Tecumseh Street Retrospect

Twenty Years Marks the First Mechanically Installed Street

1985 and 2005: For 20 years, Tecumseh Street with 11,000 sf (1,100 m^2) of mechanically placed concrete pavers enhances a revitalized Oregon Historic District in Dayton, Ohio.

1985 and 2005: Substantial City and private investment in the Oregon Historic District over the past 25 years has made it one of the most desirable places to live being within walking distance to downtown Dayton.

Dayton, Ohio boasts of famous inventors such as John Patterson who in 1884 developed the cash register (now NCR) and Charles Kettering who in 1906 perfected the automobile self-starter (now Delco). Dayton's most notable inventors are the world-famous Wright brothers who successfully flew the first heavier-than-air machine in 1903 and set into motion the aircraft industry. Besides such notables, Dayton has places well known by locals and by some outsiders. Such places include the U.S. Air Force Museum for military aircraft enthusiasts and Esther Price Candies for chocolate lovers.

A more obscure, site for innovation is found on a modest tree-lined street that represents a milestone for the concrete paver industry. Tucked away in Dayton's first

Figure 1. A glimpse of history: Peaking through holes in cracked and deteriorated asphalt in the mid-1980's motivated residents in the Oregon neighborhood to reclaim the buried heritage and character of segmental paving.

neighborhood, the Oregon District, is Tecumseh Street, the site of the first mechanically paved interlocking concrete paver public street in the United States. While the first concrete U.S. paver street project likely dates to 1973 at Roosevelt Island, New York, Tecumseh Street is the first one constructed with German mechanized equipment developed in the early 1980s.

November 2005 marks the 20th anniversary of Tecumseh Street's construction. Only 22 ft (6.7) wide by 568 ft (l73 m) long, interlocking concrete pavement for Tecumseh Street was selected to characterize 80 to 100 year-old clay brick streets found adjacent throughout the historic neighborhood. While Tecumseh Street was one of Dayton's first macadam (sand-asphalt) streets dating back to the early 1900's, most Oregon neighborhood streets are clay brick. Over the years, some of these old brick streets were covered with asphalt (see Figure 1). Some have been resurrected and renovated to enhance neighborhood historic character and indirectly help reduce vehicle speeds.

In the case of Tecumseh Street, a deteriorating macadam surface placed it on the City's repaving list in 1985 (see Figure 2). Rather than shave and pave, i.e., grind out and replace it with more asphalt, staff from the City Planning office proposed interlocking concrete pavement. This suggestion was in part a response historic district design guidelines that call for brick street preservation. The proposal met the approval of the Oregon's neighborhood association and the City's Historic Architecture Review Board.

Concrete pavers were also a reply to an early 1980s renovation of clay pavers on 5th Street, an avenue passing through a small commercial and entertainment area on one end of the Oregon District. The renovation consisted of removing, cleaning and replacing thousands of old clay bricks after replacing 5th Street's foundation. Compared to this arduous hand work, mechanical installation of concrete pavers offered labor savings while augmenting the historic appearance that marks the Oregon District with its beautiful historic homes and trees.

Prior to initiating design, five cores were drilled along the street to reveal a thin, 1 in. (25 mm) thick layer of macadam over a 7 in. (175 mm) thick concrete base. The concrete condition was acceptable but some soft spots indicated friable, crumbly material over a wet subgrade mix of sand, gravel, silt and clay. A topographic survey of the street was completed as the base map for the new street plan.

City staff was first exposed to mechanical installation while attending the Second International Conference on Concrete Block Paving in 1984 in Delft, the Netherlands. Most non-highway streets in that nation are paved with interlocking concrete pavement. Segmental paving has been used there for over 1,000 years to manage settlement from dikes and polders that hold back the ocean. Starting the in the early 1950s, concrete pavers became the modern version of brick paving. Annual use of concrete pavers in Netherlands exceeds 150 million sf (15 million m^2) with a per capita use exceeding 1 sy (1 m^2) per person.

In 1985, City of Dayton staff visited with the manufacturer of the mechanical paver installation equipment in Germany and a paver manufacturer in Cincinnati for advice on the most workable paver pattern and laying procedures. A 42-unit paver pattern manufactured in 90º herringbone pattern offered 11 sf (1 m^2) of coverage per layer. On a well-organized job site, each of these layers could be placed by the machine every 30 seconds.

Prior to placing the pavers, City of Dayton Street Maintenance Department crews ground out the old macadam surface (see Figure 3). They slightly exaggerated the crown in Tecumseh Street's cross section by grinding about 4 in. (100 mm) depth along the concrete curb and gutter. This depth accommodated 1 in. (25 mm) of bedding sand and 3$^1/_8$ in. (80 mm) thick concrete pavers.

Figure 2. Tecumseh Street was deteriorating macadam prior to renovation with interlocking concrete pavement.

Figure 3. City of Dayton Department of Street Maintenance grinds out the old macadam (asphalt) surface and accentuates the crown in the road.

After removing the asphalt, the old concrete surface revealed some soft, crumbly areas that amounted to about 20% of the street area. These were removed and replaced with new concrete including areas the street ends. Water valves and a manhole were encased with concrete so the pavers were not directly against these structures. Steel reinforcing was used on the concrete collar around the manhole.

Bedding sand was screeded and pavers delivered in a timely manner such that the mechanical installation machine operator placed between 3,500 and 4,000 sf (350 to 400 m^2) of pavers each day (see Figures 4 and 5). This included paver compaction, filling the joints with sand and completing the surface with final compaction. The completed surface enabled easier delivery and storage of concrete pavers over three days of paver installation. Unlike asphalt and poured concrete, the completed surface also enabled residents and service vehicles immediate access to the street while paving progressed.

The pilot nature of the project led the paving machine company to donate the mechanical installation machine, driver and a helper for a week. A local paver installation contractor supplied bedding sand, about 650 sf (65 m^2) of edge pavers, cut pavers along one side of the street, compacted and filled paver joints, plus the second compaction and clean up. This company provided an alternate bid price of $4.35/sf ($46.81/m^2) to install the project manually. This was compared to $2.57/sf ($27.65/m^2) which includes the value of the donated machine and labor to mechanically install the pavers as well as the price to assist in installation from the local paver installation company.

Mechanical installation demonstrated its economy compared to manual installation. It also showed cost savings compared to removing, cleaning and reinstating old clay brick pavers as was done on 5th Street and others. In the mid-1980s the City was paying $5 to $6/sf ($50 to $60/$m^2$) for this type of pavement rehabilitation.

The $3\frac{1}{8}$ in. (80 mm) thick concrete pavers met the requirements of ASTM C 936 which requires an 8,000 psi (55 MPa) average minimum compressive strength. The pavers sampled tested at almost 11,000 psi (75 MPa). The units also passed the Canadian Standards Association test for freeze-thaw deicing salt durability. This test was considered important since the street would see deicing salts every winter.

Besides testing the paver units, Tecumseh Street was evaluated for six months by an independent local engi-

Figures 4 and 5. Mechanical installation enabled placement of 3,500 and 4,000 sf (350 to 400 m^2) of pavers each day. This included paver compaction, filling the joints with sand and completing the surface with a final compaction. Concrete collars were cast around manholes and water valves.

Figures 6 and 7. An advantage of concrete pavers is that they don't incur damage from utility cuts. Such damage decreases the life of monolithic asphalt and concrete. This shows a 1986 repair of a gas line on Tecumseh Street. ICPI Tech Specs 6 and 7 provide additional information on repairs to utility cuts.

neering company. They visually surveyed the street and documented elevations to measure any settlement. They noted a few randomly cracked pavers and some joints that needed topping with joint sand. Overall, the pavement settled about $^{1}/_{16}$ in. (1.5 mm) over 6 months which was considered insignificant.

An inspection in summer 2005 showed that pavers have settled about 1 in. (25 mm) around the few utility structures likely due to consolidation of the soil subgrade. The joints were full likely from years of dirt and debris. However, no pavers suffered damage from deicing salts, no snow plow damage and no rutting from tire traffic. Moreover, Dean Clark, City of Dayton District Supervisor for the Street Maintenance Department checked city repair records and no repairs or rehabilitation has been conducted by the City since the pavers were installed in 1985. Given the minor distresses to the pavement, it is expected to last another 20 years. Unlike asphalt streets, Tecumseh Street will not need shaving and paving typical to minor residential asphalt streets at least twice over 40 years.

Utility companies have removed and reinstated pavers a few times over the years. Just six months after the project was completed, the gas company removed pavers and base, repaired a gas line and replaced the pavers. Unlike utility cuts in asphalt and concrete, reinstatement of the concrete pavers left no damage to the surface. Figures 6, 7 and 8 show the repair in 1986. Since 1986 other utility repairs were observed and reinstated with concrete pavers. No utility cuts have been performed in the last five years.

No news is good news in city street maintenance. Tecumseh Street's rehabilitation with interlocking concrete pavements is a quiet success. Innovation speaks softly in an obscure corner of Dayton's neighborhoods to economy and lower maintenance while adding life to a neighborhood. ❖