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Inspection and Service Life Prediction of ZP School Buildings in Shahuwadi Region

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Abstract: ***This paper presents a specific case study for estimating the service life of ZP school buildings in the Shahuwadi region of Maharashtra, India. Prediction of building components is evaluated by calculation of 'Condition Indices' followed by the 'Factor method'. For planning maintenance of any building it is necessary to have good information about building components and durability of materials. The construction works have to be maintained during their whole service life. Service life's knowledge becomes very important input data to guide designers, manufacturers and real estate owners in contributing for sustainability of whole building process. The case in consideration was applied to the data collected for a project to assess the condition of 30 schools that belong to selected study area.***
Keywords: Service life prediction, school,building maitainance, defects, survey.

I. INTRODUCTION

The sustainability of building process requires the control and planning of material and economic resources necessary for its life cycle [1]. Design choices should be oriented towards building's components and products characterized by an economically reasonable working life, i.e. which requires economically and materially sustainable maintenance activities, considering the predicted service life [1]. With this aim different researches and standards have been developed at national and international level on durability evaluation. At international level ISO TC 59 SC14 Service Life planning and CIB W80 RILEM Service life prediction methodologies are developing durability evaluation methods to support service life planning [1].

Considerable work has been carried out in the area of service life prediction as requisite tools for helping assess long-term environmental effects, for maintenance management of infrastructure systems, such as roads, bridges, waterways, water distribution and waste-water removal systems, or indeed for maintenance of building envelope systems, envelope components and related materials [2]. Increasingly, building material and component manufacturers are seeking systematic methods to assess the likely risk to premature deterioration of existing products given specific climatic effects, or the most vulnerable exposure conditions of new products in specified systems [2].

II. ANALYSIS

1) The current status of secondary education in rural areas is characterized by low enrollment, poor completion rates, poor physical infrastructure, and high drop out. This study will be beneficial to the low income groups of rural areas and it will add to the status of infrastructural facilities of rural education.
2) A good school infrastructure includes with building in good shape including an adequate number of well-organized classrooms, sufficient blackboards, tables, benches, chairs, an adequate number of sanitation facility, laboratory, computer facilities etc.

A. Condition Index

Condition is assessed through visual inspection and hence the repair priorities may differ from person to person based on the individuals' perception, therefore would not be unique. A questionnaire survey is formulated to resolve this issue, for manifestations of various corrosion distresses in RC buildings namely

1) Rusting _rust stains_ and cracks;
2) Delamination/spalling/loss in steel section;
3) Poor workmanship ,honeycombing and moisture marks; and
4) Carbonation and chhorides.

B. Analysis by factor method:

1) *Design Life:* intended service life, expected service life or service life intended by the designer.
2) *Reference Service Life:* service life that a building or parts of a building would expect (or is predicted
3) to have) in a certain set (reference set) of in-use conditions.

4) *Estimated Service Life:* service life that a building or parts of a building would be expected to have in a set of specific in-use conditions, calculated by adjusting the reference in-use conditions in terms of materials, design, environment, use and maintenance.

An Estimated service life (ESL) of a material or component is calculated based on a Reference service life (RSL) and a series of factors, A-G, by combining them as shown in equation (1).

$$ESL = RSL \times A \times B \times C \times D \times E \times F \times G \quad \text{……..(1)}$$

Where, A = quality of components
B = design level
C = work execution level
D = indoor environment
E = outdoor environment
F = in-use conditions
G = maintenance level

III.PRELIMINARY WORK

A. Progress of proposed work:

1) *Survey of ZP Schools Under Consideration:* There are two gram panchayats under "Shahuwadi" panchayat samiti,i.e Bambawde gram panchayat and Pishavi gram panchayat. 15 schools under Bambawde gram panchayat are selected and 15 schools under Pishavi gram panchayat are selected for case study.

TABLE 2: SCHOOL's INFORMATION

School Name	Year Of Construc-Tion	Carpet Area	No.Of Classroom	Type Of Structure	No.Of Students	Is Buiding Renovated?	Year Of Renova-Tion
Charan	2012-13	7000 sq ft	11	Load bearing- stone masona.	210	No	No
Khutalwadi	1958	5000 sq ft	6	Load bearing- stone masonary	72	No	No
Supatre	1978	3000 sq ft	4	Load bearing- stone masonary	61	As per requirement	2017
Kumbharwadi	1969	3000 sq ft	1	Load bearing- stone masonary	35	No	No
Warewadi	2011-12	5500 sq ft	7	Load bearing- stone masonary	108	As per requirement	2018
Mahatma gandhi bambawde	1996	7000 sq ft	12	Load bearing- stone masonary	644	No	No
Thergaon	1970	6000 sq ft	9	Load bearing- stone masonary	174	No	No
Ramgiri charan	1980	3500 sq ft	5	Load bearing- stone masonary	62	No	No
Bhosalewadi	2007-08 & expansion2016	2000 sq ft	2	Load bearing- stone masonary	13	No	No
Donoli	2007-08	5000 sq ft	9	Load bearing- stone masonary	140	Yes	Aug-19
Vhanagdewadi	2008	3000 sq ft	3	Load bearing- stone masonary	15	No	No
Kelewadi	2007	3000 sq ft	2	Load bearing- stone masonary	12	No	No
Powarwadi	1984	4500 sq ft	2	Load bearing- brick masonary	20	No	No
Salashi	2009	5000 sq ft	11	Load bearing- stone masonary	252	No	No
Udyahigh, Pishavi	1976	3500 sq ft	5	Load bearing- stone masonary	124	No	No
Sonavde	2011 - 12	5000 sq ft	4	Load bearing- stone masonary	150	Yes	2019
Hanmantwadi	1985	2500 sq ft	2	Load bearing- stone mason.	33	No	No
Centre school, Bambavade	1940	2 acres	11	Load bearing- stone masonary	215	Yes	2011
Khotwadi	1996	2500 sq ft		Load bearing- stone masonary	-	-	No
Vhanagdewadi	2008	3000 sq ft	3	Load bearing- stone masonary	15	No	No

B. Defects Observed

Various defects were observed and the same is attached with this thesis.

Table 3: Defects Observed

Sr. no	Defects							
	Cracks	Uplifting of flooring tiles	Failure of wooden column	Leakage	Rusting	Plaster	Defect in paving blocks	Defects in roof sheet
1	Longitudinal	Buckling	Physical decay	Roof	Localized	Blistering	Dislocation	Wearing out
2	Expansion	Cracking	Excessive moisture content	Floor	Stress	Cracks	Tilting	Floor
3	Transverse	Widening of the crack of the tile	Dimensional instability	Ceiling	Surface	Efflorescence	Cracking	Bending
4	Vertical		Chemical deterioration.	Wall	Crevice	Flaking	Uneven surface	Rusting
5	Horizo-ntal				-	Peeling	Depression	Cracking
6	Open cracks				-	Uneven plaster surface		
7	Surface cracks							
8	Diagonal							

C. Visual Inspection Of Structural Defects Of School Buildings

1) Jivan Salashi School

Fig.1 Defects in Jivan Salashi

Defects observed: Here Defective concrete as a result of ageing is most commonly found in such old buildings. There is formation of shear cracks at the joints due to load. When two materials have widely different elastic properties and are built side by side, under the effects of load, shear stress is set up at the interface of the two materials, resulting in formation of crack at the junction. Vertical crack is observed in the wall which is a common sign of structural instability. A chajja which is a projecting eave or a covering of a roof is absent in the above building and this may expose to the building to rainfall and allow seepage of water from roof and gliding downwards.

2) Charan School

Fig.2 Defects in Charan

Defects observed: Cut edges on a steel roof will experience edge creep, which is minimal rusting occurring at the cut edge. Many details in a standing seam metal roof have folds or hemmed edges that conceal the cut edge of the metal Vertical and diagonal cracks in concrete walls typically indicate foundation movement. If a vertical crack widens at the top or bottom, the wall is either settling or gradually heaving, which may present serious issues. Spalling of the mortar and brick will occur due to the expansive nature of water. This happens when excessive moisture enters the walls.

3) Bhadle School

Fig.3 Defects in Bhadale

a) Defects Observed: The metal windows have been rusted to some extent and it is form of surface rusting. Without the required servicing and maintenance, hinges may become too tight to operate, rivets may loosen up and screws may be corroded that shorten their life-span. The purlins under the manglorian roof tiles have been eroded which may lead to service failure. The W.C are not in proper condition due to falling off of bricks from the walls. Also the roof has been subjected to dampness and can be a serious matter, particularly to buildings located near water sources. Dampness led to deterioration of building structures and also damage to the furnishings.

4) Vhanagdewadi

Fig.4 Defects in Vhanagdewadi

a) Defects Observed: Mold and fungi are found everywhere either both indoors and outdoors all the year round. Mold is a type of fungi and it seems likely to grow and become bigger threat when there is water damage, high humidity or dampness. The growth of unwanted vegetation below the eater tank has led to loss in strength of concrete base. Exposure to sever changes in temperature may cause cracking of concrete flooring as we can see above image. Again, in most cases, hairline cracks are harmless and don't compromise the strength of the floor. Deeper cracks can cause a few other problems, however.

5) Warewadi School

Fig.5 Defects in Warewadi

Defects observed: Here we observe falling off of concrete patches due to defective concrete or spalling of concrete. Dismantling of door frame is also observed here. Diagonal cracks are visible If there isn't a sufficient number of vertical expansion joints along the length of the wall, the unrelieved horizontal movement will cause diagonal cracks to occur at openings and, in some cases, at building corners. Spores of mold are observed on external walls. When these spores land on a moist surface that is suitable for life, they begin to grow. *Rust* is the cancer of the metal world. It eats away at the material from the inside. Many *railing* manufactures do not galvanize their railings which leads to such failure.

D. Condition Index Calculations

Table 4: Condition Index Calculation

SCHOOL	DEFECT	DEFECTED AREA	CONDITION INDEX
1.Bhosalewadi	Wall plaster crack	15*20 sq.ft	0
2.Centre school Bambawde	Leakage in roof	15*20 sq.ft	0
3.Charan	Peeling off of column paint	5*1.5 sq.ft	0
4.Donoli	Breaking of Shahabad tiles	3*7 sq.ft	94.39%
5.Hanmantwadi	Verandah breakage	15*2 sq.ft	85%
6.Jivan Salashi	Rusting of windows	4*4 sq.ft	0
7.Kelewadi	Rotten wood support	8*15 sq.ft	0
8.Khotwadi	Andhari damage	5*0.75 sq.ft	0
9.Khutalwadi	Loss of mortar	4.5*3 sq.ft	95.5%
10.Kumbharwadi	Manglorian roof tile breakage	2*2 sq.ft	98.66%

IV. DISCUSSION

A. Maintaining your building premises is necessary in order to preserve the assets and protect the building occupants.

B. Proper building maintenance makes sure the building and the environment remains healthy, clean and a safe place to work or reside.

C. The above work will help in predicting service life of building components and carrying out the desired maintenance at the appropriate intervals.

D. The ‘Condition Index’ followed by the ‘Factor Method’ will assist in getting the required results.

V. RESULT AND CONCLUSION

In the above work, it is pointed out that the several structural defects of ZP school buildings of ‘Bambavade’ and ‘Pishavi’ region such as internal and external wall cracks, its type flooring defects, corrosion related issues, leakage of roof slabs, dampness, fungus formation were visually inspected. Each defect and failure in every part of building was significantly appraised and condition index of individual defect and failure was assigned. There is a need of immediate repair for few structural components to avoid severe loss of lives and property.

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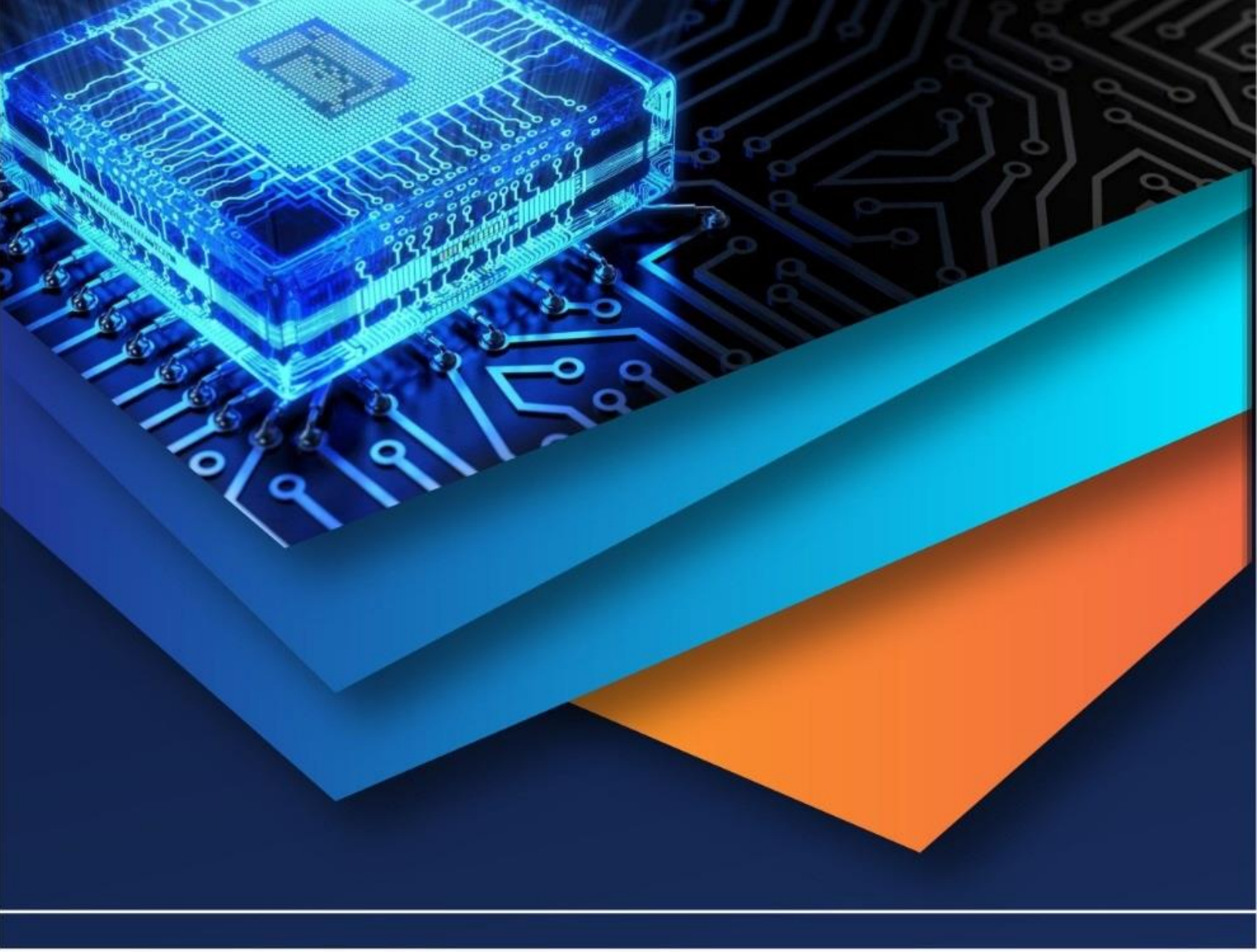

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