

The background features a series of thin, white, wavy lines that flow from the left side towards the right, creating a sense of movement and depth. The lines are set against a dark grey gradient background that transitions from a slightly lighter shade on the left to a darker shade on the right.

INTRODUCTION TO PERFORMANCE-BASED DESIGN (PBD)



Lecture 1

Introduction to PBD

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1. Definition of PBD

- Performance is defined as “**behavior of a product related to use**” by ISO 6241-1984.
- Here, the product might mean an entire building as well as a part of it.
- Preiser et al. suggest that the concept of performance in buildings was developed by Eberhard in the 1960s, and was first introduced into the profession of architecture at the end of the 1970s.
- The report titled “Performance-Based Study of Buildings” prepared for CIB provides the most basic definition of performance-based approach as follows: “**The performance approach is, first and foremost, the practice of thinking and working in terms of ends rather than the means. It is concerned with what a building or building product is required to do, and not prescribing how it is to be constructed.**”



1. Definition of PBD

Most recently the clearest definition of performance based building approach was explained in 1982 by the CIB W60 Commission in the report n.64, where Gibson stated that: "first and foremost, the performance approach is [...] the practice of thinking and working in terms of ends rather than means.[...] It is concerned with what a building or building product is required to do, and not with prescribing how it is to be constructed".

<https://cibworld.org/>



Species Niches performance pavilion. Courtesy Harrison Atelier.

2. Background

- The first record that mentioned building performance was made in the **Code of Laws drawn up by King Hammurabi**, who lived in 1700s B.C. Article 229 on obelisks that are on display in Louvre Museum in Paris reads as follows:
- **“The builder has built a house for a man and his work is not strong and if the house he has built falls and kills a householder, that builder shall be slain.”**
- This expression, despite not including any information with regards to the construction technique, material, thickness, size, etc., clearly states that the building is expected to **provide the desired performance**.
- The content of this article is compatible with the definition suggesting that the performance approach pertains to a thinking and working principle relevant more to the ends than the employed means.
- This concept is also described in **Vitruvius's "De architectura libri decem"** ("**The Ten Books of Architecture**") in first century BC. In modern times, the first definition of performance-based building design was introduced in 1965 in France by Blachère with the Agrément system.

"a
house
should
Not
Collapse
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anybody".

Code of Laws
By Hammurabi

2. Background

- Performance-Based Building Design is an approach to the **design of any complexity of building**, from single-detached homes up to and including high-rise apartments and office buildings.
- A building constructed in this way is required **to meet certain measurable or predictable performance requirements**, such as energy efficiency or seismic load, without a specific prescribed method by which to attain those requirements.
- This is in contrast to traditional prescribed building codes, which mandate specific construction practices, such as stud size and distance between studs in wooden frame construction.
- Such an approach provides the freedom to develop tools and methods **to evaluate the entire life cycle of the building process**, from the business dealings, to procurement, through construction and the evaluation of results.

The concept of performance is based on the argument that the relationship between form and function is context-based, rather than causality-based.

2. Background

- Architectural design is an **iterative process of exploration**, in which the forms and design solutions developed are continuously modified and evaluated against **performance objectives**.
- Performance-based design (PBD) in architecture is a necessary alternative to traditional architectural design, whereby **performance criteria lead the design process** from the early design phases, to the final detailed design and building construction.
- It is a paradigm of the digital design process in which 'performance' is considered "**the desirability of the confluence between form and function in a given context**" (Kalay, 1999).
- Therefore, PBD is a framework that allows designers to approach the design process systematically, and provides the essential principles for **assessing and comparing various design alternatives**.

The concept of performance is based on the argument that the relationship between form and function is context-based, rather than causality-based.

2. Background

The concept of performance is based on the argument that the relationship between form and function is **context-based, rather than causality-based**.

Hence, the performance of a proposed design solution can only be determined through an **interpretive, judgmental evaluation**, which considers the form – as well as other physical attributes – of the proposed solution, the functional objectives it attempts to achieve, and the circumstances under which the two come together.

Accordingly, performance-based design presumes that different forms can successfully achieve similar functions, and that different functions can often be provided by similar forms. As such, it accounts for the performance variances of the same form-function combinations within different contexts

2. Background

From a practical implementation perspective, the viability of the PBD depends on our ability to explicitly demonstrate the eligibility of a particular combination of **form – function – context**.

This combination predicts the behaviour of an alternative solution, which can then be assessed against the intended performance criteria.

It differs from common evaluation and simulation procedures in that it must account for **judgments and preferences**, as well as **trade-offs** and other subjective measures of satisfaction.

3. Performance Concept

- In a Performance-based approach, the focus of all decisions, is on the required **performance-in-use** and on the evaluations and testing of building asset.
- The Performance approach can be used whether the process is about an existing or new assets. It is applicable to the procurement of constructed assets and to any phase of **the whole life cycle Building Process**, such as strategic planning, asset management, briefing/programming, design and construction, operation and maintenance, management and use, renovations and alterations, codes, regulations and standards.
- It includes many topics and criteria, which can be categorized as **physical, functional, environmental, financial, economical, psychological, social, facilities**, and other more. These criteria are related to singular project, according to the context and the situation.

Performance concept is based on two key characteristics:

- the use of two languages, one for the clients/users requirements and the other for the supply of the performance
- the need for validation and verification of results against performance targets

3. Performance Concept

Two languages

- The language of **demand requirements** and the language of the **required performance** which should have a capability to fulfill the demand.
- It is important to recognize that these languages are different. Szigeti and Davis (Performance Based Building: Conceptual Framework, 2005) explain that *"the statement of the requirement in functional or performance language (**FC - functional concept**) matched to a solution (**SC - solution concept**) in more technical language, and the matching, verification / validation that needs to occur in between"*.
- The functional concept represents the set of **unquantified objectives** and scopes to be satisfied by the supply solutions, related to performance requirements.
- The solution concept represents **technical realization** that satisfies at least the required performance. Design decision is a development of a solution concept.

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- the need for validation and verification of results against performance targets

3. Performance Concept

Assessing result – match and compare

- Building performance evaluation is the process of **systematically comparing and matching the performance in use** of building assets with explicitly documented or implicitly criteria for their expected performance.
- It can be done by using a **validation method**, by measurement, calculation, or testing.
- **Tools and methods** are used to permit some form of measurement of testing of the requirements, and the relating measurement of the capability of assets to perform.

Tools are required to evaluate the PBD. These tools are the reference of whole life cycle building process, so organizations use 'key performance indicators (KPI)' to prove that they are meeting the targets that have been set by senior management.

3. Performance Concept

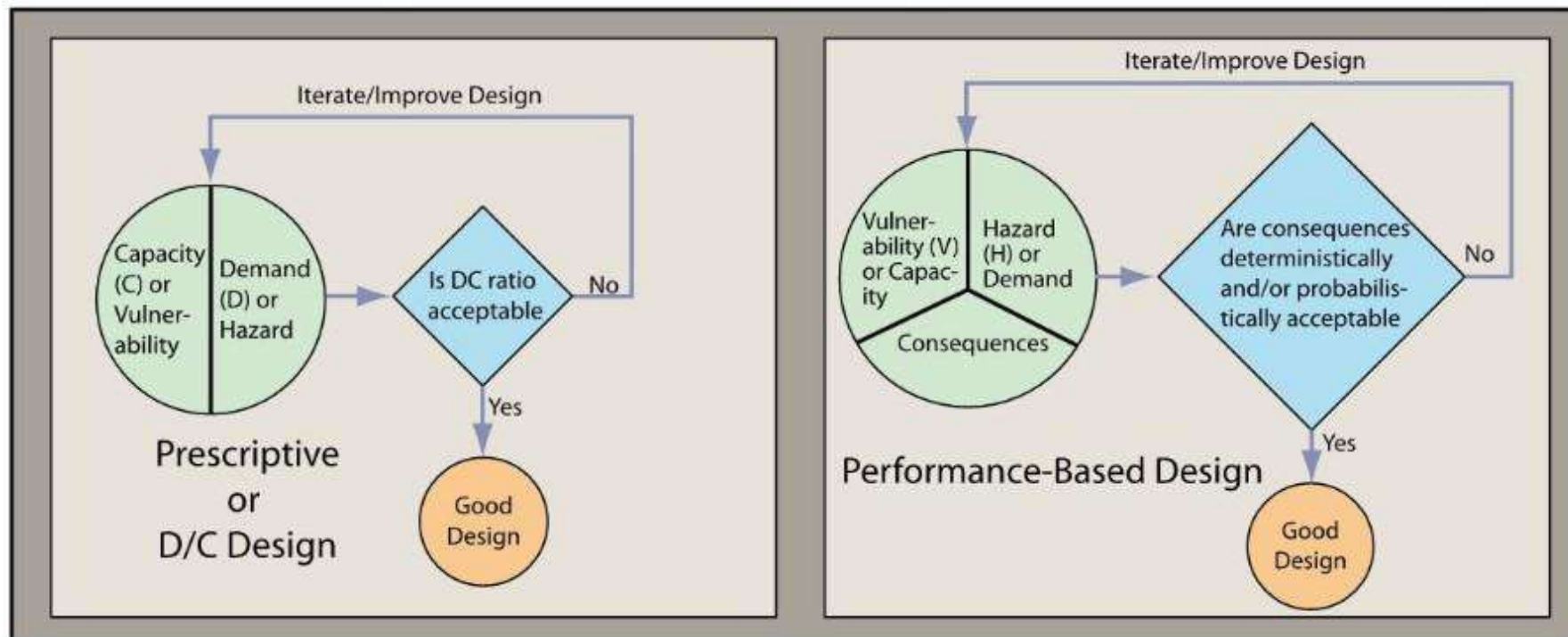
There are two different kinds of performance verifications

- Performance evaluations rate the **physical asset** according to a set of **existing criteria and indicators** of capability, and match the results against the required levels of performance.
- The **Occupant Satisfaction Surveys** record the **perceptions of the users**, usually through a scale of satisfaction measurements.
- Both types of evaluations complement each other.

at the same time performance measurement (PM) becomes central to managing organizations, their operations and logistic support. These methodologies include the feedback loop that links a facility in use to the requirements and capabilities that are compared and matched whenever decisions are needed.

4. Prescriptive v/s Performance-Based Designs

- Prescriptive design objectives require achieving an **acceptable demand-to-capacity (D/C) ratio**,
- the objective of PBD is to achieve a **specific level of performance**, as correlated to appropriate consequences, which may be measured in several ways including a monetary cost.
- Each of these methods requires design iterations until either an acceptable D/C ratio (for prescriptive design) or a desired performance level (for PBD) is achieved.



3. Performance-based Design Process

Figure 2-1:
Performance-based
design flow diagram

SOURCE: HAMBURGER, 2003

