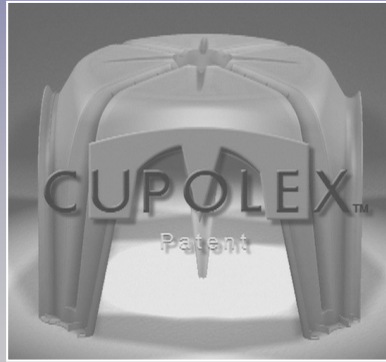
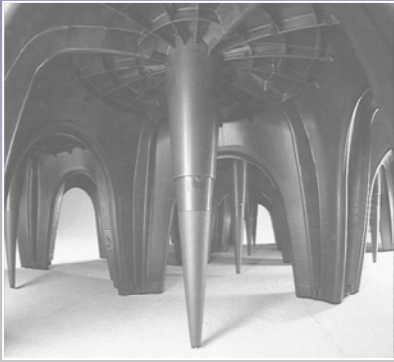
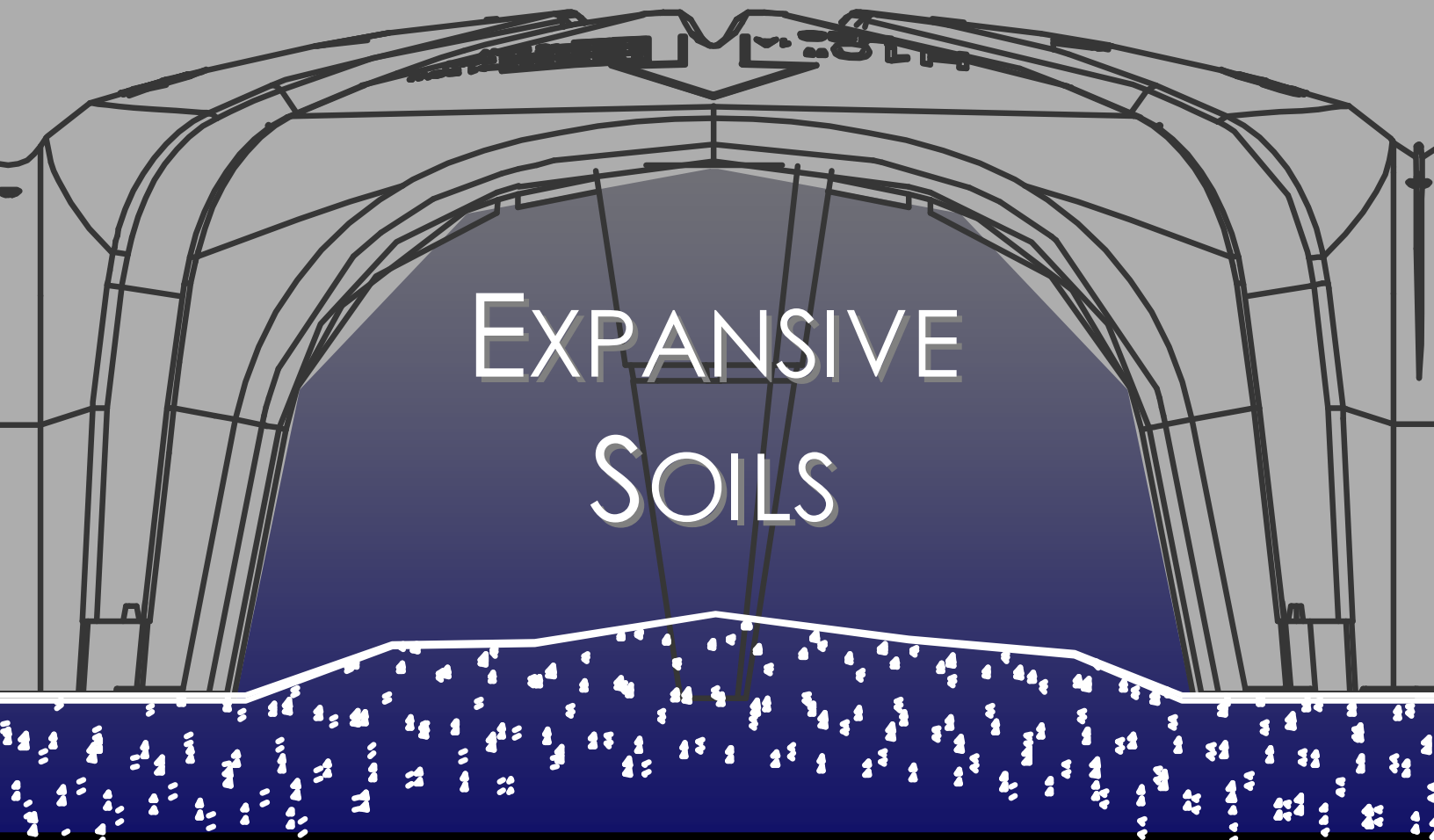


CUPOLEX[®]

BUILDING SYSTEMS



THE CUPOLEX[®] SOLUTION



The problem of “expansive soils” is well known to engineers and builders. It affects construction sites throughout the US and Canada, and particularly those in the desert, Rocky Mountain and the mid continent regions.

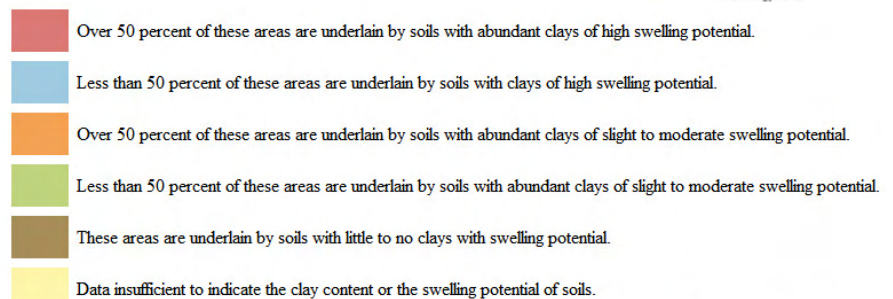
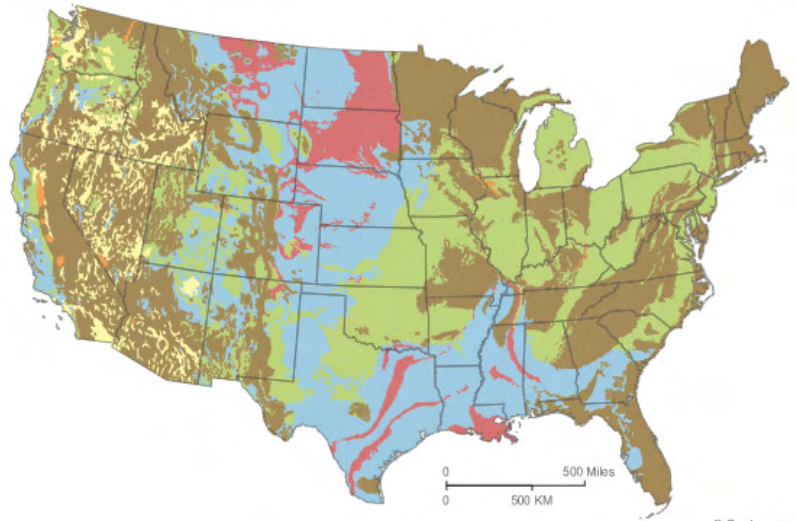
Whether the cause is ‘clay heave’ from naturally occurring shrinkable or swelling clay soils, expansive shale or overburden recovery associated with excavation, if the movement is restrained the lateral and uplift forces produced are massive.

To avoid the build up of these potentially damaging forces, Slabs and foundations must be designed to accommodate any ground movement that is anticipated.

The amount of ground movement that may occur will vary by site, and be dependent on a number of factors including;

- The Plasticity Index of the soil
- The degree of desiccation of the soil
- The removal or planting of vegetation and trees
- Ground levels and excavation depth

A suitably detailed Geotechnical Investigation should indicate the extent of ground movement expected. The Engineer can then design appropriate protection measures to ensure the long term integrity of foundations and ground floor slabs.



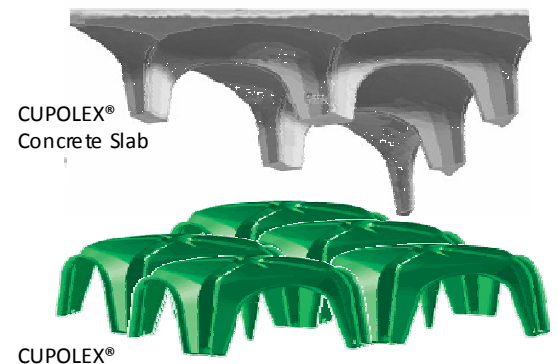
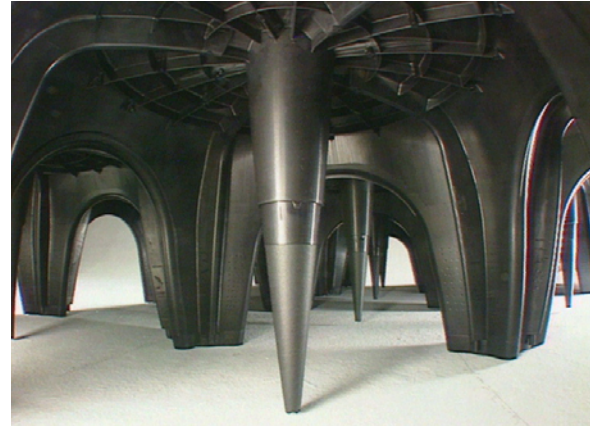
There are many companies offering products in this field with specialist services and claim to offer the most innovative and cost effective solutions . Products commonly used consist of "void forms" made from cartons or expanded polystyrene which create space between concrete structures & expansive soils. These solutions have been around for decades and haven't changed much in that time. They have been known to provide solutions to engineers designing structures that require isolating the concrete from the swelling ground on swelling soils but can also offer significant jobsite challenges, be time consuming, costly and difficult to install. Cupolex is the modern solution available to the designer, contractor and the developer for this purpose and is extremely efficient, economical, easy to design and quick to install.

The old fashioned ways of dealing with the problem

Carton Forms that are placed under structural concrete construction are known to absorb ground moisture and lose strength only after the concrete has set. These types of void forms are limited to work load allowances, they require a protective cover board to be installed on top to protect the forms from puncture and other damage during concrete placement and are known to delay construction if the forms are exposed to rainy weather during installation.

Polystyrene Form products made from environmentally unfriendly expanded polystyrene have also been used for many years. These products are light weight but are expensive to ship and warehouse, are known to damage easily during handling and concrete placement, are difficult to install in windy conditions and also limit work load allowances. In other words, these type of systems are known to collapse prematurely or unexpectedly during reinforcement preparation and during the most critical periods of concrete placement and finishing processes.

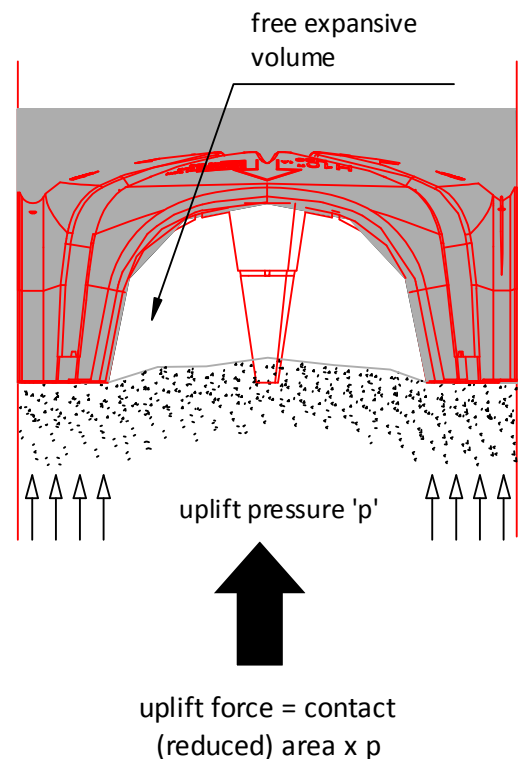
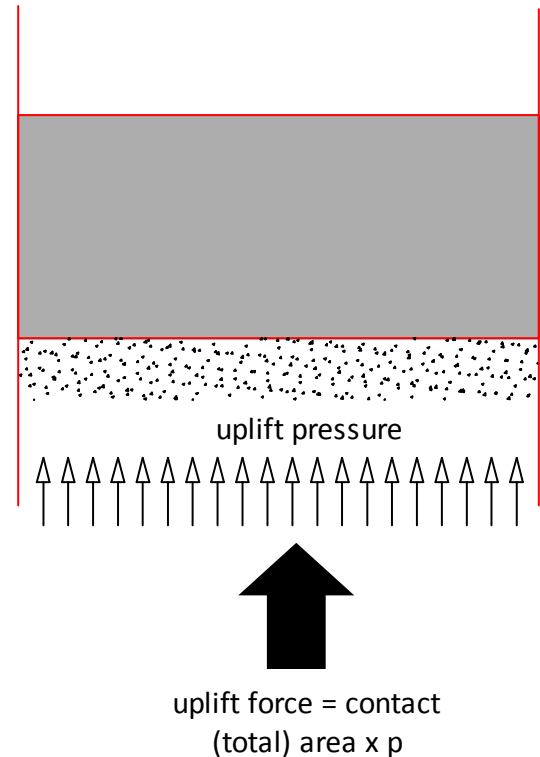
Mat Foundation designs or "waffle" type foundations have also been used for decades to provide adequate support for residential and light commercial slab on grade construction. The soil contact area of the slab for both in-ground ribbed slabs and uniform thickness slabs is equal to the total slab area. This means that when the slab is subjected to uplift forces from soil expansion, 100% of the soil expansion area below the slab exerts force on the slab. The upward force is resisted by the slab stiffness and weight of the slab and structure above. The on-grade mat foundation has emerged as a third-generation post-tensioned slab. The use of trenching or waffle type boxes are used to create a waffle-like pattern, creating a series of ribs in both directions, with post-tensioning tendons located in the ribs. Concrete is then placed creating the on grade mat foundation. They are also highly dependent on workmanship. Often, the trenches are partially caved in by workmen as they place concrete, reducing the strength and effectiveness of the ribbed foundation.



Cupolex Slabs do not Restrain Uplift Forces

CUPOLEX® is a patented concrete forming system made from 100% recycled plastic. Concrete is placed over the modular dome forms to create floating or structural slabs with an under slab void that results in minimal concrete contact with the soil, provides a capillary barrier against moisture - yet uses less concrete and rebar than a standard slab with equivalent load bearing capacity. The unique patented concrete geometry which Cupolex forms minimizes the contact area on the soil which does not restrain the potential swelling of soils beneath the slab. The minimal concrete in contact greatly reduces the lateral and uplift forces that are produced compared to a conventional slab bearing on the soil throughout the total slab area. The Cupolex slab in contact with the soil ranges from 4% to 10% of the total slab area creating a space into which soil can expand without causing damage. Cupolex slabs do not restrain uplift forces and furthermore the dead loads of the concrete slab usually are greater than the uplift forces from the soil resulting in protection of the structure. In extreme swelling soil conditions, suspended self bearing Cupolex slabs would be constructed.

CUPOLEX® is designed to support the weight of any given thickness of concrete plus any common work loading required for placing the concrete slab, during the entire curing period. Unlike other old fashioned void forming systems like cartons or polystyrene, there are no safe load requirements to meet. The only restriction is direct truck loading until the concrete has reached design strength. When ground movement or expansion occurs, old fashioned systems will compress and buckle when a pre-determined load is reached. Other old fashioned systems gradually absorb ground moisture and lose its strength after the concrete has set, creating a space into which soil can expand. Unlike other anti-heave products, Cupolex does not rely on material degradation or buckling for the system to become effective. Once the Cupolex forms are interlocked together without requiring any sealing of the joints or protective boards installed above, the surface is ready to receive the reinforcement and the concrete. The materials used are inert and non-toxic. Cupolex is unaffected by water, snow or ice so, in wet weather or when foundations are below the water table, work can continue without reducing its effectiveness. On sites where water pressure is a potential problem or the water table is expected to rise, Cupolex can also provide a cost-effective solution to deal with these circumstances. Nationally recognized structural and vapor intrusion experts on the Cupolex TEAM are ready to provide you with free tech support and design assistance.



Backed by Research

Detailed studies have been conducted for by National Research Councils and renowned Universities in Europe, Australia and North America, comparing the static behavior of CUPOLEX® Floors and conventional uniform thickened floors on ground. The research was aimed at the definition of numerical models as well as their experimental validation with tests in situ. The project data refers to the concrete over layer and to the level of reinforcement needed, as established according to the soil characteristics and loading types and levels.

Low Cost Solution

The savings in labor and materials the Cupolex system provides over conventional slabs usually can pay for the cost of CUPOLEX® so you protect concrete slabs and foundations from challenging soils and site conditions and provide a highly efficient preemptive venting system at no additional cost. Compare this to the significant additional cost of installing old fashioned void forms or gravel venting layers and liners typically required to control challenging soil problems or vapors below conventional floor slabs.

Installing gas or vapor mitigation systems in buildings with expansive soil conditions

Damage to or movement of concrete slabs due to soil expansion will reduce the integrity of the venting layer or barrier and increase the potential for vapor intrusion; therefore, any system that reduces the potential for slab damage or movement is preferred. Subsurface structures, such as pipes and membranes, could be damaged (e.g., torn or separated) by slab and/or soil movement; therefore, it is preferable not to rely on such systems for vapor intrusion protection. If the potential for movement of slabs or structures exists, the integrity of any "barrier" approach to mitigation is questionable. Besides providing a superior structural solution to limit slab movement, passive or active venting Cupolex slabs substantially reduce humidity and gas concentrations under homes and buildings, thereby mitigating potential vapor intrusion and reducing the effects of under-slab soil swelling.



Since 1995 Pontarolo Engineering and Cupolex Building Systems have built a reputation for creating innovative, cost-effective, solutions to traditional construction problems. A typical example is the development of the Cupolex Aerated Flooring System to alleviate the effects of swelling soils and provide additional advantages and benefits over old fashioned systems such as addressing humidity and vapor intrusion from soils beneath building which is a significant environmental issue for regulators, industry leaders, and concerned building occupants today.

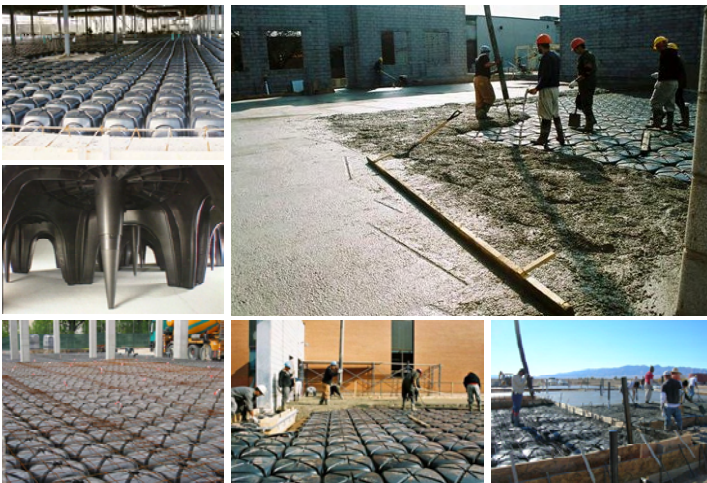
Advantages Cupolex provides are:

- Saves on concrete and reinforcing;
- Reduces fill requirements and compaction to raise subgrade elevations;
- Reduces or eliminate aggregate used for drainage or venting layers;
- Eliminates the need for vapor and gas barriers beneath slabs;
- Provides a preempting mitigation system at no extra cost;
- Delivers engineers more design options than only a suspended structural slab on a beam pile foundation or a post tension reinforced slab design on sites with swelling soils;
- Longer spans can be achieved in pile/beam structural slabs than flat standard slabs;
- Assists designers to deliver Sustainable features which contribute to GREEN or LEED certified building;

Made from 100% recycled materials, Cupolex forms provide maximum structural performance and vapor intrusion protection while allowing construction operations to be completed directly above the plastic CUPOLEX® elements before the placement of the concrete.

Cupolex is a unique forming system for the construction of slab-on-ground “Aerated Floors”. Over the past 15 years the idea of placing concrete over CUPOLEX® permanent void forms have become an increasingly popular foundation method, not only for site conditions involving expansive or poor load bearing soils, but replacing conventional slabs that are very well known to not provide healthy interior environments entirely. Building designers and developers strive to assure better results and protect themselves and their product from criticism and failure. They are constantly facing challenges when designing and installing slabs on ground including the following:

- Structural failure
- slab curling and shrinkage,
- radon,
- vapor intrusion,
- improving indoor air quality,
- reducing the environmental impact of building,
- lowering building costs and the carbon footprint,
- reduce the cycle time of building,
- reduce aggregate use,
- moisture and mold prevention,
- expansive and challenging soil conditions,
- accumulating points for LEED certification.



Both slab on grade and elevated structural slabs on grade can be created using Cupolex. Besides the advantages noted above, there are significant cost savings to the builder and owner by using the CUPOLEX® flooring formwork in the design of Aerated concrete slabs for residential, industrial, commercial and institutional applications in sites with challenging and contaminated soil conditions.

Traditional old fashioned void forming systems for in-situ ground slabs and beams are increasingly being replaced by Cupolex, a quicker and less labor intensive alternative. A trend that is encouraged by the emphasis on fast track build programs, lowering construction costs and a shortage of skilled tradesmen. Reacting to this trend, Cupolex has developed a complete design and supply service for an extensive range of slab formwork systems.

The Cupolex Forms

Cupolex is assembled with two ancillary products called Pontex and Beton Stop. All three products are patented, manufactured from recycled non-toxic plastic and they all reflect Cupolex Building Systems' commitment to quality.

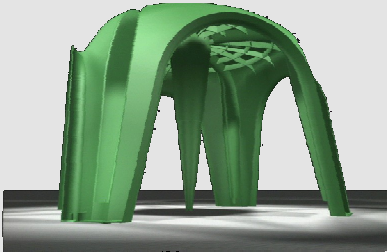
- Quick and simple to install
- Minimizes the need for skilled labor
- Supplied on short lead times
- Tailored to any type of site requirements
- Saves aggregate, concrete and steel
- Speeds construction and saves money



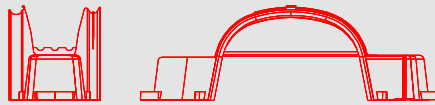
Assembly of the Forms

Each unit easily inter-connects to create a self supporting structure which acts as a permanent form work, replacing gravel, hard fill and provides under slab voids for venting. PONTEX® is an innovative structural element that, combined with CUPOLEX®, can be used to create a one directional or a two directional structural ribbed slab. In order to prevent any voids BETON STOP® provides continuous closures.

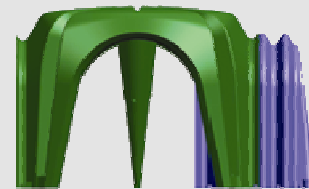
Cupolex



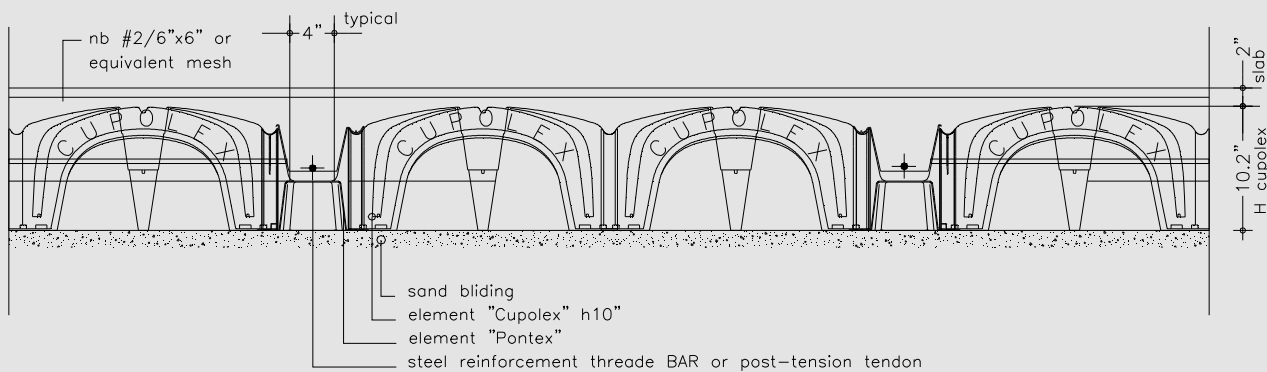
... + Pontex



... and Beton Stop



2 cupolex - 1 pontex



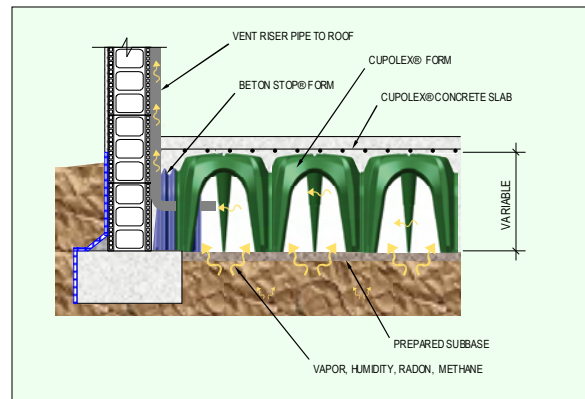
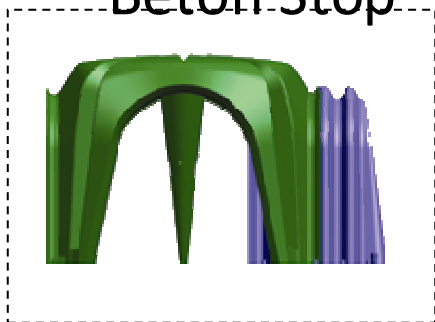
Sites with low expansive to no expansive soil conditions

On sites with low expansive to no expansive soil conditions, Cupolex and Beton Stop units are used to design both standard floor slabs and conventional floor slabs for residential, commercial or industrial projects. Typically a 7inch or 12inch thick CUPOLEX floor slab is used using CUPOLEX H. 5" Forms and H. 10" forms and the corresponding accessory BETON STOP. A welded wire fabric is used in the topping throughout the slab. Additional reinforcing is used where increased load capacity is required such as garage areas or heavy loaded floors. The wire fabric when placed directly on the Cupolex forms is positioned exactly at the elevation required with no need to be lifted up into place. Where top soil layers are thick, higher CUPOLEX® can be used to create a deeper void in the slab. This replaces the fill or gravel that typically is required to bring the slab to level and eliminate the costs associated with importing, compacting and certifying engineered fill. Passive or active venting is recommended under Cupolex slabs. Venting the under slab will reduce humidity levels that assists in controlling the saturation of the underlying soils that lead to swelling of the subbase. Venting Cupolex slabs is also recommended to mitigate any existing or potential vapor intrusion such as Radon, Methane or VOC's in the soil. Conventional Floor Slabs such in replacement of hard fill, a floating slab or providing crawlspaces where conventional block base construction or concrete stem wall foundations are used, the

Cupolex

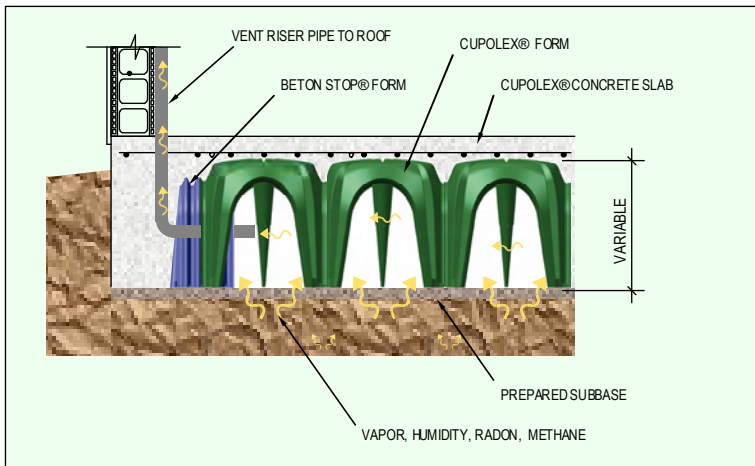


Beton Stop



Sites with low to moderate levels of soil expansion

Sites with low to moderate levels of soil expansion usually require a standard reinforced or more commonly used today, a Post Tension reinforced monolithic, poured slab foundation on grade. Concrete verifications for Cupolex slabs are performed according to national and local standards by using reinforcement threaded bars or post-tensioning tendons. Cupolex forms are installed between edge beams and Beton Stop provides continuous closures to the side opening of the Cupolex forms. The slab and foundation is designed to resist moisture-induced deformations in the soil maintaining the top surface within permissible tolerance. The Engineer designs appropriate protection measures to ensure the long term integrity of the foundations and uses Cupolex to provide protection of the ground floor slabs from being effected from potential soil expansion. Passive or active venting is recommended under Cupolex slabs. Venting the under slab will reduce humidity levels that assists in controlling the saturation of the underlying soils that lead to swelling of the subbase. Venting Cupolex slabs is also recommended to mitigate any existing or potential vapor intrusion such as Radon, Methane or VOC's in the soil.



**CUPOLEX AND
BETON STOP**



**REINFORCING
STEEL**



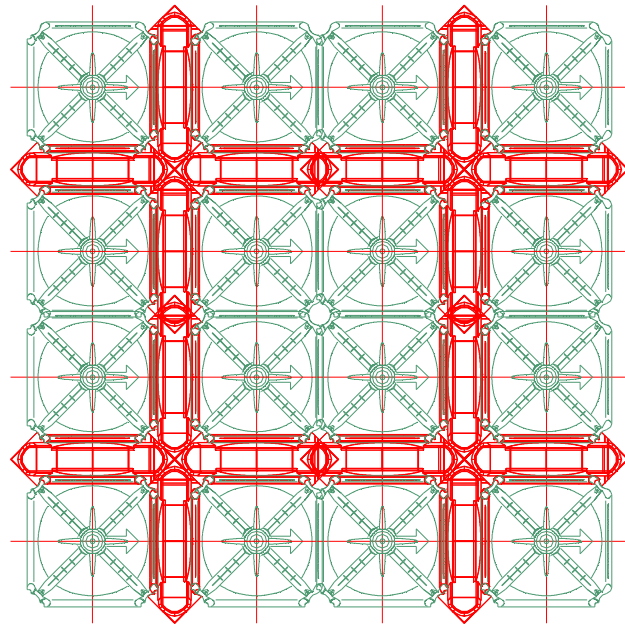
Concrete



**Finished
Cupolex slab**

Sites with high to critical and hydrocolapsible expansive soils

Sites consisting of these types of challenging soils often require very rigid slab designs with appropriate protection measures due to the seriousness structural harm these types of soils can deliver. Cupolex and Pontex units are used to provide a forming system to construct a ribbed slab on grade mat foundation. Beton Stop units are used to form the perimeter and any interior beams. Cupolex with Pontex provides a self supporting structure to form a ribbed foundation system. Cupolex are used to reduce the slab-soil contact area, provide a lighter but stiffer slab than a traditional trenched ribbed slab and have high punching resistance from arch dome engineering principles. Concrete verifications are performed according to national and local standards by using reinforcement threaded bars or post-tensioning tendons. Passive or active venting is recommended under Cupolex slabs. Venting the under slab will reduce humidity levels that assists in controlling the saturation of the underlying soils that lead to swelling of the subbase. Venting Cupolex slabs is also recommended to mitigate any existing or potential vapor intrusion such as Radon, Methane or VOC's in the soil.



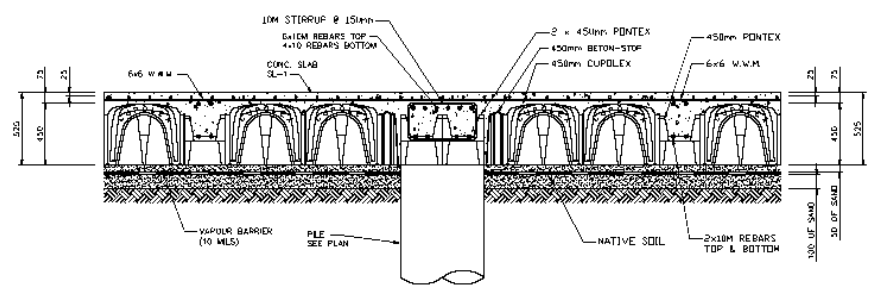
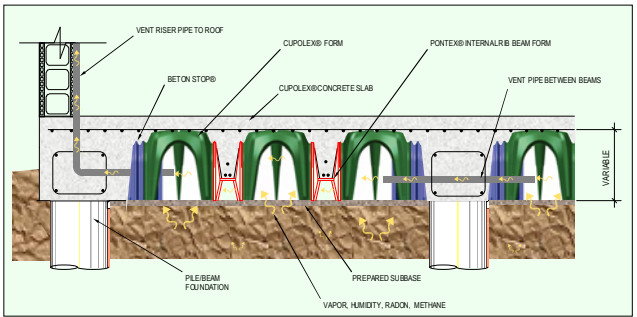
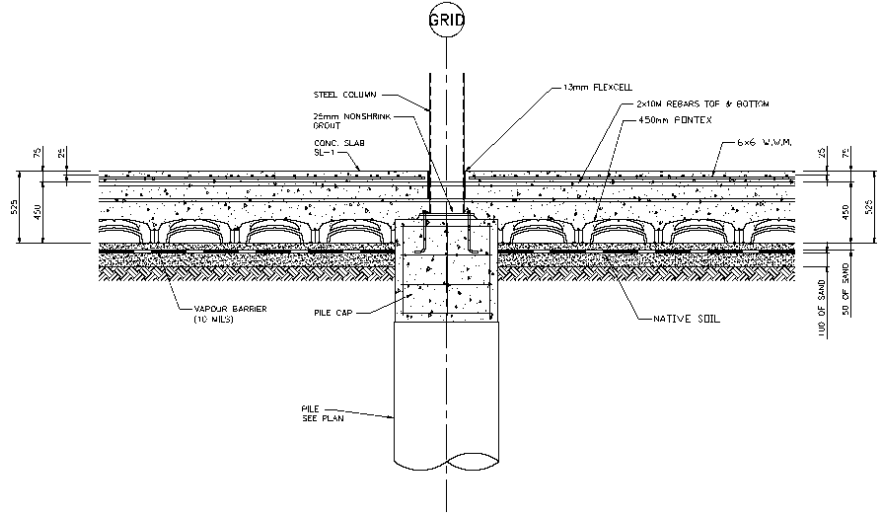
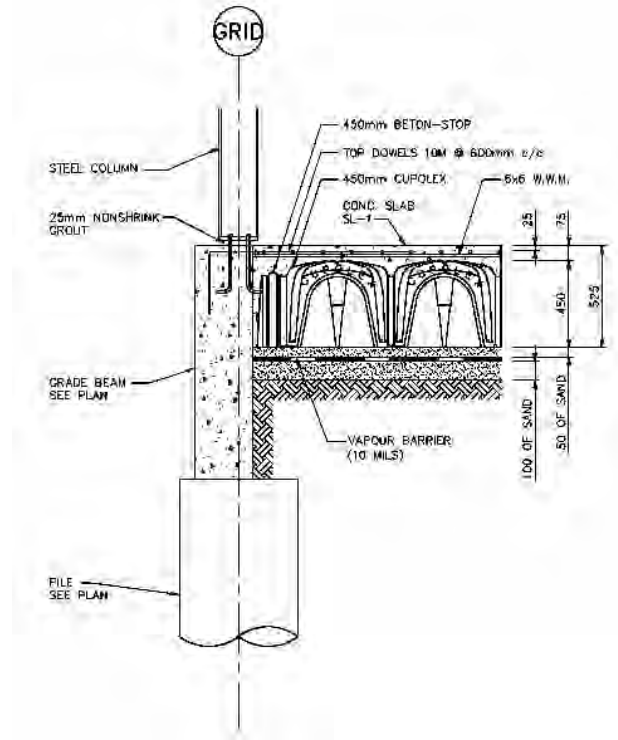
2 Cupolex & 1 Pontex ribbed slab:

- ***Cupolex + Pontex => ribbed foundation system***
- ***Reduced slab-soil contact area***
- ***Lighter than a traditional ribbed slab***
- ***High punching resistance ('dome' effect)***



Sites with low bearing and expansive soils

Cupolex and Pontex units are used to form a ribbed structural reinforced slab that can support itself across drilled piers, pads, intermittent footings, or other concrete work without relying on the soil after the concrete slab has cured. Pontex creates a one directional or a two directional structural ribbed slab and can be used to form the beams spanning between piles. Beton stop can also be used to form deep interior and exterior beams. Different heights of Cupolex forms can also be installed below the beams providing the void required to allow soil to heave freely. Passive or active venting is recommended under Cupolex slabs. Venting the under slab will reduce humidity levels that assists in controlling the saturation of the underlying soils that lead to swelling of the subbase. Venting Cupolex slabs is also recommended to mitigate any existing or potential vapor intrusion such as Radon, Methane or VOC's in the soil.



Performance Characteristics

CUPOLEX® Form	Overall Form Depth		Clear Void Equivalent		Concrete Consumption to top of Forms	
	[mm]	(inch.)	[mm]	(inch.)	[m ³ /m ²]	[cy/sq.ft]
W005	50	2	40	1.57	0.008	0.0010
C1095	95	4	80	3.15	0.014	0.0017
W010	100	4	70	2.76	0.030	0.0036
C1013	135	5	110	4.33	0.030	0.0036
C1020	200	8	170	6.69	0.035	0.0043
C1026	260	10	220	8.66	0.045	0.0055
C1030	300	12	260	10.24	0.042	0.0051
C1035	350	14	310	12.20	0.045	0.0055
C1040	400	16	340	13.39	0.060	0.0073
C1045	450	18	390	15.35	0.064	0.0078
C1050	500	20	440	17.32	0.065	0.0079
C1055	550	22	490	19.29	0.065	0.0080
C1060	600	24	530	20.87	0.07	0.0085
C1065	650	26	580	22.83	0.071	0.0090
C1070	700	28	630	24.80	0.073	0.0095

