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A Review on Performance Based Design for School Building

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A B S T R A C T

The concept of "Performance based design in school buildings" was developed as a result of usage of performance concept which has a definition of behaviour of a product related to use in school buildings. The integration of this approach into the design process of school building design brought out the "performance based building design". Performance based design contains the transformation of the functional and technical requirements which were determined at the initial phase of design into the performance requirements, and making design towards those performance requirements. In the performance based design process, the evaluation of performance of design is made by the usage of some methods in normal and obligatory conditions.

These evaluations are applied to control the required performance is met or not by design, the accuracy of the design and desired performance goals are achieved or not. In the content of this study, developed on performance based design is discussed based on literature survey. This study are performance based design teaching method , building evaluation domain model for existing building evaluations, the study that shows the relation of performance based design and knowledge based tools, design process model for high performance buildings, design decision network model, cognitive model and aspect system models. The positive and negative aspects of these models are explained, methods and procedures that were used in them are examined. As a result of the examination of this study; to increase the usage of performance based building design in the practical architectural works, a lack of approach which can turn the issue from a technical point to a business issue is established. This approach should clearly define the components of the design process and determine the steps that enable the evaluation of design and should be user friendly.

Keywords: Pbd , Performance Based Design , School Building , Earthquake , Building Code

1. Introduction

As we know with nearly quarter of India's population being in the age of attending school and college , whether our demographic situation is an asset for our country or not depends on the quality of their learning . Knowledge, skills and expertise are the key enablers for maintaining our economic growth momentum , especially in a scenario of technology – led distruption like industry where skills and expertise requirements are ever-changing . Measures that can enable the right ecosystem needed for imparting quality education are maintained infrastructure , quality of teaching and teachers , extra curricular activities . Maintained infrastructure means a clean , spacious school building having basic facilities like classroom with requisite furniture , boards , electric fittings etc and also contain accessible drinking water , activity and play areas , labs with requisite instruments an equipements , computers for students to learn and experiment with . The challenge of improving quality of teaching by training teachers and supporting them with modern teaching aids , tools and methodologies like smart classrooms and digital course content needs to be taken up so that teachers take pride in their jobs . Extra-curricular activities are also a key component in sustaining a youngster's interest at school . Schools should have requisite sporting facilities and avenues for cultural events , which together contribute to building students life skills and personality .

2.Performance Based Design School Buildings

2.1. Performance based design

A The term performance , as it relates to exposure to natural hazards , usually refers to a building's condition after a disaster , i.e., it signifies a level of damage expected or a load that can be resisted .

The performance-based design process explicitly evaluates how building systems are likely to perform under a variety of conditions associated with potential hazard events . The process takes into consideration the uncertainties inherent in quantifying the frequency and magnitude of potential events and assessing the actual responses of buildings system and the potential effect of the performance of these systems on the functionality of buildings. Identifying the performance capability of a facility is an integral part of the design process and guides the many design decisions that must be made .
Performance based design starts with the selection criteria articulated through one or more performance objectives . Each performance objective is a statement of the acceptable risk of incurring different levels of damage and losses that occur as a result of this damage . Losses can be associated with structural or nonstructural damage , and can be expressed in the form of casualties, direct economic important loss component to consider , especially for critical facilities such as schools .

2.2. Building codes and retrofitting guidelines

Building codes : Building codes are a body of rules which specify the minimum requirement a building must meet to ensure the safety and well-being of its occupants. Some building codes may provide detailed instructions that stipulate particular methods and materials, while others may only provide standards of varying specificity . Not all building codes include standards for hazard resistant buildings.

Retrofitting and building codes : Although structural principles within a building code may be established to apply equally to the construction of new buildings and the retrofit of existing ones, building codes, by and large, are oriented to new construction. If guidance on retrofitting does exist, it may often be unclear and rarely provides the detailed criteria and instruction necessary to practically and economically retrofit a building.

2.3. Characterstics of Performance based design school buildings

Energy • Conserves energy and natural resources
• Saves taxpayer money
• Improves indoor air quality
• Removes toxic materials from places where children learn and play
• Employs daylighting strategies and improves classroom acoustics
• Employs sustainable purchasing and green cleaning practices
• Improves environmental literacy in students
• Decreases the burden on municipal water and wastewater treatment
• Encourages waste management efforts to benefit the local community and region
• Conserves fresh drinking water and helps manage stormwater runoff
• Encourages recycling
• Promotes habitat protection
• Reduces demand on local landfills

3. METHODOLOGY AND EXPERIMENTATIONS

Impact of school buildings on student health : As we know it can be seen easily that the appearance and look of a school building directly effect the mind of a student . It also effects the health and performance of a student in many ways . Environmental exposures in school buildings-to mold, poorly ventilated air, uncomfortable temperature, inadequate lighting, or noise-can negatively impact student health, thinking, and performance, according to a new report form Harvard T.H. Chan school of public health's healthy building program .

The report reviewed findings from more than 200 scientific studies. Some findings included:

1) A study of 75,000 high school students in New York City found that students were 12.3% more likely to fail an exam on a 90degrre F versus a 75 degree F day

2) Poor ventilation in school was associated with student fatigue , lower attention span, and loss of concentration.

3) In a study of 500, 8-9 years olds, test scores were 5.5 points lower for each 10-decibel increase in classroom noise.

Fig.3.1 Student health in school

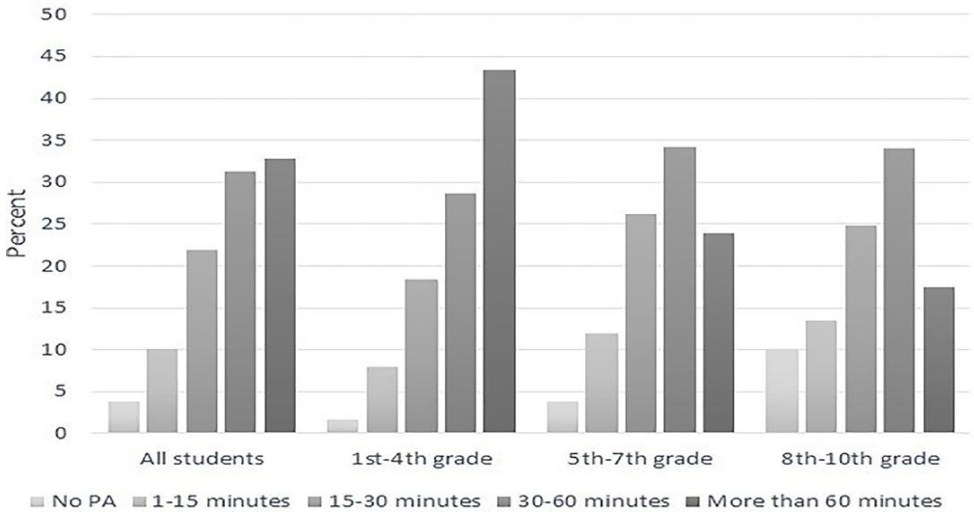

Table 3.2 Student physical activity performance due to health

The U.S. Environmental Protection Agency has estimated that more than 60,000 or 46% , of all U.S. public schools have conditions that contribute to poor indoor environmental quality, according to the report .

Determining Risk :

Risk assessment estimates the nature and extent of of risk by :

Analyzing the potential hazards a school faces

Identifying the school assets and determining their value .

Evaluating the conditions which make a school population and valuable school services and assets more or less susceptible to the potential impacts of a hazard .

Hazard * Vulnerability = Risk

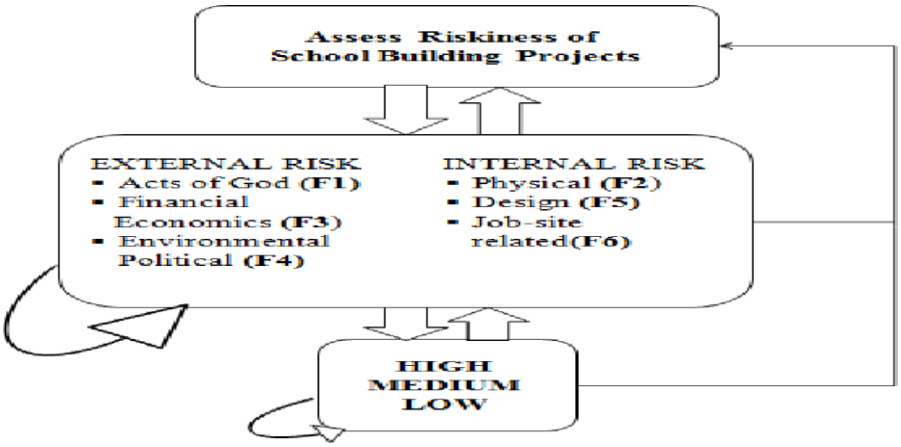

Fig.1.7 various type of risk

It is important to identify and assess each of the potential hazards. The most recent hazard event may not be the hazard which poses the most immediate or greatest danger For each hazard, you will need to determine these four main variables:

1. Magnitude
2. Duration
3. Likelihood of occurrence
4. Affected Area

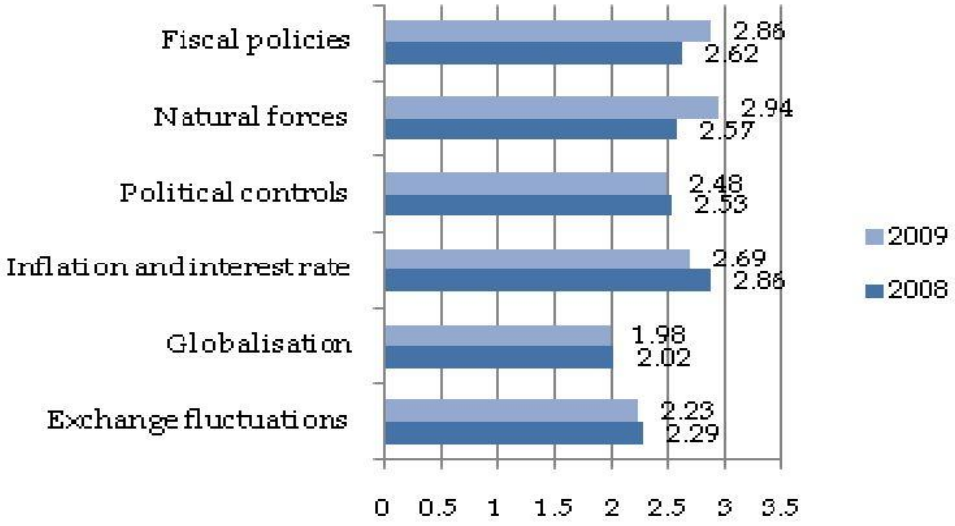

Fig 1.8 Risk management in construction

Many interim measures can be initiated in schools awaiting retrofit work. School disaster preparedness and response training, and simple non-structural measures (such as re-hinging doors to swing away) all can make a school safer. For larger scale initiatives, this assessment can lead to the elaboration of an impact study of disasters on the education sector. Such studies can be powerful tools to advocate for support and policy development and can be undertaken with assistance of local consultants, universities or technical institutes.

Defining performance objective :

In a few cases, the risk posed to a school may be eliminated. Relocating existing schools outside of a landslide hazard zone is one example. Yet most often, sitting a school outside Cambodia—Hazard impact study on the education sector To build up evidence-based rationale for raising awareness on disaster risk reduction in the education sector and to advocate for new policies, practices and hazard resilient school construction, the Ministry of

Education, Youth and Sports, the National Committee for Disaster Management and ADPC conducted a sector wide hazard impact study. The study focused on the following points:

-Socio-economic and physical impacts of disasters on education sector

- Review of current practices in school construction

- Solution oriented recommendations to:

• Minimize the social and economic impacts of disasters, especially on education sector;

• Improve procedures and guidelines for school construction;

• Identify specific opportunities to improve safety in school construction in pipeline projects over the following 3 years. the hazard affected area is not feasible. In these cases, efforts must be made to reduce the risk posed by hazards. Performance objectives, in the context of hazard resilient construction and retrofit, are objectives which describe an acceptable damage level for a given building and a given hazard or hazards. Performance objectives set a goal for how a building will be designed to perform during and after a hazard event, given technical, financial and other considerations. They may be referred to as protection levels, safety levels, or acceptable risk levels.

4. OBSERVATIONS AND RESULTS

1) Skill development

Design/methodology/approach – The design approach was to focus on the schools and those involved in teaching in order to explore their perspective of the link between investment and improved pupil performance. The methodology chosen was qualitative and consisted of questionnaires to a selected sample of state schools together with interviews with the Local Education Authority and a case study of a single school, all within Derbyshire.

2) Findings – The results clearly indicate that although direct benefits are difficult to measure accurately, the schools perceive a benefit of investment which can be illustrated in pupil attainment, motivation and pupil behaviour, with an additional benefit to staff, who find that better environments improve teacher morale and motivation.

3) Research limitations/implications – The study is of schools in one county only and includes a random sample of schools providing state education to pupils between 5 and 18 years. The data findings relate to schools that have benefited from investment by the local authority.

4) Practical implications – The research provides a timely study incorporating useful information to all of those who have an interest in the school built environment and in particular provides support for the government investment taking place in schools.

5) Originality/value – Research for this paper was carried out as part of an undergraduate dissertation, drawing from the direct placement work experience of the primary author and the professional experience of the co-author/supervisor.

6) Academic performance of students :

Going to a more modern, more comfortable school is also believed to increase motivation levels and overall effort, which indirectly supports improved student learning. Teacher health and motivation levels may also improve while working within such facilities, offering higher-quality education.

Successfully managing a quality school environment, prior research suggests, leads to greater environmental quality and impacts the attitudes of students and staff, affects overall learning behavior, and results in improved performance—all of which ultimately impacts future society- and student-outcomes.

Concerning the facility itself, a school or affiliated learning environment should be inviting to students, offering adequate lighting, a clean space, and student-friendly conditions. It is also essential that students are taught within an environment that is productive and comfortable, reducing feelings of stress. The risk of any potential adverse health effects should also be considered, particularly in terms of air quality, climate control, and overall sanitation.

Table 4.1 Performance percentage in students

S.No.	Fraction of text messages	Low GPA	Moderate GPA	High GPA
1	0.2	0.45	0.30	0.25
2	0.4	0.25	0.38	0.35
3	0.6	0.15	0.38	0.45

7)Prescriptive design vs Performance-based design :Prescriptive codes usually allow for a minimum 10% safety factor. Under PBD each situation is based on the potential uncertainties and is evaluated on a case by case basis. There appear to be too many assumptions that are used to determine a PDB safety factor.

Fire is often an unpredictable phenomenon. The use of Performance Based Design is becoming more and more popular. If used correctly the use of PBD can be an excellent enhancement to Prescriptive based codes. However at this time Performance Based Design is still at a starting point and should be viewed with healthy skepticism.

8)Effect on Economy and Environment :

Economy : Buildings that meet this building performance level may experience extensive damage to structural and nonstructural components. Repairs may be required before re-occupancy, though in some cases extensive restoration or reconstruction may not be cost effective. The risk of casualties at this target performance level is low. This building performance level allows somewhat more extensive damage than would be anticipated for new buildings designed and constructed for seismic resistance. The Life Safety Building Performance Level should prevent significant casualties among able-bodied school occupants.

Environment : The good orientation of the classroom has a great positive effect on the indoor environment and the students efficiency , concentration and performance .The windows overlooking meeting points and gathering places are not successful in schools function as the noise distract the students. Natural day light is a great factor adding freshness and enthusiasm to students. Windows in schools have a great effect on the psychology of students as well as being a great provider of day light that enhanced level of students. The environmental design of school building enhance the educational process as well as the economic status by optimizing the energy consumption.

5. Conclusions And Future

Conclusions:

From this study on the energy piles used in the performance based design of school buildings the conclusions find out are given below :

1)The Performance-based design satisfy the acceptance criteria for immediate occupancy and life safety limits states for various intensities of earthquakes.

2)It gives a structure with better seismic load carrying capacity , there by achieving the objective of performance as well as economy.

3)The theory of PBD is based on the structure analysis and is a revolution in development of seismic theory. It includes all aspects of design and has important meanings. With the quicken of economic globalization and the increment of international invest and commerce, disputes always exist because of the difference performance characteristics caused by the different codes. But all of those and be avoided when the PBD method is used. From the trend of code revision [5, 8, 12, 13] in the world, it can be said that the PBSD theory is the most popular choice.

Futurechallenges :

Other than the design challenges mentioned previously , In order to make PBD successful, new design and assessment tools and methods are needed. All over the world researchers and practitioners have already developed such tools or are in the process of doing so. A project is proposed to develop and maintain an overview of available tools and methods. Also new tools and methods are needed for the capture of client and user requirements and for the translation of these requirements into performance requirements . More over, more effort has to be put into the development of quantifiable performance criteria for – at least – 75% of built facility attributes. Special attention has to be given to the capture and handling of user requirements concerning attributes, that cannot possibly be expressed in objective quantifiable criteria, like perception and architectural and Performance based building. Exactly these ‘subjective’ attributes may to a great extend contribute to the client’s and users’ appreciation of a built facility.

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