EXPERIENCES WITH CONCRETE BLOCK PAVING THROUGH 18 YEARS OF LABOR-INTENSIVE PROGRAMS IN COLOMBIA

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SYNOPSIS

Concrete Block Paving (CBP), like many other foreign technologies, have to be adapted when transferred to developing countries, if they are intended to survive and prosper. It has been crucial for the success of CBP in Colombia, permeating every single corner of the country and adopting very unexpected schemes in the industrial, technical, financial and cooperative areas, to be based on the local needs.

In addition to a prosperous conventional industry, the involvement of several institutions and the adaptation of this technology made CBP to acquire characteristics, referred by Allan Lilley as the "backyard approach". This paper is a resume of what and how, has been done; with emphasis on small-scale, labor-intensive and social-content programs, to produce and pave with Concrete Paving Blocks (CPB); and what should be done in the near future.

1. INTRODUCTION

It is difficult for the author to talk about CBP in Colombia, without being influenced by 11 years of work on this technology and by the character of ICPC as the trade and promotional association of the Colombian Cement Industry.

This paper does not present every particular aspect of CBP in Colombia, some of them considered to be important after years of trial and error in the formulation and adaptation of this technology. Instead of that, it presents a retrospective view of how things evolved, why did they happen that way; and a program for future actions by ICPC or anyone involved in the promotion of it. This paper like other previous ones (1, 6, 7) have a clear purpose: to allow those interested in an alternative focus on CBP, to find the a recount of events and a structure to compare with, to reach faster and better results in similar environments.

2. THE EVOLUTION OF CONCRETE BLOCK PAVING IN COLOMBIA

2.1 Knowing the System

CBP was brought from Nicaragua in 1974, when a commission of engineers, promoters, precasters and ICPC went there to assimilate the technologies used for the reconstruction of Managua after the earthquake of December 1973. Some months later a block producer, Indural, made the first CPB to pave the exterior platform for the Exhibition Palace in Medellín and begun selling them for closed residential groups. To help with the development of the technology, ICPC published its first Manual reflecting the state of the art in 1975.

2.2 Initial Diffusion

With the manual and a few already built projects, ICPC started to lecture around the country to promote the use of CBP as an adequate technology for the local conditions, specially for allowing the use of a lot of labor for the production of the CPB and the construction of the pavement.

Since those early stages ICPC was conscious of the duality in the promotion of CPB with commercial producers and through labor-intensive programs; but there has been a clear idea that each one has a specific field to develop and a social function to accomplish. This second stage lasted some five years and produced such good results like the massive program developed by the IDEA (Paragraph 4.3).

2.3 Technological Development

During the early 80s there were a lot of important projects under construction, not without a few problems. At the same time, a lot of information was coming from abroad. All this was coincident with a decision by ICPC to consider the area of pavements, in all their forms, as a fundamental topic for the promotion of cement.

The first things done were the production and approval of a national standard for CPB and the edition of several manuals to show the advantages and possible applications of CBP, how to produce CPB, a design method for the pavement and a construction and maintenance guide (2). With this resource and a file of slides, ICPC started a series of lectures, at very different levels according to the requirements, talking about CBP in every possible opportunity and location.

At least 44 cities have been covered with activities from 2 hour lectures to 12 hour

courses for a more in-depth knowledge. On-site consulting for CPB production or pavement construction, including workshops for layers, are provided according to the available human resources.

2.4 Promotion

Additional promotional activities have evolved according with necessities. There has been international lecturers coming to present different scopes and national tours with basic lectures, both developed by ICPC with the economic cooperation of precasters and local producers of equipment for making CPB. Additionally, ICPC does some technical lobbying to promote some interesting projects be built with CPB, and has the largest amount of information on CPB and CBP in Latin-America.

2.5 Maintenance

After such a long effort for the promotion of CBP, ICPC needs to direct some of the available economic and human resources to other concrete products. This Maintenance period is expected to be a less active one for ICPC but precasters should play a more active role in the development of the market, offering new products and services and investing in their promotion. To help them to develop those activities, ICPC is cooperating with them for the creation of the Precast Concrete Association, with chapters for masonry blocks, CPB, pipes, etc.

ICPC regularly update the existing publications and is planning a book on CBP, in Spanish, for the Latin-American market. Several cement associations, precasters and governmental offices have asked for this publication in order to use it as a textbook for universities and by professionals in charge of important projects.

3. TECHNOLOGICAL LEVEL REACHEDIN COLOMBIA

There is production of CPB in most of the large cities, at least in the capital cities. In the largest ones there are precasters following international standards, most of them using Columbia or Besser machines. They produce mostly gray CPB and shapes have evolved from large to smaller ones, specially to the rectangle and CB Pavements are built for every possible application: pedestrian, vehicular, heavy loads, industrial floors and, even, there has been some use in ports.

The availability of several publications by ICPC have placed this technology in hands of professionals and common citizens, with a simple-enough approach for CBP to be

used everywhere and by anyone interested in it.

A special interest is placed by ICPC in labor-intensive, small-scale and social-content programs. They are based on nationally produced machines, with a production of up to 80 m²/day, using simple mechanical systems and an electric motor for vibration and with the participation of eight people. The particular approaches used to implement those production or construction programs will be explained in the next paragraphs.

4. PROGRAMS WITH A SPECIAL SOCIAL CONTENT

Social-content programs are those in which there is no profit intention beyond the provision of the service itself, in this case a CB Pavement, counting on the participation of the community in the decision and development of the program or, at least in some of those aspects. But communities are very seldom capable to do it by themselves and require a joint-venture with municipalities, non-governmental organizations, etc. When that cooperation fails, it is never because of the communities.

4.1 Reasons for the Communal Work

It has been expressed, in previous papers, why should a common citizen or a community work directly for the construction or improvement of his own house or, even, the infrastructure. It could be unthinkable in several developed countries where the State is supposed and capable to satisfy every single basic need a person could have. But it is far away or the "reality" of one underdeveloped or developing country, whatever be the parameter to differentiate one from the other.

If the State does not have enough resources and there are unsatisfied needs, the population can take one of two ways: to sit and wait for the State to come and provide everything, or to work for his own development and well-being (Photo 3). And pavements is one of the basic needs, least and last attended by poor States, since life does not seem to depend of them.

Here is where CBP appears, allowing a larger amount of communal cooperation as a cost component than the traditional concrete or asphalt pavements (Photos 5, 6). But extremes are rarely good. Communities can not and should not do everything by themselves. A cooperation between them and a conscientious and cooperative State, not necessarily a rich one, is the best way to solve all those needs. Things given for free are rarely appreciated, but the citizens can not carry the burden to have to pay taxes and, besides that, to have to work and contribute to reach those goals.

.2 Different Schemes for Cooperation with Communities

There has been a great variety of schemes in which the community has been involved with CBP. The basic ones have been:

.2.1 Cooperation between small towns and their citizens

n small towns it is easier to change the way things are done, specially since Mayors are elected by vote. It has made, more than before, concrete block paving to be a matter of government plans and public speeches.

Very rarely small towns have enough resources for paving. Those programs, if ever developed, go very slowly. So the only way to accelerate them is to adopt a cooperative effort. The municipality very often build the pavement but charges every owner of a house in front of them with an amount proportional to the width of the house, or to the area and value of the property, assuming that the value of the dwelling will be increased due to the existence of the pavement. It is what is called valorización" meaning, the increase in value.

This system, often managed by a specialized governmental office, has proven to be good for large cities to update their road structure. But in small towns contributions have to change, and citizens pay for just a part of the pavement, the CPB, or for only the cement in them. In those cases, it could be possible to pay in cash, to bring cement to a predetermined place or to pay in labor if resources are scare. In several occasions this labor is used to haul materials and to make the blocks.

This cooperation scheme have allowed some towns to be totally paved. But the implementation and continuity of those programs depend, almost totally, from the political will of the Mayor in charge. This fact and the relative ease to pave a small town or neighborhood just for reasons of size of the town and durability of the pavement, have made CBP programs appear and disappear, and appear again in several locations.

.2.2 Cooperation between large towns and their citizens

his case is much more complex. If a different scheme is intended beyond large-cale "increase in value" programs, communities have to become contractors, a more ommon situation now that no governmental office is allowed to give any economic elp without a retribution as a service, so contributions are becoming payments.

his was the case of the community of Santa Cecilia, a quarter in Usaquén, one of the

municipalities comprising the great Bogotá. A multi-institutional program was set-up by the local UNO office to generate employment. The community, represented by the Communal Action Board became a contractor for the office in charge of bidding for the construction of all the street infrastructure. With a special legal treatment and a clear preference, they sold the CPB made by them in a small plant inside their quarter and laid the blocks over the base provided and compacted by the City. The result was a less-expensive pavement, to an extent that they were able to pay for it through the "increase in value" system, and got the additional benefit of the contracts for making and laying the blocks (Photos 1-3).

For how long did it last?. Till the whole quarter was paved and a new Mayor came, with less or no direct interest in this type of projects. The plant is now dedicated to produce masonry blocks, with a more continuos demand inside the quarter. It does not mean that the community did not try to compete in the open market. They had good quality and price but a problem with this type of urban programs is the lack of a marketing infrastructure. There are institutions to provide some financing to this type of programs, and information for the technical topics is easily available; but the lack of a social marketing structure or training in those topics makes it difficult for non-exclusively dedicated people.

Something like this happened in Medellín with a group of people who lost their homes after a landslide. They where given a machine, a place and some financing to make CPB, after a donation made by the Japanese. But after they had several thousand square meters of CPB they realized they were unable to sell them. Neither they knew anybody in the construction business nor how to sell the product. So the whole program was liquidated, again after a change in the city administration.

A similar story happened with another program to provide road infrastructure to a zone formerly a dumpsite in Medellín, occupied by those recycling directly from the garbage trucks. The program was started with people from a few blocks, who were required to build the kerb or sidewalk in front of their house and contribute with labor to make and lay the CPB. The City provided the materials, the equipment to make the CPB and the base. After a few blocks were built, the project was dismantled due to a change of the City administration. Some years later the whole quarter was paved by a commercial contract (with city funds) part with CPB part with asphalt.

4.2.3 Cooperation with non-governmental organizations

Colombia has more than 22.000 non-governmental organizations dedicated to solve the housing, health, education, employment and other needs the governmental offices can not solve. The real benefit of this type of institutions is that, generally, they are the leading part in the projects, whether or not there be a governmental part involved. It means that a lot of aspects be considered, balanced and treated with the same care they treat theirs. Most of the times they survive with scarce resources, no bureaucracy and optimization of human and physical resources.

The more memorable case is the one of Aguablanca, a 250.000 people slum district in Cali where the Carvajal Foundation set-up a program to recycle home garbage and with it to pay for the pavement. The community was organized in one committee per block and money was not given back in exchange for the recycled material. Instead of it, the money was kept by the Foundation and assigned to the amount each dwelling was supposed to gather before the Foundation gave the approval to build the pavement in the respective street. The Foundation used the money to buy the materials and to make the blocks. The City built the base and several other institutions contributed: the cement industry with a special discount, the Central Hypothecary Bank with a machine to make the blocks, etc.

4.3 Massive Programs

Massive Programs are not different from those already presented like social-content ones, except for including several communities working simultaneously or consecutively to obtain the same result. Even though they are not common, there has been several of those programs in which critical aspects were detected, and solved in some of them.

The success of a Massive Programs rest in the promoter, a governmental or non-governmental institution which must be in charge of every aspect of the project. And it means everything! because separate communities or groups, learning how to work together and, besides that, using a technology totally new for them, are rarely in a position to be self-sufficient.

It is necessary for the promoter to set very clear technical and economic guidelines, and to have enough human resources to implement them. Critical aspects are the supply of materials (on-time and with the right characteristics); the provision of adequate equipment to make CPB; the design and construction of functional spaces

for the production; the instruction of those who will be involved in production, quality control and use of CPB; and the definition of a clear financial scheme for equipment, materials, honorariums and the recovery of the spent funds, either official or communal ones.

It can not be forgotten that each project must work as a commercially productive unit and budgets must be balanced. Labor or even materials can be provided for free but the final result must be, at least, a break even, including donations when available.

Besides that, the promoter must do some large-scale or common specific tasks: to provide enough technical support for eventual problems, both during production and construction; and to set-up a quality control program to periodically verify if the products fulfill the requirements of the reference national standard. Those two topics are crucial since these production units are not technically capable of solving special problems; and many times they are not questioned and this is taken as a normal thing.

Just think what could be the fate of a program with communities separated up to sixteen hours by mountain roads, and 8 hours from the regional capital, most of the time the only place to do any laboratory analysis. If there is no predetermined program to have samples sent to the laboratory and a technical body to analyze the results and to make the recommendations back to each community, quality will be easily neglected.

But then appears the problem of Who must be the promoter to assure his job is done in all its aspects. This is a difficult answer since interests are partial, most of the times. If it is a governmental institution, the program will have to obey a clear strategic and planning policy, not to a necessity of an administration to project a social-investment image. Quality and technical strength will also be required.

If it is a trade association, it will give the program a direction according to its purpose. A Masonry or CPB Producers Association will not, in general, favor on-site or communal production of blocks since they will compete with its associates, but could coordinate a program for CBP, with units provided by them. A cement producers association, being a less specific one, could develop the work as a whole, both toward production and construction; but for its general character, it is more difficult to decide to spend large resources and to dedicate great efforts to set-up a program for just one of the possible uses or cement.

Two examples may help to clarify these ideas. Five years after the introduction of

CBP to Colombia (1980), the IDEA, a development bank owned by the State of Antioquia, welcomed CBP as a solution for the common requirement for financing pavements in old small towns with old or non-yet-existing service lines (water, sewage, drainage). To use CB Pavements became compulsory and the Technical Department of IDEA analyzed each case, made the designs and helped each small town or village to set-up the production plant and to build the first blocks. But that Technical Department had not enough people to control the now more than 80 municipalities (out of 126 in the state) who have followed this program in different scales; and the frequently changed Chairmen did not see it from the same perspective.

The result was quite positive and helped to demonstrate the feasibility of CBP in small towns and semi-rural areas (Photos 7, 8); but a lot of energy was lost due to problems in several of them with the production equipment, inadequate materials, bad production and construction practices, etc., which could be avoided with a closer watch over them. It should be known that small municipalities do not have yet well equipped public works offices, leaving most of those jobs to the chief foreman; and the State Public Works Office have not enough resources to give advise to every town, just to maintain some roads, bridges and water supply systems.

Another program was developed in Cartagena by the Mayor's office, creating 16 CPB production plants in poor areas of the city, with a lot of unemployed people, to be managed by the Communal Action Boards, and coordinating the construction of the pavement. Even though the first streets were a total success (Photo 4), there was a lack of coordination, originally in the technical area but, mainly, in the financial aspects, so the administration was not capable to maintain the required rhythm of provisions and payments and the program died when a new Mayor came into office. Some of the plants are now producing blocks, an easier to sell product since it is bought directly by the final user without the need for any other cooperative effort like for CB Pavements.

5. TECHNICAL ASPECTS

Technical aspects have proven to be more critical than expected in CBP. They change a lot, depending on the size of the project and the institution in charge of it. It is not the same what could be achieved in a city, with a structured technical body in charge of public works, compared with what is obtained in small and far-away places. It makes the concept "required or adequate quality" something to be considered.

6. COSTS

It is difficult to talk about costs since they are directly related with a specific time and place. CPB have a factory price (before taxes and hauling) of US $ 6,25 and 7,40/m² for 60 and 80 mm, gray units. Pigmented ones to full color, double the cost.

Labor-intensive programs for the production of blocks have a labor component between 0,8 and 1,33 hours-men/m² depending if 8 to 4 men participate in it. The cost of labor in the costs of CPB goes from 22 to 53 %, depending of the production required form the machine, from 24 to 80 m² for 4 to 8 men. This cost is the real reduction in costs if free labor is provided by the community (4).

If labor is provided for the production of CPB and for the construction of the pavement, the reduction in costs could be between 40 and 50% of those resulting from commercial production and paving.

7. FUTURE WORK

After nearly 20 years of block paving and promotion, there is still a lot to be done. But at this level, it is no more the job for a singular institution, not even for a whole group like the producers. The next steps are such that they require the cooperation of those involved, directly or indirectly, in an active or passive way, in CBP (5).

7.1 Public Works (roads) and Planning Offices

This is maybe the more difficult area to work in, specially in those places where these institutions are not technically active in terms of research, innovation, quality and long-term goals. With them it is necessary to work for the implementation of a real policy on pavement management. Without it, any effort will be in vain, lacking a framework for a technical-economic support.

If it is possible to make pavements to be considered as an investment, not as a cost; furthermore to be considered as a public service (like water, energy, communications, etc.) the concept around them will totally change (8). It should result in all the different available alternatives being considered, from design and economy point of view, and contractors to be allowed to present alternative designs according with their possibilities and resources, to improve the result of this common enterprise.

With this investment oriented attitude, longer design periods will appear, something that is "vox populi" in nowadays pavement technology and management. But to reach

this point it is necessary to instruct professionals in both public and private sector about this change of attitude toward pavements, in general, and specifically toward CBP, since this pavement have not the weight tradition and inertia give to the "older" types of pavements (3).

A great impetus is given if an adequate set of specifications is formulated, to be easily adopted by different institutions without much research or verification effort. To implement them it is necessary to follow a familiarization process with the technology and it takes time, patience and resources to gain, in a short time, the strength and "accommodation" others have gained along 100 to 150 years, the same that stone pavements lost in many places or never had in new ones.

To reach the point when concrete block pavements are authorized by governmental offices is as hard as to get them regularly built like the other alternatives.

7.2 Pavement Designers

Every pavement should be designed according with an accepted method, and signed by a Civil or Highway Engineer. For important pavements (any public road or large-scale project), the Engineer must be a specialized Pavement Designer, by education or by verifiable experience. It is also fundamental to redefine what a pavement design should include, specially for block paving. It is necessary to have every construction detail and material specification. Most of the time critical construction details are taken for granted, and neither the designer nor the contractor take care of them.

7.3 Universities

Pavements are expensive and important structures from the safety point of view. Since many engineers build pavements without being specialists, it is urgent to make pavements a compulsory course in undergraduate Civil Engineering. The base for a fair consideration of equivalent alternatives is to know about each one so it is necessary for Pavements courses to teach every type or alternative, at least those with possibilities to be used in the country, and then to set-up the procedure to evaluate in a scientific and fair way those alternatives.

Time has indicated the necessity to constantly review the pavement design methods currently in use, to incorporate new concepts in them and to make the required modifications for the local conditions. One of the basis to perform much of those tasks is the availability of an adequate bibliographical resource for research, study and verifi-

cation, both in university libraries as in those of large consulting offices.

In places where full-time professors are not the standard in universities, it is necessary to establish periodical meetings with pavement professors to provide them with updated information and discuss changes and trends in paving technology and teaching.

7.4 Precasting Industry

With or without a trade association, it is basic to campaign for a responsible approach to quality and to work according to the standard determined for the product. If there is a real interest in the development of the technology it is necessary, additionally to the technical aspects, to work toward the provision of adequate credit or to generate joint-ventures in order to technically update and enlarge the production plants, with emphasis in new and better products.

7.5 Contractors

Contractors are the confluence of several actions and interests. Besides those already mentioned, it is necessary to provide them with adequate equipment and tools, nationally produced or imported, at reasonable prices or with ample financing for the technology to improve in quality.

As the basic tool for construction, it is crucial to design and implement training programs for all level of labor and professionals involved; CPB layers, foremen, inspectors, technicians, etc. It is something where there should be an inter-institutional cooperation. Producers, contractors, trade associations and governmental and private training institutions. The first three get direct benefits from it; the last ones area intended for it.

Training should come naturally after the creation of a conscience of the need to specialize every activity related with paving, as individuals and as companies. If this way of thinking is reached, it will allow the appearing of small sub-contractor companies to perform different activities, no matter the size of the job, allowing quality to descend to the smallest project.

7.6 Areas to be developed

After 18 years of CBP in Colombia, there is a well spread technology with different degrees of confidence, according to the previous experiences in each region. But there is technical objections or false disadvantages to stop its development.

From the applications point of view there is a great possibility to use CBP in small airports since the country, due to the existence of such amount of mountains, depend a lot on air transport. It means that almost every small town had at least al landing strip, and there are a lot of others used by the fumigation companies, specially in those areas with intensive agriculture like sugar cane, rice, cereals, etc. Recent studies have shown that for most airports with open landing strips, it is enough to slightly improve its profile and to cover them with CPB, at a lower cost than for asphalt or concrete, almost everywhere

Ports and freight terminals are becoming more important than before for Colombia since the economy has been open just recently and there is a great increase in commercial exchange with foreign countries. The previously nationally controlled ports are now competing companies so infrastructure has to be updated and enlarged to carry a large amount of incoming containers and other loads.

Up to date a little research has been done besides the one by ICPC and some projects in universities, the last ones dedicated more to evaluate failures than to do creative research. But since governmental office very rarely build CBP, it is difficult to get funding to do so; and the non-existence of a CPB association do not allow to have private funding either.

Their size, the lack of wealth and the struggle to survive has made information exchange among Latin-American countries something rare. But the market integration tendency should bring them to a larger exchange of knowledge and experiences with nearby countries, all with very similar economic, cultural and technological conditions, in order to shorten the route toward development and to help them to achieve a common wealth.

When still there is not the provision of potable water to all the population or when health and education are national priorities, it is difficult to have CBP as a national strategy, something that could be possible specially for its employment content. But at least the central government should create an easier financial and technical structure to give support to small projects for production and for paving.

8. PHOTOGRAPHS



Photo 1. "Santa Cecilia", Bogotá. A mayor street in original state. Note the plant to producing CPB.



Photo 2. "Santa Cecilia". The same street after CB Paved by a Government-Community cooperation.



Photo 3. "Santa Cecilia". Common citizens starting to build concrete kerbs in front of their homes.



Photo 4. "Cartagena". One minor street being paved with labor provided by the community.

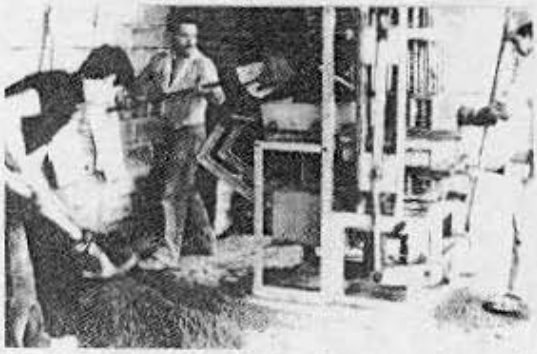

Photo 5. "Sabaneta". Work under progress in a small CPB plant, with paid labor by the City.



Photo 6. "Bogotá". Paving in the communal program coordinated by UNO, in a poor quarter of the city.



Photo 7. "Liborina". A totally paved small town using CPB in one "increase in value" program.



Photo 8. One of the multiple small CB Paved towns in Antioquia, under the program developed by the IDEA.

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