the Building Research Institute INCERC in the field of high performance concrete. Following the laboratory tests the optimum concrete mix could be established for achieving the economic requirements and the requirements for placeability, strength, durability, appearance.

The concrete proportions and the physical characteristics of the fresh concrete established following the results of laboratory tests were:

- portland cement P 40	550 kg/m^3
- water cement ratio	max 0.4
- aggregates (dry)	1650 kg/m^3
- river sand 0-3 mm	650 kg/m^3
- crushed granite 3-7 mm	1000 kg/m^3
- water-reducing and air-entraining admixture	9 $1/m^3$
- iron oxide (read and yellow)	27.5 - 33 kg/m^3
- workability - slump	65+15 mm
- temperature	max 20°C
- entrained air	max 6 %
- unit weight	min 2360 kg/m-

MANUFACTURING

The sequences of the technological process for batching, placing, compacting, curing of concrete are shown fig. 1.
7500 concrete blocks per day were performed by this technology at 40 lei cost per block.

QUALITY CONTROL

A particular attention was given for established the plan of the quality control. The main laboratory test and their frequency for the materials and the concrete were:

-cement: - specific gravity and conservation state according to STAS 227/3 - 86(4) - 2 tests each delive
-aggregates: - deteriores substances, grading, humidity according to STAS 4606-80(5) -1 test on shift
-fresh concrete: - workability according to STAS 1759-89(6) - 1 test at start of placing and on the shift
-temperature - 4 tests on shift
-entrained air according to STAS 1759-89(6) - 1 test at start of placing and on shift
-hardened concrete: - compressive strength, strength for removal, delevry strength according to STAS 1275-89(7) - 1 test on shift
-water penetration -1 test/month
-frost resistance 1 test/month
-wearing resistance -1 test/month

In accordance with the Romanian standards the test defined as the average of the three succesive test-vah and for the strength tests 10 mm edge cubes are used.
In the case of wearing resistance 70 mm edge cubes made of hardened concrete block are used.
The criteria for the concrete control and acceptance in accordance with G140-86(8) are the following:

1) the minimum value of all individual strength test (average of three cubes); ($R_{min} \geq 36.5$ mm^2)
2) the average of all strength tests (R)≥ 45 N/mm^2
3) the specified strength ($R_{k\ ef}$)≥ 40 N/mm^2

The evaluation of the compression test results (see figure 2) and the other results on frost resistance, wear sistance, water penetration provide that the concrete met the required properties.
After two years only 1,000 blocks with deteriorations caused by frost and the use of ice remover, age should be observed.

REFERENCE

(1) STAS 3519-76 — Tests on concretes - Inspection of waterproofness

(2) STAS 3518-88 — Tests on concretes - strength determination of frost - thawing

(3) STAS 5501-81 — Detrition determination in dry state

(4) STAS 227/3-86 — Cements - Physical tests

(5) STAS 4606-80 — Heavy weight aggregates for mortars and concrete with mineral binding material testing methodes

(6) STAS 1759-89 — Test of fresh concrete

(7) STAS 1275-89 — Tests of hardened concrete - Determination of mechnical strengths

(8) C 140-86 — Code for making a plain and reinforced concrete construction work

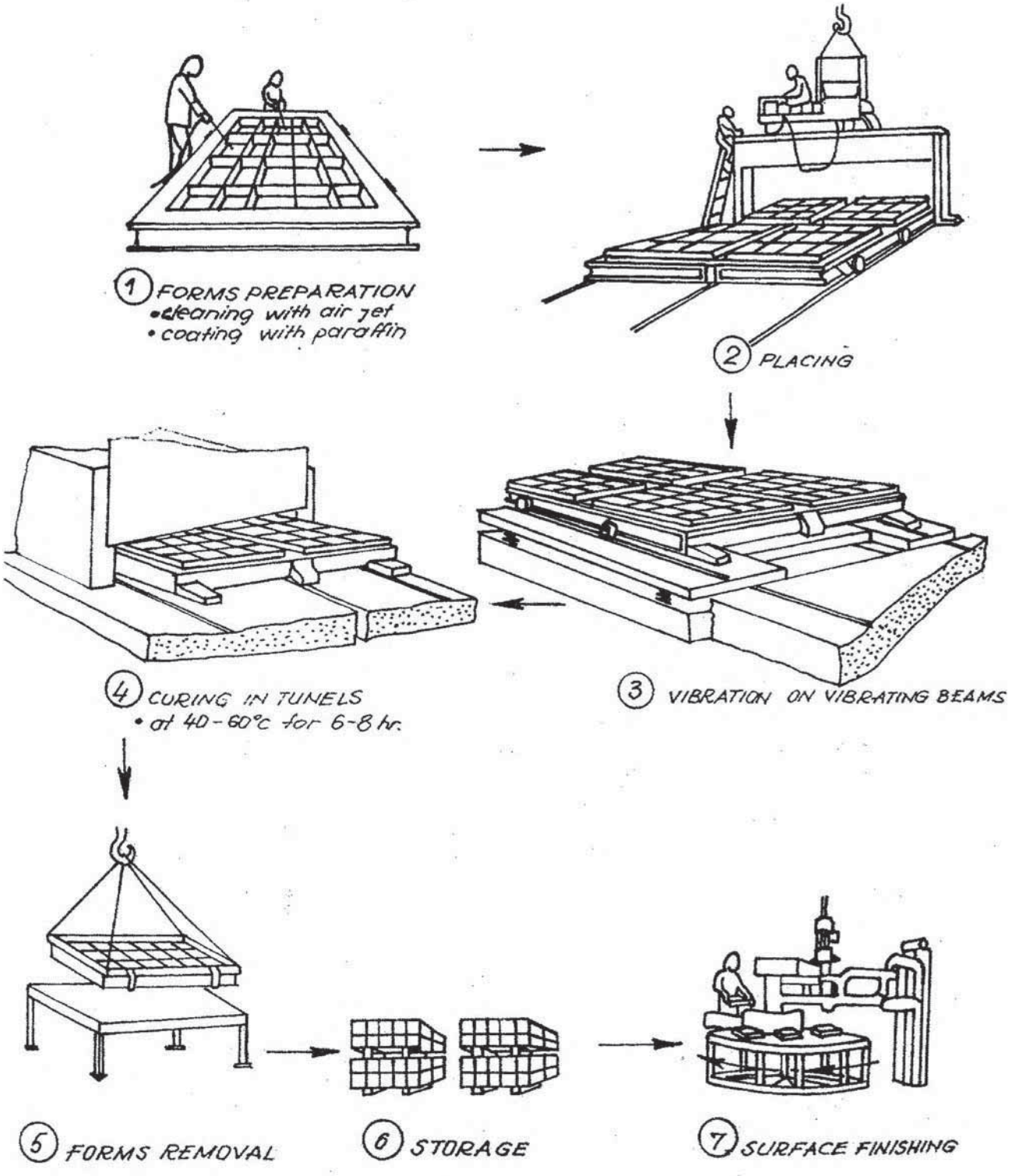
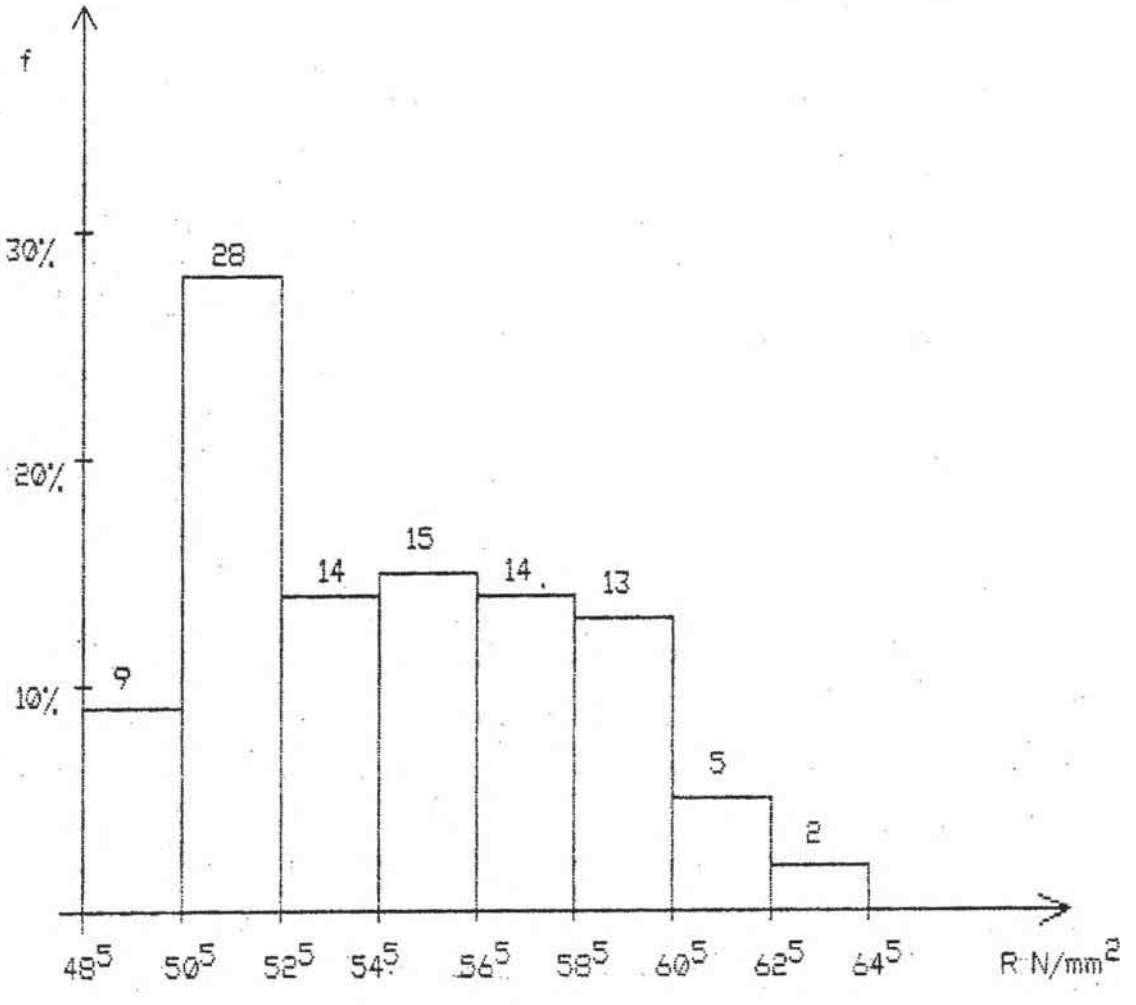

1 FORMS PREPARATION
• cleaning with air jet
• coating with paraffin
2 PLACING
3 VIBRATION ON VIBRATING BEAMS
4 CURING IN TUNELS
• at 40-60°C for 6-8 hr.
5 FORMS REMOVAL
6 STORAGE
7 SURFACE FINISHING

FIG. 1

STATISTICAL COMPRESSION TEST EVALUATION



$n = 325$

$R_{min} = 50\ N/mm^2 > R_{ad}^{min} = 36{,}5\ N/mm^2$

$R = 54{,}9\ N/mm^2 > R_{ad} = 45\ N/mm^2$

$S = 3{,}44\ N/mm^2$

$R_{kef} = 49{,}28\ N/mm^2 > R_K = 40\ N/mm^2$

$V = 6{,}26\ \%$

FIG. 2.