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BENCHMARKING - as a tool for sustainable buildings

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ABSTRACT: Sustainable development refers to use of appropriate technology by using the available resources that meets the present needs without compromising the ability of the future generations (Brundtland Report, 1987). There are many concepts evolved to achieve sustainable built environment, like-zero energy buildings, energy efficient buildings, green architecture and passive architecture. To achieve the goals of sustainable buildings we need to develop tools which will help us to measure sustainability. Benchmarking of building is one such tool for monitoring its performance as well as assessing its relative performance by comparing it to that of other known buildings. Benchmarking is one such process of creating a whole building energy consumption profile of a group of building characterized by their primary use, construction, physical, geographic and operating characteristics. The paper highlights the concept of benchmarking, its types, and methodology along with some studies. The paper also discusses the International and National approach to the bench marking system.

Introduction:

As the building construction move towards the sustainability and environment friendly design, it is becoming increasingly important that they have to available managerial tools and methodologies to improve their performance. The performance concept in building and construction had been practiced in some measure, and in very specific situations, even before it came to be formally known as “the performance approach”. The earliest, and most often repeated, example is the requirement that a house should not collapse and kill anybody in the Hammurabi Code (circa 1950 to 1910 BC). The concept is also reflected in the early architectural philosophy of the Romans, as described in Vitruvius’s (1960) landmark “*The Ten Books of Architecture*”. Performance based building spans the whole life of the building. It is applicable to cover different levels of the physical elements of a building (from performance of individual products or elements to performance of the whole building) and can accommodate a large set of attributes .Performance measurement and benchmarking are two such important tools, which can assist companies to realize the benefits of green construction. Energy Benchmarking and performance based rating establish the targets for the buildings. It helps to constantly improve the standards through healthy competitions by shifting markets better performing levels. (Abbott 2002)

Green and Sustainable development

The term “Green” and “Sustainable” designs are often used interchangeably. Sustainable construction not only refers to the buildings and spaces themselves but also the processes or activities used to construct them. It also includes the infrastructure elements such as waste management transportation, water management, energy management and utility transmission system put in place to serve this building space. This interaction of man-made surroundings and human activities that take place in them and environment in which they reside is known as the “built environment” there are also certain themes such as – design for minimum waste, less construction, preservation, and enhancement of bio-diversity, and respect for the people and their local environment (DETR, 2000,); which also leads to green building construction. ‘Our common future’, released in 1987 by the UN world commission on environment and development coined the term “Sustainability development’ (Brundtland Report, 1987). This made the people aware of the term sustainability and its importance for the future life. Green movement started further in many industries. Construction Industry is one of the major energy consuming

sectors which need to give serious thought. Many of the compare nowadays are trying hard to get their structure certified. There are many such rating system available worlds over. Such as Leadership in Energy and Environment Design(LEED), LEED India, Green Rating for Integrated Habitat Assessment (GRIHA India),Building Research Establishment's Environmental Assessment method(BREEM ,UK) Comprehensive Assessment system for Building Environmental Efficiency)CASBEE(Australia), LEED (Canada) etc. These certification shows that they have addressed the environment impact of a building.

Over all the sustainable construction also seeks to decrease or prevents pollution such as waste materials, emission from vehicles, noise, and release of contaminants to the atmosphere ground and water. Sustainable construction not only meets the local goals but also the global dimensions

What Benchmarking of buildings?

Benchmarking started in the early 1980s when Xerox developed a program to establish the performance goals for all of their performed tasks in order to have better quality products (Camp, 1989) they called this the “benchmarking” of their company. Today, there is a need for all companies (including building industry) to benchmark their performance in order to know how well they are performing compared to other companies. It is a method of improving the performance in a systematic and logical way, by measuring and comparing your performance against others, and then using lessons learned from the best to make targeted improvement (SECBE, 2009).Now a days this is a widely used tool to improve the building performance. Basically it answers the questions like “who does it best”, “how do we compare” and “what do they do that we could also do?”

Benchmarking as a tool of performance is used by many sectors such as in business, industries like chemical, food, Automobile, etc. Recently, even in building industry people have started using this tool to achieve sustainable development. Hasan (2006) proposed three steps towards using this system those are, based on sustainability principles define and rank the values of a building, then establish partnerships with outside building research sources that endorse sustainability principles and lastly adopt a procedure that ensures a comprehensive comparison.

Why is Benchmarking?

Benchmarking can help us to understand and to reduce the energy use of a building. It serves as a powerful trigger for energy use improvement by providing objective, reliable information on energy use and the benefits of improvements; it regularly prompts building owners and designers to action. It also provides to the nation about the building energy data which helps for policy level planning.

Requirements for benchmarking

Benchmarking system requires more transparent and higher quality data collection which provides a baseline for comparison and to elaborate the monitoring and evaluation procedures for policy impacts. To establish the system two tasks are essential; firstly developing a survey tool and a reference database and secondly, developing the web based interface portfolio manager tool and a program database that stores the individual building data.

Essential features of benchmarking system

Benchmarking system basically comprises of four main features (report-Council of Energy Ministers September 1st, 2009, Canada) as

- i. A reference data base; that provides benchmark ranges for actual energy by a particular building type (eg.office,school,bank,) The data would be updated for five year cycle.
- ii. A Portfolio manager and series of algorithms-that uses building data submitted through the tool to compare an individual buildings with a statistically significant set of similar buildings
- iii. A program database that stores the individual building data submitted to the benchmarking system.
- iv. An automated data submission system.

Advantages of benchmarking system

Successful implementation of the system will not only lead to environmental but also economic benefits. The environmental benefits are;

- a) creates owner /designer awareness of energy use
- b) provides critical base knowledge for governments to measure energy savings and CHG emissions from the buildings

- c) provides a mechanism for evaluating continuous improvement
- d) Provides a common platform for multiple market transformation tools (codes, programs, policies).

Economically, the system could enable verifiable assertions about the increased market value of energy-efficient green building.

Overview of International and Indian initiatives.

The United Kingdom (UK) has detailed set of benchmarks developed in various governments' programmes since 1970's (carbon trust). Closer examination of UK benchmark reveals that –they practice it in three levels such as-simple Benchmarks (level 1), corrected Benchmarks (level-2), and customized Benchmarks (level-3), for the simpler and more standard buildings generally Level 1 and Level 2 benchmarks are used, and for more complex buildings Level 3 benchmarks are used. Level 3 benchmarks may be difficult to integrate into statutory repeatable procedure. Depending on the complexity of the projects these benchmarks are used.

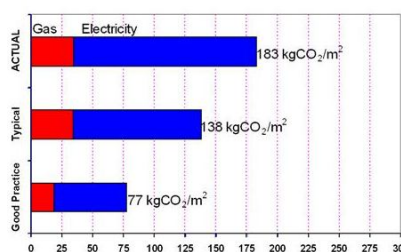


Fig1: Simple benchmarks

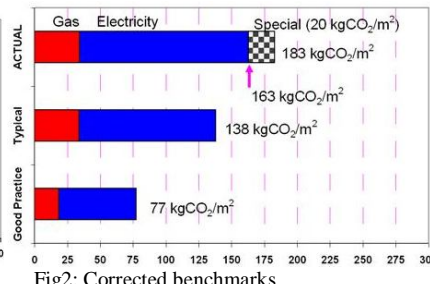


Fig2: Corrected benchmarks

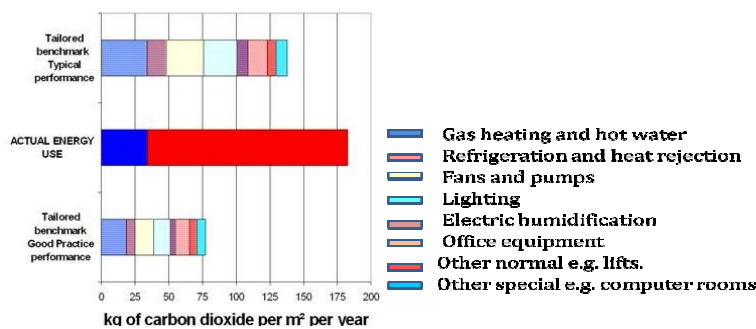


Fig3: Customized, benchmarks
Source: EPLabel Benchmark Report

The above charts shows a building actual carbon dioxide emissions in comparison with fixed typical and good practice benchmarks appropriate to the building with level 2 approach, the emissions from a special energy use are identified by measurement and deducted from the total emissions before making the benchmark comparisons. The fig.3 includes benchmarks built up from each of the energy end uses occurring separately assuming typical and good practice of energy efficiency.

In United States, secretary of the United States Department of Energy (DOE) is responsible for selecting or develop a building energy use benchmarking system and to issue guidance for use of the system. DOE has selected the ENERGY STAR Portfolio Manager Tool for the benchmarking system. DOE has selected Portfolio manager as a tool to assess the performance of a building. The energy star approach to the functions of Benchmarking is straightforward; they have developed a limited set data for each building which is entered into an online interface tool called portfolio manager. The tool itself establishes a benchmark for the building.

India's building and construction sector has seen unprecedented growth post liberalization circa 1991. Print and motion media explosions around the same time exposed the entire population to western lifestyles and trends including those of architecture and design. A resulting spurt in commercial and residential building types constructed in a distinct western style with an absolute disregard to context and climatic conditions led to a steady increase in building energy consumptions. The building trends ever since, have involved the use of high embodied energy materials such as aluminum and steel, extensive external glazing systems, leading to increased heat gains and (consequently) use of extensive refrigeration based space-conditioning systems, electrical appliances etc. To cater to the increased demand for such equipments in the increasing urban settlements, more industries were set up to manufacture and provide such appliances etc. Increasing travel times due to increased fringe development and satellite towns led to a sudden explosion in the transport sector as well, with unparalleled growth in the automobile sector and increased demand for petroleum and diesel. The current state of an overburdened energy infrastructure may be traced using the same route (fig 4).

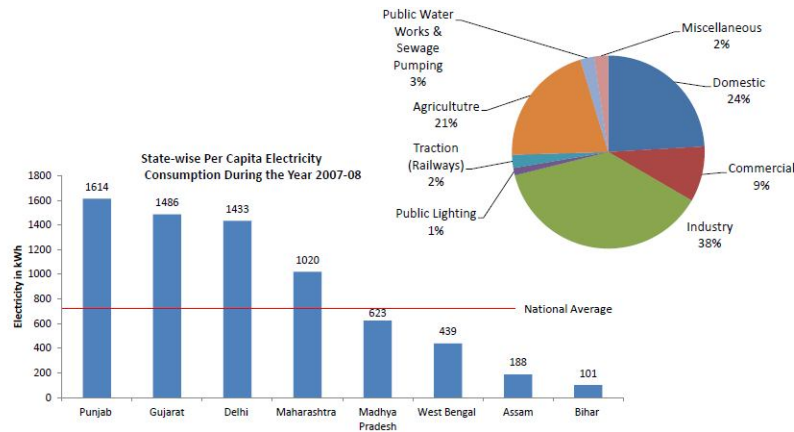


Fig 4: Electricity Scenario in India (2007-2008)
Source: Central Electricity Authority's 'Year End Review 2007-08'

The Benchmarking System along with the energy rating has started with the formation of technical committee in 2008 (ECO project was signed in 2000 between USAID and Government of India), which is followed by several efforts such as data collection and launching the energy star rating system. In 2010 system level data collection and benchmarking system was introduced.

In India basically Benchmarks are done at two levels such as (USAID ECO-III)

-At building level benchmarks-less costly

- Energy consumption/employee in an office
- Energy consumption/bed in hospital
- Energy consumption/room in hotel.

-At system level Benchmarks –more costly and data intensive

- Lighting system : 5 watt/m²
- Equipment power :10 watts/m²
- HVAC system:50 m²/ton of refrigeration;25 watts/m²

So for in India in concerned Benchmarks were used for Hotels, hospitals and commercial buildings.

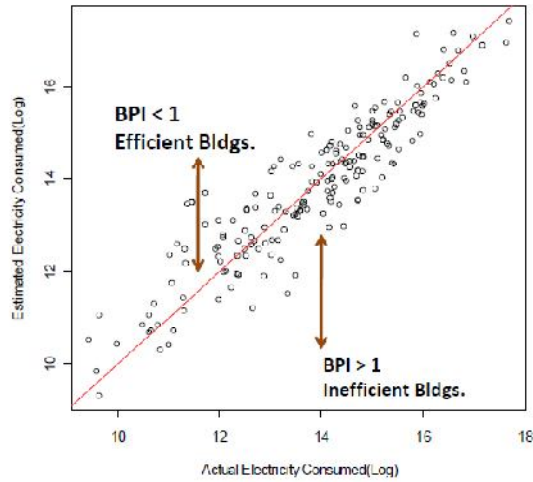


Fig 5: Performance rating (Building Performance Index)
Source: USAID-Eco-III report

The study reveals that still there is a need to work more on methodology of the benchmarking system; also it needs a lot of research on the working methodology and detail data input. Different countries have adopted different methods; depending on the context there is a need to adopt the suitable methodology.

Observations and recommendations:

- India still needs to define the relevant tools which will further help in energy saving and cost effectiveness.
- Needs to do a lot of surveys on structures of different uses and prepare the data set which will give the details of energy uses and help to benchmark them.
- Awareness among the people about different effective tools to measure the sustainability is necessary especially for the developers and stakeholders.
- Benchmarking is an effective tool to measure the performance of a building which needs to be integrated with the energy rating.
- Needs to carry the research and technological solution for the different working methodologies and solutions.

Conclusions:

The range of problems prevalent in India in Building sector clearly establishes the need for Benchmarking. Benchmarking can be a Useful mechanism to help each level to reduce the energy consumption. Governments will need to develop suitable sustainability-based benchmarking framework for assessing the relative performance of utilities which in turn would facilitate efficient practices towards sustainable development.

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