



Supporting the  
stakeholders  
of construction  
activity report 2015



**COVER PAGE**

*Measuring the noise level generated  
by a standard level of rainfall.  
Tests conducted in the laboratories  
devoted to acoustic performance  
and sound comfort at the CSTB.*

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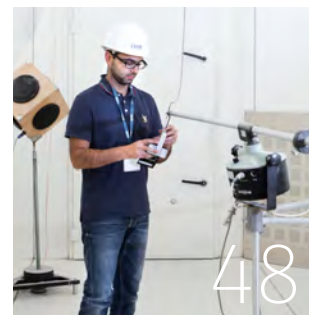
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"The construction sector is undergoing profound transformations in connection with ecological and digital transitions. At the same time, project owners increasingly require managers, consulting firms and contractors to guarantee the results, and not just the means they will implement for the construction or major renovation of a building. The CSTB continues to modernize itself to guide stakeholders as they navigate these profound changes."

**ÉTIENNE CRÉPON**, CSTB President

## ANTICIPATING AND GUIDING INNOVATION

### ACTUAL PERFORMANCE, HEALTH AND DIGITAL REVOLUTION

The sector is mobilizing around the challenges of the digital revolution. In the near future, constructing a building will first mean developing its virtual avatar. After participating for nearly 30 years in the design and development of the digital model at the scale of building, the CSTB is leveraging its expertise and multidisciplinary scientific skills to structure the innovative concept of "City Information Modeling," or CIM. This is "Building Information Modeling," or BIM, expanded to the scale of entire cities, which the CSTB deploys for major development projects such as Marne-la-Vallée, Bordeaux Euratlantique, Marseille-Euromed and Paris La Défense. In addition, digital avatars associated with the deployment of the Internet of Things will add to the available data on buildings and their usage, which will require skills in large-scale data management. This will be a major area of research for the years to come, in partnership with the research centers and laboratories that have expertise in big data.

The COP21 climate talks and the French energy transition law for green growth have set very ambitious targets for reducing greenhouse gas emissions. The CSTB will guide the government in developing the necessary regulatory tools, based on theoretical calculations of residents' energy consumption. But, because the distinguishing feature of the residents of a building is the diversity of their behavior and practices, it is now crucial to ascertain the actual energy efficiency of the premises, as they are occupied. The CSTB is currently deploying this approach for social housing operators in order to compare the theoretical performance levels initially projected with the actual consumption levels, so as to explain and remedy any gaps.

Health in buildings is another key topic. The CSTB, which runs the Indoor Air Quality Observatory, has been involved in environmental microbiology for ten years. This work will soon transition from research to industrial deployment, enabling owners to detect the presence of dry rot or mold in their building. The implications are far-reaching, from health to the safety of people and property in buildings.

### LOCAL SUPPORT FOR STAKEHOLDERS

The VSE/SME Innovation Barometer, launched in 2015 with IFOP Market Research, found that two-thirds of the 500 industrial companies interviewed had innovated or were intending to innovate in the next 18 months. Likewise, over 80% of building contractors were seeking innovations in the energy installation sector. In light of these results, the CSTB has increased the ARIANE service devoted to advising and supporting the VSEs/SMEs of the construction industry. The structuring of the National Support Network (RNA) has also continued with the 2015 signing of agreements with CoDEM in the Nord-Pas-de-Calais – Picardie region, and with Astus in Auvergne-Rhône-Alpes. The RNA should be fully deployed by the end of 2016, in line with the request of the French Housing Ministry.

This comprehensive program is designed to provide innovative contractors with assessments tailored to their industrial and commercial development objectives. One result of this has been a rise in requests for Technical Experimentation Assessments (ATEX) – the first simple step in the assessment of innovations. Meanwhile, for the first time in years, the number of Technical Approval Procedures (ATec) has decreased thanks to the optimization of the initial assessments and the greater focus on truly innovative products.

### CONTINUAL IMPROVEMENT OF CONSTRUCTION QUALITY

#### *QB, the unified certification mark of the CSTB*

On the occasion of the *Mondial du Bâtiment 2015* trade fair, the CSTB launched a consolidation of its quality certification marks under a single banner: QB. In 2016, the CSTB, together with industrial companies, will continue to roll out a proactive communication campaign promoting the level of quality on the market.

#### *International horizons*

The international development of the CSTB got a big boost in 2015, which should materialize in 2016 in the form of partnerships with counterparts, both in Europe and elsewhere around the world. These partnerships are based on expertise, particularly in complex major structures, and the certification of products or buildings through Cerway, our joint subsidiary with Qualitel.

So, in addition to our traditional role supporting public policy in the construction industry, the CSTB has modernized and expanded its horizons to better serve stakeholders in France and abroad, to the benefit of a rising number of private stakeholders.

New collaboration agreements with clients and partners in 2015 demonstrate their continued confidence in the skills and professionalism of CSTB staff. Be they researchers, engineers, technicians or administrative staff, they work every day to promote construction that is safer, more sustainable and comfortable for its users, and more environmentally friendly.

# Governance

*The missions and the legal organization of the Scientific and Technical Center for Building, a public organization of an industrial and commercial nature, are defined in Articles L142-1, L142-2 and R142-1 to R142-14 of the French Building Code. The president is appointed by governmental decree.*

## THE BOARD OF DIRECTORS

It is composed of eighteen members appointed by Ministerial Order in three colleges:

- six staff representatives;
- six government representatives;
- six qualified experts.

Defined by government decree, its powers include approval of budgets and financial statements, validation of the Objectives and Performance Contract and annual research programs, and strategic issues of all types.

The Government Commissioner, the Economic and Financial Auditor General, members of the Executive Committee and the secretary of the Works Council participate in the meetings of the Board.

### *The following Board members are appointed to represent the government*

**Élodie BOUDOUIN:** representing the Minister for Industry;

**Étienne CRÉPON:** CSTB President, representing the Minister for Construction;

**Patrick-Paul DUVAL:** representing the Minister for Research;

**Emmanuelle GAY:** representing the Minister for the Environment;

**Hervé TÉPHANY:** representing the Minister responsible for Civil Security;

**Agnès VINCE:** representing the Minister responsible for Architecture.

### *Experts:*

**François BERTIÈRE:** president of Bouygues Immobilier;

**Michel DROIN:** president of Batisol Plus, representing the French Building Federation (FFB);

**Patrick LIÉBUS:** president of the Confederation of Craftsmen and Small Builders (CAPEB);

**Hervé DE MAISTRE:** president of the Association of Construction Product Industries (AIMCC);

**Yves METZ:** president of Ingerop and vice-president of Syntec;

**Nasrine SERAJI:** architect.

### *Elected staff representatives*

**Olivier FLAMAND**

**Nadine GABRIEL**

**Catherine GUIGOU**

**Claude POMPÉO**

**Florence RENIER**

**Thibaud ROUSSELLE**

### *Also present at Board meetings:*

**Paul DELDUC:** Director-General for Development, Housing and Nature, as Government Commissioner;

**Jean-Philippe TORTEROTOT:** Deputy Director – Research and Innovation Department – Ministry for the Environment, Energy and the Sea;

**Jean-Louis TERTIAN:** Economic and Financial Auditor General.

## EXECUTIVE COMMITTEE

The Executive Committee of the CSTB defines the strategy, oversees and organizes the management of the CSTB in line with the Objectives and Performance Contract.

**Étienne CRÉPON,** President;

**Charles BALOCHE,** Deputy Chief Executive Officer in charge of Technological Activities and Technical Director;

**Hervé CHARRUE,** Deputy Chief Executive Officer in charge of Research and Director of Research & Development, CSTB Carnot Institute;

**Sylvie RAVALET,** Deputy Chief Executive Officer in charge of Strategy and Finance and Secretary-General;

**Florence FERRY,** Director of Communication and External Relations;

**Albert REIS,** Human Resources Director;

**Béatrice CROMIÈRES,** Quality and Ethics Director, in charge of the Secretariat.

## THE MANAGEMENT COMMITTEE

The Management Committee includes the members of the Executive Committee as well as the following people:

**Robert BAROUX,** Deputy Director for Research & Development

**Sophie MOREAU,** Director of the CSTB Carnot Institute;

**Christophe MOREL,** Deputy Director in charge of technical partnerships;

**Katy NARCY,** Deputy Director in charge of developing technology-related activities;

**Bruno MESUREUR,** Director of Standardization, Marketing and International Affairs;

**Tony GANE,** Chief Accounting Officer;

**Dominique NAERT,** Director of entities in Île-de-France.

## THE MANAGEMENT BOARD

The members of the Management Board are the President, all Management Committee members, the operational and functional department managers, local office directors and the director of Certivéa. It coordinates all of the divisions and subsidiaries of the CSTB group, discusses specific topics and current events.

## THE EXTERNAL BUSINESS ETHICS COMMITTEE

The six external experts on this committee guide and support the CSTB in ensuring full compliance with its stated commitments for the purpose of guaranteeing ethical behavior and preventing conflicts of interest.

### *Members of the External Business Ethics Committee:*

**Thierry BERT**, as president of the CSTB Certification Committee;  
**Pierre GRAFF**, as president of the External Business Ethics Committee;  
**Niklaus KOHLER**, as president of the CSTB Scientific Council;  
**Patrick LIÉBUS**, as a member of the Board, from the College of “Qualified Experts”.

**Michel RAY**, as president of the CSTB Consultative Committee;  
**Jacques ROUDIER**, as a qualified expert in the areas of competence of the CSTB.

## THE MEDIATOR

The mediator’s role, in case of difficulties arising in the progress of a commercial service, is to facilitate exchange and dialogue between the CSTB and the requester of the service. This task is performed by Mr. André Crocherie for ATEc applications and by Mr. José Fontan for other activities.

## THE CONSULTATIVE COMMITTEE

The mission of the Consultative Committee is to support and guide the CSTB’s R&D policy. Its composition is defined by ministerial order and its members come from a broad range of disciplines. In addition to representatives of the government and its agencies, the members of this committee include representatives of research organizations and socioeconomic stakeholders from the construction industry. It is chaired by Michel Ray, the former Technical and Innovation Director of EGIS.

### Stakeholders on the Consultative Committee:

#### *Consultative Committee members*

ADEME | Anah | ANR | CGI | Ministry of Social Affairs and Health | Ministry of the Environment, Energy and the Sea | Ministry of Housing and Sustainable Habitat | Ministry of Land Use Planning, Rural Affairs and Local Governments | Ministry of National Education, Higher Education and Research | BRGM | CEA | CEREMA | ENPC | ENSMP Mines Paristech | Ifsttar | IGN | Ineris | Institut Telecom | Irstea | Météo France | Comue Paris-Est | Advancity | Aetic | Aimcc | Astee | Capeb | Cerib | Cetiat | Cicc Construction | Cinov | Ctcm | Effinergie | FCBA | FFB | France Nature Environnement | Renewable Energy Syndicate | Syntec Ingénierie |

## THE SCIENTIFIC COUNCIL

The Scientific Council performs a scientific assessment of the CSTB Carnot Institute’s research programs. The mission of the Scientific Council is to issue an opinion on: the scope and scientific quality of projects; the development of cross-disciplinary approaches; academic partnerships; interaction with the socioeconomic environment; the dissemination of results; their exploitation and transfer; involvement in education; and to issue an appreciation of the research strategy over a five-year period.

Chaired by Niklaus Kohler, the Scientific Council consists of experts from outside of the CSTB. Its composition covers all of the scientific and technical priorities of the CSTB. It met for the first time on 6 July 2015.

## THE CERTIFICATION COMMITTEES

Acting on behalf of the CSTB Board, the Certification Committee of the CSTB deals with general issues concerning certification. To ensure certification with added value that effectively meets the expectations and needs of stakeholders, the Certification Committee comprises representatives from the different interested parties, without predominance of any given interest. The CSTB Certification Committee is chaired by Thierry Bert, the Inspector-General of Finance.

# Ethics

*The Ethics Charter of the CSTB describes the shared values that are the foundation for the code of conduct, through six basic principles applied to all of the activities of the CSTB:*

1. Impartial judgment
2. Social responsibility
3. Transparency
4. Dissemination and confidentiality
5. Duty to alert
6. Scientific and technical quality



# The Management Board



Bruno Mesureur

Christophe Morel



Souheil Soubra

Christian Cochet



Emmanuel Girard



Florence Ferry



Hervé Charrue



Sylvie Ravalet



Philippe Pied

Tony Gane



Yann Montrelay

Stéphane Munier





Patrick Morand



Sophie Moreau



Robert Baroux



Michel Cossavella



Maxime Roger



Anne Voeltzel-Lévêque



Hubert Lagier



Jean-Christophe Visier



Étienne Crépon



Charles Baloche



Albert Reis



Béatrice Cromières



Laurent Viel



Patrick Nossent



Dominique Naert



Jacques Martin



# Supporting stakeholders in the process of innovation







### **Philharmonie de Paris**

Architects:  
Ateliers Jean Nouvel

### **Innovation**

ATEX 1887 – Screen-type  
curtain wall facade  
ATEX 1922 – Interior envelope  
of the concert hall (plaster  
shell sprayed onto framework)  
ATEX 2090 – Siding tiles and  
installation.

### **Expertise**

Characterization of  
the effect of the wind on the  
envelope and the structure,  
study of wind comfort.  
Acoustic testing.  
Project consultancy for  
the choice and sizing of an  
appropriate coating solution  
for the building's outer skin.  
Assistance with the artificial  
lighting design.



# INNOVATION SUPPORT SERVICES

## DEVELOPMENT OF THE NATIONAL SUPPORT NETWORK

In order to provide a local advisory service to innovators in the construction industry, especially to VSEs/SMEs, the CSTB continues to develop the National Support Network (RNA). Two new partners, Astus Construction (Auvergne-Rhône-Alpes) and CoDEM-Le BATLAB (Nord-Pas-de-Calais – Picardie), joined the RNA in 2015. The CSTB now has 10 partners in various French regions, with the objective of completing the network

across France by the end of 2016. It also supports local interaction between stakeholders. For example, two gatherings were held in 2015: the Innovative VSE/SME Day at CSTB Paris and a speed meeting during the Mondial du Bâtiment trade fair in Paris Villepinte, in November. The speed meeting was attended by construction VSEs/SMEs and experts from the RNA and the CSTB. Similar meetings will be held in French regions in 2016.

### Close-up



**Blaise Dupré**  
CEO of CoDEM-Le BATLAB,  
member of the RNA

On 30 June 2015, CoDEM-Le BAT LAB and the CSTB signed a joint support mission agreement for innovative companies in Normandy, Nord-Pas-de-Calais – Picardie.

“Our resource center is specialized in research, development and testing of construction materials and systems,” explained Blaise Dupré. “It was only natural for us to associate with the CSTB as part of the RNA, in order to better support stakeholders with their projects. We see every day how important it is to reassure stakeholders about innovation, through a local relationship built on trust. We need the mentorship of the CSTB so that, starting at an early stage,

we can efficiently share information about the scientific challenges of each innovation and the technical documentation requirements for the assessment. This helps innovators save time. Furthermore, we are well positioned in French regions, to diagnose stakeholders’ needs and guide their decision-making. We particularly need the CSTB’s support when we are studying multi-function, innovative and relatively complex processes, which are developed for use on the building’s envelope. Coming from various backgrounds, entrepreneurs and small companies often think first of the Technical Approval Procedure (ATec). But other, simpler solutions are often more appropriate. We provide insight to help them move their projects forward, for example, with explanations about regulations, characterization studies or by referring them to the appropriate assessment procedure.”



## THE CSTB, ATTENTIVE TO INNOVATIVE VSEs/SMEs

In 2015, on behalf of the CSTB, the IFOP market research firm conducted two surveys of VSEs/SMEs – first of manufacturers and then of building contractors – to identify their perception and expectations of innovation. In a clear demonstration of the market’s vitality, the results showed that 61% of manufacturers considered innovation to be important, while 77% of building contractors had integrated at least one innovation into their business during the year. To help steer the energy and digital transitions with these crucial stakeholders, the CSTB and its partners expanded their RNA and ARIANE support services, initiated two years earlier. Also in 2015, the CSTB and Bpi France signed a partnership agreement to pool their expertise in financial engineering solutions adapted to innovative projects in local areas.

# RESEARCH & EXPERTISE



## RAMPING UP ARIANE

As a complement to the RNA, ARIANE, the advisory and support service of the CSTB, meets the needs of innovative companies, from the idea to the market. More than 800 requests from professionals have been handled since 2013, half of them in 2015 alone, from a large number of VSEs/SMEs. These figures highlight the development of the CSTB's support service for professionals.

In 2015, construction stakeholders mainly contacted ARIANE to develop innovations in the field of structural systems, climate engineering (energy systems) and building envelopes (thermal insulation, lightweight facades, coatings and cladding). To support these innovative projects, the team at ARIANE works with the professionals to resolve a crucial issue: how to integrate the product/process into the building. The solution lies in precisely defining the product's fitness for and conditions of use.

## ANTICIPATING THE CHALLENGES OF THE FUTURE

### MEETING THE CHALLENGES OF CONSTRUCTION AND DEVELOPMENT

Research in the building industry has evolved dramatically over the past decade. It has explored the impacts of climate change and their prevention – remediation, in connection with urbanization, the aging of populations and access to resources. It takes a cross-disciplinary approach to these issues, encompassing environmental, economic and social aspects.

At the same time, the surge in digital technologies and the resulting multiplicity of possibilities and innovations – simulation, analysis, monitoring and cross-fertilization – have radically changed the scientific and technical approach, which must systematically integrate this dimension.

The research themes of the CSTB therefore focus on the energy and environmental performance of buildings, the management and renovation of existing buildings, especially at the scale of the building stock, the comfort level and quality of ambient conditions in living spaces (air quality, acoustic quality, lighting quality, etc.), and risk management (fire safety, adaptation to climate change, etc.).

### NETWORKING WITH THE SCIENTIFIC COMMUNITY

Scientific collaboration between the CSTB and academic stakeholders strengthens the research capacities of the CSTB. This collaboration enriches the resources of the CSTB Carnot Institute, enabling it to better respond to issues arising from the market. One example of this type of collaboration is an agreement signed with the LaSIE<sup>1</sup> in 2015, in two specialist areas: Health & Comfort and Environmental Performance of Buildings. It supplements the CSTB's four other agreements with the Navier, CERTES and LEMTA laboratories<sup>2</sup> and with the Climate Economics Chair.<sup>3</sup>

### SUPPORTING PUBLIC POLICY

A prime resource for the public authorities, the CSTB also mobilizes its research capabilities to serve national priorities. This role provides it with knowledge and in-depth understanding of the challenges facing construction and urban development. In 2015, the government initiated three plans in which the CSTB is playing a key role: digital technologies, the quality of construction for the energy transition, and asbestos.<sup>4</sup> As part of the Asbestos R&D Plan in particular, the CSTB is responsible for two research areas on the detection and measurement of asbestos, and on the management of construction sites with a risk of asbestos exposure.

1. LaSIE: The Environmental Engineering Sciences Laboratory at the University of La Rochelle.

2. Navier Laboratory: Joint Research Unit of the École des Ponts ParisTech, IFSTTAR and the CNRS.

The research conducted concerns civil engineering, the environment and sustainable development, energy and transportation.

CERTES: Center for Thermal, Environmental and Systems Studies and Research at the University of Paris-Est.

LEMETA: The Theoretical and Applied Energy and Mechanical Engineering Laboratory at the University of Lorraine.

3. The Climate Economics Chair aims to build an academically recognized research platform open to the economic sector and political decision-making.

4. This refers to the French Plan of Action for Construction Quality and Energy Transition (PACTE), the National Digital Transition Plan for Construction (PTNB) and the Asbestos Research & Development Plan (PRDA).



## SUPPORTING STAKEHOLDERS WITH THE CSTB CARNOT INSTITUTE

### IN ASSOCIATION WITH THE MARKET

Thanks to a proactive approach fostering technology transfer, the CSTB Carnot Institute, accredited since 2006, offers a Research & Expertise solution in six specialist areas: Energy & Environment, Health & Comfort, Digital Technologies, Major Structures, Transport, and Urban Development. It thus addresses the building industry and the sectors of civil engineering and mobility, with the aim of improving the living environment in cities.

Taking a multidisciplinary, systemic approach, the CSTB Carnot Institute meets the needs of the market, energized by the digital and energy transitions and marked by increasingly stringent environmental and health-related requirements. The Institute is also open to other industrial sectors, such as the Internet of things, culture, the agri-food industry, sports, cosmetics and the circular economy, always with the aim of fostering the transfer of know-how.

### AN EXPANDED ORGANIZATION

Since September 2015, Sophie Moreau has been in charge of the operational management of the CSTB Carnot Institute. She develops activities with the socioeconomic stakeholders in collaboration with an internal team of business developers. They provide

the CSTB Carnot Institute's expertise to local governments and companies, offering solutions and planning projects. They also work in a network with the other Carnot Institutes.

### PUBLIC/PRIVATE PROJECTS CONTINUED

In 2015, the CSTB Carnot Institute got involved in R&D partnership projects, bringing together public and private stakeholders. For example, it participates in the Efficacy Institute, dedicated to the energy transition of cities, in which 28 industrial companies and researchers are partners. It is also involved in the development of smart networks, through Smart Grid demonstrators in France and Europe (H2020 projects).

### SUPPORTING STAKEHOLDERS: A PRIORITY

In 2015, the CSTB Carnot Institute developed research projects with more than 500 companies. One of its priorities concerns the support of VSEs/SMEs in the construction industry, which have high expectations (see IFOP-CSTB innovation survey 2015). The CSTB Carnot Institute leverages its expertise to help manufacturers and building contractors to optimize their products and processes for integration into buildings.

### HIGHLIGHTING INNOVATION

The CSTB Carnot Institute fosters the emergence of new markets through a series of patents holdings. For example, the development of its activity in fungal biodetection is based on an innovation protected by a cluster of six patents.

It is now finding market outlets in construction and cultural heritage. Another example of this dynamic is a partnership with the start-up Partnering Robotics, which led to the development of Diya One, an indoor air purification robot.

### INTERNATIONAL DEPLOYMENT

In 2015, international activity represented a third of the Institute's contract research. This growing volume is due in part to projects carried out in the sector of Major Structures. The CSTB Carnot Institute exports its know-how in aerodynamics, contributing to the design of streamlined structures, such as bridges and high-rises. It also works on the comfort of indoor ambient conditions (acoustics, lighting and airflow management) for buildings with complex architectural styles. Finally, the transportation sector generates activity in areas such as automobiles, aeronautics and rail.



**100% wood**  
BBC Construction,  
Saulx-les-Chartreux.  
3F, leading social  
housing operator  
and project owner  
in France.  
Architects:  
Jean and Aline Harari



# TECHNICAL ASSESSMENT

## PROGRESS IN TECHNICAL EXPERIMENTATION ASSESSMENT

In 2015, the number of Technical Experimentation Assessments (ATEX) issued was up 23% over 2014 and 43% over 2013. This assessment, which validates the conditions of use of new products and processes, allows them to be tested at new construction sites. This is a step that facilitates access to the Technical Approval Procedure (ATec).

The growth of ATEX reveals the development of increasingly complex innovations to improve building performance. These innovations mainly concern the building envelope, which has become multipurpose in order to meet energy and climatic comfort objectives, above and beyond its stability and durability function. For example, roofs and facades now integrate innovative insulation materials, sun screens, rolling shutters and production systems based on renewable energy and greening solutions.

The shape of buildings, including high-rises, is becoming more sophisticated as well, in response to new urban architectural ambitions. Verifying the feasibility of integrating innovations into complex structures is essential. Another market trend: the boundary between design and construction is tending to disappear. This means that some innovations also concern manufacturing processes that make products easier to use at the worksite.

To support project leaders in the process of innovation, the CSTB reviews ATEX requests and makes their results available.

Since June 2015, the CSTB has been posting ATEX applications on its website: [evaluation.cstb.fr](http://evaluation.cstb.fr). This dissemination of information will eventually be expanded to include all assessment services.

## THE CCFAT RE-FOCUSES TECHNICAL APPROVALS ON THE MOST INNOVATIVE PROCESSES

In 2015, the Technical Approval Development Committee (CCFAT) requested a change in the scope of the Technical Approval Procedure (ATec). It now focuses on innovative technologies that have emerged on the market recently. The aim is also to facilitate the transfer of technologies after several years of ATec status into the domain of traditional techniques. In practical terms, the scope of ATec is now defined by a list of 412 families of products and processes, which will expand as new technologies are developed by stakeholders on the market. This new definition has been operational since November 2015, and the list of product families is available on the new website, [ccfat.fr](http://ccfat.fr).

More generally, the [ccfat.fr](http://ccfat.fr) site explains to stakeholders how the Technical Approval Procedure (ATec) works. It also offers online services that streamline procedures for innovators. For example, innovators can check the status of their request or apply to join a Specialist Group (SG) as a member or president, based on a list of vacant positions. The CSTB also offers a working tool for the SG experts. The software compiles previous ATec decisions and their justification into a scientific and technical ATec database.

## ENVIRONMENTAL PERFORMANCE ASSESSMENTS

Currently, each manufacturer must file a declaration on the environmental performance of its construction products before making any advertising claims. Starting on 1 July 2017, French regulations will require verification of environmental declarations by an independent third party. This change will improve the reliability of the data. The Environmental Performance Laboratory of the CSTB, which has four approved auditors, leverages its experience acquired in the past decade, and its renowned know-how, to serve manufacturers and develop or verify regulatory environmental declarations and Environmental and Health Product Declaration Forms (FDES<sup>1</sup>). In a broader eco-design approach, it helps stakeholders improve their products in order to boost the environmental performance of buildings.

## HIGHLIGHTING INNOVATIVE PRODUCTS IN THE DIGITAL TRANSITION

When it comes to the digital transition, one of the top priorities for the CSTB is to facilitate the use of innovations in construction projects designed with digital modeling. Starting in 2016, the CSTB is developing a new service. This will consist of a summary sheet for each innovation assessed (ATec, ATEX, etc.). Created in a format that is compatible with the digital model, it will compile the crucial characteristics of the innovation, directly extracted from the assessment document. Easy access to this data will foster the integration of new products and processes into building projects which make use of BIM.

1. FDES: Environmental and Health Declaration Form.

# QB CERTIFICATION



## Close-up



**Philippe Malé**

Manager of the Products  
Division and Technical  
Management of Terréal

“The quality of our products and customer satisfaction are our key concerns. We have been involved in certification procedures for a long time, and the QB mark represents a key argument of distinction. It supports the development of our business on the market for the design and manufacture of terracotta solutions for buildings, specifically, roofing, structural elements, facades and decoration.

In 2015, we were among the first to adopt the QB mark, and our range of roof underlayments featured this new mark at the Batimat trade fair, replacing the “CSTB Certified” mark. QB increases the legibility of the certification of our products and broadens their visibility. The clarity of the “Quality Building” name, for any construction stakeholder, is an undeniable advantage. QB is also a timesaver for professionals who need to choose high-quality products for construction projects. And they save time with complete confidence, because this certification substantiates the performance of the product over time, with verified characteristics suitable for the conditions of use required by the market. In 2016, we will switch our other products to the QB mark – in particular the roofing products that are currently using the CSTBat mark – so as to offer a product range with a single certification mark. First in France, and then for our international markets.”

*In a landscape that is increasingly cluttered with certification marks for the construction industry and its products, the CSTB has simplified its solution with a single unifying mark: QB – Quality for Buildings. Since October 2015, QB, a certification mark of the CSTB, has been gradually replacing several existing marks: CSTBat, CSTBat Service, Certifié CSTB Certified, CSTB Compétence and UPEC.*

The streamlining of the CSTB’s five marks ensures clearer legibility of the quality, performance and reliability of the certified products, services and stakeholders. Developed in cooperation with the sector’s trade organizations, manufacturers, users and standards organizations, QB maintains the high level of quality and reliability of the marks it is replacing, in terms of certification process and impartiality. Initially, the reference framework for each application area is maintained. In the medium term, QB will integrate additional requirements adapted to the environmental and digital transitions and the needs of the market.

QB is also an advantage in terms of visibility and development for stakeholders in the construction industry.

For its launch in France in 2015, the mark received coverage in the media and beyond, through a digital campaign associated with a major event at the Salon Mondial du Bâtiment 2015. In 2016, extensive promotion and communication campaigns will continue to enhance the brand recognition of the QB mark.

A badge of quality promoting the know-how of stakeholders in France, QB will also be deployed internationally in 2016, mainly in Europe and countries of the Mediterranean Basin.

## THE FIRST QB-CERTIFIED PRODUCTS

With its launch in late 2015, QB is now used by about 20 manufacturers of flexible roof underlayments.

# DISSEMINATION OF KNOWLEDGE

## BATIPEDIA.COM: 360° CONSTRUCTION

The BATIPÉDIA web portal now features all the latest news about regulations, standards and technical issues in the construction industry, to support stakeholders in the management of their projects and activities. This content is available through online services and publications, and in the form of training and business software packages. In 2015, the expanded BATIPÉDIA served to supplement the knowledge-sharing programs put in place by the CSTB.

## TECHNICAL-REGULATORY INFORMATION

The technical and regulatory information provided on batipedia.com is structured around the REEF. This database, a benchmark on the market, is available online and updated continuously. It is supplemented with handbooks in digital and hard copy form that provide expert insight into the rules of the state of the art.

These handbooks are part of the catalogue of CSTB Publications which now comprises 12 collections. Handbooks may also be submitted by the partners of the CSTB, including the AQC and the IRIS-ST.<sup>1</sup>

In addition, batipedia.com offers thematic documentation, selections of technical/regulatory texts by area of expertise, as well as the CSTB handbooks. In 2015, three new themes were added to this collection: the Eurocodes, electrical systems in buildings and landscaping.

## BIM AND DIGITAL MODELS

In order to help professionals learn how to use BIM methods and tools, CSTB Editions has made eveBIM available for free download on batipedia.com. This 3D digital model viewer, which imports files in IFC format, offers annotation, editing and sharing functions – representing a major advantage in the deployment of BIM to the widest-possible audience. And, in partnership with Editions Eyrolles, CSTB Editions has published the second version of “BIM and Digital Model,”<sup>2</sup> a benchmark work on the digital transition in construction, as well as “Conducting a Construction Project with BIM,”<sup>3</sup> a more practical handbook on using BIM.

The CSTB also increased its BIM training courses in 2015. A comprehensive training program is offered to stakeholders on the collaborative management of projects with digital modeling, while a range of BIM courses targets more specific audiences. Another course presents the main BIM tools and their compatibility using the IFC file format.

## ENERGY AND ENVIRONMENTAL PERFORMANCE

The primary goal of the CSTB's knowledge dissemination strategy is to improve the energy performance of new and renovated buildings. This is covered in a new online theme, on traditional and innovative solutions aiming to make new and renovated buildings more energy-efficient. Furthermore, in 2015, CSTB Training began offering the HQE adviser training course recognized by Certivéa. The role of these advisers is to help project owners with their certification procedures. In 2016, the training courses offered by the CSTB will expand to train advisers on the new HQE (High Environmental Quality) framework and the new BBKA (Low Carbon Building) label.

## MODERNIZING CONTINUING EDUCATION

As digital technologies develop in the construction industry, the CSTB has sought to integrate the possibilities offered by distance education. For example, in 2015, the first sessions of blended learning were offered. This approach combines online courses, or SPOCs (Small Private Online Courses), with face-to-face instruction. This educational method, which has the advantage of adapting to each student's individual pace, was used in 2015 for the training of HQE advisers outside of France, and it will be offered in 2016 for courses on Life Cycle Assessment, BIM tools and the legal framework of BIM. This blended-learning method fits into the inter-company solutions offered by CSTB Training, and it supplements the intra-company and tailored courses offered.



1. AQC: Construction Quality Agency.

IRIS-ST: Association devoted to issues surrounding the health and safety of construction industry workers.

2. Directed by Olivier Celnik and Éric Lebègue.

3. By José Cuba Segura and Éric Lebègue.



# THE CSTB GROUP AT INTERNATIONAL LEVEL

*At the United Nations Climate Change Conference (COP21) in 2015, for the first time, a day was devoted to the construction industry, a sector that is responsible for one-third of global greenhouse gas emissions and which itself is exposed to the impact of climate change. During that day, on 3 December in Le Bourget, 20 countries together with 40 local organizations signed the Global Alliance for Buildings and Construction. As a member of this alliance, initiated by the French Ministry of Ecology, Sustainable Development and Energy, the CSTB participates in the French steering committee, monitoring the commitments that were made and preparing for the Building Day scheduled in late 2016 in Morocco, as part of COP22. The CSTB is thus continuing its involvement on a global scale, contributing to sustainable and affordable housing, energy-efficient buildings and green construction.*

*In 2015, the CSTB's expertise also served international projects at the scale of cities and individual buildings.*

## CUTTING-EDGE EXPERTISE IN AERODYNAMICS AND CLIMATOLOGY

In 2015, the number of aerodynamic and climatology studies conducted by the CSTB on major structures outside of France was significantly higher than in 2014, with projects in Western Europe, North Africa and the Middle East, in particular.

For each mission, the CSTB adapts to the local context: the legal and regulatory framework, the ways of working, the architectural style and the type of wind, as well. Certain phenomena are rarely encountered in France, such as tornadoes, cyclones and flash storms. The feedback from

## THE INTERNATIONAL INFLUENCE OF THE CARNOT INSTITUTE NETWORK

*The CSTB Carnot Institute is a member of the international working group of the association of Carnot Institutes, created in 2015. The objective is to share knowledge in order to promote the international presence of the network of 34 French Carnot Institutes. In 2015, a comparative study of the international strategies of major European research organizations was conducted with the participation of the CSTB.*

this international experience has enhanced the expertise of the CSTB, which now guides French stakeholders in their projects outside of France. In concrete terms, studying the wind resistance and wind comfort of major structures involves choosing the most appropriate measuring system and then carrying out tests: in climatic wind tunnels at full scale or in atmospheric wind tunnels on the basis of rigid or aeroelastic models designed by the CSTB. To make its expertise more complete, educational and visual, the CSTB also uses digital modeling, which is a useful complement to the experimental procedures.

## ENERGY PERFORMANCE OF EUROPEAN CITIES

In order to improve the urban energy system, the CSTB is participating in two R&D projects begun in 2015, with funding from the European Commission.

One of them, E2DISTRICT, focuses on improving heating and cooling systems so that they integrate more renewable energies. The development of innovative management functions is essential. Associated with Irish, Spanish and French partners, the CSTB is using its modeling expertise and the Dimosim platform to calculate and simulate the expected performance gains.

Another project is the Dr-BOB project, getting citizens involved in better electricity management<sup>1</sup> in the United Kingdom, France, Italy and Romania. The CSTB is in charge of the technical and socioeconomic assessments of these experiments. It takes into account different climates and practices to study falls in electricity demand. And the CSTB is developing digital tools for managing electricity consumption in housing blocks.

## ENVIRONMENTAL CERTIFICATION OF BUILDINGS AND LOCAL AREAS

A joint subsidiary of Certivéa (CSTB Group) and of Cerqual Qualitel Certification, Cerway is the international operator of the HQE™ certification for sustainable buildings and local areas. As of late 2015, Cerway was present in 20 countries. This development was supported by the signing of two new certification partnership agreements between Cerway and local stakeholders in Canada and Lebanon. Cerway also organized professional training courses in Canada, Morocco and Colombia. By the end of 2015, it had a network with 130 HQE™ “Référénts” advisers recognized worldwide. Furthermore, in a global context in which environmental and health-related requirements are increasingly stringent, the CSTB contributes its expertise



*Accent Eco, Poland, the first HQE-certified residential building in Europe (outside of France). HQE certified buildings under construction with a VERY GOOD score issued by Cerway.*

for the inclusion of air quality in environmental building certifications. In 2015, it conducted the first study on this subject, comparing 31 certifications in 30 countries on every continent.

#### **CERTIFICATION OF WINDOWS AND GLAZING IN CHINA**

From 11<sup>th</sup> to 14<sup>th</sup> November 2015, the CSTB participated in the 12<sup>th</sup> edition of the major window trade fair in China, called “Fenestration” which

attracted more than 70,000 window and glazing professionals. At its booth, the CSTB displayed its know-how and test facilities. Before the trade fair, the CSTB signed an agreement on November 10<sup>th</sup> in Shanghai with the Chinese body CCMSA,<sup>2</sup> an organization bringing together a large number of Chinese industrial companies that produce construction products, specifically in the window sector. This collaboration is an important step

for the development of the CSTB's activities in China in the certification of windows and glazing. It comes ahead of the creation of a French/Chinese assessment and certification organization to improve the quality and performance of windows made in China for the domestic market. These activities are set to launch in 2016.

#### **EUROPEAN TECHNICAL ASSESSMENT OF CONSTRUCTION PRODUCTS**

*In 2015, the number of requests for European Technical Assessments processed by the CSTB was much higher than in 2014. This trend is linked to the gradual roll-out of the European Construction Products Regulation (CPR). The references of the first European Assessment Documents were published in the OJEU,<sup>3</sup> and their content was made available by the EOTA<sup>4</sup> on its website.<sup>5</sup> Finally, in July 2015, the EOTA, which is currently chaired by the CSTB, shared educational information on its website on the European Technical Assessment procedure.<sup>6</sup> This clarified the approach of the CPR, which focuses on the declaration of performance regarding a product's essential characteristics, chosen by the manufacturer.*

1. A Demand-Response experiment, in which the end users are involved in maintaining the equilibrium of the electricity system.

2. CCMSA: China Construction Metal Structure Association

3. OJEU: Official Journal of the European Union

4. EOTA: European Organisation for Technical Assessment

5. <http://www.eota.eu/en-GB/content/eads/56/>

6. <http://www.eota.eu/en-GB/content/what-is-an-eta/18/>



# Scientific and Technical Excellence



PARIS

ÉcoQuartier  
Claude Bernard  
urban development zone  
certified in 2013.



To achieve an energy transition for green growth, projects need to move forward quickly. More than ever, construction and land management projects are working toward energy and environmental efficiency, as well as controlling costs and usages to sustainably improve people's quality of life. With this in mind, CSTB teams are mobilizing all the corresponding scientific and technical disciplines: Energy & Environment, Economics & Usage, Health & Comfort, Risk Mitigation and Digital Technologies. Their wide-ranging skills are made available to public and private stakeholders to guide innovation in materials, components, buildings and the city. The CSTB collaborates with its partners to promote the pooling of expertise and optimize project management through the development of digital modeling. This working tool can be shared among stakeholders and is playing an increasingly important role in the design and management of collaborative projects.





# AT THE LEVEL OF MATERIALS AND COMPONENTS

## Structures

### CHEMICAL ANCHORS: TOWARD WORLDWIDE RECOGNITION OF THE FIRE TEST AND ASSESSMENT PROTOCOL



*Tests specified  
in VULCAIN:  
preparation of a test body,  
with eight rebar anchors  
connecting the floor  
and wall.*

International Code Council (ICC) Evaluation Service,<sup>3</sup> to harmonize evaluation and testing methods on both continents.

To refine these studies, a full-scale trial will be conducted using the CSTB's VULCAIN furnace in 2016. The underside of a 3-meter balcony with one side anchored to a concrete wall will be subjected to fire. This will make it possible to observe the fracture process in a realistic configuration. This work is part of a thesis being written with the Laboratoire Navier<sup>4</sup> on the high-temperature behavior of chemical anchors in wood and concrete.

1. EOTA: European Organisation for Technical Assessment. EAD 330087-00-0601.

2. "Comportement des scellements chimiques d'armatures rapportées pour béton en situation d'incendie (Behavior of chemically bonded post-installed rebars for concrete in a fire situation)," CSTB thesis in collaboration with École des Mines de Douai and the U.S. National Institute of Standards and Technology (NIST) ([www.nist.gov](http://www.nist.gov))

3. International Code Council (ICC) Evaluation Service ([www.icc-es.org](http://www.icc-es.org)).

4. Laboratoire Navier is a mixed unit of joint research at Ecole des Ponts ParisTech, the French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR) and CNRS (UMR 8205 - <http://navier.enpc.fr>).

**Anchoring a post to a concrete slab or attaching a balcony to a facade requires chemical sealing in concrete. To describe the behavior of this type of connection in case of fire, the CSTB developed a testing and assessment method. Product of four years of research and development, it received Europe-wide approval in 2015. It is now being offered for use in North America.**

In March 2015, the European Organisation for Technical Assessment (EOTA)<sup>1</sup> published the European Assessment Document (EAD), developed by the CSTB, for chemical anchors subjected to fire. Until now,

products used for anchoring rebars to existing structures were not subject to measurement and approval for this type of situation. Manufacturers can now assess their resins according to European standards, and project managers and construction contractors can obtain assessments of the duration of load resistance in a fire. Launched in the early 2010s, the CSTB used theoretical studies<sup>2</sup> and high-temperature tests. The final report was then shared with the International Federation for Structural Concrete (FIB). This cleared the way for Europe-wide recognition through the EOTA. In 2016, the CSTB will partner with its US counterpart, the

## THERMAL BRIDGE BREAKS: DO THEY WEAKEN STRUCTURES?

***As energy regulations become more stringent, new seismic building codes must be applied. Specifically, the widespread use of thermal bridge breaks in construction raises the issue of their impact on the structural behavior of buildings in seismic regions. In 2015, the CSTB worked with CERIB, FIB, COPREC and AFIPEB<sup>1</sup> to conduct a study on this subject.***

Installed on the edges of floors on beams, thermal bridge breaks decrease the stiffness of the mechanical connection with walls. Traditional bracing, mostly provided by the

exterior walls and, more weakly, by the internal walls, is disturbed because the internal walls are subjected to extra load. To check these assumptions, the CSTB coordinated a study with its partners that compares four types of buildings: private homes and apartment buildings, with and without thermal bridge breaks. The various floor and material types were also considered. The models covered about 90% of construction situations encountered. Earthquake resistance tests conducted in the CSTB laboratory show that the mechanical connections between

the floor and wall are more or less stiff depending on the orientation of forces - parallel or perpendicular to the structural elements. Overall, the resistance demonstrated by the models with thermal bridge breaks were adequate and the study thoroughly characterized the models. We learned two main lessons from this study: First, the use of engineering is essential to resolving the issue. Second, it is possible to reconcile requirements, meaning that thermal insulation in the building envelope can be improved while complying with seismic building codes.

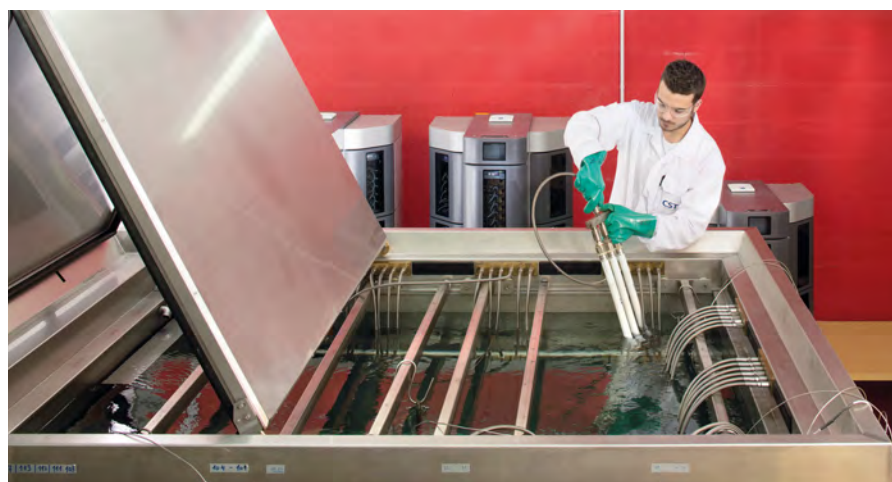
1. CERIB: French Concrete Industry Design and Research Center. FIB: Concrete industry federation. COPREC: Confederation of independent prevention, monitoring and inspection bodies. AFIPEB: French association for expanded polystyrene insulation in construction.

## Networks

### ASSESSING THE DURABILITY OF PIPES MADE OF SYNTHETIC MATERIALS

***In 2015, the CSTB developed a new testing method combined with digital simulation to assess the service life over 50 years of pipes made of synthetic materials. The CSTB guides system manufacturers that use pipes made of synthetic materials in the development of high-quality products.***

Whether single-layer or multilayer pipes, the CSTB Hydraulics and Sanitary Equipment Laboratory (Cofrac accreditation No. 1-305, scope available at [cofrac.fr](http://cofrac.fr)), can determine their minimum service life.



*Turning on piping pressure,  
Hydraulics and Sanitary  
Equipment Laboratory.*

The test report enables manufacturers to demonstrate the compliance of their products with European standards<sup>1</sup> and prepare their technical assessment documents.

The CSTB relies on a set of laboratory tests used on samples for 10,000 hours (over a year).

Test parameters are calculated beforehand using a digital model the CSTB designed in 2015. The measurements obtained are then analyzed to establish regression curves. Using the statistical results, it is possible to determine pipeline aging for up to 50 years.

1. Standards: NF EN ISO 9080 and NF EN ISO 17 456. See CSTB e-book No. 3597\_V2: "Système de canalisations à base de tubes en matériaux de synthèse pour eau chaude et froide sous pression" [piping system with pipes made of synthetic materials for hot and cold water under pressure].



## Envelope

### VACUUM INSULATION PANELS: INITIAL TECHNICAL APPROVALS OF “SUPERINSULATION”



*Facade consisting of 39 180-m<sup>2</sup> BEPIV® panels on the Betsinor factory and office extension.*

***New insulation materials, known as vacuum insulated panels, are entering the market. The CSTB has been conducting research on such materials for several years and continues to support its development to ensure thermal performance and durability.***

Vacuum insulation materials have earned the name “superinsulation” because of their thermal characteristics. The vacuum insulated panel (VIP) is one of them, consisting of a silica core at lowered pressure and protected by a metal envelope. It’s a real technological breakthrough thanks to its heat resistance, which is significantly higher than that of conventional insulation. Buildings can thus be insulated with thinner layers, considerably reducing the

loss of internal surface area. The VIP is a suitable material when energy performance and property value are key requirements.

Vacuum insulated panels are entering the market after years of research that addressed a major challenge: durability. They must maintain their performance during the entire life of the structure. To achieve this, manufacturers had to work on designing the VIP envelope, which is the only external protection for the vacuum. The CSTB’s research on the durability of the envelope led to the development of an assessment method for comparing the sustainability of VIPs with that of conventional insulation material. After that, assessment benchmarks and certification of the material were established.

Vacuum insulated panels can now receive the same assessments and certifications as all other insulation materials. The first Technical Approvals were published in 2015 with the assessment of the CSTB. They concern processes using VIPs for insulating buildings internally or externally. Example with BEPIV® designed by Betsinor, leader in the French cement matrix architectonic component market. Fully panelized and ultrathin, this process consists of a vacuum-insulated sandwich panel between two layers of rock wool. Its glass fiber reinforced concrete skin can be textured, forged, colored, etc. The CSTB led the assessment of this innovation, which obtained Technical Approval in June 2015.

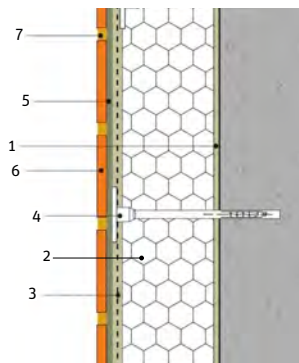
Research on vacuum insulation materials is continuing as part of a program of the International Energy Agency (2013–2017). The CSTB is the international coordinator of this research, which brings together about 50 public and private partners in science and industry from about a dozen countries. Their objective is to analyze the long-term performance of superinsulation. This is an opportunity for the CSTB to internationally promote the research conducted in France on these products.



**Armaterm external thermal insulation composite system.**

**General installation of an ETICS:**

1. Bonding or adjustment of insulation material
2. Thermal insulation
3. Reinforced undercoating
4. Pin placed after reinforcement
5. Adhesive for splits
6. Splits
7. Joint between splits



## EXTERNAL THERMAL INSULATION: PROCESSES ASSESSED FOR NEW AND RETROFITTED BUILDINGS

**External thermal insulation systems contribute to the energy performance of buildings by acting as thermal bridges. This solution also avoids loss of valuable surface area. Already a preferred solution for retrofit, it is now used for new buildings thanks to the diversity of its building skins. Examples of innovative processes that received Technical Experimentation Assessments (ATEX) in 2015, with the support of the CSTB.**

Estimated at several million square meters installed per year, the French market has seen growth in the use of ETICS<sup>1</sup> and cladding solutions.

### ETICS WITH SPLIT BRICKS

Glued or doweled onto the wall, ETICS consist of insulated panels covered with a coating. Among a wide choice of finishes, split bricks are making a comeback in both new and retrofitted buildings. In 2014 and 2015, the CSTB handled several requests for Technical Experimentation Assessment (ATEX) of this type of process.

For example, the French company Zolpan received two ATEX in 2015. The company uses ETICS with splits in buildings with four or five stories; previously, their use was limited to two-story buildings. In the future, the use of ETICS with splits will be extended to insulate buildings of different heights with finishes of varied colors.

### CLADDING FOR EXISTING BUILDINGS

Like ETICS, Rockzed® cladding enables retrofit of facades without dismantling them. It is fitted to existing metal cladding, which serves as a support. Developed by Rockwool, the world's

leading manufacturer of rock wool, and Bacacier, one of the top manufacturers of metal cladding for buildings in France, this innovation received an ATEX in 2015.

To perform the technical assessment, Rockwool and Bacacier called on the CSTB, which calculated the heat gain of the system using digital simulation and mechanical and earthquake resistance tests. The Rockzed® system, whose outer skin is currently made of sheet metal, can now integrate new materials to vary the aesthetics of facades.

### INSULATED METAL PANELS

Mainly intended for new facades, and faster to fit than conventional processes, insulated metal panels offer a variety of finishes. The first skin consists of a sandwich panel that provides air and water tightness, onto which a secondary frame is anchored. An external facing provides the second skin: ribbed or corrugated plates, metal blades and cassettes, conventional wooden skins, etc. The first insulated metal sandwich panels were developed by Arcelor Mittal (Archisol process) and Kingspan (Benchmark Karrier Fr process), both of which received an ATEX in 2015. The CSTB supported these innovations by conducting a thermal study and mechanical and earthquake tests.

1. ETICS: External thermal insulation composite system.



## ATEX FOR THE SOLAR TRACKER THAT PRODUCES DOMESTIC HOT WATER

**Winner of the Charles-Henri de Besnard Grand Prize for Innovation 2014, the solar tracker developed by IDCmem received a Technical Experimentation Assessment (ATEX) in 2015. Installed on a terrace, flat roof or in a garden, this process uses solar energy to heat the water of an individual home. An innovation for positive energy buildings.**

Equipped with a movable plate, the sensor follows the sun's path while its mirrors concentrate solar radiation onto a heat exchanger, which heats domestic water. The creator of this innovation for homes is IDCmem, a small company that received the Charles-Henri de Besnard Grand Prize for Innovation 2014, organized by

the Mecenat Besnard de Quelen and administered by the Conservatoire National des Arts et Métiers. Thanks to the funding received, the director of IDCmem decided to initiate assessment of its innovation and turned to the CSTB. Various tests confirmed the thermal performance of the system, its resistance to high temperatures when in operation and its durability. They were performed using the CSTB testing platform for solar processes at Sophia Antipolis. The Technical Experimentation Assessment received in October 2015 is a milestone in the development of the process. IDCmem presented this innovation at COP21 in November 2015 and will continue its development in 2016 to extend its uses.

### Close-up



**Daniel Winninger**  
Director of IDCmem, a VSE

**“As part of the assessment, we had regular and productive contact with the CSTB, and the recommendations I received helped us make significant changes to the system. The Technical Experimentation Assessment has greatly increased the value of our innovation and opened up the possibility of partnerships in preparation for its industrial development. I am now working with the Casablanca University to adapt the solar tracker to heating water for hammams and desalinating seawater.”**



**Testing the thermal performance of the solar tracker at the CSTB in Sophia Antipolis.**





625-m², Vertiflore®  
insulating plant wall,  
Ecole Bernard Buffet, Paris 17.

## DURABLE GREEN WALL

***Aesthetic and ecological, the Vertiflore® process developed by Tracer Urban Nature, an SME, has proven its merits. This system of plant-covered wall cladding received the first Technical Approval in its class in 2015. As examiner of the project, the CSTB studied its durability and performance in terms of fire safety.***

Specializing in greening solutions since 1989, the Tracer Urban Nature approached the CSTB for assessment of its plant-covered wall cladding: the Vertiflore®. Used with or without an external wall insulation system, Vertiflore® consists of vertical frames

onto which horizontal rails with plant modules are anchored. A ventilated air space is created between them and the bare face of the load-bearing wall, and a water system enables automated irrigation of the plants. As part of the Technical Approval examination, a durability study was a key requirement. The CSTB checked the corrosion protection of wet metal components. The fire safety study took into account plant changes. Poor maintenance and dried plants increase the hazard. Ultimately, tests of the fire resistance and reaction to fire improved overall system performance.

### Close-up



**François-Xavier Jacquinet**

*Director of the SME  
Tracer Urban Nature*

**“For SMEs like ours, all the tests required to receive a Technical Approval are substantial investments but crucial to fine-tuning the performance and safety of our processes. The role of the CSTB is indispensable. We jointly determined the tests essential to assessing our plant-covered wall cladding, even including sound insulation tests. They were not only crucial to the Technical Approval, they also enabled us to enhance the value of the product. The experience was mutually rewarding.”**



## IMPRESSIVE GLASS FACADE FOR THE NEW FACULTY OF MEDICINE IN MONTPELLIER

***It's a monumental architectural project: The glass facade of the future Faculty of Medicine in Montpellier measures 65 meters long and 12 meters high. Designed by the Catalan company Bellapart, specialized in the design and implementation of innovative glass and steel structures, it received a Technical Experimentation Assessment in 2015, with support from the CSTB. It was installed in 2016 during construction of the building.***

For the new University of Montpellier, the architect François Fontes, also Chairman of Ateliers Jean Nouvel, wanted a fully open facade, with no posts.

***Main facade of the Faculty of Medicine of Montpellier.  
Innovation: ATEEx No. 2238,  
Structural glass facade.***

Monumental laminated-glass stiffeners, consisting of a single element measuring 12.7 meters high, support the four facades to create window walls. These walls, subjected to wind loading, must support the weight of the glass on the upper levels and, generally, contribute to the stability of the facade. As part of its technical assessment, the CSTB determined the need to perform wind and earthquake resistance tests. The CSTB went to the Bellapart workshops to assist with the performance of these tests on very high windows. The innovative facade received an ATEEx in October 2015.

### Close-up



**Jean-François Portal**  
*Director of Bellapart France*

**“Francesc Arbós Bellapart, president Bellapart Group, spearheaded the move of the company toward increasingly complex projects and products. He considers ATEEx, since their first applications in 2000, to be the most appropriate procedure for providing a framework for new technologies and ensuring the safe implementation of projects. The CSTB knows how to start a real dialog and forge constructive relationships through the professionalism of its monitoring and its understanding of our technological added value. The CSTB acts as a watchdog and true coach for guiding us to a flawless product.”**



## Interior design

### PLASTERBOARD FOR VERY WET AREAS: NEW TESTS

***Plasterboard are used in places such as kitchens or public restrooms. But not without conditions because the moisture performance of the material must be assessed. The CSTB developed specific testing procedures to meet the needs of Siniat, the manufacturer of innovative solutions for the design, insulation and finishing of buildings.***

In 2015, Siniat submitted its innovation, the Prégywab™ system, for Technical Approval: a reinforced, waterproof, plaster-based partition wall intended for very wet areas, such as collective showers, swimming pool

changing rooms and kitchens that are subjected to high-pressure cleaning. Assisting with this approach meant innovating because the behavior of the system in high levels of moisture must be taken into account.

The CSTB developed testing procedures: exposure of the process to steam saturated at 7.5 g/m<sup>3</sup> minimum, water spraying at least three hours a day, high-pressure water jet cleaning at more than 10 bar with up to 60°C water, with or without harsh cleaning agents. This protocol was presented to experts from specialized groups for the Technical Approval concerned:

Group 9, in charge of partitions, linings and ceilings, and Group 13, in charge of coverings. Group 13 requested the addition of wall tile tear-off tests and checks of the adhesion of the watertight membrane onto the waterproof plaster core. This test procedure ensures maintenance of the initial performance of the system for at least 15 years. In addition, CSTB experts guide the Technical Approval issued to manufacturers and provide a user's guide for assembly of this type of plasterboard in wet areas.

### HOW DO YOU LAY FLOOR COVERINGS? EVERYTHING DEPENDS ON THE USE

***An alternative to gluing when dealing with soft floors, new techniques for laying coverings have a key advantage: requiring less preparation of the surface, they reduce the processing period for renovation projects. But how effective are they? The CSTB has been working with manufacturers since 2013 to answer this question. Results vary depending on the type of building for which the coverings are intended.***

To meet public health requirements, changes to the bonding of resilient floor coverings have led manufacturers to turn to other solutions. These concern installation methods: a semi-loose lay with double-sided perimeter adhesion; a loose lay with rolls or tiles by tongue and groove fitting; and dovetail connections or bonding incorporated into tiles or floor boards.

Since 2013, the CSTB has been working with manufacturers to assess the suitability of these processes as part of Technical Approvals or Technical Experimentation Assessment (ATEX). Specific criteria were studied: stability depending on humidity and temperature conditions, and mechanical behavior. For this purpose, the CSTB used special methods to test products for deformation, tensile strength and punching shear. The results of the tests show manufacturers the importance of precision when determining the areas where a product can be used, to ensure suitability. Apart from gyms, loose lay or semi-loose lay of thin coverings in rolls seems limited to housing, whereas mechanical connection can be appropriate for offices and small businesses.



***Punching shear test.***

Reinforced loose laid tiles, from 5 to 6 mm thick, held together by dovetail connections are appropriate for certain premises with heavy traffic (airport halls, commercial areas, etc.).



# AT THE LEVEL OF BUILDING

## Energy & Environment

### MOBILIZE CONSTRUCTION FOR SUSTAINABLE DEVELOPMENT



**Michel HAVARD**  
President  
of Association HQE

***With COP21 making international headlines, environmental performance is changing profoundly in France. Michel Havard, president of Association HQE, presents the new reference framework for sustainable buildings. Supporting the HQE™ certification is a key driver in reducing the environmental impact of the construction sector while meeting the expectations for quality of life.***

#### ***What changes does this new reference frame offer?***

**Michel Havard:** It broadens the scope of application. HQE now fully covers the sustainable building through four commitments: quality of life, economic performance, respect for the environment and responsible management. Furthermore, the assessment method has changed and now focuses on performance targets, rather than an obligation of means. Established by Association HQE with all stakeholders – government, professionals, local authorities, users and experts – this new reference framework serves as a road map for the sustainable development of all new buildings, renovated or operating.

A longtime partner of Association HQE, the CSTB contributed substantially to shaping this major collaborative work.

#### ***Deploying the new reference framework***

The first step is to raise awareness. We are very pleased with how well it was received regionally and nationally during the 2015 tour.

The second step of deployment is the creation of operational tools by our partners based on the new framework. In September 2015, Céquami, a subsidiary of the CSTB, and Qualitel launched a new certification offer: NF Habitat HQE™. Certivéa, manager of the HQE™ offer for non-residential buildings, is very active. The launch of these benchmarks is planned for June 2016 and will include services that help stakeholders obtain the certification (assessment, online comparison, etc.). Finally, to adapt to the significant changes underway, new knowledge must be put into practice, which is why the third step involves training. CSTB Training anticipated this and already offers specific accredited HQE™ courses.

#### ***How did the HQE™ certification do internationally in 2015***

HQE™ is present in 22 countries worldwide through Cerway, the international manager of this certification.

In 2015, the joint subsidiary of Certivéa/CSTB and Qualitel Certification Cerqual signed two new certification partnerships with local stakeholders in Canada and Lebanon. Cerway also organized new professional training courses in Canada, Morocco and Colombia. To make the training more accessible worldwide, Cerway set up an e-learning platform.

#### ***Where does INIES fit in?***

INIES is the French national database of environmental and health declarations for products, equipment and services for the assessment of building performance. Association HQE is the owner-manager within the framework of a multi-stakeholder governance. INIES centralizes and shares online French environmental and health product declarations (FDES), based on voluntary submissions from manufacturers. As of December 2015, there are 1,653 FDES documents representing more than 34,000 commercial references.

INIES also offers a third-party audit program for FDES documents and includes among its accredited inspectors six CSTB experts working in its environmental performance laboratory opened in late 2015.

## FOR POSITIVE ENERGY BUILDINGS WITH LOW CO<sub>2</sub> EMISSIONS

*Performance criteria are more stringent to make construction a key driver of energy transition and the national low carbon strategy. To guide this development and support stakeholders in ecodesign for buildings, the CSTB is continuing to adapt indicators and the methods of calculating environmental performance. In 2015, it enhanced its work with professionals through several steps.*

To meet environmental quality requirements for construction projects, professionals need performance indicators that take into account several criteria: energy, CO<sub>2</sub>, water, waste, and others, over the entire life cycle of the building, from design to demolition.

### CHARACTERIZING ENVIRONMENTAL PERFORMANCE

With the French Department for Housing, Urban Planning and Landscape (DHUP), the CSTB is developing an environmental label for construction that will be launched in 2016. Like the energy label for household appliances, the challenge is to make the environmental performance of buildings clear to all professionals and users based on reliable scientific indicators. The CSTB is also using its expertise to analyze life cycles for the certification of buildings. Through its subsidiary Certivéa, and in collaboration with Association HQE, the CSTB is defining the indicators and methods of calculating the environmental performance of nonresidential buildings that are candidates for the new HQE™ certification starting in June 2016 (see interview opposite).

In addition, it is participating in the definition of benchmarks for low carbon emission labeling for new buildings. The BBCA label (low-carbon building), which will be issued by Certivéa starting in Spring 2016, will recognize construction with low CO<sub>2</sub> emissions.



*Green Corner, Saint-Denis (93) – Foncière des Régions, building certified NF HQE for office buildings and BBC Effinergie 2005 by Certivéa. Architect: Quadri Fiore.*

### DEFINING POSITIVE ENERGY BUILDINGS (BEPOS)

The scientific definition of the positive energy building is under study by the CSTB in collaboration with the DHUP. Association Promotelec is also tackling the subject and wants to offer professionals a service to assess the consumption of buildings that have solar and photovoltaic systems. The CSTB is developing indicators and methods for calculating the energy self-sufficiency of these buildings.

In addition, as part of the Comepos project supported by the French Environment and Energy Management Agency (ADEME) and Union des Maisons Individuelles (union of private home builders), the CSTB developed indicators in 2015 adapted to assessing positive-energy private homes. The challenge is to optimize their energy potential by using the surfaces of roofs. By 2016, these indicators will be used for the construction of demonstrators.

### EVALUATING INTELLIGENT ENERGY CONSUMPTION

In 2015, CSTB researchers initiated the development of an original method to assess the carbon footprint of energy consumed by buildings in use.

Knowing this input improves the assessment of the carbon footprint for all energy consumed: by the building's users and upstream for producing, transporting and distributing energy to the building.

This kind of indicator makes it possible to assess the contribution of a building to optimized energy management across the territory.

It is useful in defining the flexible building, or Building 2.0, which can adjust its energy use to available resources in order to reduce its environmental footprint.



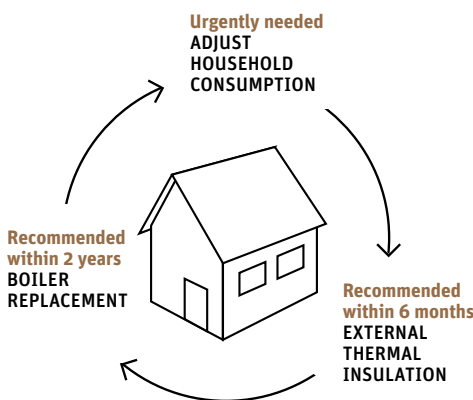


## MAKING HOUSING ENERGY RETROFIT EASIER WITH ÉNERGIE PERSPECTIVE

***What kind of renovations are needed to improve the energy performance of housing units, while keeping time and cost under control? Énergie Perspective, an engineering firm, offers a service that identifies the most effective retrofit measures for a wide range of users and professionals through a Web platform called izigloo. This pragmatic tool was developed with the scientific expertise of the CSTB Carnot Institute and the energy performance calculation engine Cometh.***

Individuals and professionals can use an online platform for energy balance assessments and work plans tailored to the characteristics of the housing units and their occupants: izigloo.com. Launched in 2015 by the Nantes start-up Énergie Perspective, this Web service facilitates the retrofit process: using a compendium of specific information, it provides stakeholders with a list of priority energy retrofit measures to be implemented. This decision support tool is based on an intelligent simulator, SmartDiag®, which combines actual data with

predictive modeling. Partner of this innovation with the French National Institute of Geographic and Forest Information (IGN), the CSTB Carnot Institute used its expertise in energy upgrades, physical modeling and data mining to develop this tool. The Cometh energy performance calculation engine was integrated into the Web platform to generate the energy profiles of housing units. Assessments are made using basic information entered by users, and data is automatically collected or estimated using statistical analyses.



***FOR NEW DESIGNS OR RETROFITTING: COMETH SOFTWARE FROM THE CSTB improves the energy performance of buildings.***

***A product of several years of research and development, this CSTB tool for dynamic energy simulation has demonstrated its robustness. Tested internationally in Europe (CEN standard) and the United States (ASHRAE standard), it provides high-quality results. Initially developed for compliance with the 2012 French energy regulations (RT2012), Cometh can now meet the varied needs of professionals: energy balance, retrofit impact assessment, optimization of performance during design, etc. Capable of processing a large amount of data, the software can connect to different computer environments and accepts customized Web interfaces.***

## THE CSTB ENGAGED IN THE ENERGY PERFORMANCE GUARANTEE (GPE)

In addition to quantitative objectives (500,000 retrofits annually by 2017), the French National Housing Energy Upgrade Plan includes qualitative goals: Make sure that retrofit work achieves the desired energy savings. The construction sector therefore requires operational methods appropriate for assessing the energy performance of retrofitted buildings. The CSTB addresses this challenge with the REPERE<sup>1</sup> method, which provides information about the effective energy gains of specific projects. The CSTB's expertise also helps build trust among stakeholders in retrofit projects through its guidance on Energy Performance Contracts (EPC), a tool for contractualizing and financing the GPE. A comprehensive review of the Guarantee and Contract mechanism has been conducted on two major projects in France. With ADEME and CEREMA in 2016, the CSTB is continuing to share its experience by creating the new National EPC Monitoring Center, which brings together public and private stakeholders.

1. REPERE: Retour d'Expérience sur la Performance Effective des Rénovations Énergétiques (feedback on effective energy performance of energy retrofits).

## MEASURING THE INTRINSIC ENERGY PERFORMANCE OF HOUSING UNITS WITH ISABELE



### Close-up



**Yves Laffoucrière**  
CEO of 3F

**“As a builder and manager for the long term, 3F has been leading projects to improve its properties for decades. Innovation and experimentation are in 3F’s genes. So, it’s only natural that we made our diverse resources available to the CSTB to advance research and better adapt our specifications, both for new construction and renovation, to increase the effectiveness of our investments.”**

***In order for the construction of low-energy buildings to become more widespread, project owners must be certain of obtaining the promised energy performance. The ISABELE method<sup>1</sup> developed by the CSTB Carnot Institute represents a major advance from research to real-life testing by providing stakeholders with a practical solution for measuring the intrinsic energy performance of housing units.***

### ISABELE METHOD

ISABELE measures the effective thermal performance of a building’s envelope. Designed by the CSTB, this method takes into account insulation materials, heat loss through windows, thermal bridges, the quality of installation and other factors. Similar to measuring air tightness, ISABELE assesses the level of effective heat insulation provided by the building envelope, by identifying any

discrepancies in the expected results (design projections). This method has the advantage of taking less than a week after the end of work on unoccupied buildings.

### TESTING ON THE GROUND

In 2015, the CSTB partnered with PYRESCOM<sup>1</sup>, an SME in the Pyrenees region specializing in networking and communication technologies, to develop an instrumentation kit for the ISABELE method. It will be deployed in 2016 in several housing construction projects. In addition, on January 28, 2016, the social housing operator 3F and the CSTB signed a research and development partnership for four programs. Regarding Energy & Environment, the partnership will use the ISABELE method to measure the actual energy performance of private homes in Normandy.

### PROSPECTS

The CSTB is working with Cerema<sup>1</sup> and Costic<sup>1</sup> to develop an operational protocol for the general market that uses the ISABELE method to measure the intrinsic energy performance of buildings upon commissioning. Winners at the end of 2015 of one of the first calls for projects of the PACTE<sup>2</sup> program, they will provide the industry with a tool which aligns accurate indicators with technical and economic constraints, thereby enabling project owners, managers and businesses to measure the impact of their collective work.

1. ISABELE: In-Situ Assessment of the Building Envelope pErformances. PYRESCOM: PYrénées RÉSeaux COMMUNICATIONS. Cerema: Centre d’études et d’expertise sur les risques, l’environnement, la mobilité et l’aménagement (center for study and consulting on hazards, the environment, mobility and land management). Costic: Centre Scientifique et Technique des Industries Climatiques (scientific and technical center for the climate industries).
2. PACTE: French plan of action for construction quality and energy transition, initiated by the Minister for Housing, Regional Equality and Rural Affairs. This is the Merlin project.



## RECOVERING HEAT FROM WASTEWATER WHILE PRESERVING THE ENVIRONMENT: A NEW ASSESSMENT PROTOCOL



*Heat exchangers at the Aquasim-CSTB climatic basin.*

***How much energy can be recovered from hot wastewater?***

***This question is analyzed by the CSTB and its partner Efficacy: Institute for Urban Energy Transition. The next step is a study on the impact of lower wastewater temperatures on the operation of water treatment stations. In 2015, thanks to its testing platform for the sustainable management of water – Aquasim – the CSTB developed an experimental protocol on the subject.***

Historically, water treatment stations have had the capacity to treat wastewater ranging from 12 to 18°C; now, they must be able to treat effluents at about 5°C (after heat recovery). CSTB experts want to analyze whether low temperatures can degrade pollutants efficiently enough to preserve the natural environment in which treated wastewater is discharged. This study integrates climate variations depending on the territory. Not only do bacteria react to changes in wastewater temperature, the temperature also affects the natural environment differently, according to the outside temperature. In 2015, CSTB experts developed an experimental protocol to assess the performance of water treatment stations that purify colder wastewater.

They used Aquasim, the CSTB testing platform for sustainable water management. Water treatment stations are reproduced on a smaller scale and fed volumes of wastewater equivalent to those of cities. Ground temperatures are monitored and the experts then test the operation of water treatment stations with effluents at different temperatures (5 to 30°C). They measure the quality of treated water to determine the performance of the station. Testing campaigns will take place in 2016. The results will help fine-tune the calculation of the potential energy at the city level, including the recovery of end-energy from wastewater.

## Health & Comfort



# ADAPTING HOMES TO FRAGILE RESIDENTS: FROM DIAGNOSIS TO DEPLOYMENT OF SERVICES

***Live well at home: a choice made possible for fragile residents, today and tomorrow. With this goal in mind, the CSTB Carnot Institute guides stakeholders in the development of appropriate solutions for all homes (private or retirement). Listening to needs and using expertise in new technologies and construction are the keys to innovation at the CSTB. Here are some examples of how the new diagnostic tool for accessibility in the housing stock, and deployment of housing-related services can be used.***

### STATUS OF ACCESSIBILITY IN HOUSING

Mapping the existing housing stock to identify required facilities is an important challenge to estate managers. In response, the CSTB Carnot Institute is offering a new online application. Diagnosticians use it to characterize private homes and apartments, occupied or not. It takes into account the needs of seniors, those with reduced mobility, visual, auditory or cognitive disabilities. The result is an accessibility performance label (DPA) which, like the energy performance label EPC (energy performance certificate), assesses the degree of accessibility in housing units, with ratings from A to F. This decision and planning support tool focuses on housing as well as public and outside areas of buildings. The recommendations can include the furnishing of housing units, for example, installation of support rails and special shower seats. It can also include work at building entrances, such as creating ramps for wheelchairs and installing video intercoms.

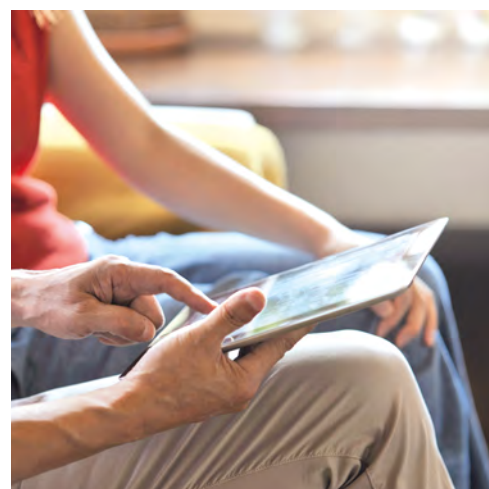
The CSTB tool uses a general approach to support the deployment of large-scale solutions. It complements detailed analyses with information from health professionals to customize the approach based on the needs of the people concerned. After two years of R&D by the CSTB in partnership with CEP-CICAT<sup>1</sup> and OPUS 67 (social housing operator in Bas-Rhin), the software was tested in 2015 by diagnosticians and therapists.

### VIVRAUDOM: SERVICES FOR HOUSING UNITS

Homes may sometimes require urgent adaptations, for example to prepare for the return home of seniors after hospitalization. To ensure their safety and continued autonomy, the association *Vivre dans Son Pays* is experimenting with VivrauDom, an innovative system of services for seniors in their home. This system was developed by the CSTB and the manufacturer Elderis, with the support of the Regional Council and Regional Agency for Health. Between November 2015 and June 2016, VivrauDom is being tested in 20 housing units near Laragne-Montéglin (Hautes-Alpes).

VivrauDom allows the home care association to provide personalized remote monitoring 24/7.

Specifically, VivrauDom uses a dashboard connected to an information system with sensors throughout the housing units. In this way, the association can monitor multiple safety parameters, such as indoor temperature, time spent in bed or number of visits. In addition, it assists people in their daily lives by



sending information via television and telephone: the market is open in the village; there will be a water shutdown tomorrow; ice has developed overnight, etc.

After developing the VivrauDom specifications with the association *Vivre dans Son Pays*, the CSTB Carnot Institute provided the analysis software and online application and then trained the users. It supervised the installation in housing units of connected objects designed by Elderis. In 2016, the CSTB will lead the technical and economic assessment of this experiment while ARS PACA<sup>2</sup> performs the medical assessments.

1. CEP-CICAT: Centre de ressources, d'informations et de conseils en aides techniques (center for resources, information and consulting on technical aids).

2. ARS PACA: Agence Régionale de Santé en Provence-Alpes-Côte d'Azur (regional agency for health in Provence-Alpes-Côte d'Azur).





## POOLS: ASSESSING THE EFFECTIVENESS OF DISINFECTION TREATMENTS THROUGH TESTING

***At the request of ANSES, the CSTB is studying the impact of disinfectants on indoor pools. In 2015, it developed a protocol to measure the performance of products and processes. A reference pool at the Aquasim testing platform examines various solutions. The CSTB is continuing its assessment of the effectiveness of water treatments in different contexts.***

ANSES<sup>1</sup> observations were the starting point of CSTB research. It focuses on air pollution (trichloramine and trihalomethanes) in indoor pool facilities associated with the use of water disinfectants, most often containing chlorine. After two years of R&D to explain what conditions lead to the formation of disinfectant byproducts, the CSTB made new advances in 2015 by developing a protocol to measure the performance

of disinfectant processes, allowing comparative assessment of solutions available on the market. This method is based on observations of water and air pollution in a reference pool – 8 m long, 4 m wide and 1.3 m deep – located in Aquasim, the CSTB testing platform for sustainable water management. Before being subjected to various treatments, the chemical composition of the water takes into account the equivalent of the presence of swimmers for a representative simulation of reality. Then, pollution is precisely measured under varying usages (number of users, water and air temperatures). The CSTB began this work in October 2015 with École Nationale Supérieure de Chimie de Rennes. The work combines previous hydrodynamic analyses with a study of the chemical behavior of chlorine. New measurements are performed

in the CSTB reference pool using membrane-introduction mass spectrometry (MIMS). Through a computational study, all the data can be extrapolated for a pool measuring 25 or 50 meters and compared with measurements made in a public pool. This makes it possible to predict the emission of disinfectant byproducts based on the operating conditions at facilities. This is key information to support new regulatory requirements for hygiene and the quality of environments in swimming pool facilities.

1. Opinion of the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) concerning "assessment of health hazards related to swimming pools – part 1: regulated swimming pools," June 9, 2010.



## FUNGAL BIODETECTOR MAKES VISIBLE THE INVISIBLE

***The fungal biodelector detects the presence of dry rot and mold in buildings, even when they are not visible to the naked eye. Compact and portable, this monitoring and diagnostic detector, designed by the CSTB, contributes to health, building sustainability and the conservation of cultural heritage assets. CSTB experts are adapting its use to current and future market needs.***



The result of 10 years of R&D in environmental microbiology, and awarded for Innovative Techniques for the Environment at Pollutec 2014,<sup>1</sup> the CSTB's fungal biodelector is now being used on the market for specific applications. Thanks to its ability to detect mold at a very early stage of growth, this technological innovation can prevent damage to buildings and preserve the health of their occupants. For a French housing stock with an estimated 34 million housing units, about one third is damaged by various fungi, with a 10% detection rate. Schools, offices and hospitals are also subject to infestation of these microscopic contaminants, as are museums, archives and works of art. Such contamination is partly responsible for allergies in seven million residents of France.

***CSTB fungal biodelector.***

Once installed in the environment to be monitored, the fungal biodelector analyses the information collected in real time and issues an alert if fungal growth is detected. Action can then be taken as soon as possible to stop mold proliferation and correct any hygrothermal factors promoting the infestation.

With the fungal biodelector, building stock managers, conservators of cultural heritage assets and ordinary residents can prevent damage. It also contributes to maintaining indoor air quality. In the long run, other stakeholders, for example, in the cosmetics industry, will be able to benefit from the fungal biodelector.

1. Pollutec brings together professionals from around the world, whether manufacturers, governments or commercial businesses, to consider innovative solutions that reduce the impact of human activities on the environment.

## IS INDOOR AIR QUALITY INCLUDED IN ENVIRONMENTAL CERTIFICATIONS WORLDWIDE?

***The CSTB conducted the first international review of indoor air quality as a criterion in certification benchmarks for sustainable buildings, in design and operation. Published in 2015 in the journal Building and Environment,<sup>1</sup> the study compares 31 certifications in 30 countries on every continent. It is a major contribution to the continuing development of environmental and health performance indicators for building works.***

All environmental certifications studied by the CSTB worldwide take into account the indoor air quality. For those based on ratings, the weight of indoor air quality varies from 3 to 11%, averaging 7.5%. There are three common factors used for certifications: limitation of pollutant sources (77% of certifications), ventilation (100%) and measurement of indoor air pollutants (65%). For measurements of indoor air pollutants, there is a great deal of variety in the pollutants covered, the sampling strategies, measurement methods and reference values for interpreting the results.

This new CSTB study provides a comprehensive and global view of indoor air in certifications. It is the starting point of substantial in-depth work that will be conducted as part of the CSTB research and development program or for private operators. Studies will focus on performance indicators and current challenges, such as the management of particulate pollution and asbestos in renovated buildings.

1. Indoor Air Quality Requirements in Green Building Certifications, Building and Environment, 2015, vol. 92, p. 10–19. Authors: Corinne Mandin, Olivier Ramalho and Wenjuan Wei. Location of 31 "Green Building" certifications listed around the world and analyzed. Excerpt from Wei et al., 2015.



## SEMIVOLATILE ORGANIC COMPOUNDS: UBIQUITOUS SUBSTANCES IN HOMES

***For the first time, a measurement campaign for the French housing stock was conducted to determine the levels of SVOC contamination. This project was coordinated by the CSTB and EHESP School of Public Health as part of the Indoor Air Quality Observatory's (OQAI) mission. The results were shared in June 2015 in the OQAI<sup>1</sup> newsletter and at a workshop at the CSTB in Paris.***

Semivolatile organic compounds (SVOCs) are chemical substances used in the manufacture of many products: insecticides, plasticizers, preservatives,

flame retardants, etc. In buildings, SVOCs are found in the air and the dust deposited on surfaces. Young children, who often put their hands in their mouths, are particularly exposed. The health effects of some of these chemicals (phthalates, bisphenol, polycyclic aromatic hydrocarbons (PAHs), etc.) are known or suspected (cancer and effects on the nervous system, immune system and hormonal function).

The measurement campaign demonstrates that SVOCs are ubiquitous in homes. Phthalates and PAHs are present at high levels

in all housing units, both airborne and in floor dust. Other SVOCs are also present in more than 98 percent of homes. This is particularly true for bisphenol A and permethrin in floor dust and triclosan in the air. Multiple pollutants are present: 32 of the 48 SVOCs searched in floor dust, and 35 of the 66 SVOCs searched in the air are found in half of all housing units. The study results provide valuable information for assessing the health hazards associated with these substances and to propose, if necessary, measures to reduce exposure of the population, in collaboration with the French national research program on endocrine disruptors (PNRPE) led by the French Ministry of Ecology, Sustainable Development and Energy and the environmental and occupational health research program of the French Agency for Food, Environmental and Occupational Health and Safety (ANSES).

1. See the website [www.oqai.fr](http://www.oqai.fr)



## Risk mitigation



### FIRE SAFETY: R&D ADVANCES

*In France, fire safety in buildings is based on three priorities: ensuring the evacuation of people, limiting the spread of fire and facilitating the intervention of fire fighters. In 2015, the CSTB made two scientific advances in these areas. With LEMTA (Université de Lorraine),<sup>1</sup> it is releasing the first results of a study on sprinkler protection systems and how they affect the evacuation conditions for people in the event of fire (active protection). And with FCBA,<sup>1</sup> the CSTB is developing a guide on timber solutions to promote their safe use in high-rise buildings.*

#### SPRINKLER SYSTEMS AND ACTIVE FIRE CONTROL

Water mist protection is now considered an active fire control solution, in the same way as traditional sprinkler protection. In its 2015 scientific publications,<sup>2</sup> the CSTB confirmed the benefits of this technology, which uses less water. It also specified the conditions for use of sprinkler protection (pressure adjustment, proper triggering, etc.) to prevent water from obstructing the visibility of people evacuating the premises and fire fighters. After seven years of research by LEMTA and the CSTB, these advances were published in scientific journals, elucidating the phenomena of interaction between water discharged from sprinkler devices and fire conditions. They will be complemented by a study on the use of sprinkler protection combined with other solutions (detection and smoke extraction). In addition, the CSTB provides training at the French

Academy for Fire, Rescue and Civil Protection Officers (ENSOSP). It also guides project owners and managers in the use of active fire protection for fire safety in buildings.

#### TIMBER AND SPREAD OF FIRE THROUGH FACADES

In 2015, to meet the fire safety objectives specified in the French Building and Housing Code, the French Technology Institute for Forestry, Cellulose, Wood Construction and Furniture (FCBA) and the CSTB, partners in SynerBois, embarked on the development of a guide to timber solutions in order to assess the risk of the spread of fire through facades. The solutions concern high-rise residential buildings and buildings open to the public (ERP). Developed through collaborative work, these trade guidelines are based on a testing campaign (2012–2015) conducted with funding from the Department for Housing, Urban Planning and Landscape (DHUP),



the Professional Committee for the Development the French Furniture and Timber Industries (Codifab) and the association France Bois Forêt (FBF). The guide will be available in early 2016 at [www.batipedia.com](http://www.batipedia.com). It is intended for stakeholders in high-rise construction projects using timber, led by the Association for the Development of Residential Buildings (ADIVbois).

1. LEMTA: Theoretical and Applied Energy and Mechanical Engineering Laboratory. Joint research unit of Université de Lorraine and CNRS.

FCBA: French Technology Institute for Forestry, Cellulose, Wood Construction and Furniture.

2. References: "Stratification thermique et optique d'un environnement enfumé et interactions eau/fumée sous aspersion (Experimental and Numerical Study of Smoke/Mist Interactions Related to Heat Transfer and Optical Properties in a Corridor)," thesis of Romain Morlon, doctoral candidate at Université de Lorraine and the CSTB, defended in 2015. "Experimental and Numerical Study of the Interaction Between Water Mist and Fire in an Intermediate Test Tunnel," article in Fire Technology, Volume 50, Issue 3, pp. 565–587. Authors: Elizabeth Blanchard and Philippe Fromy, CSTB experts in fire safety. Jack Bono Prize in 2015.



## Digital Technology



### DIGITAL MODEL OF FARO AIRPORT

*In 2015, the CSTB created a digital model of Faro Airport in Portugal as a starting point for developing tools for the daily management of energy and long-term energy improvement scenarios. Here are some observations on a key experiment that brings BIM to building operation and upgrades.*

The Energy in Time project unites the CSTB with 12 partners from eight European countries – private companies, research centers and universities – with financial support from the EU's Seventh Framework Programme for Research and Technological Development (FP7). Launched in 2015, this R&D project is based primarily on building information modeling (BIM) of existing buildings, such as Faro Airport.

An accomplishment led by the CSTB with the airport's technical manager, the ANA Group, a subsidiary of Vinci. The digital model of the 75,000-m<sup>2</sup> airport terminal consists of 19,000 discrete objects. Designing the model required a thorough review of the existing facility and the creation of BIM files on the building envelope and structure, the layout of areas on seven levels and air handling installations. This digital model makes it possible to guide stakeholders in operation and optimized upgrades of buildings. The Energy in Time project continues in 2016 along these lines. It is developing energy management and multi-criteria assessment tools connected to the digital model. The CSTB is specifically involved in the design of a calculation and simulation tool for preparing energy upgrade plans covering the next 30 years.



*Le Corbusier  
immersive room, CSTB  
at Sophia Antipolis.*



### BIM: "THE KEY TO SUCCESS IS INVOLVEMENT OF THE VARIOUS STAKEHOLDERS"

***Work on the new hospital in Ajaccio started in 2015. Michel Filleul, project manager, talks about the use of digital modeling, developed with the support of the CSTB Carnot Institute. In 2015, this fully BIM project was awarded the BIM Best Practices award by the French Minister for Housing, Regional Equality and Rural Affairs and received a silver medal at the BIM d'Or 2015 ceremony.***

***CSTB: What made you choose digital modeling?***

***Michel Filleul:*** I wanted to incorporate its use at the project planning stage. Upon delivery of the building, we have an established database for all future operators of the building, hospital staff and contractors.

***Can you give examples of its use?***

With digital modeling, it's easy to detect inconsistencies in the design. They can be resolved because you spot them well upstream of construction. This way, the contractor encounters fewer difficulties, and construction can progress more quickly.

Digital modeling also makes it possible to optimize operation of the building. By clicking on a valve in the digital avatar of the building, you can find out where it was purchased, how much it cost and its service life, allowing you to anticipate its replacement. If there is a breakdown, you can view the breakdown area and identify the piping. When you open a false ceiling, you'll be closer to the breakdown.

***What changes is digital modeling offering?***

Digital modeling is radically changing the way all stakeholders work. It requires much more diligence: all objects must be entered in the system. The key to success is involvement of the various stakeholders. In the near future, I'm sure that firms will be using BIM for projects, incorporating the construction phase. This will allow them to optimize the means of implementation to shorten construction time and increase profitability.

## Economics and Society

### ENERGY CONSUMPTION IN HOUSING UNITS

***At the request of ADEME and the Ministry for Housing, Regional Equality and Rural Affairs, the CSTB conducted several studies in 2014–2015 on energy consumption in housing units in France and on factors for change. The studies contribute to the development and monitoring of the national low carbon strategy applied to buildings.***

Complete knowledge of energy spending and consumption by households in France, based on the type of housing unit, is essential to developing the national low carbon strategy introduced by the French energy transition act for green growth.

The CO<sub>2</sub> reduction targets for 2030 are particularly ambitious for buildings. Using data from the new Phébus<sup>1</sup> survey, the CSTB performed a very detailed review of the French residential building stock and provided insights into the dynamics that are changing performance: upgrades, residential preferences of households, behavior, practices, energy prices and other factors.

The studies provide a unique perspective on the rebound effect. Energy savings brought by improvements in energy efficiency in homes often turn out to be lower than the forecasts by models calculating thermal performance.

One explanation for this gap is the phenomenon known as the rebound effect: households tend to increase their comfort or decrease their restrictions in upgraded and better insulated housing units. However, various analyses developed with the Phébus data show that the rebound effect is generally rather limited, below 20%.

1. Phébus: Performance de l'Habitat, Équipements, Besoins et Usages de l'Énergie (performance of housing, equipment, energy needs and practices). A survey conducted by the statistics department of the French Ministry of Ecology, Sustainable Development and Energy.

### REQUIRED ENERGY EFFICIENCY IMPROVEMENTS IN COMMERCIAL BUILDINGS

***The CSTB guided the French Department for Housing, Urban Planning and Landscape (DHUP) in analyzing best practices in energy upgrades and commercial building management. Published in June 2015, this information shed light on the effect of mandatory measures for energy savings in this sector.***

The French energy transition act for green growth includes objectives for energy savings that are strengthened every decade to reduce consumption by at least 60% before 2050. To prepare for this change with commercial real estate professionals,

the CSTB identified the drivers of energy performance based on feedback from the signatories to the Charter for energy efficiency in public and private commercial buildings.<sup>1</sup>

This analysis shows that substantial savings are possible. Stakeholders involved for several years say that it is possible to save up to 20% on energy costs per building without major work by raising awareness among occupants and optimizing use. However, achieving such performance requires certain tools and perseverance over the long term. First, energy efficiency in buildings must be addressed as a real business

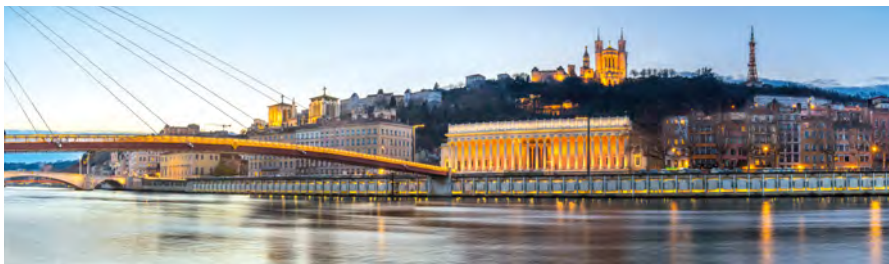
project, driven by the management team and monitored by an internal organization. At the same time, management instruments must be used: energy audits, meter systems, contract oversight, monitoring and adjustment of automation processes. These actions are relatively inexpensive and the cost is generally recouped in two to three years by substantial energy savings.

1. The charter for energy efficiency in public and private commercial buildings was created in 2013 by the National Sustainable Building Plan and DHUP to mobilize interested stakeholders to improve energy performance.



# AT NEIGHBORHOOD AND CITY LEVEL

## Energy & Environment



## TOWARD THE INTELLIGENT CITY THANKS TO INNOVATIVE POWER MANAGEMENT

**Smart ready? This is the objective for buildings connected to power grids and their willing occupants participating in an experiment on flexible electricity consumption. The initiative involves installing automatic control systems in buildings connected to the power grid and getting users to modify their consumption when they receive alerts. The Smart Electric Lyon project and CityOpt in Nice are experimenting with this innovative approach to power management. As an expert in physical modeling, the CSTB is participating in the deployment and assessment of these projects. Here is a zoom on their applications in housing units.**

### SMART ELECTRIC LYON PROJECT: ACHIEVING BUILDING 2.0

Supported by the French Environment and Energy Management Agency (ADEME) and various partners from academia and industry, the Smart Electric Lyon project, led by EDF (2013–2016), is experimenting with technical and pricing solutions downstream of the meter. Objective: optimize electricity consumption in 2,500 voluntary residential homes.

The project implements automated load shedding, and the CSTB, project partner, is helping to assess the impact. Example: one day ahead, the power company schedules rate increases for peak hours. An information system sends an alert to the building through its communicating electric meter.

Smart ready energy control systems then have several options: overheat the building before cutting it at peak hours, temporarily lower the temperature setting or completely turn off heating. The CSTB is analyzing the benefits of a technical solution that uses an automatic rate alert to adjust energy consumption in a building. The assessment method includes five criteria: amount of deferred energy, CO<sub>2</sub> emissions prevented, changes to electric power demand, user comfort and economic gain. The CSTB bases its analysis on physical modeling of situations and strengthens its approach with periodic measures.

To date, load shedding has a proven impact on the deferral of power demand. This could lead to a collective environmental benefit by lowering investments in electric

power infrastructure (generation, transmission and distribution). This prospect appears even more promising when energy management solutions are tailored to the type of building and take into account occupant comfort. With so many lessons learned, the Smart Electric Lyon experiment is strengthening the CSTB's expertise in energy systems adapted to Building 2.0. It is offering this expertise to industrial manufacturers (optimized integration of solutions into construction) and power grid stakeholders (study of the electrical behavior of all connected buildings).

### CITYOPT IN NICE: FOR BETTER CONTROL OF USAGE

Supported by the European Commission, the CityOpt project (2014–2016) brings together Nice Côte d'Azur Métropole, Vienna and Helsinki. In the Nice Métropole, 140 families have volunteered to reduce or shift their electricity usage during periods of peak consumption. Testing of this "energy social network" will run for six months, starting in November 2015. It analyzes the conditions under which residents agree to change their behavior.

For this project, the CSTB developed the CityOpt online application, available to families on tablet computers. This allows them to receive SMS and e-mail alerts from the power company the day before consumption peaks. They are asked to take simple measures, such as deferring use of clothes dryers until after the peak period. The CSTB is tasked with assessing and disseminating the project results.

## Health & Comfort



### IMPROVING THE QUALITY OF LIFE NEAR THE GRAND PARIS EXPRESS METRO

***The future Paris region railway system, known as Grand Paris Express, is developing as a French model of the smart and sustainable city. Commissioned by the Société du Grand Paris for an outside opinion, the CSTB's mission is to ensure comfort in nearby buildings. It is overseeing the control of noise and vibration associated with the new metro.***

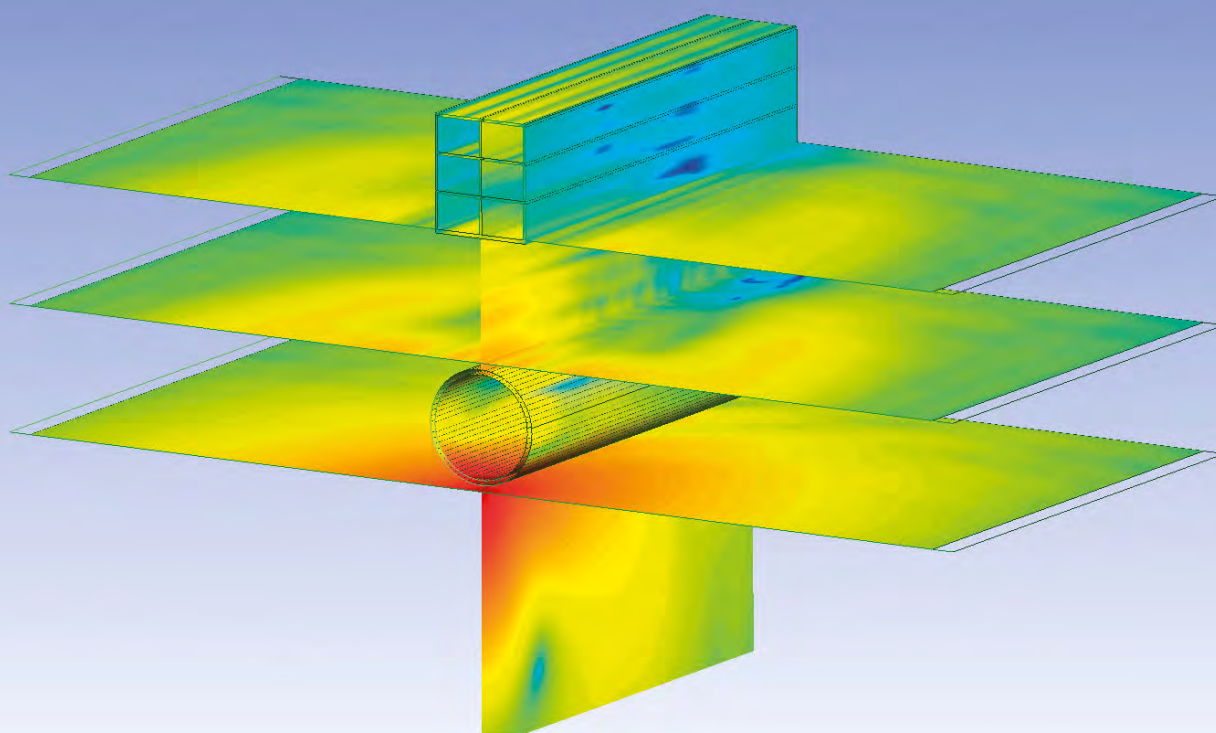
Spearheading new mobility, the Grand Paris Express metro will deeply change the urban landscape in the Paris region, especially around the new stations. Its impacts below ground are challenging to assess but they must be fully understood. Underground railways emit vibrations that propagate to foundations and

nearby building structures and can generate structure-borne noise.<sup>1</sup> The challenge is to control noise and vibration to improve the quality of life of local residents. The Société du Grand Paris chose the CSTB to give an outside opinion on the construction of the future red line encircling the city, the iconic Grand Paris Express metro. Since February 2015, the CSTB has been involved in the first project phase: determining the methods and variables required to characterize, assess and predict vibration phenomena and supervise the predictive studies that will follow. The limits on structure-borne noise and vibration related to railway

systems are not yet specified in regulations. Through its consulting mission for the Grand Paris Express, the CSTB is developing a national reference framework.

More broadly, the CSTB's work assesses the levels of vibration and structure-borne noise in structures. It also determines the comfort threshold of local residents to alert stakeholders and suggest mitigation systems on the tracks, if necessary. The role of the CSTB includes monitoring measurements on-site and along the operating line to contribute to the quality of living spaces close to the Grand Paris Express metro.

1. Structure-borne noise originates from direct vibration of a structure, unlike airborne noise generated by sources having no contact with the built structure.



***Vibration analysis of a source in a tunnel.***



## Major Structures

### STABILIZING TOWER CRANES TO IMPROVE SAFETY ON WORK SITES

*There are several thousand every year on construction sites in France, essential to handling loads but also potential sources of accidents, especially in cities.*

Tower cranes must be properly stabilized when they are not in use to prevent toppling by the wind. In 2004, the first guidelines of the National Health Insurance Fund for Employees (CNAMTS)<sup>1</sup> gave construction site supervisors a qualitative description of the impact of nearby buildings on the stability of cranes. Now there are specific rules to assess the speed stability of cranes to lower the risk of falling. These rules were published in 2015 in a reference brochure developed by the French National Institute for Research and Safety (INRS) and the CSTB, an expert in this field. They are based on four years of studying the behavior of tower cranes in the wind using models in a wind tunnel at the CSTB. Ultimately, the stability of cranes depends on two main conditions: understanding and then controlling the impact of nearby buildings whose heights are similar or greater than that of the crane. The flow disturbances due to buildings can strongly affect the jib/counter-jib of the crane when turning, to the point of causing instability.

1. Guideline R 406.



### NEW AERODYNAMIC DESIGN TO IMPROVE THE SAFETY OF TRUCKS IN THE CHANNEL TUNNEL



*Prototype  
of the new spoiler  
for Eurotunnel.*

***140 km/hour: This is the speed  
of freight trains traveling in the  
Channel Tunnel, much faster than  
trucks on the roadway.***

The tarps of trucks transported on rail shuttles can tear under the effect of aerodynamic forces. There is also a fire hazard if they come into contact with the catenary system. The CSTB partnered with the industrial group Safran to develop a new aerodynamic spoiler design. This structure protects transported trucks and optimizes power consumption related to

their journeys. The development of the prototype required several measurement campaigns: force, pressure and airflow velocity on trains. To do this, the CSTB conducted tests on a 1:12 scale model of the tunnel under the English Channel, and then full scale in the climatic wind tunnel. It used high-precision measurement technology (particle image velocimetry and multichannel pressure scanner with high-frequency acquisition). The prototype developed in 2015 will be deployed on trains in 2016 with the support of the CSTB.



## DOUBLE EXPERTISE FOR FUTURE DUO TOWERS: WIND RESISTANCE AND COMFORT

*The development plan for the southeast of the capital (Paris 13<sup>th</sup> district) includes the construction of two asymmetrical towers for offices, shops and a hotel. Designed by Ateliers Jean Nouvel, the DUO towers will be 180 and 122 meters high, one with 39 floors and the other 27. Ahead of construction, which will begin in 2016, the CSTB Carnot Institute studied the towers' wind resistance and comfort with the structural engineering consulting firm Aedis, at the request of the project owner, Ivanhoe Cambridge and Hines.*

To assess the wind stability of the future towers in their urban environment, and examine the comfort of nearby pedestrians and vehicles, the CSTB conducted an experimental aerodynamics study that included digital simulation.

**RENOVATION OF HIGH-RISE BUILDINGS** can also create aerodynamic problems. For example, in 2015, the CSTB studied the feasibility of renovating the envelope of the two Pascal towers in Paris's La Défense business district, in terms of wind resistance. Before having its facades renovated, the Grande Arche was also studied by the CSTB: wind loading of the project; the comfort of pedestrians who will now have access to the observation deck at the top of the monument; and wind safety for the construction site which uses platforms.



Model of the DUO towers in the atmospheric wind tunnel of the CSTB Nantes facility.

### Close-up



Davor Grgic

founder of the structural engineering consulting firm Aedis

“The DUO project involves the construction of high-rise towers with complex geometry. The first has a stepped facade on its full height. The second, trapezoidal, slopes 10 percent. It is essential to check the wind resistance of this tower which, because of its slope, already relies heavily on its central core. Wind blowing from the opposite side of the inclination is the most adverse. We called on the CSTB Carnot Institute to determine the wind load supported by the two towers, using an experimental study to collect very precise values. The CSTB created a 1:200 scale model of the project and tested it in an atmospheric wind tunnel. The testing confirmed that the oscillation of the towers under the effect of the wind remains below the maximum values in all cases.

Together with digital simulation, the testing also allowed us to check the wind comfort of pedestrians walking across the square at the foot of the towers. In addition, we analyzed the impact of the DUO I tower on the safety of vehicles traveling on Boulevard Périphérique ring road. Experimental and digital studies demonstrated that the tower is a barrier to wind flow, causing sudden acceleration in some areas. This can potentially destabilize cars. The CSTB proposed installing a perforated windbreak at the foot of the towers, on the side of the boulevard, to create a transition in the wind flow. We were impressed by the creative and collaborative spirit of teamwork of the CSTB, which guided us in completing a sophisticated design for the project. We worked together for about ten years and developed a method that allows us to obtain reliable data.”





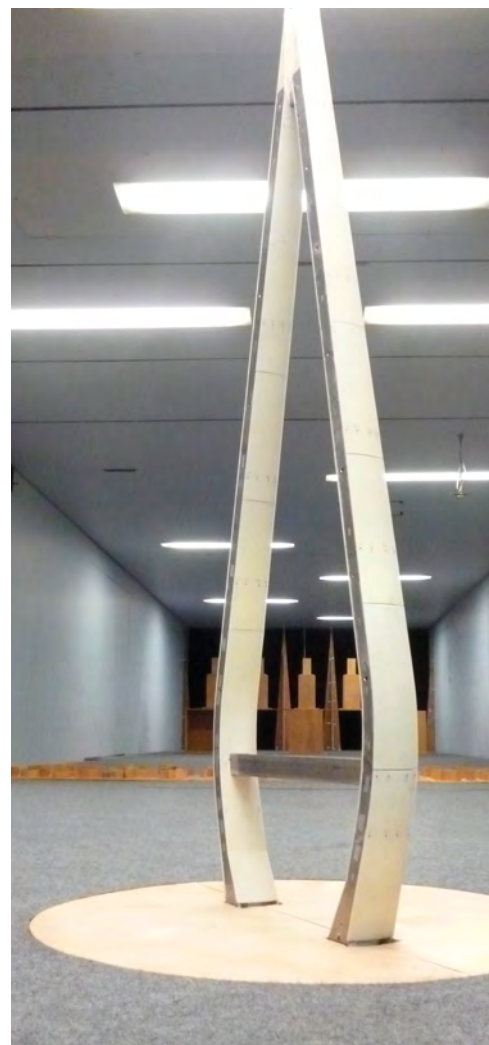
## CABLE-STAYED BRIDGES AND WIND: A CHALLENGING TEST IN BRITAIN AND MOROCCO

*The CSTB uses its expertise in aerodynamics and climatology to guide builders around the world in designing stable and sturdy bridges. In 2015, it participated in projects for cable-stayed bridge in Casablanca and in northeast England above the River Wear in Sunderland. A combination of weather analysis, wind tunnel tests and engineering studies increased the safety of these major structures, currently under construction.*

As an important feature in any territory, new bridges require a preliminary study of wind stability to ensure long-term durability and the safety of pedestrians, bikes and vehicles. For the new bridge over the River Wear, the CSTB conducted tests on a bridge deck and pylon model in a wind tunnel with different wind patterns. In light of the results, it recommended to the English consulting firm BuroHappold Engineering some simple structural

changes (adding vertical screens and modification of the shape of ledges) to increase safety and reduce vortex-induced vibration during construction and operation.

At the request of the Moroccan civil engineering firm SEPROB, the CSTB also studied the wind resistance of the future Sidi Maârouf Bridge in Casablanca, intended to improve traffic flow between the airport and the country's business capital. The CSTB demonstrated the stability of the structure, even when supporting heavy traffic. To do this, it conducted tests on models reproducing a portion of the bridge deck, with and without vehicles. At the request of the client, it designed large-scale models (1:20) with dimensions four times greater than usual. The bridge deck model alone measures 4.40 m long and weighs 210 kg. It was specially installed in the large Jules Verne climatic wind tunnel for the tests.



^  
Aluminum pylon model created using digital machining and 3D printing for the cable-stayed bridge in Sunderland.



<  
Model of the bridge deck of the Sidi Maârouf Bridge with vehicles, tested at the Jules Verne wind tunnel in Nantes.



## GRAND MUSÉE DE L'AFRIQUE IN ALGIERS: INNOVATION, ELEGANCE AND EFFICIENCY

*Bordering the Mediterranean Sea in the Bay of Algiers, the future Grand Musée de l'Afrique in Algiers (GMAA) deploys three monumental shade structures. Designed by architect Nadir Tazdaït, this museum will host exhibitions and shows about African heritage and contemporary art in a 14-hectare garden. At the request of the project owner – the African Union, Algerian Ministry of Culture, and Algerian agency for the implementation and management of major cultural projects (ARPC) – the CSTB Carnot Institute guided the project design by determining wind loading to ensure the stability of the structure in sea winds, and the comfort of visitors strolling through the gardens and roof terraces.*

A marriage of architecture and aerodynamics: that is the ambition of this museum of African civilizations. Its vertical, horizontal and oblique shade structures, 60 meters each, shield visitors from the Mediterranean sun. The shadows cast on the building structure provide user comfort. They must also withstand major sea winds on flat land with few structures, far-removed from the nearest houses. To analyze the impact of wind on these shade structures, the CSTB employed a special methodology that combines two types of measurements. Using a 1:200 scale model of the project, installed in a wind tunnel, it measured local pressure on the facades and shade panels.

It also determined overall wind loading using dynamometers. In collaboration with the engineering consulting firm VP & Green, this study made it possible to anticipate the bracing measures needed in the construction phase (starting in 2016). How does the wind affect roof terraces, gardens, walkways and parking areas? For each of these locations, the CSTB studied the comfort based on the type of use. It measured wind-generated turbulence and defined the quality criteria before recommending designs to optimize the comfort of visitors year round: installation of windbreaks, pergolas, street furniture and vegetation, for example.





## Digital Technology

### AREAS EAST OF PARIS ADVANCE TO BUILDING 2.0



*Fontenelle neighborhood in Chanteloup-en-Brie. Model created by Guillaume Junqua for Epamarne. Integration into the digital model of the area by the CSTB.*

new Marne-Europe neighborhood, both located near the future Grand Paris Express metro stations. The idea is to offer virtual construction of these major sites before the start of the construction phase.

#### *What benefits do you expect from digital modeling?*

In the design phase, digital modeling makes it possible to improve sharing of projects with all regional stakeholders, residents and elected officials through the study of various working assumptions. Used for real estate projects, it offers developers a better understanding of the global project costs as early as the initial planning stage, limiting the risk of defects and remedial work. Ultimately, digital modeling of neighborhoods offers authorities an urban maintenance tool to better manage its spaces and public facilities. The use of digital modeling throughout a region is in line with evolving practices that provide greater clarity and smooth flow in project design, improved overall efficiency and lower construction costs.

*In May 2015, the Marne-la-Vallée public urban development agency signed a partnership with the CSTB to implement BIM for its development operations. Joint testing is carried out in the Paris region, including major neighborhoods of urban area such as Marne-Europe and Cité Descartes.*



**THREE QUESTIONS FOR NICOLAS FERRAND, CEO OF EPAMARNE AND EPAFRANCE**

#### *CSTB: Why is Epamarne using the digital approach?*

**Nicolas Ferrand:** As we move to Building 2.0, Epamarne anticipates that, by 2017, there will be substantial impetus in France to use BIM in all public consultations. We want to strategically position our development agency by incorporating BIM into our development operations. Of course, we want this for buildings, but we also want to expand the initiative to

neighborhoods. The new digital tools are essential today because they offer many uses: defining and managing urban projects, joint construction projects, engineering studies, to name just a few. The CSTB provides its expertise to guide us in this transformation.

#### *What is the nature of the partnership with the CSTB?*

It covers various aspects of project assistance over three years. It includes a phase for operation planning and preparation, with the set-up of a digital data base. The CSTB will prepare guides to BIM data generation and requirements to include in land plot commercialization specifications. The second phase of the CSTB mission is the assessment and monitoring of projects. In summer 2015, with the help of the CSTB, we launched real estate operations managed with BIM in Champs-sur-Marne, Bussy-Saint-Georges and Chanteloup-en-Brie. In 2016, digital models of urban development projects will be created, including the Cité Descartes and the

## DEVELOPING THE INTELLIGENT CITY IN BORDEAUX

***In June 2015, the Bordeaux-Euratlantique public urban development agency and the CSTB signed a collaborative research agreement for digital technology. It covers several projects implementing a CIM approach – BIM extended to the city – led by the Bordeaux-Euratlantique OIN.<sup>1</sup>***



**QUESTIONS  
FOR STÉPHAN  
DE FAÿ, CEO OF  
EPA BORDEAUX-  
EURATLANTIQUE**

### ***Why has EPA Bordeaux-Euratlantique committed to BIM-CIM?***

It is our responsibility as a public stakeholder to increase the quality of living spaces over the long term, and this is only possible with a comprehensive approach, from design to implementation, to the operation of buildings and the neighborhood. BIM is key because it reliably organizes data production and sharing on all levels. Also, we want the data collected to be public and useful to regional stakeholders for sustainable innovation. We call on the CSTB for its proven expertise in BIM and scientific and technical objectivity, and we rely on it to ensure interoperability of the data generated. Its job is to work with us to define the structures and formats of the reference data. The CSTB is also tasked with creating a multiscale digital model of the useful details of construction projects, integrating them into the region according to a collaborative and adaptive process.

### ***What do you specifically expect from digital modeling?***

It's an information tool. Beyond visual representation, digital modeling provides detailed information on building and city objects (physical characteristics, costs, deadlines, quantities, energy consumption, etc.). It is also a shared work tool that brings together all stakeholders in a joint project from the start. With digital modeling, we can put operational issues at the center of projects. We can expect optimization of the cost/quality/turnaround ratio for construction and development projects. This requires ownership of the method and tool. Historically, the work process has been compartmentalized by expertise and stage. Digital modeling implies a change comparable to transitioning from the typewriter to the computer word processor.

We want to work with the CSTB to bring this new culture to the sector. Furthermore, we want to collaborate with the CSTB to improve the potential of digital modeling. The objective is to develop 3D digital imaging to improve sharing of development projects with the general public. We are convinced that this will further boost the development of our region. Finally, we want to make digital modeling information accessible as open data, to the extent permitted by data protection regulations. Contractors will then be able to take full advantage of it and offer value-added services. We want to support the economic and social vitality of the region through better data management with BIM-CIM.

1. BIM-CIM: building and city information modeling. OIN: Operation of national interest, Bordeaux-Euratlantique is planning the construction of 2,500,000 m<sup>2</sup> of housing units, offices and public facilities on more than 700 hectares in Bordeaux, Bègles and Floirac. About 25,000 new residents and 25,000 new jobs are expected in this territory.



*Belvédère project  
in Bordeaux.*



# Test Facilities

## 01 ARIA

*Laboratories studying the hygienic health quality of indoor environments*

## 02 AQUASIM

*Research platform for sustainable water management in buildings*

## 03 PHÉLINE

*Platform for the study of electromagnetic fields*

The competencies of CSTB laboratories are recognized through accreditation issued by the French Accreditation Committee (Cofrac) in accordance with the NF EN ISO 17025 standard. Accreditation numbers: 1-0300, 1-0301, 1-0302, 1-0304, 1-0305, 1-0306, 1-2122 and 1-1542 for testing and 2-1930 for calibration. Scopes of accreditation are available at [www.cofrac.fr](http://www.cofrac.fr).

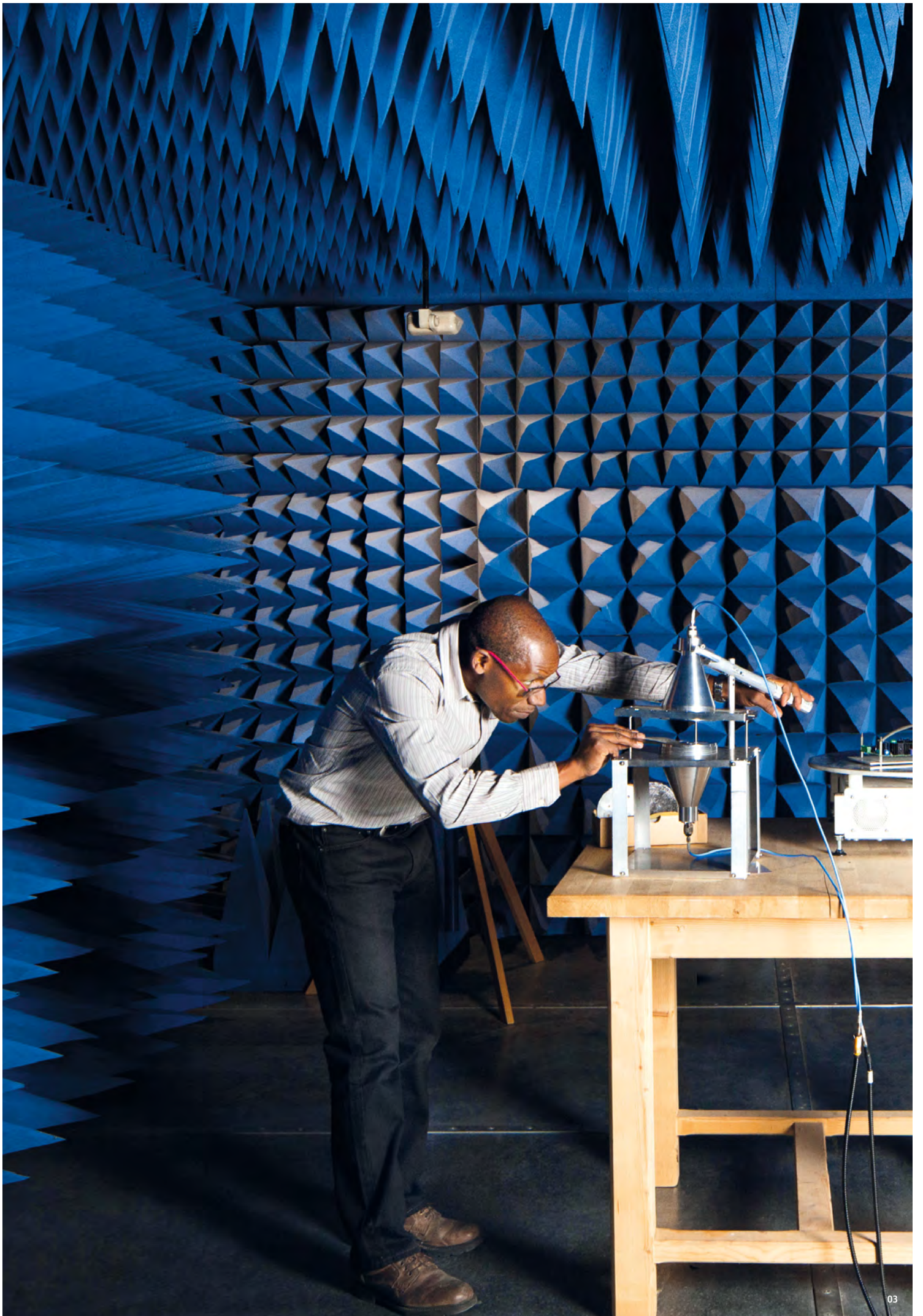


01



02







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**01 VULCAIN***Fire test platform*

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**02 LE CORBUSIER  
IMMERSIVE  
ROOM**

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**03 JULES VERNE  
CLIMATIC  
WIND TUNNEL**







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**01 LABE**

*Laboratories  
for acoustic  
performance  
and sound  
comfort*

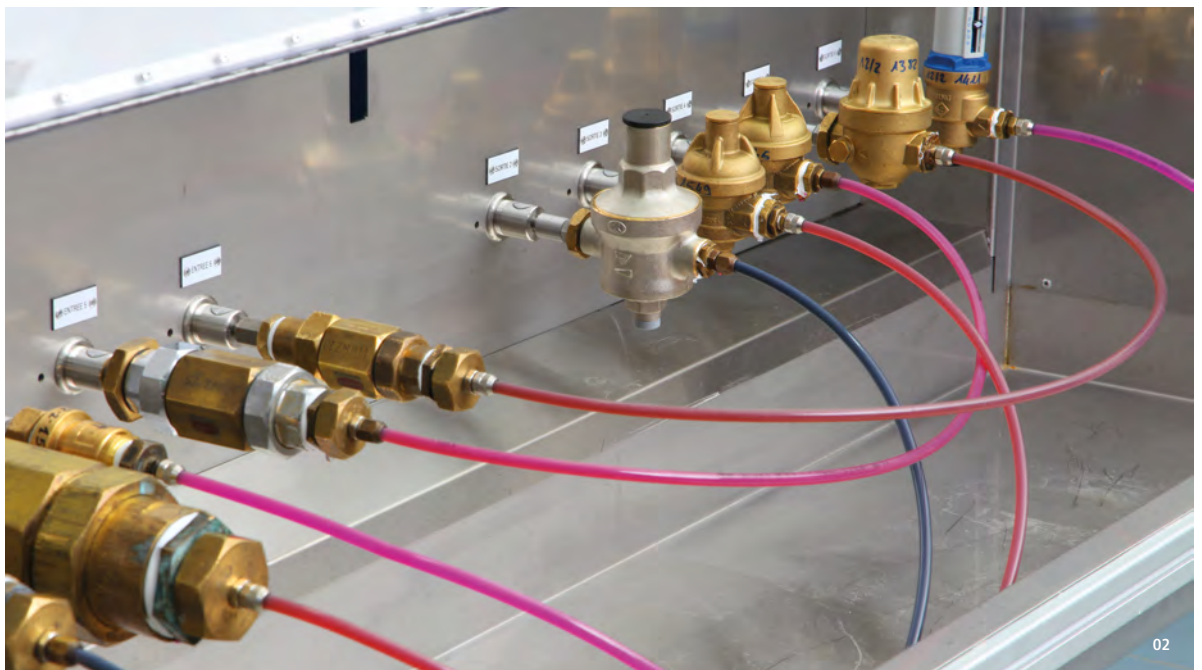
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**02 Hydraulics  
and Sanitary  
Equipment  
Laboratory**

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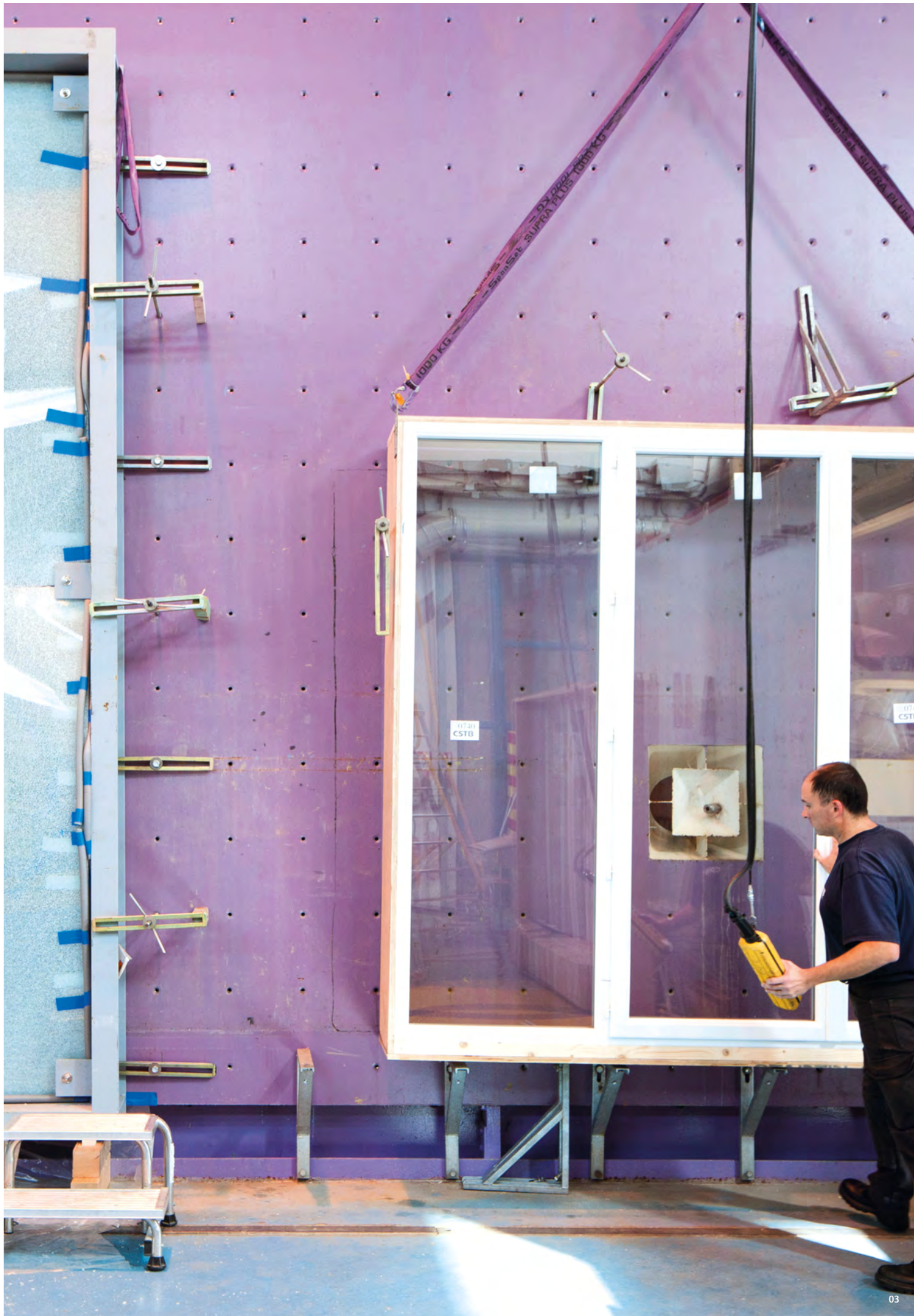
**03 Windows  
and Glazing**

01



02







# Organization & Teams

MARCH 2016

## Human Resources

**Albert Reis**

*Director*

**Christophe Jeannot**

*Deputy*

## Communications and External Relations

**Florence Ferry**

*Director*

**Étienne Crépon**

*President*

## Research and Development Department

The CSTB Carnot Institute

**Hervé Charrue**

*Deputy Chief Executive Officer*

*Director of research and development*

**Robert Baroux**

*Deputy Director*

**Sophie Moreau**

*Director of the CSTB Carnot Institute*

## Technical Department

**Charles Baloche**

*Deputy Chief Executive Officer*

*Technical Director*

**Christophe Morel**

*Deputy Director*

*of technical partnerships*

**Katy Narcy**

*Deputy Director*

*of development*

## Publishing and Training

**Patrick Morand**

*Director*

**Éric Coignoux**

*Deputy Director*

**Émilie Suire**

*Engineering and training services*

**Philippe Gil-Garcia**

*Marketing and editorial production*

**Mylène Chevert**

*Business development*

**Isabelle Meunier**

*Sales administration and customer relations, publishing*

**Gilles Romang**

*Electronic publishing*

## Information Technology

**Souheil Soubra**

*Director*

**Franck Andrieux**

*Deputy Director*

**Nicolas Pastorelly**

*Intelligent and connected buildings*

**Julien Soula**

*Digital modeling and concurrent engineering*

**Benoît Vinot**

*Information systems and business applications*

## Economics and Social Sciences

**Yann Montrelay**

*Director*

**Olivier Teissier**

*Economic analysis manager*

## Energy, Environment

**Jean-Christophe Visier**

*Director*

**Julien Hans**

*Deputy Director of research*

**Jean-Robert Millet**

*Deputy Director of public expertise*

**Dominique Caccavelli**

*Renewable energy*

**Lionel Bertrand**

*Innovation and development*

**Jacques Chevalier**

*Environment and life cycle engineering*

**Patrick Corralès**

*IT and digital methods development*

**Mireille Jandon**

*Automation and energy*

**Charles Pelé**

*Energy performance*

**François Olive**

*Innovative envelopes and materials*

**Coralie Nguyen**

*Assessment of power installations*

## Health, Comfort

**Christian Cochet**

*Director*

**Jacques Martin**

*Delegate Director*

**Séverine Kirchner**

*Deputy Director, OQAI Director of scientific research*

**Jean-Baptiste Chéné**

*Acoustics*

**Corinne Mandin**

*Expology – Indoor Air Quality Observatory*

**Christophe Martinsons**

*Lighting and electromagnetism*

**François Maupetit**

*Physical chemistry Sources and transfer of pollutants*

**Enric Robine**

*Biological agents and air contaminants*

## Quality and Ethics

**Béatrice Cromières**  
Director

## Accounting Office

**Tony Gane**  
Accountant

## Strategy and Finance

**Sylvie Ravalet**  
Deputy Chief Executive Officer  
Secretary General

**Bruno Mesureur**  
Director of standardization,  
marketing and international affairs

**Emmanuel Girard**  
Director of investments

## CSTB Marne-la-Vallée Paris

**Dominique Naert**  
Director

**Franck Sénécal**  
Deputy

## CSTB Nantes

**Maxime Roger**  
Director

**Christian Barré**  
Deputy

## CSTB Grenoble

**Christian Cochet**  
Director

**Pierre Verri**  
Deputy Director

## CSTB Sophia Antipolis

**Patrick Morand**  
Director

**Christiane Pujol**  
Delegate,  
General Administration

## Climatology, Aerodynamics, Pollution and Purification

**Maxime Roger**  
Director

**Pierre Palier**  
Deputy Director

**Philippe Delpech**  
Wind, airflow management  
and comfort

**Philippe Humeau**  
Water

**Jean-Paul Bouchet**  
Industrial facilities  
and transportation

**Sylvain Aguinaga**  
Digital modeling

## Safety, Structures and Fire Performance

**Anne Voeltzel-Lévêque**  
Director

**Ménad Chenaf**  
Deputy Director

**Martial Bonhomme**  
Fire reaction studies and tests

**Stéphane Hameury**  
Regulatory assessments,  
Research

**Philippe Rivillon**  
Mechanical  
and fire resistance

**Anca Cronopol**  
Structures, Masonry  
and Partitions

## Envelope, Insulation and Flooring

**Michel Cossavella**  
Director

**Stéphane Gilliot**  
Facades, Coverings  
and Roofing

**Salem Farkh**  
Hygrothermal properties  
of structures

**Christine Gilliot**  
Coverings, waterproofing,  
rendering and mortars

## Windows and Glazing

**Hubert Lagier**  
Director

**Marc Goessel**  
Certification profiles,  
exterior doors, verandas  
and thermal properties

**Laurent Doffin**  
Certification of windows,  
fittings and garage doors

**Yann Faisant**  
Assessment, windows  
and cases

**Stéphanie Le Roux**  
Glazing, assessments,  
certification and testing

**Kevin Nadolny**  
Testing, characterization  
and safety

**Pierre-Charles Bugeau**  
Audits

## Hydraulics and Sanitary Equipment

**Philippe Pied**  
Director

**Jean-Marie Franco**  
Tapware  
and sanitaryware

**Walid Jaafar**  
Pipes for fluids,  
materials

**Thibaud Rousselle**  
Processes,  
system services



Focusing on VSEs/SMEs and start-ups, ARIANE, the CSTB advisory and support service, is intended for all creators of innovative processes and services in the construction sector. Nadège Blanchard is the manager.



The CSTB Carnot Institute contains those CSTB teams involved in R&D and the promotion of research results. It fosters and facilitates innovation for all construction sector stakeholders through the use of its laboratories and extensive research facilities to improve building quality and safety.



# 2015 Key Figures

## Employees

as at December 31, 2015 (excluding subsidiaries)

914 employees

636  
Champs-  
sur-Marne

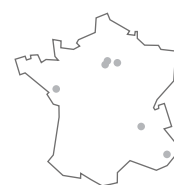
17  
Champs-  
Bienvenüe

12  
Paris

92  
Nantes

77  
Grenoble

80  
Sophia  
Antipolis



## 2015 operating income (excluding subsidiaries)

Forecast, excl. VAT 2015

€97.3 million

€23.7M  
Contract research  
and Expertise

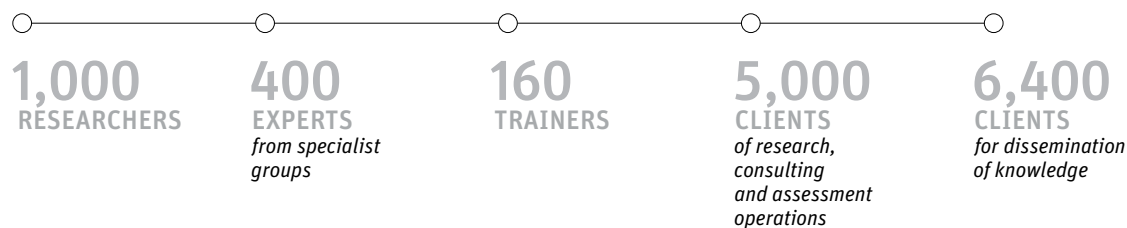
€14.1M  
Government  
grants

€45.5M  
Technology-  
related

€5M  
Dissemination  
of knowledge

€9M  
Other income

## The CSTB networks with



## Technology-Related

**113** Technical Experimentation Assessments (ATEx)

**711** Technical Approvals and Technical Application Documents<sup>1</sup>

1. All types: New, Revisions, Addenda, Commercial Extensions and Amendments (excluding expiration date extensions)

**AVERAGE  
TECHNICAL  
APPROVAL  
PROCEDURE LEAD  
TIME IN 2015:  
9 MONTHS**

**179**  
New Technical Approvals / DTAs

**65**  
European Technical Assessments (ETAs)

### Product certification

**4,455**

Active certificates

**1,651**

Certification holders  
(51% outside France)

### CE marking certification

**644**

Active certificates

**380**

CE marking holders  
(20% outside France)

## Research and Expertise

**€7.9** M in research funding under the CARNOT partnership

**118**

Collaborative research projects  
ADEME/ANR/Europe

**77**

Scientific publications

**16**

In-house research projects

**58**

Ongoing theses

**169**

Researchers (full-time equivalent)

**6**

Postdoctoral students

## Dissemination of knowledge

**30,000** subscribers  
to technical and regulatory information services, including 29,000 REEF users

**126**

Publications available

**76**

Publications in digital format

**85**

Training modules, including 20 new modules

**10,847**

Hours of training



# Subsidiaries

## ACOUSTB

**Controlling noise and vibration: analyze, recommend, measure, calculate and protect**

Acoustb is a consulting firm specializing in acoustics and vibration in the environment, construction and industry in France and abroad. Established by the CSTB in partnership with Egis, Acoustb provides comprehensive project management services (initial conditions, study and acceptance) and complex studies (vibration propagation and finite element modeling).

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Tel.: +33 (0)4 76 03 72 20  
[www.egis-acoustb.fr](http://www.egis-acoustb.fr)

**ACOUSTB**  
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**The leading French environmental certification agency for nonresidential buildings, sustainable communities and stakeholders**

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4, avenue du recteur Poincaré | 75016 Paris  
Tel.: +33 (0)1 40 50 29 09  
[www.certivea.fr](http://www.certivea.fr) | [www.certivea.com](http://www.certivea.com)



## CERTISOLIS

**Testing laboratory and certification body for solar photovoltaic module performance**

Certisolis performs qualification testing of solar photovoltaic modules, certifies their performance in accordance with international standards and issues accreditation labels. Jointly owned by the CSTB and the French Metrology and Test Laboratory (LNE), it operates under a scientific partnership with CEA/INES at the Savoie Technolac center of excellence.

BP 364 | 39, allée du Lac de Côme |  
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## CÉQUAMI

**Energy and environmental quality  
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Jointly owned by the CSTB and the Qualitel Association, Céquami leads the market in certification, labeling and promotion of quality for new-build and refurbished homes. It issues and manages the NF Habitat HQE™ certification and Reconnu Garant de l'Environnement (RGE) status. Céquami also certifies the water-proofing process for residential buildings with the PRO PERMÉA certification.

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[www.cequami.fr](http://www.cequami.fr)



## CERWAY

**International HQE™ certification  
body owned jointly by Certivéa  
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Cerway awards HQE™ certification worldwide for all types of buildings under construction, in the process of renovation or already in operation, as well as regional development initiatives. Cerway is attentive to the needs of project sponsors throughout the certification process and provides them with a full range of HQE™ expertise and a network of qualified HQE™ certification advisors. The training provided by Cerway promotes progress throughout the building construction and operation industry, as well as in regional development.

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## EUROVENT CERTITA CERTIFICATION

**Climate engineering certification**

Jointly owned by ATITA, CETIAT, the CSTB, Eurovent Certification Company and the French Metrology and Test Laboratory (LNE), Eurovent Certita Certification is a leading European certification organization for climate engineering. Its 38 certification programs cover the full range of applications, from private homes to industrial-scale facilities.

48-50, rue de la Victoire | 75009 Paris  
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# Social Responsibility at the CSTB

## RESOURCE MANAGEMENT

In 2015, as part of a process of continuous improvement in energy performance and management, the CSTB renewed its ISO 50 001 certification in Marne-la-Vallée and obtained it for the first time for the Nantes facility. Since July 2015, the CSTB has also been involved in the CUBE 2020 competition with its building in the 16<sup>th</sup> district in Paris. This competition, organized by the French Institute for Building Efficiency (IFPEB) aims to reduce the energy consumption of participating companies, mobilizing their teams to tackle the issue of energy efficiency. Because every action counts, awareness campaigns are conducted so that everyone adopts environmentally responsible behavior. Energy consumption is determined every month and compared to historical consumption to measure savings. At Sophia Antipolis, three showers that use solar hot water were installed to improve the comfort of employees while reducing overall energy costs at the facility. The Marne-la-Vallée facility now has separate systems for wastewater and rainwater. This means that rainwater

can be directly used for pouring concrete and watering plants, thereby saving water.

## ECOLOGICAL MANAGEMENT OF GREEN SPACES

In December 2015, the Marne-la-Vallée facility received the EcoJardin label for its comprehensive approach to ecological management of green spaces and continuous improvement. Sustainable grazing, beehives, insect hotels, herb gardens, veteran trees and orchards, elimination of pesticides: all these activities demonstrate the CSTB's commitment to environmental protection.

## ÉNERGIE HANDICAP: OUTCOME OF THE COMPANY AGREEMENT

The three-year agreement for the employment of people with disabilities at the CSTB expired at the end of 2015. With the support of the Énergie Handicap team, 12 CSTB employees were recognized as workers with disabilities. At the same time, eight people with recognized disabilities were employed, three with permanent employment contracts and five with fixed-term contracts over six months. To ensure retention, improve

workstation accessibility and assist with integration, the CSTB also conducted ergonomic studies to remove barriers to comfortable and efficient work for employees with disabilities. For example, electric carts to ease handling, ramps to improve accessibility, and swiveling supports for workstations were installed. Awareness campaigns and training further helped to overcome misconceptions. The CSTB also participated in Forum Handicap in Paris, organized by ADAPT, and Forum Cap Emploi in Meaux to promote recruitment of people with disabilities. From 2013 to 2015, the overall employment rate of persons with disabilities increased by 3.87 to 5.45 percent, the mandatory rate being 6 percent. The CSTB is renewing its commitment to an active policy for people with disabilities with the signing of a second company agreement for 2016–2018.

## SUSTAINABLE MOBILITY



Renewal of the vehicle fleet: hybrid and electric vehicles preferred. Commitments to carpooling signed at the Marne-la-Vallée and Grenoble facilities.



More than 100 employees signed the bike commitment charter and a pedestrian charter was instituted in Sophia Antipolis.



55 Day CSTB  
in Marne-la-Vallée.



All CSTB operations are ISO 9001 certified.



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## Building the future

The Scientific and Technical Center for Building (CSTB) is a public body for innovation in construction. It focuses on four key activities: research and expertise, assessment, and dissemination of knowledge, all performed to address the challenges of energy transition in the construction sector. Its expertise covers construction products, buildings, and their integration into neighborhoods and cities. With its subsidiaries, networks of national, European and international partners, and over 900 employees, the CSTB offers its services to all stakeholders involved in construction to improve the quality and safety of buildings.



The CSTB, a Carnot-accredited institution, supports construction industry stakeholders in developing innovations that improve building quality and safety. The prime mission of the CSTB Carnot Institute is to transfer research outcomes to socioeconomic stakeholders.