CIB Pro-Active Approach

Priority Theme 2 - Performance Based Building

Compendium of Building Performance Models

Full scale implementation of The Pro-Active Approach Programme is an ambitious undertaking calling for significant inputs of time and resources.
So the CIB Programme Committee has carefully reviewed the separate components of the programme and assigned an order of priority to each.

Topping the list is the Preparation of a Compendium of Building Performance Models which is scheduled for completion by the end of the current Triennium.

Some members may well ask: what actually is this Compendium? and more importantly, what are the envisaged benefits to CIB and to industry that will flow from its production?

We attempt to answer these and other questions by drawing heavily on a proposed Work Plan compiled by Greg C. Foliente, CSIRO Building, Construction and Engineering, Victoria, Australia and Rachel Becker who is currently on sabbatical leave from the Faculty of Civil Engineering, National Building Research Institute, Technion City, Haifa, Israel. Rachel Becker, a former Vice President and Member of the CIB Board and its Committees, is pursuing her Sabbatical as a Guest Researcher at NIST Building and Fire Research Laboratory in Gaithersburg, Maryland, USA. Dr. Jack Snell and other NIST staff members provided material assistance in drawing up this Work Plan.

Building Performance Models

The term "Building Performance Models" in this context is used to refer to computational procedures and/or computer programmes that can be used in:

- Developing quantified performance criteria for building codes and standards
- Designing a building or its part to a target performance

OR

- Evaluating a given design (or product) for each level (or matrix cell) in the building performance hierarchy (from the whole building to individual elements or materials).

Since the focus is on models that can be used to develop and implement performance based standards, emphasis is given to models based on "first principles" and which target "in-service performance".

The CIB Compendium

The end product is intended to be the first edition of a publication which will provide a framework that can be populated with new or revised models as they become available. The Compendium will be structured to parallel an envisaged performance-based building code or regulatory document, organised according to building attributes or user needs, such as:

- Safety

    - Structural safety
    - Fire safety
    - Safety in use (or accident safety)
- Comfort
    - Acoustical comfort
    - Visual comfort
    - Hygrothermal comfort
    - Structural serviceability
- Health and Hygiene
- Durability
- Sustainability

There will be a hierarchy of building parts under each attribute, (e.g., from whole building to individual elements or materials).

Each model entry in the Compendium will include:

- Name of model and keywords
- A clear and concise description of what the model does (scope) and its uses, scientific basis (i.e., a short overview or outline of physical/mathematical concepts; with publication references), limitations/assumptions and extent of experimental validation
- Classification/Status (i.e. one of the classifications described below)
- Developer/Publisher/Supplier (with complete contact information)
- Availability (i.e., if software: commercial, shareware, freeware with or without source code)
- System requirements (hardware and software)
- At least one example of a project where the model has been used previously

The models will be classified as follows:

- "Model based on 'first principles'" - one that is used to improve our fundamental understanding of building performance, either as a research tool or a diagnostic tool. Based on "first principles", this is the ideal model from which, if too complicated for practical application, a simplified model for performance-based codes and standards can be derived.
- "Model implementing a standard" - one that wholly implements a computational procedure for evaluating performance that is recognised in regional/national or international performance-based codes or standards.
- "Model with part(s) implementing a standard" - one that implements, in at least one part or aspect of the model (typically a computer program), a computational procedure for evaluating performance that is recognised in regional/national or international performance-based codes and standards.
- "Widely used in practice" - one that does not have a status of a formal standard but is used widely in the industry or in an industry sector and is generally accepted by professionals in this area (like a "de facto" standard).
- "Under development" - one that is currently under development. This may be upgraded to any of the above classifications in the future.

The expectation is that some sections of the Compendium (e.g., sections related to structural performance, fire performance and thermal analysis) will be populated with plenty of models, while others may be empty. Sections without any entry will not be excluded; they are an important part of the Compendium in that they identify gaps in knowledge. Where there are many known models under a given heading/sub-heading or section/sub-section, further sub-divisions will be introduced. Ideally, the Compendium should be some kind of a "living document"; that is, it should be subject to regular updates (e.g., every two years).

What are the expected benefits?

The authors of this proposed Work Programme liken the Compendium to a "one-stop shop" for industry and the research community, where they can find in one place various kinds of computational procedures or computer programmes that are needed to support, implement and further develop the performance concept in building and construction.

Benefits to industry:

- Designers and builders - will have a choice of tools for performance-based design and for evaluating in-service building performance during occupancy. This will provide designers with the opportunity to consider various levels of performance that reflect the value of quality (according to the preferences of the owner/consumer). The use of generally accepted tools/models in the project will hasten the acceptance of selected design by building officials. The use of appropriate models in design has the potential to improve the quality of construction, and thereby to reduce the occurrence of expensive and time-consuming litigation.
- Product manufacturers - will know what specific tools can be used to assess the performance of their products for intended use, and become aware, right from the start, of the basis upon which their innovations could be verified. The use of generally accepted models will shorten the product acceptance cycle, and provide manufacturers with the opportunity to produce and sell differentiated products that reflect the value of quality.
- Building regulators and officials - regulators will receive guidance as to where development of quantified performance criteria can certainly be applied (i.e., where models for evaluation are available). Building officials will know and/or be acquainted with the capability and limitations of tools for verifying the minimum performance levels required in codes. The decision time required in accepting new or innovative design and/or products using the performance approach can be reduced.
- Owners and facilities managers - will have a better chance of having their performance demands achieved because accepted performance based models and tools are in the hands of designers, builders and manufacturers. Faster acceptance cycles of new and innovative technologies will mean earlier occupancy or use of their buildings. Furthermore, using some of the models in the Compendium, they may obtain better data to manage their assets more efficiently.

Benefits to CIB and CIB Member Institutes:

- Enhance the image and reputation of CIB as an important provider of relevant and useful information to industry (as described above).
- Provide an exhaustive list of tools to which reference can be made in pre-standardisation documents, or that can directly assist in developing quantified building performance criteria for codes and standards.
- Identify gaps in knowledge and models/tools; researchers can focus on filling-in the gaps.
- Facilitate collaboration between/among CIB Working Commissions and Task Groups.

Strategies

Clearly a single narrow line of action will be inadequate to realise a task of this complexity and a combination of strategies have been proposed.

The salient ones under active consideration are:

- Collaborative CIB Member Project
- Committed Projects by CIB Commissions and Task Groups
- Targetted Partnerships with Other Organisations

The following CIB Member Institutes are already committed to participation in the envisaged Collaborative CIB Member Project: CSIRO - Australia, NBRI - Israel, NIST - USA, VTT, Finland and the Dutch combination of SBR and RGD.

How can you contribute?

Greg Foliente and Rachel Becker have drafted a Compendium Outline or Framework and developed a template for contributing to the Compendium.
(These will soon be available in the CIB Home Page). Individuals, CIB Working Commissions and Task Groups have important contributions to make in the following areas:

1. Provide suggestions to refine or improve the Compendium Framework;
2. Supply names of possible contributors for specific parts of the Framework; and
3. Submit completed template(s) for their areas of interests or specialties.

The completeness and quality of the Compendium depends heavily on contributions in the above areas by CIB members.

For an inventory of ongoing CIB Commission Projects, the results of some of which are also expected to contribute to the Compendium, reference is made to the section **Performance Based Buildings** in the CIB Home Page.