INTERLOCKING CONCRETE PAVEMENT

Construction Specifications Institute – Spec Data
Product Application Guide
Section 02518 – Interlocking Concrete Pavement
(CSI revised Master Format 02790)

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The ICPI has a series of technical bulletins available called the TECH SPEC series on terminology, design, construction, edge restraints and maintenance. The series includes new publications from time to time. These provide essential information to Engineers, Architects and Landscape Architects on interlocking concrete. Construction detail drawings of many applications are available. Call the R.I. Lampus Company at 412.362.3800.

PRODUCT DESCRIPTION

Applications: Interlocking concrete pavements are appropriate for any application that requires paving. These areas include patios, driveways, pool decks, sidewalks, parking lots, pedestrian plazas, roof plaza decks, roof ballast, roof parking decks, embankment stabilization, gas stations, medians, streets, industrial pavements, ports and airports.

Composition and Materials: Interlocking concrete pavers are composed of Portland cement, fine and coarse aggregates. Color is often added. Admixtures are typically placed in the concrete mix to reduce efflorescence. These materials are combined with a small amount of water to make a “zero slum” concrete. Pavers are made in factory controlled conditions with machines that apply pressure and vibration. The result is consistent, dense, high strength concrete that can be molded into many shapes. Special surface finishes can be produced to give an upscale architectural appearance. These include unique aggregates, colors, shot blasting, bush hammering and polishing.

TECHNICAL DATA

Physical Characteristics: When manufactured in the U.S., interlocking concrete pavers made by ICPI members meet or exceed the requirements in ASTM C936 Standard Specifications for Solid Interlocking Concrete Paving Units. ASTM C936 requires a minimum of 8500 psi (55MPa) compressive strength, an average absorption not exceeding 5%, resistance to abrasion and to freeze-thaw cycles.
Concrete pavers produced by Canadian ICPI members conform to the standard published by the Canadian Standard Association, CSA-A231.2-95, Precast Concrete Pavers. This product standard requires a minimum cube compressive strength of 7250 psi (40MPa) and resistance to freeze-thaw cycles while the test specimen are immersed in a 3% saline solution.

Applications Standards: For pedestrian applications and residential driveways, 2 ⅜” (60 mm) thick paves are recommended. Pavement subject to vehicular traffic typically require pavers that are 3 ⅛” (80 mm) thick.
Interlocking concrete pavements are typically constructed as flexible pavements on a compacted soil subgrade and compacted aggregate base. Concrete pavers are placed on a thin layer of bedding sand, compacted, sand swept into the joints and the units compacted again. When compacted, the pavers interlock, transferring vertical loads from vehicles to surrounding pavers by shear forces through the joint sand. The sand in the joints enables applied loads to be spread in a manner similar to asphalt, reducing the stresses on the base and subgrade.

Benefits: As interlocking concrete pavements receive traffic, they stiffen and increase their structural capacity over time. The structural contribution of the interlocking pavers and sand layer can exceed that of an equivalent thickness of asphalt. The recommended minimum paver thickness will achieve interlock that contributes to the structural performance of the pavement system.
Concrete pavers do not require time to cure. They arrive at the site ready to install, ready for traffic immediately after paving. This can reduce construction time and restore access quickly. The joints between each paver eliminate cracking, normal to conventional asphalt and concrete pavement. Unlike concrete or asphalt, concrete pavers do not rely on continuity of their material for structural integrity. Therefore, utility cuts can be reinstated without damage to the pavement surface. Repair to underground utilities and to local deformations in the base materials can be accessed by removing and later reinstating the same pavers. No pavement materials are wasted or hauled to the landfill. Jackhammers are not required to open interlocking pavements. The modular units enable changes in the layout of the pavement over its life.
Colored units can be used for lane and parking delineations, traffic direction markings, utility markings and artistic super graphic designs. Various colors, shapes and laying patterns can support control and direction of pedestrian or vehicular traffic and can be used as detectable warnings on pedestrian ramps at intersections. The chamfered joint in the pavement surface facilitate the removal of surface water. This decreases nighttime glare when wet and enhances skid resistance. Pedestrian slip resistance meets or exceeds guidelines recommended in the Americans with Disabilities Act (ADA). Snow is removed as with any other pavement. Concrete pavers have greater resistance to de-icing salts than conventional paving materials due to high cement content, strength, density and low absorption.

INSTALLATION

Interlocking concrete pavements typically consist of a soil subgrade, an aggregate base, bedding sand, concrete pavers, edge restraints and drainage (see drawing). Geotextile are sometimes used under the base, over fine, moist subgrade soils to extend the life of the base and reduce the likelihood of deformation. The installation guideline below applies to pedestrian and many vehicular applications. For street, industrial, port and airport pavement designs, consult with a qualified Civil Engineer familiar with local soils, pavement design methods, materials and construction practices.

Soil Subgrade: Once excavation has been completed, the soil subgrade should be compacted prior to placing the aggregate base. Compaction should be at least 95% Proctor density (per ASTM D698) for pedestrian areas and at least 95% modified Proctor density (per ASTM D1557) for areas under continual traffic. Consult compaction equipment manufacturers’ recommendations for applying the proper equipment to compact a given soil type. Some soils may not achieve these levels of density and compaction. These soils may have a low bearing capacity or be continually wet. If they are under a base that will receive constant vehicular traffic, the soils may need to be stabilized or have drainage designed to remove excess water.

Aggregate Base: Aggregate base materials should conform to that used under asphalt. If no local standard exist, the requirements for aggregate base in ASTM D2940 are recommended. The base should be compacted in 6” (150 mm) lifts. The thickness of the base depends on the strength of the soil, drainage, climate and traffic loads. Thickness of the base depends on the strength of the soil, drainage, climate and traffic load. Base thickness under asphalt can typically be used under interlocking concrete pavers. Aggregate bases for walks are 4 - 6” (100 - 150 mm), for driveways are 6 - 8” (150 - 200 mm) and for streets are 8 - 12” (200 - 300 mm)). Thickness may be adjusted depending on site conditions and traffic. The aggregate base should be compacted to at least 98% modified Proctor density (per ASTM D1557). Compaction next to curbs, utility structures, lamp base and other protrusions in the pavement is essential to minimize settlement. Site inspection and testing of the compacted soil and base materials are recommended to ensure that compaction requirements have been met. Compacted base materials stabilized with asphalt or cement may be used in heavy load applications or over weak soil subgrades. The surface of the compacted base should be smooth with a maximum tolerance of +/- ⅜” (10 mm) over a 10’ (3m) straight edge.

Bedding Sand: Bedding sand should conform to the grading requirements of ASTM C33. Do note use mason sand. Stone dust or waste screenings should not be used, as they can have an excessive amount of material passing the No. 200 (75 um) sleeve. The sand should be screeded to an even thickness of 1" to 1 ½" (25 - 40 mm). Do not use the sand to fill depression in the base. These eventually will be reflected in the surface of the finished pavement. Fill any depression with base material and compact. Geotextile may be applied under the bedding sand in certain places. These areas are adjacent to curbs, roof parapets, drains, utility structures and over asphalt or cement stabilized base to prevent migration of the bedding sand into joints or cracks. When applied in these locations, the fabric should be turned up against vertical surfaces to contain the bedding sand.

Concrete Pavers: The shape of the concrete pavers determines the range of laying patterns. 45 to 90 herringbone patterns are recommended in areas subject to continual vehicular traffic. They will give the maximum interlock and structural performance. Some patterns have "edge" pavers specifically designed to fit against edge restraints. Concrete pavers can be cut with a splitter or masonry saw to fit along the edge of the pavement. For streets and industrial areas, pavers no smaller than one-third of a unit are recommended along the edge of the pavement.
Once the pavers are placed in their specified pattern(s), they are compacted into the bedding sand with a plate compactor. For vehicular pavement, the compactor should have a minimum force of 5000 lbs (22 kN) and frequency of 75 - 90 cycles/sec. After the pavers are compacted, sand is swept and vibrated into the joints until they are full. Fine sand can be placed in the joints. It should conform to the grading requirements of ASTM C144. Coarse bedding sand can be used in the joints also, but extra effort may be required in sweeping and compaction to fill the joints. All pavements within 3' (1M) of unfinished edges should have the joints full and be compacted at the end of each day.

Edge Restraints: Edge restraints around interlocking concrete pavement are essential to their performance. The pavers and sand are held together by them, enabling the system to remain interlocked. For walks, patios and driveways, edge restraints can be steel, aluminum, troweled concrete and submerged concrete curb (both recommended for non-freeze-thaw climates), or plastic edging specifically designed for concrete pavers for crosswalks, parking lots, drives, streets, industrial, port and airport pavements. Precast concrete and cut stone curbs are suitable for streets, drives and parking lots. Edge restraints are typically placed before installing the bedding sand and concrete pavers. Some edge restraints such as plastic, steel and aluminum can be installed after placing the concrete pavers.

Drainage: Surface and subsurface drainage should conform to that used on any other flexible pavement.

Pavement Overlay/Inlay: New or existing asphalt or concrete pavements can be overlaid with concrete pavers. The surface of the existing pavement can be ground out and bedding sand and pavers placed in the milled area. Considerations should be given to drainage of excess moisture in the bedding sand during the early life of the pavement overlay/inlay. Drainage can be achieved by drilling/casting holes at the lowest elevations of the pavement or directing drain holes to catch basins. The drain holes should be covered with geotextile to prevent loss of bedding sand. Geotextile may need to be applied at pavement joints and cracks. Cracks larger than ¼" (10 mm) width should be patched prior to placing geotextile, bedding sand and pavers.

Rigid Pavement: Concrete pavers can be set on a bituminous setting bed with neoprene modified asphalt mastic. Pavers can be mortared directly to a concrete base using an acrylic fortified mortar bed. Mortared applications are recommended in non-freeze-thaw regions. Polymer adhesives specially designed for adhering concrete pavers to concrete enable faster installation without the chance of accidentally staining the surface of the pavers with mortar. Bitumen Mastic, mortared, or pavers set with polymer adhesive are not recommended for vehicular areas.

Mechanical Installation: Certain laying patterns can be installed mechanically, saving construction time. Specialized installation equipment enables over a square yard (sq m) of concrete pavers to be placed in succession, rather than one paver at a time. Contact a local ICPI supplier for availability of laying patterns for contractor experienced with mechanical installation equipment

AVAILABILITY AND COST

Availability: Interlocking concrete pavers are available from ICPI members throughout the U.S. and Canada. Check with a local member for available shapes, thicknesses and colors. For more information, please contact the R.I. Lampus Company, P.O. Box 167, 816 R.I. Lampus Avenue, Springdale, PA 15144, Phone 412.362.3800, Fax 724.274.2452.

Cost: Cost will vary depending on the pattern, thickness, color, area and base requirements.

WARRANTY

ICPI paver suppliers will certify that the specified product will meet or exceed the requirements of ASTM C936 or CSA-A3231.2-95 as applicable.

MAINTENANCE

When properly installed, interlocking concrete pavements require practically no maintenance. As with all pavements, they will become soiled over time depending on the amount of use. Contact a local ICPI supplier for information on cleaning concrete pavers.

TECHNICAL SERVICES

Technical information and literature is available from local ICPI members and from the ICPI. This includes technical bulletins, guide specifications, sample construction detail drawings and design guidance for all applications. Write or fax ICPI for a list of publications and a list of our member suppliers and contractors throughout North America.

FILING SYSTEMS

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