Sustainable Pavement & Stormwater Solutions for your Green Initiatives

Planting Trees in Pavements Made Easy

Presentation for:
RESILIÈNT/CITY
Know Your Risk - Reduce Your Risk - Be Resilient
Our mission

- is to create a more livable built environment,
- providing a high level of ecosystem services, and

by using green infrastructure like sustainable pavements, trees, soil, and Stormwater management.
ABOUT US

Pontarolo is a dynamic company, formed by a motivated team, that over the years has been a leader in developing new ideas and successful at commercializing them for global markets.

Pontarolo constantly strives to improve its technological performance through innovations by operating in very technical environments. By establishing operations both in Europe and North America, Pontarolo is fully knowledgeable of the building industry’s global needs and problems.

New products and innovative building technology are in on-going development at Pontarolo Engineering.
ABOUT CUPOLEX-RIALTO

CUPOLEX is a forming system for providing an easy, efficient and fast solution for constructing ELEVATED pavements

- CUPOLEX-RIALTO is a forming system
- providing an easy, efficient and fast solution for constructing an ELEVATED pavement with heights from 500mm (20 inches) to 2500mm (100 inches)
- cutting edge forming system comprises of CUPOLEX domes, pipes and bases that quickly interlock and connect to each other composing a self bearing structure ready for the placement of a concrete slab.
- The elevated CUPOLEX slab supported by the matrix of columns formed by the pipes allows the system for high load-bearing capacities and the elevated CUPOLEX RIALTO structure and the void created below the slab can be used for various purposes and applications.
- All components that make up the CUPOLEX®-RIALTO® forming system are made from 100% recycled plastic.
COMMON USES

• A sustainable and cost effective alternative to Structural Fill

• Creating Rain water/Grey Water Subsurface detention/infiltration Storage tanks and Collection Systems

• A Cost effective and a more structural performing alternative to Structural soil cells - Creating under slab soil layers for Tree Pit Root Protection and Stormwater management

• Creating Crawl Spaces and elevating building foundations above flood levels

• A Solution for Structural Weight limits and for post-construction settlement of sub grades.
OTHER APPLICATIONS

- Radon & Soil Gas (VI) Mitigation
- Alternative to Structural or light weight fill
- Replacing Gravel Drainage Layers
- Replacing Vapor Barriers & Liners
- Concrete Stormwater Detention Tanks
- Concrete Stormwater Retention Tanks
- Solution for Structural Weight Limits
- Refrigeration & Freezer Floors
- Building Green With LEED
- Concrete Subfloor Crawl Space
- Technical/Electrical Sub Floors
- Acoustical Floors
FOR TREE AND STORMWATER MANAGEMENT

Planting trees in pavement made easy by employing advanced concrete design geometry.
CUPOLEX RIALTO SOIL CELLS CONCRETE PAVEMENT

The CUPOLEX SOIL CELL concrete pavement forming system employs advanced concrete design geometry to produce the latest generation of under pavement soil cells for trees that can be adequately provided for in their setting.

- Proper compaction of the soil so that the root system is able to expand more quickly and evenly;
- Greater volume for the expansion of the roots resulting in increased stability of the tree;
- Greater surface area for gas exchange between soil and air resulting in increased oxygenation of the roots;
- Easy installation of irrigation systems;
- Percolation of rainwater allowed in conjunction with pavement drainage;
- The roots, finding the correct oxygenation and the right compaction, do not need to emerge;
UNLIKE OTHER PLASTIC STRUCTURAL CELL SYSTEMS – CUPOLEX IS FORMWORK!

- CUPOLEX is a forming system for providing an easy, efficient and fast solution for constructing a pavement;

- With heights from 300mm (12 inches) to 2500mm (100 inches);

- Comprises of CUPOLEX domes, pipes, bases and a patented bracing system that quickly interlock and connect to each other;

- Composing a self-bearing structure ready for the placement of planting soil and furthermore the concrete pavement;

- The elevated CUPOLEX pavement supported by the matrix of columns formed by the Rialto tubes can be designed to support high load-bearing capacities;

- The elevated CUPOLEX RIALTO structure and the void created below the slab can be used to contain quality and unlimited soil-volumes.
TIME-TESTED AND PROVEN TECHNOLOGY

The placement of the concrete represents one of the last procedures to be completed. There remain a number of operations that are completed directly above the plastic forming system before the placement of the concrete. This is what is termed “impact resistance”.

The positioning of the elements and the layout of the reinforcement are tasks that require the workers to walk on top on the elements with various loads, and sometimes in difficult situations.

CUPOLEX RIALTO, therefore, guarantees superior characteristics of stability and resistance in its structure.

- Elements tested in collaboration with the National Research Counsel

- CUPOLEX-RIALTO has been designed to support work loads and form a monolithic structure with excellent modular strength, both vertically and laterally.
### AVAILABLE HEIGHTS

<table>
<thead>
<tr>
<th>Overall Form Depth</th>
<th>Plan Dimension Installed</th>
<th>Concrete Consumption to top of Domes</th>
<th>Clear Void Equivalent</th>
<th>Soil Volume</th>
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<tbody>
<tr>
<td>cm (inch)</td>
<td>cm (inch)</td>
<td>m3/m2 (cy./sq.ft.)</td>
<td>cm (inch)</td>
<td>m3/m2 (cy./sq.ft.)</td>
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<td>1.25 (0.176)</td>
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<tr>
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<td>0.080 (0.0109)</td>
<td>145 (58.0&quot;)</td>
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</table>
Environmentally Friendly

CUPOLEX-RIALTO® Forms are 100% by weight recycled material and are classified as a ‘Green Building Product’.

CUPOLEX-RIALTO® contributes in numerous categories within the LEED Rating system for residential, commercial, industrial and institutional applications.
Features

• Enables trees to accept, store and transmit water, nutrients and energy
• Provides room in which roots can propagate. Rialto creates space below the pavements which is required for good soil life and the necessary biochemical exchanges to promote tree growth
• Trees are not planted in cramped planting pits and poor subsoil
• Roots do not colonise the area immediately underneath the paved surface, thus preventing structural pavement damage
• Solid and compacted ground for pavements is not required
• Can be designed to support any vehicular traffic
• Trees do not compromise or damage the structural integrity of the paved surfaces
• Urban trees can be adequately provided for in their urban setting
• Provides savings in time and materials compared to other tree and Stormwater management systems
**DESIGN & ENGINEERING**

- Pontarolo Engineering provides all engineered drawings and details relating to the Cupolex Soil Cell system and concrete pavement design that will meet and/or exceed the following criteria:
  - The Cupolex drawings provide the construction details for the access hatches, access for inspection and irrigation to be installed through the Cupolex Rialto system and pavement. The size and locations and specifications of the hatches, surface drainage and irrigation is provided by the Designer.
  - The Cupolex Soil Cell Concrete Pavement System is design to meet and/or exceed the soil volumes required by the City for the tree species proposed that will be calculated and provided by the Landscape Architect;
  - The Cupolex Rialto Soil Cell Concrete Pavement system has been utilized for successful tree planting globally with 20 year track record.

We provide PE stamped IFC drawings, construction training, and installation observation and we work closely with the design team, the contractor, and the owner to ensure the success of the project.
DESIGN & ENGINEERING

DESIGN CALCULATION REPORT FOR CUPOLEX PAVEMENT

The Finite Element Analysis design data refers to the concrete geometry and to the level of reinforcement needed if required, as established according to the founding subgrade soil characteristics and loading types and levels.

The design report is verified through a finite element model in which the soil is represented as a homogeneous material with linear elastic behavior.

The following variables are considered in the Concrete Pavement Design Calculations:

1. Height of CUPOLEX
2. Thickness of concrete above the Cupolex Domes
3. Levels of reinforcement
4. Type of subgrade soil

The static behavior of the CUPOLEX concrete pavement depends on the following factors:

1. Geometry:
   - Dome geometry
   - Minimum thickness of the slab above the Cupolex domes
2. Type of Subgrade Soil
3. Type of Subbase Layer below the Cupolex Concrete pavement structure
4. Loads and Position of loads on the CUPOLEX slab

Three different schematizations are considered in the Design Calculations:

1. Beam grid model (fig.1)
2. Plate model (fig.2)
3. 3D model (fig.3)

A non-uniform contact with the soil is also taken into account (for example different yielding)
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

- EXCAVATE CONFINEMENT AREA
- PREPARE SUBGRADE AND DRAINAGE AS SPECIFIED
- INSTALL FILTER FABRIC AS SPECIFIED
- PLACE & COMPACT SUBBASE AS SPECIFIED
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

- EXCAVATE CONFINEMENT AREA
- PREPARE SUBGRADE AND DRAINAGE AS SPECIFIED
- PLACE & COMPACT SUBBASE AS SPECIFIED
- INSTALL FILTER FABRIC AS SPECIFIED
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• INSTALL RIALTO BASES AS TO LAYOUT ON DRAWINGS PROVIDED BY CUPOLEX
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• INSTAL UTILITIES
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• INSTAL RIALTO TUBES IN BACES
• INSTALL SOIL BRACES
• INSTALL SOIL CAPS
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• FILL THE PLANTER WITH PLANTING SOIL MIX AS SPECIFIED
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• REMOVE ALL SOIL CAPS TO BEGIN INSTALLING CUPOLEX DOMES

Note*  CUPOLEX DOMES DO NOT CONNECT IF SOIL CAPS ARE LEFT IN TUBES
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• INSTALL IRRIGATION TUBES AS SPECIFIED
• INSTALL CUPOLEX DOMES
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• BOX FORM THE TREE PIT AND CURBS

• PLACE REINFORCEMENT WIRE MESH ON CUPOLEX DOMES FOR CONCRETE PAVEMENT AS SPECIFIED
CUPOLEX SOIL CELL SYSTEM
INSTALLATION PROCEDURE

• PLACE AND FINISH CONCRETE PAVEMENT AS SPECIFIED
INSTALLATION PROCEDURE

- PLANTING
- PAVING
CUPOLEX SOIL CELL SYSTEM
Public realms
SOLUTION FOR NEW PAVEMENTS AND PAVEMENT RESTORATION SURROUNDING EXISTING TREES
CUPOLEX SOIL CELL SYSTEM

REPLACING DAMMAGED PAVEMENTS
CUPOLEX SOIL CELL SYSTEM

OPTION FOR CREATING STORMWATER IRRIGATION TANKS
BENEFITS

• Innovative
• Resolves issues involving exposed tree roots
• Cost effective
• Easy design and for application in new projects for restoration
• Simple to install
• Concrete design allows for high load capacity
• Great adaptability
• Environmentally friendly
• Made from 100% recycled plastic
6mm THICK BENT STEEL PLATE COLLAR AS SPECIFIED

DECORATIVE UNIT PAVERS AS SPECIFIED
UNIT PAVERS SUB-BASE AS SPECIFIED
152x152 MD11.1 x MD11.1 WELDED WIRE MESH
570mm x 570mm x H.1000mm CUPOLLEX SOIL CELLS FORMING SYSTEM WITH 150mm THICK CONCRETE ABOVE CUPOLLEX DOMES
150mm GRANULAR 'A' COMPACTED TO 98% SPD AS SPECIFIED

TYPICAL 3.0 m PLANTER SECTION

SCALE 1:50
TYPICAL 3.0 m PLANTER SECTION WITH
CUPOLEX STORMWATER SYSTEM BELOW BIKE LANE

SCALE 1:50
TYPICAL 3.0 m PLANTER SECTION WITH CUPOLE
STORMWATER SYSTEM BELOW BIKE LANE AT TREE PIT

SCALE 1:50
1. **Typical Cupolex Soil Cells Transition**
   - Scale: N.T.S.

2. **Typical Cupolex Soil Cells Separation Section**
   - Scale: N.T.S.

3. **Typical Soil Cells Hatch Detail**
   - Option 1. Through Cupolex
   - Scale: N.T.S.

4. **Typical Soil Cells Hatch Detail**
   - Option 2. With Removing Cupolex
   - Scale: N.T.S.
CUPOLEX
STORMWATER
MANAGEMENT

FORMING SOLUTIONS FOR SUBSURFACE STORMWATER DETENTION AND RETENTION SYSTEMS
STORMWATER MANAGEMENT

THE CUPOLEX SOLUTION

• CUPOLEX® is a forming system for providing an easy, efficient and fast solution for constructing cast in place underground concrete Stormwater storage tanks. CUPOLEX® concrete tanks can be designed at various depths either as shallow or deep tanks.
STORMWATER MANAGEMENT

FEATURES

- High Load Bearing exceeding HS-40 loading
- Can be designed as watertight system
- Custom design and layout
- Applications for pavements or green space
- Streamlined installation supporting required work loads
- Suitable in minimum or no cover applications
- Cost-effective, quick and easy installations
- No liners or geotextile fabric required
- Maximum storage volume up to 98% void space
- Isolator Rows can easily be incorporated in any CUPOLEX tank design with TSS removal efficiency exceeding 90%

- Filter fabric can be used on transfer inlets incorporated in tank to remove Phosphorous, Petroleum Hydrocarbons and Zinc.
- Shipped unassembled, saving costs for freight
- Allows for inlet/outlet pipes and cleanout/observatory ports installed at any location of tank
- Easy access for maintenance & inspections
- Saves space and money
- Engineered Design
- Options for watertight systems
- Can be designed for sites with high water tables
- Time tested technology with over 500 million sq.ft manufactured to ISO 9000:2002 high quality standards
CUPOLEX® provides cost-effective Stormwater Management solutions to engineers, developers and municipalities that are customized for their site specific needs.

Applications include:

• slowing or reducing volume from your project site,

• protecting waterways and maintaining Stormwater quality, or

• storing water for harvesting, redirect or reuse.

CUPOLEX® Stormwater management systems can address all these needs with simple and cost effective concrete forming solutions.
CUPOLEX STORMWATER MANAGEMENT

FOR SUBSURFACE STORMWATER TANKS BELOW GREEN SPACE OR PAVEMENTS
CUPOLEX
STORMWATER
MANAGEMENT

QUICK AND EASY STREAMLINED
INSTALLATIONS
CUPOLEX
STORMWATER
MANAGEMENT

QUICK AND EASY STREAMLINED
INSTALLATIONS
FEATURES

- CUPOLEX® is capable of providing carrying capacities equivalent to conventional slabs.
- Requires less concrete.
- The under slab void reduces the slab’s contact with the base layers.
- Water cannot leach up through the bottom of the concrete slab, providing protection from moisture and humidity.
- The under slab void also allows for the quick, easy and cost-effective installation and repair of buried utilities, such as cables and pipes, after construction.
- The CUPOLEX® system has inherent properties associated with the dome shape which reduce slab curling, when compared to conventional concrete pavements.
- The use of CUPOLEX® can also reduce the need for granular base materials or engineered fill.

- Can also be incorporated into creative Stormwater management solutions below roads and pavements.
- Effective control of expansive soils and frost action below pavements.
- Reduces the environmental impact by saving concrete and conserves valuable aggregate.
- One truckload of CUPOLEX® replaces over 50 truckloads of gravel.
- CUPOLEX® is compatible with conventional slip-form paving equipment, allowing for fast and easy paving.
- CUPOLEX® slab has a low potential for cracking. Furthermore, the low overall variability in strains reduces the potential for fatigue failures.
- The ability of CUPOLEX® to reduce the initial construction costs of concrete pavements can make them much more attractive economically to transportation agencies.
- CUPOLEX® could be integrated into pervious concrete pavements.
- Manufactured to ISO 9000:2002 high quality standards.
SUSTAINABLE CONCRETE PAVEMENTS

REDUCING THE ENVIRONMENTAL IMPACT

- Minimizing the use of natural resources;
- Reducing energy consumption;
- Reducing greenhouse gas (GHG) emissions;
- Limiting pollution (air, water, earth, noise, etc.);
- Improving health, safety and risk prevention; and
- Ensuring a high level of user comfort and safety.
Sustainable Pavements Solutions

Innovative solutions to build more economical, more sustainable, more durable concrete pavements with integrated subsurface Stormwater management.
Sustainable Pavements Solutions
The concrete pavement industry is actively seeking new and innovative solutions to build more economical, more sustainable and more durable roads.

CUPOLEX® is an innovative concrete pavement technology that is evolving the Road and Highway construction industry.

Cupolex Roads have a significantly lower CO₂ footprint thanks to the longer lifespan and the decrease in transport movements compared to traditional road constructions. The void space can be used as (temporary) water storage and thus prevents flooding in extreme precipitation.
Sustainable Pavements Solutions

CUPOLEX® consists of interlocking, modular, dome-shaped, high density plastic units that serve as a permanent formwork within the concrete pavement structure.

The resulting product is a concrete pavement slab with a system of interconnected vault-like voids below the surface.
The dome shape is capable of providing carrying capacities equivalent to conventional concrete thickened pavements, but requires less concrete to do so and also provide additional drainage and stormwater storage.
CUPOLEX® technology can provide significant material cost savings, when compared to conventional jointed plain concrete pavements.

Using linear extrapolation methods, CUPOLEX® pavements are found to be equivalent to conventional jointed plain concrete pavements 230-280 mm thick. This finding indicates that CUPOLEX® can achieve significant cost savings in concrete pavement construction.
Applications

- Highways
- Municipal Roads & Streets
- Parking Lots
- Laneways
- Driveways
- Roads constructed on challenging sites
- Airport Pavements