Condition Assessment and Rating of a Building using Condition Survey Protocol (CSP) 1 Matrix

[1]Lavingiya Raag [2]Qureshi Sulaim [3]Solanki Parth
[1,2,3]UG Student
[1,2,3]Department of Civil Engineering
[1,2,3]S V National Institute of Technology, Surat, Gujarat, India

Abstract

Purpose - This study aims to provide assessment method for building's condition. Building inspection is one of the key component of building maintenance as it is used for evaluating building's current condition. Traditionally, a longhand survey description has been used for condition report. Survey that employ ratings instead of description are gaining acceptance in the industry. Hence this study provides quantitative approach towards assessing buildings condition which can be used for defining maintenance plan and also presents a case study carried out.
Methodology - In this study, we adopted a condition survey protocol (CSP) 1 matrix for assessment of building's condition. Two types of ratings are condition assessment and priority assessment. These two assessment criteria are then multiplied to find out the final score of the defects.
Findings - The full score is used to give the building an overall rating: good, fair or dilapidated and according to the score type of maintenance can be suggested for the building.
Originality/value – The computerized tool can be used for condition assessment, providing an overall rating to the building and type of maintenance needed.
Keyword- Building Defects, Defect Identification, Condition Assessment, Building Maintenance

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I. INTRODUCTION

Researchers are trying to prolong the life of structures but building defects are inevitable. Defects occur in various forms and to different extent in all types of building. To determine remedial solution for it, the identification of particular building defect, the causes of that building defect and materials used for construction of that particular building component should be studied.

The purpose of conducting a building inspection is for condition assessment of a building. Inspection is used for identification of building defects. Traditionally, building surveyors have primarily relied on descriptive longhand surveys. Surveyors used to record every detail by hand while performing on-sight survey, which consumes more amount of time and also subjected to the bias of inspector. A lot of research has been carried out in the field of identification of building defects and condition assessment by using different innovative techniques. After studying various modern condition assessment methods, condition survey protocol (CSP) 1 matrix has been adopted to assess buildings in reasonable condition. This system provides rating criteria that can be used to assess buildings defects. The benefits of using this system are to help surveyor to collect data within shortest time by avoiding description, helps to assign priority to each defect recorded based on the guidelines provided, to obtain an overall rating of the building's condition. The objective of the study is to provide quantitative approach for condition assessment of buildings in reasonable condition.

II. CLASSIFICATION OF DEFECTS

Building defects can categorized into two types.

A. Non-Structural Defects
The defect that will eventually affect the appearance of the structure.

B. Structural Defects
The defects that affect the performance of building structure.

III. CAUSES OF DEFECTS

The defects in buildings results due to design and construction problems which are poor workmanship, construction materials, faulty during construction, and not according to the specification, etc. Other than that, climatic condition, lack of maintenance, external environment, limited time and cost will also cause defects to be occurred.

IV. TYPES OF BUILDING DEFECTS

Defects that occurring in the building are due to poor workmanship, lack of supervision and etc. There are various types of building defect can be found in the building, regardless of the age.

Fungal straining, erosion of mortar joint, peeling of paint, poor installation of building services equipment, defective plaster, cracks, transverse cracks, longitudinal cracks, shear cracks, plastic settlement cracks, crack in plastic shrinkage, crazing crack, map crack, defective rainwater good, decayed floorboards, insect or termite attacks on timber elements, roof defects, roof leakage, flat roof leakage, pitch roof leakage, dampness penetration, corrosion of reinforced steel, unstable foundation etc. are frequently found defects in buildings.

V. CONDITION ASSESSMENT

Traditionally, building surveyors have primarily relied on descriptive longhand surveys. Surveyors used to record every detail by hand while performing on-sight survey. These surveys are reasonable for small projects but becomes difficult to manage for a large project due to its time-consuming nature. These condition assessment surveys yield variable results due to subjective perception of surveyor which is known as surveyor variability. This variability is caused by a variety of factors such as previous experience, attitude to risk and, heuristics – the use of "rules of thumb", and biases – a leaning towards a particular opinion regardless of the available evidence.

A lot of research has been carried out in the field of identification of building defects and condition assessment by using condition rating.

Dutch Standard of Condition Assessment and (N. Hamzah 2010) have developed condition rating systems which gives overall score to a building which represents its condition and classifies it in various classes. These methods are successful for quantitative representation of condition of a building. It makes the technical status of the building transferable between property managers. Among these methods, latter one is used as the basis of this research due to its simplicity and widespread use.

A. CSP-1 Matrix

Mahmood et al. (2009) developed Navil™ matrix, which is currently used in building inspections in Malaysia.
The CSP (Condition survey protocol) 1 matrix is preliminary based on Navil™ matrix.
The goals behind the CSP1 Matrix are:

1) To enable the surveyors to collect data within shortest possible time by avoiding descriptive, longhand write- ups during fieldwork;
2) To record the existing defects of the building, the main source of data, by assessing the condition and assigning priority to each defect recorded;
3) To obtain an overall rating of the building's condition.
4) To use the numerical rating acquired from the survey work to perform statistical analysis.

This system gathers two sets of data, namely, the condition of the building and the seriousness of a building's defects, which can be analyzed to provide a rating of the building's overall condition.

The data required for the CSP1 Matrix are the condition and the priority assessments as shown in table 1 and 2 each numerical score is accompanied by a scale value and description. This will help surveyor rate buildings defects and determine the exact condition implied by the scale value.

Condition	*Scale value*	*Description*
1	*Good*	*Minor servicing*
2	*Fair*	*Minor repair*
3	*Poor*	*Minor repair/replacement*
4	*Very poor*	*Malfunction*
5	*Dilapidated*	*Damage/replacement of missing part*

Table 1: Condition assessment protocol 1 (N. Hamzah 2010)

Priority	*Scale value*	*Description*
1	*Normal*	*Functional; cosmetic defect only*
2	*Routine*	*Minor defect, but could become serious if left unattended*
3	*Urgent*	*Serious defect, doesn't function at an acceptable standard*
4	*Emergency*	*Element/structure doesn't function at all; OR Presents risks that could lead to fatality and/or injury*

Table 2: Priority assessment (N. Hamzah 2010)

Each recorded defect is assigned a condition and priority rating. Each rating is then multiplied to determine the total score of a defect. The total score is then matched with the matrix. The scores range from 1 to 20. A colour (green, yellow or red) is then applied to indicate the score in each of the 3 parameters: Plan Maintenance (1 to 4), Condition Monitoring (5 to 12) and Serious Attention (13 to 20), as shown in Table 3.

Scale		*Priority assessment*			
		E 4	*U 3*	*R 2*	*N 1*
Condition Assessment	*5*	*20*	*15*	*10*	*5*
	4	*16*	*12*	*8*	*4*
	3	*12*	*9*	*6*	*3*
	2	*8*	*6*	*4*	*2*
	1	*4*	*3*	*2*	*1*

Table 3: The Matrix (N. Hamzah 2010)

This method of analysis makes it easy to identify the level of seriousness of each defect recorded during the building inspection.

It is important to keep in mind that red coded defects should be dealt with first, this will influence the overall building rating and highlight the individual defects that are posing extreme danger to building. This will also help the surveyor to identify the risk of individual defects and provide clients with well-informed defect summaries.

No	*Matrix*	*Score*
1	*Planned maintenance*	*1 to 4*
2	*Condition monitoring*	*5 to 12*
3	*Serious attention*	*13 to 20*

Table 4: The descriptive value according to score (N. Hamzah 2010)

After scoring every defect, the overall building condition is calculated by adding up the score of each defect and dividing it with the total number of defects. The building is then rated Good, Fair or Dilapidated, according to the score (out of 20).

No	*Building rating*	*Score*
1	*Good*	*1 to 4*
2	*Fair*	*5 to 12*
3	*Dilapidated*	*13 to 20*

Table 5: Overall building rating (N. Hamzah 2010)

VI. SURVEY

To define the scope, a survey of Old CRC building and Civil engineering department of SVNIT, Surat has been carried out and the photographs of all the kinds of defects prevalent in these buildings are taken. In addition to them, the defects generally occurring in various classes of buildings are included.

The table below provides photographic guidelines to the surveyor about the defects to make it easy and accurate for the surveyor to detect the building defect. The priority of all these defects has been determined on the basis of guidelines provided by (N. Hamzah 2010) and (Handbook on repair and rehabilitation of RCC buildings n.d.).

A. Case Study

For making the tool more efficient, the case study of condition assessment has been done on heavy structure lab of Applied Mechanics Department, SVNIT. The case study starts with the plan of the lab drawn on a plain paper with clear indication of entry, doors and windows and the defects are numbered on the plan. The identification of different types of defects start from the outside of the building and it is compared with the prepared database. These data is recorded with the help of developed tool. Different types of cracking were the most common defects observed in this lab. The other types of defects seen in the same were discoloration, rusting, peeling of paint, concrete spalling, corrosion, vegetation, etc. 47 defects in this building were recorded with the use of the tool and the responses of the were saved in google drive in the form of excel sheet. To find the condition rating of the building, the priority for each defect which is already determined will be multiplied with the extent of defect recorded. The summation of these values, divide by total number of defects will give the weighted average of defects. This average value will be compared with the standard range given in (N. Hamzah 2010) and the condition of the whole building can be determined.

Figure 1 shows the plan of the heavy structures lab on which the pilot study has been carried out. This plan shows the location of the defects as per number given to them in schedule.

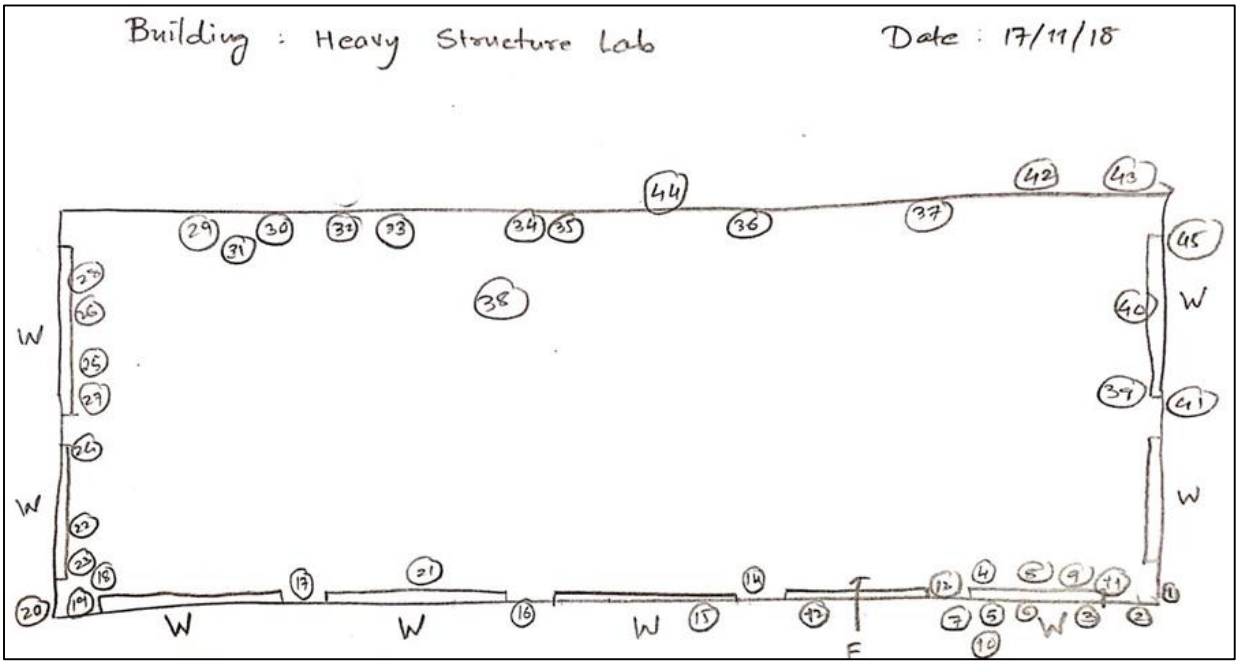

Fig. 1: Plan of heavy Structure lab (Case study)

B. Property Information

Building address: Heavy structures lab, SVNIT Surat
Owner: SVNIT, Surat
Date of inspection: 16/11/2018
Weather: Clear
Note: The defects which are found in case study is listed out in appendix with their priority and score.

C. Executive Summary Case Study

No.	*Matrix*	*Score*	*Color code*	*Findings*
1	*Planned maintenance*	*1 to 4*		*36*
2	*Condition monitoring*	*5 to 12*		*11*
3	*Serious attention*	*13 to 20*		*0*
Total defects				*47*

Overall building rating
Total marks – 172
Number of defects - 47
Total score – 3.66
Overall building condition – Good

VII. CONCLUSION

Building inspection is the first step of building maintenance process. Building inspection requires skill in identifying defects and familiarity with reporting procedures. It primarily involves onsite work and preparation of a report. This research work primarily focuses on the defect identification and giving quantitative assessment to every defect in turn overall condition assessment of the building. Traditionally, longhand descriptions have been employed for reporting building inspection work. These are time consuming, particularly during site inspections. The developed tool has been developed to shorten this process, thus shortening on-site inspection time. As the case study has shown, the tool achieved its objective and proved to be a reliable and practical assessment method for building inspections performed under reasonable property conditions. It is likely that the tool developed is not suitable for unreasonable property conditions, where more detailed descriptions of the defects are required, particularly for the preparation of a Building Survey Report.

APPENDIX

Defect plan tag	*Building Component*	*Type of defect*	*Condition Rating*	*Priority*	*Defect score*
1	*Column*	*Vertical crack*	*2*	*4*	*8*
2	*Column and wall*	*Separation crack*	*3*	*2*	*6*

	joint				
3	*Walls*	*Diagonal crack in the external corner of the building*	*2*	*3*	*6*
4	*Walls*	*Vertical Crack*	*1*	*2*	*2*
5	*Plaster*	*Debonding of plaster*	*3*	*2*	*6*
6	*Beam*	*Spalling of concrete*	*2*	*3*	*6*
7	*Beam*	*Reinforcement corrosion*	*1*	*3*	*3*
8	*Walls*	*Diagonal cracks emanating from corners of window*	*1*	*2*	*2*
9	*Paint*	*Peeling of paint*	*1*	*1*	*1*
10	*Doors and windows*	*Rusting*	*3*	*2*	*6*
11	*Doors and windows*	*Broken panel/glass*	*1*	*2*	*2*
12	*Walls*	*Shrinkage crack/Hairline crack*	*1*	*1*	*1*
13	*Walls*	*Vegetation growth*	*1*	*2*	*2*
14	*Column and wall joint*	*Separation crack*	*1*	*2*	*2*
15	*Column and wall joint*	*Separation crack*	*1*	*2*	*2*
16	*Doors and windows*	*Broken panel/glass*	*2*	*2*	*4*
17	*Walls*	*Diagonal cracks emanating from corners of window*	*2*	*2*	*4*
18	*Doors and windows*	*Broken panel/glass*	*2*	*2*	*4*
19	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
20	*Doors and windows*	*Timber rotting*	*3*	*2*	*6*
21	*Walls*	*Diagonal cracks emanating from corners of window*	*1*	*2*	*2*
22	*Paint*	*Discolouration*	*2*	*1*	*2*
23	*Paint*	*Discolouration*	*2*	*1*	*2*
24	*Walls*	*Diagonal cracks emanating from corners of window*	*2*	*2*	*4*
25	*Walls*	*Shrinkage crack/Hairline crack*	*1*	*3*	*3*
26	*Beam*	*Spalling of concrete*	*2*	*3*	*6*
27	*Plaster*	*Crazing/map cracking*	*2*	*1*	*2*
28	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
29	*Walls*	*Shrinkage crack/Hairline crack*	*1*	*1*	*1*
30	*Walls*	*Shrinkage crack/Hairline crack*	*2*	*1*	*2*
31	*Paint*	*Discolouration*	*2*	*1*	*2*
32	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
33	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
34	*Floor*	*Unevenness*	*2*	*1*	*2*
35	*Foundation*	*Foundation settlement*	*2*	*3*	*6*
36	*Plaster*	*Debonding of plaster*	*2*	*2*	*4*
37	*Floor*	*Floor cracking*	*1*	*2*	*2*
38	*Walls*	*Diagonal cracks emanating from corners of window*	*3*	*2*	*6*
39	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
40	*Plaster*	*Blistering*	*2*	*1*	*2*
41	*Column and wall joint*	*Separation crack*	*2*	*2*	*4*
42	*Plaster*	*Debonding of plaster*	*2*	*2*	*4*
43	*Walls*	*Vegetation growth*	*2*	*2*	*4*
44	*Beam and wall joint*	*Separation crack*	*2*	*2*	*4*
45	*Beam and wall joint*	*Separation crack*	*2*	*2*	*4*
46	*Between terrace beam and wall*	*crack*	*3*	*3*	*9*
47	*Walls*	*Staining*	*2*	*1*	*2*

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