# STANDARDS AND SPECIFICATIONS FOR CONCRETE PAVING BLOCKS IN LATIN-AMERICAN COUNTRIES

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## SUMMARY

This paper is a compilation of the available standards and specifications in eleven Latin-American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, Haiti, Mexico, Peru, Uruguay and Venezuela). Instead of a series of statistical analysis about different topics of the standards, some considerations are made about their origin and relationship with the concrete block paving activity in the respective countries.

The standardization process for concrete paving blocks in Latin America (from Mexico down to the southern extreme of South America, including the Caribbean), do not differ from the ones in other parts of the world. Most of the national standards, summarized in Table 1, appeared 8 to 15 years after the introduction of this technology in the respective countries. Some of those countries like Argentina, Guatemala, Nicaragua and Mexico had concrete block pavements since the late 60's or early 70's, but their standards date only from 1686, in most of the cases. One of the reasons for this fact, not much different from the situation in other parts of the world, is the slow development of the concrete block paving market in those countries.

Most of the standards in Table 1 have, as a reference, other standards from Europe or North America. The DIN (German) standard is quoted by those from Argentina, Chile, Guatemala and Mexico; the NEN (Holland) by the Colombian standard, which was the model for the Venezuelan standard. The ASTM (USA) standard appears in those from Chile and Peru and the BS (United Kingdom), or its preceding recommendations, in the ones from Chile, Ecuador, Mexico and Peru. This multiple origin makes allot them look very similar to the group or standards reported by Houben, Van der Kreeft and Leewis in Delft (12), and those presented in Rome (13), but in the ones listed here, no one uses the Splitting Strength Test..

One important fact is that the climate in Latin-America is mild, with rainy and dry season. Most of the countries are on the Torrid Zone, with temperatures dependent mostly from the height over the sea level. There is seasonal climate only in the southern part of Argentina and Chile, but there are no big cities in that area. With this in mind, one could say that the strength parameter (to be required) in all the Latin-American countries should be the abrasion resistance, and only those already mentioned should consider freezing and thawing for veryspecific areas.

It could be very convenient that a unique strength criterion be determined for the non-seasonal areas of the world, in the same way it will be determined in the European Standard for the freezing and thawing condition, in order to have only two strength requirements (without any other possible alternative). A further step would be, for the different countries, to adopt the Splitting Strength Test, or to adapt those strength requirements to the test currently in use in each one.

The type of testing procedure has generated some inconveniences in the past. When the Colombian standard was developed, it was not possible to propose a Compressive Strength Test since there were a lot of concrete block pavers with an area of more than 40 000 $mm^2$, not able to be tested in the standard equipment available in most of the laboratories. For this reason, a Flexural Strength Test was developed.

This test has a difference with the ones from Holland and Finland, in terms of the width to be considered at the failure section, specified, in the Colombian and Venezuelan standards as the one of the "inscribed rectangle", in order to set all the discrepancies arising from the irregularities in the width of the shaped blocks. The width, calculated by this method, is the minimum of any vertical cross-sectional plane, and makes the test more

| Table 1. Summary of the Standards for Concrete Paving Blocks In several Latin-American countries | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. GENERALITIES** | | | | | | | | | | | |
| 1.1 Country | ARGENTINA (1) | BRAZIL (2) | CHILE (3) | COLOMBIA (4) | ECUADOR (5) | GUATEMALA (6) | HAITI (7) | MEXICO (8) | PERU (S) | URUGUAY (10) | VENEZUELA (11) |
| 1.2 Type | Standard | Standard | Recomendations | Standard | *Standard* | Specifications | Specifications | Standard | Draft | Standard | Draft |
| 1.3 Status | National | National | Cement Manuf. Asso, (I.Ch.C.H.) | National | National | Municipal | Proyect | National | National | National | National |
| 1.4 Standard for Requirements | RAM 11656 ('85) | NBA 9 781 ('87) | S-106 ('87) | ICONTEC 2 017 ('83) | INEN 1 483, 1 488, all ('66). | | | NOM 0-314 ('86) | 339.124 ('87) | UNIT 787 ('89) | COVENIN A 312-012 ('90) |
| 1.5 Standard for Testing | RAM 11656 ('85) | NBR 9 780 ('87) | E-301 ('87) | ICONTEC 2 017 ('83) | INEN 1484, 1 485, 1486, 1 487, all ('86). | | | NOM C-3t4 ('86) | 339.124 ('87) | UNIT 787 ('89) | COVENIN 42, A 312-012 ('90). |
| **2. MATERIALS AND MIX DESIGN** | | | | | | | | | | | |
| 2.1 Cement (Standards) | RAM 1 503 | NBR 5 732, 5 733. 5 735, 5 736. | NCh 148 | ICONTEC 121, 321. | INEN 152 | X | NF P 15*-301 ASTM C-150 | NOM C-1,2,175. | INTITEC 334, 009,038, 040.044. | UNIT 20 | COVENIN 28 |
| 2.2 Aggregate® (Standards) | RAM 1512,1531 | NBR 7211 | NCh 163 | ICONTEC 174 | INEN 872.1 487. | | | NOM C-111 | INTITEC 400.037 | UNIT 84,102. | COVENIN 255 |
| 2.2.1 *Grading* | | | Vibrating table/ automatic equip.<br>Sieve %pas.<br>3/4 95-100<br>1/2 75-85<br>3/8 60-72 100<br>#4 42-58 50-90<br>#8 35-50 40-65<br>#16 30-42 32-50<br>#30 20-35 24-37<br>#50 10-22 16-25<br>#100 2-10 8-14 | | | ≥ 80 % passing sieve # 8;<br>≤ 20% passing sieve # 30. | | | | | Sieve % pas.<br>3/8 100<br>#4 85 - 100<br>#8 60 - 95<br>#16 40 - 60<br>#30 20 - 60<br>#50 8 - 30<br># 100 2 - 10 |
| 2.2.2 *Maximum size* | | | | 12.7 mm | 1/4 of thickness | 13 mm | 9.6 mm | 20.0 mm | | | 10.0 mm |
| 2.2.3 *Solubility In acid* | | | | | | < 25 % of portion retained or passing # 600 pm sieve. | | | | | |
| 2.3 Water (Standards) | RAM 1601 | X | NCh 1498 | X | | X | X | NOM 0122 | INTITEC 339.088 | RAM 1 601 | COVENIN 2385 |
| 2.4 Admixtures (Standards) | RAM 1663 | X | | ICONTEC 1 299 | X | | | X | INTITEC 339.086 | X | COVENIN 356 |
| 2.5 Pigments (Standards) | | X | | X | BS 1014 | | | NOM C-313 | X | X | X |
| 2.S.1 *Special requirements* | | | Maximum Size ASTM # 325 | | | | | 10% of cement weight, max. cont. | | | |
| 2.6 Other material® | | | | | Fly Ash INEN 1 501 | | | X | | | |
| 2.7 Curing | | | | | X | X | | X | | | |
| **2.3 Sampling** | | | | | | | | | | | |
| 2.8.1 *Method* | RAM. 11627 | X | | | INEN 1484 | | | | | | COVENIN 42 |

| Table 1. Continuation. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | ARGENTINA | BRAZIL | CHILE | COLOMBIA | ECUADOR | GUATEMALA | HAITI | MEXICO | PERU | URUGUAY | VENEZUELA |
| 2.8.2 *Lot size* | | 1 600 $m^2$ | 10 000 blocks | 5 000 blocks | 20 000 blocks | | 10 000 blocks | 10 000 -100 000 b. | 100 000 blocks | 5 000 blocks | |
| 2.8.3 Total s*ample size* | | 6/300 $m^2$ + 1/50 $m^2$ up to 32 | 5(1/2 000). 15 recommended. | 5 (1/1 000) | 10 (1/2 000) | | 9 (1/1 111) | Lot size n upto 10000 10 10001-25000 20 25001-50000 30 60001-$10^6$ 40 +10/50 000 over 100000 | Type II. first lot + 12 each other Type I, 50% | 9, speclal vehicles; 6, pedestrians. | |
| 2.8.4 *Second option* | | | 10 Blocks | 5 (1/1 000) | 10(1/2000) | | | | | | |
| 3. PROPERTIES | | | | | | | | | | | |
| 3.1 Physical | | | | | | | | | | | |
| 3.1.1 *Shape* | | | | | See Type | Recomended | Besser PF 504 | | X but unclasified | | |
| 3.1*2 Texture*(surface) | X | | | X | X | | | | X | X | X |
| 3.1.3 *Color* | X | | | | X | | | | | | |
| 3.1.4 *Visual Inspection* | | ≤ 5% defective | | | | | | | X | ≤ 5% defective | |
| 3.1.5 *Chamfer* | | | Optional | Optional | | Optional | | | | Compulsory, by definition | |
| 3.1.5.1 *Vertical* (maximum) | | | | | | | 7 mm | | | 7 mm | |
| 3.1.5.2 *Horizontal* (maximum) | | | 30 % of total area | | 30 % of total area | | 7 mm | 30 % of total area | | 7 mm | 30% of total area |
| 3.1.6 *Dimensions* | | | | | | | | | | | |
| 3.1.6.1 *Measuring* (standard or accuracy) | Vernier caliper, ruler; 0.5 mm. | NBR 9 780 | 7 times/b lock | 1.0 mm | INEN 1486 Vernier caliper, ruler; 0.5 mm. | | | Over 1/4 of the sample | Average of two; mier or vernier caliper. | | |
| 3.1.6.2 *Area* | 15 000 to 90 000 $mm^2$ | | | | | 45 000 to 55 000 $mm^2$ | | | | | |
| 3.1.6.3 *Length* | | | | | | | | | | | |
| *3.1.6.3.1 Minimum* | | | | | | | | | | | |
| *3.1.6.3.2 Maximum* | | 400 mm | 240 mm | 250 mm | | | 250 mm | 250 mm | 240 mm | | 250 mm |
| *3.1.6.3.3 Tolerances* | ± 2 mm | ± 3 mm | ± 2 mm | ± 2 mm | ± 2 mm | | ± 2 mm | ± 2 mm | ± 1 % | ± 2 mm | ± 2 mm |
| 3.1.6.4 *Width* | | | | | | | | | | | |
| *3.1.6.4.1 Minimum* | | 100 mm | | | | | | 80 mm | | | |
| *3.1.6.4.2 Maximum* | | | 240 mm | | | | | | 120 mm | | |
| *3.1.6.4.3 Tolerances* | ± 2 mm | ± 3 mm | ± 2mm | ± 2 mm | ± 2 mm | | ± 2 mm | ± 2 mm | ± 1 % | ± 2 mm | ± 2 mm |

Table 1. Continuation.

| Country | ARGENTINA | BRAZIL | CHILE | COLOMBIA | ECUADOR | GUATEMALA | HAITI | MEXICO | PERU | URUGUAY | VENEZUELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.1.6.5 *Thickness* | | | | | | | | | | | |
| *3.1.6.5.1 Minimum* | 60 mm<br>≥ 80 mm Type 1 | 60 mm | 60 mm | 60 mm | 60 mm:<br>pedestrians;<br>80 mm:<br>vehicular Italic. | 100 mm | 60 mm:<br>pedestrians,<br>light traffic;<br>80 mm:<br>heavy traffic. | 40 to 60 mm:<br>Type A;<br>80 mm:<br>Types B to D. | 40 mm | 60 mm: pedest-<br>rians, vehicular<br>trade;<br>80 mm: special<br>vehicles:<br>80 mm all AHV<br>blocks. | 40 mm |
| *3.1.6.5.2 Maximum* | 130 mm<br>≤ 79 MM Type II | | 100 mm | | 100 mm | | | | 140 mm | | |
| *3.1.6.5.4 Prefered* | | | | Multiple of 20 mm | | | | | Multiple of 20 mm | Multiple of 20 mm | Multiple of 20 mm |
| *3.1.6.5.3 Tolerances* | ± 2 mm | ± 5 mm | 4 mm in each<br>block | ± 3 mm | ± 3 mm | | ± 3 mm | ± 3 mm | ± 3% | + 3. -0 mm | ± 3 mm |
| 3.1.6.8 *Length /Thick* .(max.) | | | | | | | | 2 to 5 | | | |
| 3.1.6.7 *Length/Width* (max.) | | | 2 for Type 1,<br>2 for rectangles | | 2 | | | 1 to 2 | | | |
| 3.1.6.8 *Area /Thlckness(max.)* | | | | | | | | | | 150: pedestrians,<br>80: other traffic. | |
| 3.1.6.9 *Squafeness{max.dev.)* | | | 1(50 | | 2 mm | | | X | | | |
| 3.1.7 *Welpht/block* (max.) | | | | | | | | | 8 kg | | |
| 3.2 Type (Traffic) | Type: Traffic<br>I: Public roads<br>II: Other roads | | | | Type: Shape<br>A: Shaped, 4 sides, herring-bone pattern;<br>B: Shaped, 2 sides, no her-ringbone pattern;<br>C: Rectangular, | | | Type: Traffic-<br>8.21 Axels<br>A: Pedest., ga-rages-no axels.<br>S: Light traffic.<br><$5x10^5$(8.21 t a.)<br>C: Medium traffic,<br>$5x10^5$ - $5x10^6$.<br>D: Heavy traffic.<br>>$5x10^6$. | Type: Traffic.-<br>Thickness (mm)<br>I: Pedestrians-<br>40-60;<br>I: Vehicular and<br>other-<br>60, 80, ISO. | Due to shape:<br>A: Classic, unshaped sides;<br>AH: Shaped for horiz. load trans.;<br>AHV: Shaped for horiz.and veritlcal load transfer;<br>Due to traffic:<br>Pedestrian;<br>Standard Veh.:<br>Special Veh. | |
| 3.3 Strength | | | | | | | | | | | |
| 3.3.1 *Compressive* | | | | | | | | | | | |
| 3.3.1.1 *Sample size* (blocks) | 6 | 6 to 32 | | | 10 | | 9 | | 12 first,<br>6 each other. | 3 | |
| 3.3.1.2 *Type of specimen* | Cylinder;<br>Φ: 100 ±2.5 mm<br>h: height of the block | Whole block;<br>sawed if<br>width > 140 mm. | | | Whole block | | Whole block | Sawed cube;<br>dimensions equal to thickness. | Whole block | Whole blJarea<br>< 26 000 $mm^2$;<br>if not, over a sawed portion. | |

Table 1. Continuation.

| Country | ARGENTINA | BRAZIL | CHILE | COLOMBIA | ECUADOR | GUATEMALA | HAITI | MEXICO | PERU | URUGUAY | VENEZUELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.3.1.3 Age *when tested* | 28 days | | | | 28 days | 28 days | 3 blocks. 7 days; 3 blocks, 28 days; 3 blocks; further verification. | X | | | |
| 3.3.1 .4 *Storage of blocks* | Saturated | Saturated | Saturated | Ambient, 24 h | Saturated | | Saturated | Oven dry | Saturated, 24 h. | Saturated | |
| 3.3.15. *Loadings device* | | Circular plates; Φ: 90 ± 0.5 tnm | | | 25 mm thick steel plates over the whole block area | | | | | | |
| 3.3.1.6 *Capping* | | Sulphur; max. 3 mm thick. | 4 mm thick plywood, exceeding the perimeter 5 mm. | | 4 mm thick plywood or sulphur. | | 4 mm thick plywood. | NOM C-109 | 4 mm thick plywood, exceeding the perimeter 5 mm. | Sulphur; max. 3 mm thick. | |
| 3.3.1.7 *Equipment requirement* | | X | | | INEN 1 502, 1 503. | | | NOM C-83 | X | Unit 40 | |
| 3.3.1.8 *Loading speed* | | 0.3 to 0.8 MPa/s | 0.25 ± 0.05 MPa/s | | 0.25 MPa/S | | | | 0.25 ± 0.05 MPa/s | | |
| 3.3.1.9 *Required strenght* | CS=(P/A)-TF | CS=(P/A).TF | CS=(P/A) | | CS=(P/A) | CS=(P/A) | CS=(P/A) | CS=(P/A).TF | CS=(P/A).TF | CS=(P/A) | CS=(P/A) |
| *3.3.1.9.1 Individual* | Ty. Thick. (mm) Strength (MPa)<br>I 100 30.0<br>II 70 32.0 | | Ty. Thick. (mm) Strength (MPa)<br>I 60 45.0<br>I 80-100 40.0<br>II 60 35.0<br>II 80-100 30.0 | | | 24.0 MPa: light traffic; 28.0 MPa: heavytraffic. | 35.0 MPa | a 85% of the reaquired average value. | | 35.0 MPa: pedestrians, vehicular traffic; 45.0 MPa: special vehicles. | Thick. (mm) Strenght (MPa)<br>40-60 ≥ 24.5<br>60 ≥ 34.5<br>≥ 80 ≥ 34.5 |
| *3.3.1.9.2 Average* | Ty. Thick. (mm) Strength (MPa)<br>I 100 36.0<br>II 70 35.0 | | Ty. Thick. (mm) Strength (MPa)<br>I 60 50.0<br>I 80-100 45.0<br>II 60 40.0<br>II 80-100 35.0 | | | | 30.0 MPa | Any 5 consecutive samples<br>Type Strength (MPa)<br>A 24.0<br>B 24.0<br>C 29.0<br>D 34.0 | | | |
| *3.3.1.9.3 Characteristic* | | XS=CS-(t.s)<br>35 MPa: commer-cial vehicles; 50 MPa; special vehicles.<br>n t n t<br>6 .920 18 .863<br>7 .906 20 .861<br>8 .896 22 .859<br>9 .889 24 .858<br>10 .883 26 .856<br>12 .876 28 .855<br>14 .870 30 .854<br>16 .866 32 .842 | | | XS=CS-(1.64s)<br>Type Strength (MPa)<br>I 20.0<br>II 30.0<br>III 40.0 | | | | XS=CS-(1.5s)<br>Ty. Thick. (mm) Strength (MPa)<br>I 40-60 31.38<br>II 60 41.18<br>II 80 37.26<br>II 100 35.30 | | |

**Table 1. Continuation,**

| Country | ARGENTINA | BRAZIL | CHILE | COLOMBIA | ECUADOR | GUATEMALA | HAITI | MEXICO | PERU | URUGUAY | VENEZUELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.3.1.10 *Thickness factor (TF)* | Thick. TF<br>Type<br>(mm) I II<br>60 - 1.11<br>70 - 1.00<br>79 - 0.94<br>80 1.10 -<br>90 1.04 -<br>100 1.00 -<br>110 0.97 -<br>120 0.95 -<br>130 0.93 - | Thick. TF<br>(mm)<br>60 0.95<br>80 1.00<br>100 1.05 | | | Thick. TF<br>Chamfer<br>(mm) (no) (yes)<br>60 1.00 1.06<br>80 1.04 1.11<br>100 1.08 1.16 | | | Thick. TF<br>(mm)<br>60 0.95<br>80 1.00<br>100 1.05 | | | |
| 3.3.2 *Flexural* | | | | | | | | | | | |
| 3.3.2.1*Sample Size* | | | | 5 | | | | | 12 first lot;<br>6 other lots. | | |
| 3.3.2.2 *Type of specimen* | | | | Whole block | | | | | Whole block | | Whole block |
| 3.3 2.3 *Age when tested* | | | | | | | | | | | |
| 3.3.2.4 *Storage Of blocks* | | | | Ambient, 24 h | | | | | Saturated, 24 h | | Ambient, 24 h |
| 3.3.2.5 *Loading* | | | | | | | | | | | |
| 3.3.2.5.1 *Loading schemes* | | | | Center loading | | | | | Center loading | | Center loading |
| *3.3.2.5.2 Loading devices* | | | | Round steel bars | | | | | Round steel bars | | Round steel bars |
| 3.3.2.5.3 *Distance between supports* | | | | 1- (L-20 mm) | | | | | l | | l= (L-20 mm) |
| *3.3.2.5.4 Distance to ends* | | | | 10 mm | | | | | 50 mm | | 10 mm |
| *3.3.2.5.5 Φ Supports* | | | | 9.5 to 16.0 mm | | | | | 40 mm | | 9.5 to 16.0 mm |
| *3.3.2.5.6 Capping* | | | | | | | | | | | |
| *3.3.2.5.7 Loading speed* | | | | 0.5 MPa/s | | | | | | | Fast up to 50%.<br>slow for 2 min. |
| 3.3.2.6 *Required strength* | | | | FS= $3Pl/2bh^2$ | | | | | FS= $3Pl/2bh^2$ | | FS= $3Pl/2bh^2$ |
| *3.3.2.6.1 individual* | | | | 3.6 MPa | | | | | | | 3.6 MPa |
| *3.3.2.6.2 Average* | | | | 4.5 MPa | | | | | | | 4.5 MPa |
| *3.5.2.6.3 Characteristic* | | | | | | | | | XS=FS-(1.5.s)<br>4.9 MPa | | |
| *3.3.2.6.4 Aproximation* | | | | 0.1 MPa | | | | | | | 0.1 MPa |
| 3.4 Absorption (Max.) | 5% | | | | | | | 8% | 6% for Type It | 7% | 5% |
| 3.4.1 *Sample Size* | 6 Blocks | | | | | | | | 12 first lot.<br>6 other lots. | 3 Blocks | |

**Table 1. Continuation.**

| Country | ARGENTINA | BRAZIL | CHILE | COLOMBIA | ECUADOR | GUATEMALA | HAITI | MEXICO | PERU | URUGUAY | VENEZUELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **3.5 Abrasion** | | | | | | | | | | | |
| 3.5.1 *Simple Size* | 6 Blocks | | | | | | | | | 3 Blocks | |
| 3.5.2 *Type ot specimen* | Sawed | | | | | | | | | Sawed | |
| 3.5.3 *Testing machine* | Dorry;<br>IRAM 1 539 | | | | | DIN 13 501 | | | | Dorry | |
| 3.5.4 *Abrasive agent* | Sand:<br>pm % Passing<br>850 100<br>600 >95<br>425 <25 | | | | | | | | | Sand:<br>Passing 350 µm.<br>Retained 88 µm;<br>UNIT sieves. | |
| 3.5.5 *Testing Iced* | 0,04 MPa | | | | | | | | | 0.2 MPa | |
| 3.5.6 *Testing Length* | 1 000m | | | | | | | | | 4000m | |
| 3.5.7 *Shape and dimensions of the sample* | Cylinder:<br>Φ 25 mm.<br>h ≤ 70 mm. | | | | | | | | | Prisms:40 mm x 60 mm x Thick. | |
| 3.5.8 *Height or volume loss.* | < 1.5 mm | | | | | 25000 $mm^3$/<br>5 000 $mm^2$:<br>light traffic:<br>15000 $mm^3$/<br>5 000 $mm^2$:<br>heavy traffic. | | | | < 15 mm:<br>only for special traffic. | |
| **4. IDENTIFICATION** | X | X | | X | X | | | X | | | X |

CONVENTIONS:

X: Mentioned. No specific requirement or too long to be included.

CS: Compressive Strength

- P: Total applied load
- A: Total area of the block
- TF: Thickness factor

FS: Flexural Strength

- P: Maximum applied load
- I: Distance between supports
- L: Length of the inscribed rectangle
- b: Width of the inscribed rectangle.
  In Peru, the average width of ruptute section.
- h: Thickness of the block

XS: Characteristic Strength (Compressive or Flexural)

- s: Standard Deviation
- n: Number of samples
- t: Student Coefficient

Ty.: Type

Thick.: Thickness

%Pas.: % Passing

Stren.: Strength

demanding for narrow blocks, without lateral prominencies at the center. The inscribed rectangle also helps to determine where to place the supports and the loading device (bars).

Another singularity about the tabulated standards is that those from Peru and Venezuela require both Compressive and Flexural strength. It is the author opinion that since both tests are used as indirect methods for the evaluation of another characteristic of concrete (abrasion resistance in this case), to have two strength requirements could not help to assure a better quality but contribute to create a constant cause of discrepancies when only one of the requirements is accomplished, since the correlation between the results of both testing procedures is not 100 %.

A recent experience in Haiti, during the modification and consolidation of the specifications for the Urban Development Project, showed that the sulphur capping, If not very precisely made, gives a considerable reduction in the values and a great dispersion of the results so, when this type of troubles are detected and no solution is at hand, it is much better to use plywood, taking into account that the obtained results could be around 5 % over the ones obtained with sulphur, 20 % over those without any capping and 30 % over the ones using cardboard (14).

Another point related with standardization is the precise determination of the shape and size of the paving blocks, not from the point of view of labor health but due to the difficulties to maintain an urban network of concrete block pavements built with different shapes and sizes, specially when the maintenance departments of the public works offices do not have the right structure to do so. This requirement is written in the Haitian specifications, where most of the block making equipment are Besser machines and, as a consequence, the shape is given by means of a code in the catalog of this company.

This argument has been considered very convenient in Colombia, thinking that the local specifications for each city could limit the shqpe to two or three type of blocks in those streets where the maintenance will be performed by the public works office, and giving freedom of shapes and sizes for those pavements in closed urban developments, shopping centers, etc., where the maintenance will be in charge of the owners or administrators.

The standardization process in America (the continent) is in a very advanced stage, meaning that most of the large countries have their own standard. In the list presented in Table 1, there are only three countries missing from those in South America (Bolivia, Paraguay and Surinam). Several more from Central America have local specifications (not included here) and many in the Caribbean follow their own specifications (like Haiti) or those form the European countries of which they make a part or got their independence from. But a lot of work need to be done for a unification, or at least a rationalization, of the standards and construction recomendatios, because the development stages of this technology is very different.

## REFERENCES


1. **ARGENTINA**

INSTITUTO ARGENTINO DE RACIONALIZACION DE MATERIALES. Bloques de hormigón para pavimentos : inspección y recepción. - Buenos Aires : IRAM, 1985. - 12p. - (IRAM, Norma 11 627).

_____. Bloques de hormigón para pavimentos articulados : requisites y métodos de ensayo. -- Buenos Aires : IRAKI, 1985. -- 23p. - (IRAM, Norma 11 626).

_____. Bloques de hormigón para pavimentos intertrabados : requisites y métodos de ensayo. -- Buenos Aires : IRAM, 1985. - 21 p. - (IRAM, Norma 11 656).


[1] This standard is for “articulated" blocks, with keys and holes in their vertical walls for vertical interlocking, without the possibility for taking out one block only. This technology has been used in Argentina, Bolivia, Colombia (in a very minor scale) and some other South-American ountrles, generally under the name of "Biocretos”.

2. **BRAZIL**

ASSOCIAÇAO BRASILEtRA DE NORMAS TECNICAS. Peças de concrete para pavimentaçao. -- Rio de Janeiro : AB NT, 1987. - 4p. - (ABNT, NBR 9 781).

_____. Peças de concrete para pavimentaçao : determinaçao da resistencia a compressao. -- Rio de Janeiro : ABNT, 1987. -- 3p. - (ABNT, NBR 9780).

3. **CHILE**

INSTITUTO CHILENO DEL CEMENTO Y DEL HORMIGON. - Adoquines prefabricados de hormiódn : especificaciones. - Santiago de Chile : IChCH, 1987. - 3p. - (IChCH, S-106).

_____. Ensayo para determiner la resistencia a compresión de los adoquines de hormión. - Santiago de Chile : IChCH, 1987. -- 2p. -- (IChCH, E-301).

4. **COLOMBIA**

INSTITUTO COLOMBIANO DE NORMAS TECNICA. Adoquines de hormigón. -- Bogotá : ICONTEC, 1986. - 4p. -- (ICONTEC, Norma 2 017).

5. **ECUADOR**

INSTITUTO ECUATORIANO DE NORMALIZACION. Adoquines : determinación de la porción soluble en ácido del árido lino. -- Quito : INEN, 1986. -- 4p. -- (INEN, 1 487).

_____. Adoquines : determinación de la resistencia a la compresión. - Quito : INEN, 1986. - 7p. -- (INEN, 1 485).

_____. Adoquines : determinación de las dimensiones, área total y área de desgaste. - Quito : INEN, 1986. -3p. -(INEN, 1 486).

_____. Adoquines : muestreo. -- Quito : INEN, 1986. -- 4p. -- (INEN, 1 484).

_____. Adoquines : requisites. -- Quito : INEN, 1986. -- 5p. -- (INEN, 1 488).

_____. Adoquines: terminogia y clasificación. -- Quito : INEN, 1986. -- 3p. -- (INEN, 1 483).

6. **GUATEMALA**

INSTITUTO DE FOMENTO MUNICIPAL. DIVISION DE OBRAS MUNICIPALES. Normas y especificaciones técnicas para pavimentación con adoquines de concrete. -- Ciudad de Guatemala : IFM, 1987. -- 18p.

7. **HAITI**

HAITI. MINISTERE DES TRAVAUZ PUBLICS, DES TRANSPORTS ET COMMUNICATIONS. PROJET DE DEVELOPPEMENT URBAIN. Specifications techniques. -- Port-au-Prince : P.D.U., 1991. -- P.V.

8. **MEXICO**

MEXICO. DIRECCION GENERAL DE NORMAS. Industrie de la construccion : concrete : adoquines para uso en pavimentos. -- Mexico, D.F.: DGN, 1986. -- (DGN, NOM C-314).

**9. PERU**

INSTITUTO DE INVESTIGACION TECNOLOGICA INDUSTRIAL Y DE NORMAS TECNICAS. Adoquines de concrete : hormigón l-R : pavimentos : requisites y método de ensayo. -- Lima : ITINTEC, 1987. -- 15p. -- (ITINTEC 339.124, Proyecto).

10. **URUGUAY**

INSTITUTO URUGUAYO DE NORMAS TECNICAS. Norma para adoquines de hormigón de cemento pórtland. -- Montevideo : IUNT, 1989. -- 6p. -- (UNIT, 787).

11. **VENEZUELA**

COMISION VENEZOLANA DE NORMAS INDUSTRIALES. Adoquines de concrete : requisites. -- Caracas : COVENIN, 1991. - 9p. -- (COVENIN, 312-012, Proyecto de norma).

12.

HOUBEN, L. J. M., KREEFT, S. G. van der and LEEWIS, M. Specifications and standards for concrete paving blocks : a world-wide survey based on an inquiry by the programme committee CBP. -- P.2-14. // IN : INTERNATIONAL CONFERENCE ON CONCRETE BLOCK PAVING (2 : 1984 : Delft). Proceedings. -- Delft : CBP, 1984. -348p.

13.

MAIN RESULTS of Inquiry into specifications and standards for concrete paving blocks. - P.X-XI. // IN : CONCRETE BLOCK PAVING : INTERNATIONAL CONFERENCE (3 : 1988 : Roma). Proceedings. -- Treviso : Pavitalia, 1988.-- 497p.

14.

GARCIA GOMEZ, John Jairo and HERNANDEZ MUÑOZ, William. Resistencia que deben tener les adoquines. Medellin : Universidad de Medellin, 1983. -- 125p. -- Trabajo de Grade.