## Design & Layout

- The **foundation layer** is composed of an easily-excavated cement-treated material that offers streamlined access to utility lines with the use of just a small power shovel. This requirement necessitates developing a material featuring intentionally weak, yet well controlled, mechanical characteristics.
- The **roadbed face** allows for both slab calibration and water drainage.
- The **concrete slabs** are mechanically independent one from the other. The choice favoured hexagonal slab designs, which display the advantage of completely paving the space while containing no sharp angles. This is precisely the level where square or rectangular slabs tend to lose their effectiveness. The hexagon side length (R) is imposed by the pavement width as well as the allowable mass associated with each slab.
- According to this project, a 7-m pavement width would lead to R = 0.77 m, or slabs 1.54 m² in size. Slab thickness (21 cm) was determined by means of finite element computations, which enabled evaluating the axle positions generating the highest stresses. These computations were validated on two slabs using strain measurements submitted to a static loading. The design steps ultimately yielded an 800-kg mass for each slab.
- A **space of approximately 10 mm needs to be left between slabs**; this space serves to avoid any kind of wedging potentially caused by imperfect placement of the removed slab or by dilatation of the other slabs due to heat exposure. In order to limit the penetration of water and various materials, a flexible elastomeric joint is cast between the slabs.

## Project execution monitoring

Subsequent efforts will serve to validate this concept of the Removable Urban Pavement. Drainage collection systems will be installed onsite at the outset, followed by slab placement. The pavement will be initially opened once first-phase construction has been completed to a point of allowing the other utility lines to be extended. The second construction phase, scheduled for 2009, will require additional work on the utility lines, giving rise to a repeat pavement opening.

This feedback makes it possible to determine whether the various operators have actually mastered this technique and, from the standpoint of the LCPC research project, improved the corresponding technology to ensure nation-wide distribution.

*The LCPC research project entitled "Removable Urban Pavements, 2004-2007" (French acronym CUD) is being coordinated by the LCPC Laboratory, within the scope of research conducted by the Public Works Ministry's RST scientific and technical network. Besides LCPC, this network combines France's regional Ponts et Chaussées laboratories in Autun, Rouen and Trappes, as well as the Rouen-based CER Road Experimental Centre, the Nantes CETE Public Works Research Office and the CERTU Transport Institute (Lyon). The owner partners are the City of St. Aubin lès Elbeuf and the Nantes Metropolitan Government, with financial backing from the Seine Maritime Local Council and CIMBETON (French cement industry). The contract for CUD installation in the municipality of St. Aubin lès Elbeuf was awarded to the contractor SCREG.*

LCPC Laboratoire Central des Ponts et Chaussées

Ville de saint aubin lès elbeuf

# Removable Urban Pavement


Saint-Aubin-lès-Elbeuf

# Background & Key issues

- The subsoil of streets in cities is always filled with layers of various utility lines whose actual trajectory is often poorly known by the utility service concessionaires themselves, given the inaccuracy or, in some cases, absence of previous network drawings.

- This situation has resulted in a random set of trench openings, emergency intervention impossible to schedule, and the timeless image of a jackhammer tearing up pavement just 48 hours after service start-up.

- Consequences:
  - A legitimate **lack of understanding on the part of nearby residents**
  - **Major inconvenience caused to users** due to a repetition of construction activity, exacerbated in commercial and service areas
  - **Excessive costs** for the facility owner, with largely disappointing results in terms of pavement evenness and a **patchwork pattern of surfacing materials**
  - **A waste of noble building materials**, which prove to be relatively incompatible with the **sustainable development** approach favoured by local public authorities.

# Project description

- The procedure consists of seeking the best feasible functional, technical and economic compromise that assimilates social acceptance, reduces operating and maintenance costs for all major facility owners, and optimises investment within the framework of reclassifying urban spaces, as part of a combined environmental and sustainable development vision.

- Solution proposed by the Ponts et Chaussées network of laboratories, consisting of:
  - Hexagonal concrete slabs, 77 cm side length and 20 cm thick
  - No mechanical bond
  - Cast elastomeric joints
  - Bed face made of 6/10 granular materials
  - Foundation layer featuring an easily-excavated cement-treated material.

# Characteristics of the Saint-Aubin CUD

| Type of pavement layout | |
|---|---|
| Layout plan | Straight street 90 x 7 m |
| Joints either visible or invisible | Indifferent |
| Colour and appearance with respect to the environment | An "urban feel" |

| Technical specifications | |
|---|---|
| Platform (stiffness) | PF2 |
| Traffic during the construction phase | 50 trucks/day; total of 20,000 |
| Traffic during the service phase | 10 trucks/day; total of 100,000 |
| Structural life cycle, probability of fatigue failure | 30 years, 5% |
| Skid resistance | Comparable to the conventional solution (0/6 asphalt mix) |
| Comfort, noise | |

| Functions related to pavement removal | |
|---|---|
| Total or partial (aligned with network passages) | Total – pavement alone (no sidewalk) |
| Maximum lifting load of modular elements | 1,000 kg -> weight of elements ≤ 800 kg |
| Minimum weight of modular elements | 100 kg |
| Type of fastening (suction cup, hook, etc.) | Suction cup |
| Opening and re-closing time for a road pit (not including the time required to make utility network alterations) | Opening: 30 min.<br>Closing (including backfilling): 4 hours - Easily-excavated, self-compacting fill material |
| Pit width | Between 0.40 and 2 m |
| Minimum depth of utility networks | 0.60 m (France Telecom phone lines) |
| Maximum depth of utility networks | 1.50 m and greater (sewer line) |