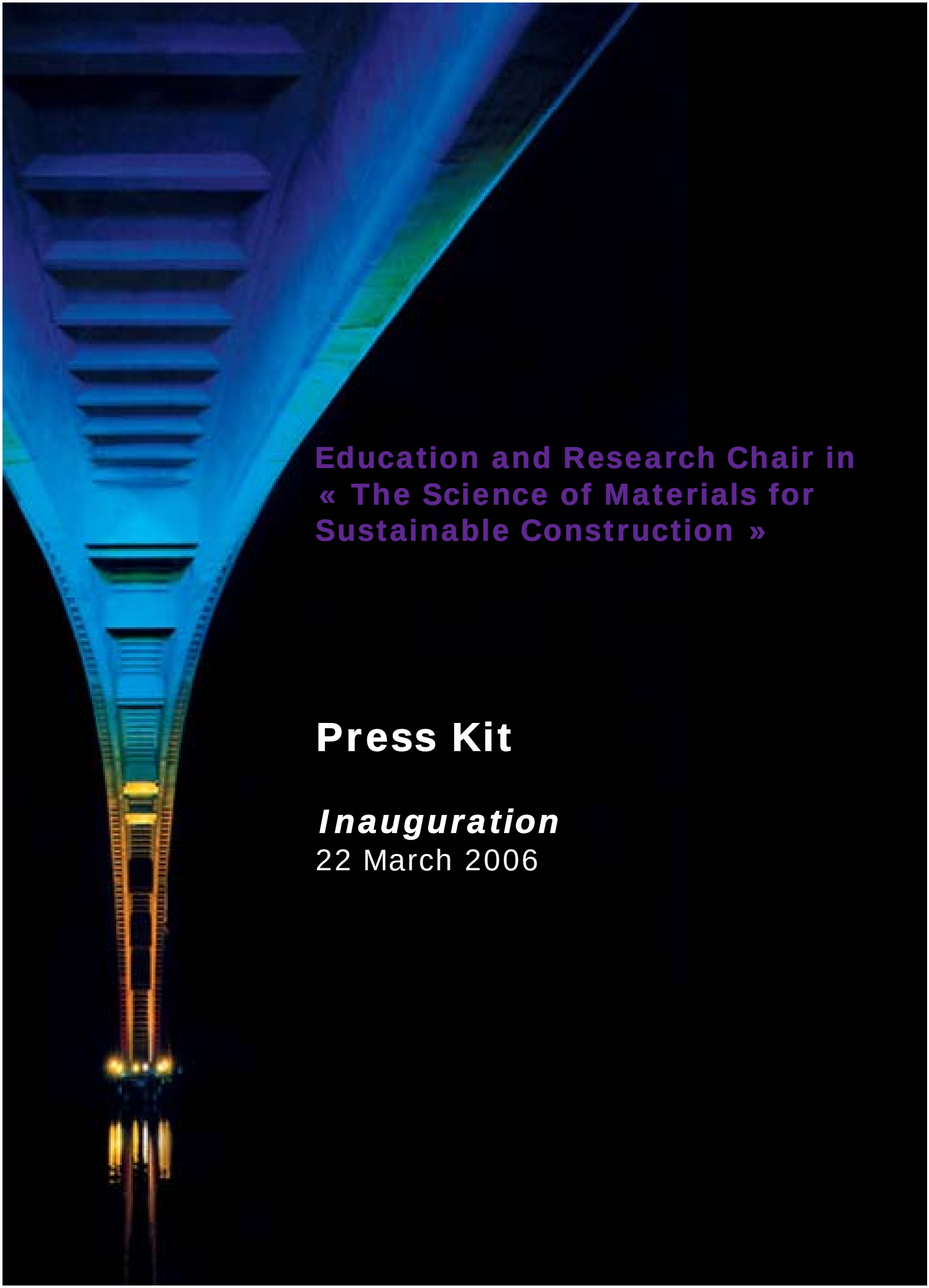

Education and Research Chair in « The Science of Materials for Sustainable Construction »

Press Kit

Inauguration

22 March 2006

ÉCOLE NATIONALE DES PONTS ET CHAUSSÉES

LAFARGE

ÉCOLE POLYTECHNIQUE

Summary

PRESS RELEASE

Paris, March 22 2006

Lafarge joins forces with two of France's leading engineering schools, *Ecole des Ponts* and *Ecole Polytechnique*, to set up a chair in the Science of Materials for Sustainable Construction

Lafarge, *Ecole des Ponts* and *Ecole Polytechnique* announce the creation of a new education and research chair in the Science of Materials for Sustainable Construction. This chair, the only one of its kind in the world, will further a high level, innovative, interdisciplinary approach to materials research, opening huge scope for new construction techniques that are more respectful of the environment, people and the planet.

In the last few years there has been a revolution in building materials, with the emergence of ultra-high performance concretes that are more ductile, more durable and more resistant to abrasion, corrosion and adverse weather conditions. We have also seen the emergence of self-placing concretes, and plasterboards with improved fire resistance, acoustic and thermal insulation properties. The development of these exceptional materials has only been possible thanks to an increasingly rigorous interdisciplinary scientific approach, covering physics, chemistry and mechanical engineering, along with sophisticated observation and digital modeling systems for accurate analysis at nanometric scale. These innovations are transforming the construction industry, revealing vast new horizons for architectural and structural progress.

It is this context that has prompted Lafarge to set up a chair in the Science of Materials for Sustainable Construction, calling on the complementary scientific expertise of two of France's leading engineering schools – Ecole Polytechnique and Ecole des Ponts — in addition to the unique know-how developed at the Lafarge Research Center at Isle d'Abeau. The chair will aim to develop the scientific basis required for an interdisciplinary, multi-scale approach to construction materials engineering, the optimization of the application of these materials, their functional properties and durability under specific environmental conditions.

The new chair fits in with wider-reaching initiatives on sustainable development, with sustainable construction emerging as a key issue as economic growth and urban development lead modern society to approach the natural limits of the planet. Sustainable construction involves many factors, including the sustainable use of natural resources, the reduction of disturbance caused by worksites, better thermal and acoustic building insulation, positive-energy buildings, controlled structural ageing, and recycling of materials and structures. The new chair will help stimulate research in these areas, the aim being to reduce the ecological footprint of buildings, meeting the needs of current generations without jeopardizing the capacities of those to come.

The **course** (Master's level) will start in September 2006, and will be open to Ecole des Ponts and Ecole Polytechnique graduates, plus French and foreign graduates (engineering school or Bachelor's), post-doctorates and research scientists.

Teaching will draw chiefly on the expertise of the Mechanical Engineering and Physics Departments of Ecole Polytechnique and on the specialist know-how developed by Ecole des Ponts in thermodynamics and thermomechanics in complex continuous environments.

Teaching personnel will also include engineers and research scientists from the Lafarge Research Center and professors and researchers from prestigious international universities such as the Massachusetts Institute of Technology (MIT), Berkeley and Princeton.

Research will be organized in projects lasting several years on major issues, combining a strong industrial emphasis with a solid scientific content. Typical research topics include the environmental behavior of plaster, the deferred behaviour of concrete, the reaction of concrete to freezing, and the analysis of CO_2 emissions generated during the life cycle of concrete.

The **Directors of the Chair** in the Science of Materials for Sustainable Construction are Patrick Le Tallec (Ecole Polytechnique), Olivier Coussy (Ecole des Ponts) and Paul Acker (head of Structured Materials Department at Lafarge Research Center, Isle d'Abeau).

The **opening ceremony for the new Chair** will take place today, March 22 2006, at the Lafarge Research Center at Isle d'Abeau, near Lyon, with proceedings overseen by Dominique Perben, Minister of Transport, Infrastructure and Tourism. Yannick d'Escatha, the Dean of Ecole Polytechnique, Philippe Courtier, Director of Ecole des Ponts, Bertrand Collomb, Chairman of Lafarge and Bruno Lafont, CEO of Lafarge, will be present at the ceremony.

Other information

Lafarge is the world leader in building materials, with top-ranking positions in all four of its businesses: Cement, Aggregates & Concrete, Roofing and Gypsum. With 80,000 employees in 75 countries, Lafarge posted sales of Euros 16 billions in 2005.
Lafarge is the only construction materials company to be listed on the 2006 '100 Global Most Sustainable Corporations in the World'. Lafarge has been committed to sustainable development for many years, pursuing a strategy that combines industrial know-how with performance, value creation, respect for employees and local cultures, environmental protection and the conservation of natural resources and energy. To make advances in building materials, Lafarge places the customer at the heart of its concerns. It offers the construction industry and the general public innovative solutions bringing greater safety, comfort and quality to their everyday surroundings.

Ecole Polytechnique enjoys a long tradition of scientific excellence in French higher education, fulfilling its mission of training people capable of designing and running complex innovative endeavors at the highest international level. In addition to a very solid multi-disciplinary scientific core, its four-year engineering degree courses also include modules in humanities, ethics and sports, and place a strong emphasis on interaction with business and industry. Ecole Polytechnique also runs 19 master's degree courses and receives over 400 PhD students every year. The student population of 1500 includes 30% from outside France. The teaching staff numbers 400, and there are 600 researchers in 21 research laboratories. Ecole Polytechnique is a member of ParisTech.

Ecole Nationale des Ponts et Chaussées pursues a dual mission of teaching and research, training engineers and doctors with top-class scientific, technical and general skills in civil engineering, development, construction, transport, industry, economics and the environment. It has 1300 students, including 160 PhD students (35% of students are from outside France), and around 300 researchers at 13 laboratories. Operations are structured by two supporting networks in the form of ParisTech and the Marne la Vallée Polytechnicum.

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Why develop research in building materials?

Developing high-performance building materials

In the last few years there has been a revolution in building materials, with the emergence of ultra-high performance concretes that are more ductile, more durable and more resistant to abrasion, corrosion and adverse weather conditions. We have also seen the emergence of self-placing concretes, and plasterboards with improved fire resistance, acoustic and thermal insulation properties. The development of these exceptional materials has only been possible thanks to an increasingly rigorous interdisciplinary scientific approach, covering physics, chemistry and mechanical engineering, along with sophisticated observation and digital modeling systems for accurate analysis at nanometric scale. These innovations are transforming the construction industry, revealing vast new horizons for architectural and structural progress.

Paulo Monteiro, Professor at Berkeley:

"The general public does not always associate new materials with fundamental research. Yet the development of new building materials presupposes an overall understanding of the mechanisms responsible for their solidity and durability. This is why a precise exact knowledge of the microstructure of these materials is necessary."

Professor Franz-Josef Ulm, Vice Professor of Civil and Environmental engineering, Massachusetts Institute of Technology (MIT), USA:

"In the context of a partnership with Lafarge, I study the mechanical properties of cement at the nanometric level (10-9m), in other words infinitely small. It is a particularly interesting scientific approach, because it reveals previously unknown, yet universal, properties. Like the human genome project, and the gene therapy that has developed from its decoding, this research will make it possible to design extremely high performance materials and to prolong their useful life. Concretely, I test materials in partnership with researchers from Lafarge. In my view, Lafarge is the only company in the construction industry that has mastered a nanometric approach to materials."

It is in this context, therefore, that Lafarge decided to create a university Chair in "The Science of Materials for Sustainable Construction", bringing together the complementary scientific skills of Ecole Polytechnique and the Ecole des Ponts and the unique expertise of its Research Center at L'Isle d'Abeau in France.

Promoting sustainable construction

By 2025, the world's population is expected to increase by 33% to nine billion inhabitants. Two billion more individuals will need housing, places to work and the infrastructure to ensure mobility. All of this will have to be built – but in a different way. The building industry alone consumes about 40% of the natural resources and energy produced in the developed countries and is the source of 40% of world greenhouse gas emissions, mainly through the use of buildings throughout their life span.

Sustainable construction attempts to address this issue. First created in the 1990s, this concept is based directly on the main principles of sustainable development. For the construction industry, it means limiting the impact of buildings while guaranteeing higher-quality aesthetics, durability and resistance. Sustainable construction takes into account the entire life span of a structure and aims to reduce the impact of each phase - from the initial choice of building materials through final demolition. It involves the sustainable use of natural resources, worksite nuisance reduction, thermal and acoustic building insulation, positive-energy buildings, controlled structural aging, and recycling of materials and structures.

The Chair in The Science of Materials for Sustainable Construction will help stimulate research in these areas, to reduce the ecological footprint of buildings and meet the needs of current generations without jeopardizing the capacities of those to come.

Paulo Monteiro, Professor at Berkeley :

"A major theme is that of the material longevity. A useful life of about fifty years is no longer acceptable. Consequently we are working on developing a new generation of materials with a much longer product life."

Yves Malier, *Académie des Technologies*, former head of ENS Cachan school:

"Aside from their obvious mechanical advantages, new ultra-high-performance concretes herald in substantial social and environmental progress. These materials will bring radical changes to working conditions on construction sites and prefabrication plants, with systematic pumping, greatly reduced noise and vibration, rapid strength build-up, rheology adaptable to nature and dimensions of structure, etc. This means a great improvement in the workplace environment, higher safety levels, fewer worksite materials, much less neighborhood nuisance, and shorter construction times."

Jacques Ferrier, Architect and author of the Hypergreen concept in partnership with Lafarge (see p.18):

"Architecture of the 21st century will have no other choice but to be environmentally responsible! We must work to minimize the overall impact of buildings."

The Chair in «The Science of Materials for Sustainable Construction»: the only one of its kind in the world

The goal of the Chair: To create a world center of excellence in the science of building materials for sustainable development.

Initiated by **Lafarge** the chair aims to develop the scientific foundations required for an interdisciplinary, multi-scale approach to construction materials engineering, the optimization of the application of these materials, their functional properties and durability under specific environmental conditions.

Ecole des Ponts, Ecole Polytechnique and Lafarge, are joining forces to create an education and research program that is unique in the world. It will further a top-level, innovative interdisciplinary approach to materials research to accelerate the pace toward sustainable construction.

The teaching and research chair takes an original, avant-garde approach that combines the most advanced expertise in the fields of physics, mechanical engineering and chemistry to create an international-level curriculum and search for excellence in the science of materials for sustainable development.

The research team will be supported by the renowned expertise of the mechanical engineering and physics departments of the Ecole Polytechnique, the leading expertise developed by Ecole des Ponts in thermodynamics and thermo-mechanics in complex continuous environments, and the unique industrial expertise of the Lafarge Research Center. Special contacts will be developed with the greatest international universities working in the sciences and engineering of building materials.

This master's program will be one of the options offered by Ecole Polytechnique and Ecole des Ponts. It will focus on the preparation of a thesis with support from CIFRE research training contracts or postgraduate scholarships.

Level of studies required: The course is open to graduates (Bachelor's) of Ecole Polytechnique and Ecole des Ponts Bachelor's and other engineering schools.

Launch: September 2006

Academic Directors of the Chair:

~ Patrick Le Tallec, Ecole Polytechnique
University Profesor, Ph.D., Doctor of Sciences, Former engineer of Ecole des Ponts, Professor of Ecole Polytechnique, vice - President of the mechanical engineering department of Ecole Polytechnique

~ Olivier Coussy, Ecole des Ponts
Director of research at the Ministry of infrastructure, Director of the Navier Institute, Ph.D., Doctor of Physical Sciences, Civil engineer of Ponts

~ Paul Acker, Lafarge
Director of the "Structured materials" Competency Center in LCR (Lafarge Research Center), Doctor of Ecole des Ponts, hdr, Former Director of research in the central laboratory of les Ponts in pre-cast concrete, Bachelor of Ecole Centrale

Ecole Polytechnique runs research partnerships with many leading organizations in French research and industry. All of the school's 21 laboratories are governed jointly by Ecole Polytechnique and CNRS (the French national research institute). Partners are brought in on specific projects, in areas including information science (with CNRS, INRIA and Paris Sud), optics (with IOTA, ONERA and Thales), electronics (with Thales), and biology (with INSERM). International research partners include CERN, NASA and other research laboratories. Research contracts amount to around €10 billion per year, and there is a business department for innovative startups on-site. A number of teaching and research chairs have been set up with industrial partners, on sustainable development (with EDF), complex systems engineering (with Thales), innovation management (with Arcelor, Dassault Systèmes, Renault and Valeo), and nanosciences for large-substrate electronics and flat screens (with Samsung).

For **Ecole des Ponts**, the decision to take part in the new chair was prompted by a growing awareness that progress in research on construction materials requires a multi-disciplinary approach, and by a strong conviction of the need for industry to be closely involved in research. The new chair, set up to facilitate innovative research in construction materials, and effective application of research through a strong partnership with a leading company, fits in with the school's overall strategy of promoting postgraduate qualifications and effective crossover into business life.

A program organized around six thematic modules

The Chair offers students a high-level education, one that proposes the latest scientific knowledge, the acquisition of technical know-how, a mastery of methodologies and industrial tools, as well an understanding not only of the challenges of sustainable construction, but also the economic constraints of the business world.

The program

The course is organized around **six thematic modules** that represent the fundamental scientific disciplines. Students will study industrial applications based on industrial and social issues that have generated major scientific advances in recent years. The modules are:

~ ***Economics, sustainable development and management of the CO_2 emissions market***
Presentation of the economic, environmental and social stakes associated with the manufacture and application of building materials. Analysis of the life cycle of concrete. Market for CO_2 emissions trading.

~ ***Physicomechanical characteristics of porous environments***
Building materials are porous matter subject to various physical phenomena: hydric transport, sorption, crystallization, internal reactions, thermo-hydro-mechanical coupling. This module aims to understand these different phenomena in a unique environment, and to experiment with them in the laboratory.

~ ***Physicochemistry of building materials***
Physicochemical mechanisms, that are triggered during hydration of hydraulic binders (such as cement), and their interaction with the environment. The Study of key drivers to modify these mechanisms.

~ ***Rheophysics and soft matter***
The study of the rheophysical behavior of viscous pastes and mixtures. Applications to the formulation of materials in order to facilitate their use under all conditions, reducing their environmental impact, and improving the quality and aesthetics of the final structure.

~ ***Digital simulation and methods for changing scale***
Presentation of different approaches and digital methods to better understand the multi-scaled nature of building materials, from the smallest nanometer to the full size of the structure.

~ ***Disordinate structures and physical tools***
Presentation of the most recent results in the observation and physical characterization of the microstructure of materials.

The Research program

Research will be organized in projects lasting several years (master internship in research labs, thesis, and contracts) that address major issues with strong industrial applications and substantial scientific content.

Some examples of research themes include:

~ ***The Environmental behavior of plaster***
The challenge is to guarantee the durability of plasterboard's mechanical performance in environments with variable humidity.

~ ***The Deferred behavior of concrete***
The challenge is to predict the long-term behavior of major structures (bridges, nuclear power plants, etc…)

~ ***The Reaction of concrete to freezing***
The challenge is to develop types of concrete that are more resistant to freezing damage, especially in countries like Canada and the United States.

~ ***The Analysis of CO_2 emissions generated during the life cycle of concrete***
The challenge is to develop a life cycle that limits the CO_2 balance of concrete.

An international program

The Chair works in close collaboration with international experts in the sciences and engineering in building materials from the world's top academic centers of excellence.

~ Conferences with international professors, including:
~ Pr. R. James Kirkpatrick, University of Illinois, Urbana-Champaign
~ Pr. Paulo Monteiro, Berkeley
~ Pr. Leo Pel, Delft
~ Pr. George Scherer, Princeton
~ Pr. Franz-Josef Ulm, MIT

~ ***International student exchange programs***

~ ***Organization of international internships***

~ ***Organization of conferences and seminars***

~ ***An active policy of publishing in international reviews***

Lafarge, world leader in construction materials

Founded in 1833 Lafarge is the world leader in building materials. With 80,000 employees in 75 countries the Group holds top-ranking positions in all four of its businesses: Cement, Aggregates & Concrete, Roofing and Gypsum offering a range of products and solutions to its clients in the construction chain. Lafarge posted sales of €16 billion in 2005.

To improve building materials, Lafarge focuses on the customer. The Group strives to offer sector professionals and consumers a complete range of innovative solutions designed for greater safety, comfort and quality, thereby improving the quality of everyday life. Lafarge has been pursuing a growth strategy within the framework of sustainable development for many years combining industrial know-how, performance, value creation, respect for employees and local cultures, environmental protection and the conservation of natural resources and energy.

Lafarge is the only construction materials company to be listed on the 2006 '100 Global Most Sustainable Corporations in the World'.

- **World Leader in Cement**
  Wide range of cements, hydraulic binders and lime for building, renovation and public works.

- **World N°2 in Aggregates & Concrete**
  Range of aggregates, standard concrete, "speciality" concrete (such as ready to use or prefabricated) for civil engineering, roads, and buildings.

- **World Leader in Roofing**
  Comprehensive range of roofing products (concrete/metal/clay roof tiles), accessories and chimney systems.

- **World N° 3 in Gypsum**
  Gypsum blocks and wallboard, plaster coating for finishing works for all kinds of buildings – new or renovation.

Lafarge – Keys dates

1833	Lafarge founded in France
1956	Lafarge starts operating in North America
1997	Acquisition of Redland (Aggregates & Concrete, Roofing)
2001	Acquisition of Blue Circle (Cement)
1999	Launch of Ductal – an ultra-high performance concrete
2000	Launch of Agilia – a range of self-placing, self-levelling concrete
23 Feb 2006	Bruno Lafont, CEO Lafarge, highlights the importance of innovation during the presentation of his strategic outline for the Group and sets the target of taking a further lead, ahead of competitors in this area.
Mars 2006	Presentation of Hypergreen - a very tall building project for a sustainable world designed in Partnership with Architect Jacques Ferrier, presented for the first time in Europe at MIPIM.

Bruno Lafont, CEO Lafarge:

"Innovation is one of the driving forces of our strategy. We are eager to widen the gap between us and our competitors, by optimally harnessing our research power and our capacity to bring new products to market, to create even greater value to our customers. One of our ambitions is to promote more sustainable construction methods for all working in the industry, the challenge being to develop new products and new solutions capable of minimizing the ecological imprint of buildings. This initiative extends across our whole workforce. We are also engaged in cooperation with partner organizations throughout the construction chain, one example being the partnership with architect Jacques Ferrier on design of an ecologically friendly tower building."

Research at Lafarge

As the world leader in building materials Lafarge has always placed research and innovation at the forefront of its strategy for growth. Research and Development at Lafarge is comprised of 500 employees within the Group.

The Lafarge Research Center (LCR) in Isle d'Abeau is the world's largest building materials research facility, with 180 researchers from a dozen different nationalities working on a site housing 6,000 m² of laboratory space with highly sophisticated testing and analytical equipment. The Lafarge Research Center strives to understand basic mechanisms and to validate technological breakthroughs.

LCR is organized around four, multi-product areas of expertise: active components; formulation & implementation; structured materials; and analysis & measurements. Each oversees several research units dedicated to specific issues. There are three parallel project portfolios – cement; aggregates & concrete; and plasterboard & roofing tiles – each under the direction of a portfolio director who defines research strategies by field of activity. This matrix organization optimizes the allocation of resources and synergies between research teams and ensures that research truly serves the Group's business units.

Open to outside partnerships, Lafarge's research teams work regularly in close collaboration with the world's most prestigious universities, engineering schools and public research labs. Partners include the Massachusetts Institute of Technology (MIT), Berkeley and Princeton University in the United States; the Laval and Sherbrooke Universities in Canada; and the French Science Research Center (CNRS), the largest fundamental research center in Europe. LCR is also part of the NANOCEM network, which brings together about thirty universities and industrial groups for long-term research on cement and concrete.

Over the past ten years, Lafarge has made some fundamental innovations, not only in concrete with the Agilia® line of self-placing and self-leveling concretes and Ductal® ultra-high-performance concretes, but also in gypsum, with Signa®, a revolutionary plasterboard, roofing and cement. Major innovations were also introduced to improve production processes and to reduce energy consumption and the environmental impact of manufacturing building materials.

Agilia ® - a high value-added concrete

Agilia® is a self-placing or self-leveling concrete thanks to its great fluidity, enabling it to effortlessly fill all the corners and areas in the formwork or mold, spreading easily and quickly throughout. This fluidity, quite similar to a liquid, eliminates some of the more physical or noisy steps, such as vibration, which are necessary with traditional concretes. This means that the use of Agilia® is easier, quicker to use for high quality results. After years of research on its composition, the superplasticizer additives, its fabrication process, and all steps of its process of use, Agilia® solution ensures the robustness, aesthetics, quality and reliability of the material everywhere in the world.

Ductal® - An ultra-high performance concrete

Thanks to its fiber composition and its low mass, Ductal® displays superior tensile and compressive strength and unrivalled ductility, very relevant for earthquake resistant structures. The 2 to 4% of steel or organic fibers it contains enable total absence of passive reinforcement, facilitating the creation of large complex shapes and very thin sections. Ductal® provides lighter structures, with reduced volumes and weight, which lead to cost savings on the quantities of materials used, simplifying methods (prefabrication can shorten deadlines), and reducing transport. The Ductal® microstructure is completely closed, giving it an outstanding durability and making it resistant to abrasion, corrosion or chemical attacks. Ductal® can also be used as a self-placing concrete.
Ductal® combines aesthetics with a mechanical performance that is six to eight times greater than that of traditional concrete. It uses significantly fewer natural resources during its fabrication thus requiring less energy and producing less CO_2. A study has shown that a bridge built in Ductal® consumes 50% less energy therefore producing less CO_2 by the same amount and gives a 35% saving in raw materials, compared to a structure made in steel and traditional concrete.

Rudy Ricciotti, Architect:

"Today, with ultra-high-performance fiber-reinforced concrete, we are about to embark on a new industrial adventure. Architects are like test pilots heading down the runway; ready for take-off… they must have total confidence in the calculations and professional skills of mechanics and engineers. We are on the verge of switching from propellers to jet engines. The Footbridge of Peace in Seoul, South Korea, spans 130 meters, with a deck only three centimeters thick for an end beam static height of 1.30 meters. Concrete is now melding into the landscape by a simple stroke."

Lafarge's commitment to sustainable development

Lafarge has been pursuing a strategy of sustainable development for many years because it believes that long-term value is best created when considering the interests of the community and environment in which it operates. This strategy reflects the Group's core values and combines industrial know-how, performance, value creation, respect for employees and local cultures, environmental protection and the conservation of natural resources and energy. In recognition Lafarge is the only construction materials company to be listed on the '100 Global Most Sustainable Corporations in the World' for two consecutive years in 2005 and 2006.

Each year Lafarge's report on Sustainable Development reports on the Group's environmental and social performance, highlighting year-on-year improvements. This report is produced in partnership with the Group's stakeholders including: union representatives, NGOs with whom it collaborates and architects.

For several years the Lafarge has sought to develop a long term dialogue with members of the broader community. The best example of this is its partnership with WWF which the Group first signed in 2000 and renewed in 2005 in order to improve its environmental performance and contribute to raising standards within the construction industry. In the context of this partnership Lafarge is committed to reducing its worldwide CO_2 emissions by 20% by 2010. This target is measured each year by an independent auditor. The results already show an 11% reduction in 2004.

As a result of this commitment to sustainable development Lafarge demonstrates that it is at the forefront of its industry.

Lafarge and sustainable construction

Today, Lafarge is convinced that its commitment toward society should extend beyond the borders of its own industrial sites to cover the entire value creation chain of the construction industry, from suppliers to end customers. Building products can have a considerable impact on the environmental and social performance of buildings. We know, for example, that over the course of its lifetime, 90% of the CO_2 emissions associated with a building stem from its use – whereas the manufacturing of the building's materials generates only 10%.

At Lafarge we believe that it is our responsibility to not only understand the impact of our products over the entire life span, but to work very closely with architects, engineers, developers and contractors to and promote the best construction methods for a more sustainable development.

Lafarge has entered several partnerships that fit perfectly within the framework of sustainable construction:

~ One of the priorities of the **new partnership agreement signed with WWF** on 21 June 2005 is to promote sustainable construction with all sector players.

~ With **WBCSD (World Business Council for Sustainable Development),** which brings together 180 companies, Lafarge is the driving force behind the creation and management of a five-year plan of action to develop a "sustainable cement industry". In an exemplary sector initiative, the ten cement manufacturers involved in the program are seeking solutions to protect the climate, reduce consumption of fuels and raw materials and guarantee the health and safety of employees.

~ Lafarge is a founding member of **Fondation Bâtiment Energie,** which provides financing for R&D projects to reduce greenhouse gas emissions by reducing energy consumption and to encourage greater use of renewable energy sources in the building sector. After a bidding process launched in 2005, five projects were selected to receive major financial support in 2006.

~ In France, Lafarge is one of the founders of **Entreprises & Construction Durable,** an initiative launched by the Utopies consulting firm in early 2004. Member companies, including major groups like Accor, BNP Paribas and Bouygues Construction, work to better understand the issues and to improve practices.

Lafarge is also working in collaboration with **architects,** and has made major efforts to advance construction methods. For example, the Lafarge Group is working in association with Jacques Ferrier on the Hypergreen project, a very tall building concept for a sustainable world.

« Hypergreen », presented for the first time in Europe at MIPIM in March 2006, is a concept of a mixed-use, environmentally responsible tower building, designed for the world's mega-cities. Hypergreen is designed to be environmentally responsible throughout its entire life-cycle thanks to its use of renewable energy sources and high performance building materials. The materials and techniques proposed in the concept are already available, demonstrating that sustainable construction – one that better respects the environment and society– is possible now and not just a dream for the future.

Because of its size and height (246m), the Hypergreen tower is able to generate most of the energy necessary to cover its own needs. Extensive use of renewable energy sources including: earth cooling tubes (puits canadiens), geothermal heat pumps, photovoltaic panels and wind turbines has been made to limit the tower's impact on the environment.

In addition, the tower's shape, façades and components have all been designed and positioned to capitalize on the building's orientation, unlike existing buildings that are indifferent to the climatic context. For example, building's exterior, a 'grid skin' façade built with ultra-high performance concrete Ductal®, optimizes the passage of natural light into the building and ensures horizontal stability. The interior structure, freed from any wind bracing functions, consists of freestanding plates that are simply superimposed. As a result, the building's interior is totally flexible and adaptable.

The basic concrete structure can be entirely prefabricated: all columns, beams and slabs can be manufactured at industrial sites, under optimal manufacturing conditions, therefore lessening the amount of time and labor required on site. At the end of the tower's life-cycle these prefabricated components can also be dismantled causing limited disturbance to the surrounding environment (reduced noise and dust emissions) and can, moreover, be completely recycled.

Other initiatives in sustainable development introduced by Lafarge include:

~ **Signa®, the new generation plasterboard**

With Signa® Lafarge has found the solution to an 80-year old challenge, to make installation easier and reduce on-site work time whilst improving the quality of plasterboard ceilings.

Traditional plasterboard was, until recently, only tapered along its vertical sides which allowed for a perfect fit on vertical elements that were not very high but not those that were. Lengthy and arduous finishing on all four sides was necessary for very high ceilings and partitions.

Lafarge is the first company to have succeeded in mass-producing plasterboard which is tapered on all four sides, making installation quicker and easier whilst at the same time guaranteeing a perfectly flat surface. Internationally patented, Lafarge markets this revolutionary plasterboard in a pre-painted version which requires only one coat of paint as opposed to two.

~ « Monier Cool Roof », an innovative roofing system designed for hot countries

Thanks to this innovative roofing system we can now reduce air-conditioning and subsequently electricity consumption in hot countries. « Monier Cool Roof », developed by Lafarge and marketed in Malaysia is made of concrete roof tiles with a thermal reflective screen and an air circulation system under the tiles. Thanks to this roofing solution room temperatures can be reduced by 3-5° without the need for any energy input by preventing outside hot air from entering inside.