THE INSTITUTIONALIZATION OF CONCRETE BLOCK PAVEMENTS IN NORTH AMERICA

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Segmental paving has been an integral part of the human environment since the beginning of recorded history. Since the invention of the automobile, segmental paving has been on the decline in North America. Evidence is in many North American cities as asphalt has covered clay brick streets. The decline of segmental paving since the beginning of the 20th century has been accelerated by other paving materials being available at a lower cost. Only recently has segmental paving, specifically concrete block paving, stimulated a reversal of this trend. The process in North America is described in this paper. The process, called [11] institutionalization", is directed through the North American industry by the Concrete Paver Institute. The discussion provides some guidance to those countries whose block pavement industry is contemplating the establishment or expansion of an industry association.

INTRODUCTION

The manufacture of concrete block pavements in North America has been doubling every five years since 1980. Some 15 - 16 million square meters are projected for consumption in 1992. Most of the sales are residential or commercial uses. These have been the easiest markets to develop since sales are primarily based on aesthetics. The municipal market has been slowly opening, but still most projects have been sold on aesthetics, usually as part of center city renovation plans.

In 1989, the concrete paver industry came to a cross roads in its development. Individual companies were experiencing success in the selling a basically "pretty" product, but still experiencing frustration through rejection of the paving system by engineers. While research and applications overseas made interesting reading, it was not sufficient to convince most Canadian and U.S. engineers of the benefits of pavers, especially when their cost was higher than conventional pavements. Engineers asked, "Where is the performance data on North American municipal and industrial projects? Where is the research and documentation by US and Canadian universities established in supporting the technical needs of the engineering profession?" North American producers came to realize that no single company could meet the needs of engineers for "domestic" experience and research to support the use of concrete pavers.

In August 1989, the Concrete Paver Institute (CPI) was formed specifically to address the paving markets designed by engineers, namely municipal streets, ports, industrial and airport pavements. The Concrete Paver Institute, or CPI, was created as a division of the 71 year-old National Concrete Masonry Association (NCMA). The CPI is a self-funded, self-governed division that forms its own programs with dues from producers, paving contractors, and suppliers to the industry.

Asphalt and reinforced concrete pavements have enjoyed a secure place in the local, state, and federal government funding for research and construction over the past 75 years. Likewise the asphalt and concrete industries have developed associations to act as technical resources for design professionals, university students, and contractors. Institutions such as the American Concrete Institute (ACI), The National Concrete Pavement Association (NCPA), The National Ready Mixed Association (NRMCA), the Asphalt Institute, and the National Asphalt Pavement Association (NAPA) act as voices for their respective industries. North American institutions such as universities, the Federal Highway Administration (FHWA), the Federal Aviation Administration (FAA), Transportation Association of Canada (TAC), the American Association of State Highway and Transportation Officials (AASHTO), the American Society of Testing and Materials (ASTM) and the Transportation Research Board (TRB) help perpetuate the use of asphalt and concrete pavements.

It was clear that the concrete paver industry needed to relate domestic based information on block paving to many of these organizations and the engineers within them. As a first step, the CPI gathered 22 top pavement experts from the U.S. and Canada in a two day conference during May, 1990. They were asked what the concrete paver industry needed to do in order to give engineers greater confidence in concrete block pavements. They provided a list of ideas for developing existing product specifications, refining structural design methods, developing maintenance and life-cycle information, and establishing demonstration projects. The large list of prioritized ideas provided by the conference participants were then formulated in to a multi-year research and development plan for the Concrete Paver Institute. The overriding theme of the plan is it must be developed in and by North American institutions and engineering consultants.

INSTITUTIONALIZATION OF CBP

The challenge for the CPI is to develop the technical credibility of concrete block pavement while integrating it into government, design, construction, and university institutions throughout North America. This process of integration is called "institutionalizing" the product. Every building product (including asphalt and concrete pavements) must be institutionalized in order gain widespread use by a society. The process consists of six continuous functions. They are:

1. Standard product specifications, design and construction criteria.

2. Research and demonstration to expand the use of the product, as well as understand the limits of its applications.

3. Training programs to insure a ready source of qualified labor to install the product.

4. University curriculum for students in architecture, landscape architecture and engineering schools so that they are exposed to the product and its design early in their professional careers.

5. Continual impi vement of the manufacturing process and control of manufacturing quality through certification.

6. National marketing through advertising, public relations, and sales promotion tools (audio-visual materials, brochures, etc.) to communicate the features, advantages and benefits of the product to the potential users.

The CPI is building a program of institutionalization by making the above process its mission and program. The remainder of this paper will touch on elements of the program with special emphasis on reaching engineers who design and specify pavements.

1. Standard product specifications:

The American Society of Testing and Materials (ASTM) governs the standards for most paving products in the US including concrete pavers. In Canada, the Canadian Standards Association (CSA) promulgates standards for paving materials. The CPI is represented on these groups, reviews standards and makes recommendations on changes. Preliminary discussions have begun on harmonizing the two standards.

Structural design criteria has been developed by the CPI through adopting (with modifications) flexible pavement design procedures developed by AASHTO in 1986. The design procedure is discussed elsewhere in these proceedings. The AASHTO procedure is widely used, not only in the U.S. but its design concepts are used by several countries. The CPI developed an inexpensive software package called PAVECHEK in which new and rehabilitative overlay designs can be made. This is a useful tool in reaching the city engineer, since many who deal with pavements are familiar with the concepts in the AASHTO procedure (1).

Construction design criteria have also been developed into a software program that can be readily used by the architect, landscape architect, or engineer. The program called the CPI Vertex CADalog (2), is a compilation of 50 drawings and specifications for almost every application for pavers. A partial list of the applications include crosswalks, streets, roof decks, interiors, fountains, planters, ports, airfields, details for curbs, manholes, etc. The program has computer aided drawings (CAD) that can be viewed on most personal computers so that the use of CAD software in not needed to see them. The drawings, once selected, can be exported to a CAD program for changes. In a similar manner, specifications can be exported to word processing programs.

The Vertex CADalog unifies the standard details and specifications for a wide range of applications. Since 95 percent of all design professionals use CAD in their offices in North America (3), the program is readily integrated into the working procedures and information systems. The program is both and educational and time saving tool for design professionals.

Besides the CPI developing a standard specification for construction, the Army Corps of Engineers has done likewise for military construction contracts (3). They have also developed a manual for the US Air Force for military applications of block paving in airfields (5).

Like similar organizations, the Concrete Paver Institute publishes a series of technical notes, four to six page brochures similar to those developed by other associations to explain various aspects of structural design, construction, edge restraints, and maintenance.

2. Research and Demonstration

The CPI is investigating the relationship between compressive strength and tensile splitting. The existing compressive strength standard of 55 MPa has caused some confusion among users in that it does not account for different thickness. While some countries have adopted thickness factors to compensate for lower compressive strengths at higher thicknesses, those factors vary. Tensile splitting may overcome this limitation. Results of this work will be complete in early 1992.

Factors that effect freeze-thaw durability of pavers are being investigated, too. The intent of the research is to correlate strength and material characteristics that indicate high freeze-thaw durability. This will enable assessment of durability during production, rather than waiting weeks for test results after making thousands of square meters of product. Again, research results are expected in early 1992.

The CPI has commissioned an engineering evaluation of concrete pavers in streets in five North American cities. The study will include structural evaluations with a falling weight deflectometer and rut measurements, as well as assessment of maintenance and life-cycle costs. This is the first study of its kind in North America. The results will be especially useful in convincing city engineers of the benefits of concrete pavers since it the work is being done an American consulting engineering company.

Other agencies have pursued demonstration projects. Dallas Fort Worth International Airport placed 26,000 square meters in three cross taxiways to conserve down time during construction of an adjacent active runway. The first use of concrete block paving in a U.S. airport saved the airlines over four million (U.S.) dollars in delays at a construction cost similar to reinforced concrete.

The Army Corps of Engineers has conducted a successful demonstration of block paving in an intersection trafficked by 20 fifty ton tanks per day in Aberdeen Proving Grounds, Maryland. The U.S. Air Force has made a federal budget request in 1992 for a demonstration project of concrete block paving on a military airfield.

3. Training for Installers

Training materials are being distributed to the vast network of vocational schools throughout North America. These schools are the training grounds for the construction trades. Several CPI members are already working with their local schools to institute training programs.

4. University Curriculum

Two curriculum guides have been developed, one for engineering students and the other for architecture/landscape architecture students. These will be introduced at university and professional association conferences on educational curricula. The curriculum is designed to be integrated into existing courses on construction, pavement materials, or design courses. Again, several CPI members have already established contacts with local university professors and have been distributing materials and introducing concrete pavers to future design professionals.

5. Improvement of manufacturing processes.

Product certification is viewed as important part of the future of the industry. Refinements on paver block material strength standards will likely be addressed first before establishing a certification program.

6. National Marketing

No single producer can effectively (nor inexpensively) communicate the advantages of concrete pavers to 70,000 architects, 50,000 civil engineers and 15,000 landscape architects, not to mention 80 million home owners. The CPI reaches them through advertising, magazine articles, press releases, trade show exhibits, direct mail, and literature distributed through its members. The thrust of the programs has been to the civil engineer.

CONCLUSION

The institutionalization process necessary for integrating concrete pavers into the design and construction profession has begun in North America through the Concrete Paver Institute. It may take 10 to 15 years from now to realize complete integration of concrete pavers into all institutions that influence pavements.

Acceptance by two key institutions will accelerate the use of pavers. One is AASHTO, with whom the CPI has engaged in discussions to include concrete pavers in their material specification and design manuals. The second is the Federal Aviation Administration (FAA). The first use of concrete pavers in America at Dallas Fort Worth International Airport has opened a potentially vast market. The CPI is seeking support from the FA A for funding approval concrete pavers in airport projects (FA A pays up to 75% of the costs for new airfield pavements in many airports in the United States.) Similar discussions have started with Transport Canada. Approval may be a reality in the next few years which coincides with the continued expansion of airports.

The potential is enormous. The total pavement placed each year in the US and Canada is estimated to be about 75,000 hectares. Approximately 36 billion dollars are spent each year on new and rehabilitated in North America pavements. About 25 percent is spent on roads with speeds less than 60 kph. The paver industry produces about 1400 hectares annually or about two percent of all paving in North America. To express the potential in other terms, the per capita consumption of pavers in the US is 0.04 square meters annually, Canada about 0.16 square meters per person annually. When compared to England and Western Europe nations whose consumption ranges from 0.2 to 1.4 square meters annually, the future for North America looks very promising. Institutionalization of the paving system is vital to making this potential a reality.

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