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A STUDY OF THE PERFORMANCE OF BUILDINGS

by K.W. Jaeggin and A.E. Brass

ANALYZED

A joint project of the School
of Architecture, University of
Toronto and the Division of
Building Research, National
Research Council of Canada



Ottawa

May 1967

Price 75 cents

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A STUDY OF THE PERFORMANCE OF BUILDINGS

by

K.W. Jaeggin, M.Arch, M.R.A.I.C.
and
A.E. Brass, B. Arch., Dipl. T. and R. Pl.
School of Architecture, University of Toronto

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PREFACE

This Report is intended to provide an informational background to the use of the "Check List on the Performance of Buildings" which is being issued simultaneously. It is based upon a longer paper, by the same authors, which is available for study in the Library of the Building Research Centre in Ottawa, together with the report upon the pilot application of the Check List mentioned in the text.

The Division of Building Research of NRC has been concerned with the performance of buildings from the earliest days of its work. One of the first talks that the writer had about the work of the new Division was with Professor Walter Voss of MIT. In the course of this discussion there developed a mutual appreciation of the value of studies of the performance of buildings in use. The idea of providing the architects of Canada with practical assistance for the regular examination of the buildings they designed dates from that time.

DBR/NRC welcomed the opportunity of sharing its interests in this matter with the School of Architecture of the University of Toronto and is pleased indeed to be able to issue this report and the associated Check List as a joint venture.

The value of the Check List to all practising architects for assisting them in examining the performance of the buildings they have designed is jointly urged. Comments upon the usefulness of the List and suggestions for its improvement will always be welcomed.

Ottawa
May 1967

Robert F. Legget,
Director,
Division of Building Research

A STUDY OF THE PERFORMANCE OF BUILDINGS

by

K.W. Jaeggin and A.E. Brass

An activity that has been conspicuously missing from the building process is that of post-construction study - the process which enables designers, builders and owners to learn of the satisfactory and unsatisfactory features of their buildings by examining them after a period of use. Recognizing the value of such information to future building projects, the Division of Building Research of the National Research Council of Canada has studied the matter intermittently over a period of years.

With the encouragement of the Research Committee of the Royal Architectural Institute of Canada, DBR/NRC pursued the problem further by carrying out a survey of practices throughout the world and by preparing a First Draft of a Proposed Check List on the Performance of Buildings in May 1962.

In the summer of 1962, arrangements were made by the Division of Building Research with the School of Architecture, University of Toronto, to develop the draft check list into a more complete form and by testing its completeness and usefulness in the examination of an actual building. The work was carried out by K. W. Jaeggin, M.Arch., M.R.A.I.C., in consultation with A. E. Brass, B.Arch., Dipl. T. & R.Pl., and under the direction of Dr. T. Howarth, Director, and W. G. Raymore, Professor of Architecture, of the School (now Faculty) of Architecture, University of Toronto.

REVIEW OF REFERENCE SOURCES

Earlier studies by the Division of Building Research had revealed the dearth of existing literature pertaining directly to studies of the performance of buildings and obviated the need for an intensive literature search as part of the project. Use was made, however, of currently available literature on the subject, such as references of a general nature relating to materials and methods of construction, literature concerned with the durability of buildings, and the writing of specifications. These references revealed information on the various elements of buildings and the major factors affecting their performance. This was of value in developing a check list and in pointing out the major performance characteristics to be looked for.

At the same time, correspondence was initiated with organizations concerned with building maintenance or those who were multi-building owners and might have developed systematic procedures for inspecting their buildings for maintenance purposes. A list of the organizations that contributed information is contained in the Acknowledgements. This correspondence revealed that all of the organizations were interested in and recognized the value of check lists to record the performance of buildings. Only one firm contacted, however, was actually using a check list. This was the office of the regional architect of the Bell Telephone Company of Canada which used a check list developed by the American Telephone and Telegraph Company for the examination of their buildings to determine what maintenance measures were required. It consisted of a brief listing of items to be examined and an explanatory document outlining the nature of the most common defects.

Two other reference sources in addition proved of value. One was the documentation material of the International Council for Building Research Studies and Documentation (CIB) (see ref. 7). This material indicated systematic ways of organizing and presenting information about buildings and was of assistance in refining the draft check list into a more complete form.

The other reference source was "An Appraisal Method for Measuring the Quality of Housing." (see ref. 5). This document is intended for use in examining housing to assess defects of interest to Public Health Departments, Building Departments, Planning Boards, and Fire Departments. It is divided into a condensed check list for field investigations and a very detailed guide for inspectors, outlining the procedures to be used in the investigations. This format was similar to the one used by the Bell Telephone Company and was adapted for the check list developed in this project.

FIRST USE IN THE FIELD

Utilizing the reference material, the Draft Check List on the Performance of Buildings developed by the Division of Building Research was revised and developed into a form for use in the field study. A school was chosen for the first field study because of the assistance and records available from the Toronto Board of Education which would not have been as readily available for other buildings.

The sequence of items in the check list was found to be good in the field observations and the list itself was a valuable aid in ensuring a comprehensive examination of the building in a systematic

and logical sequence. Some of the items, such as condensation and air leakage, could not be detected at the time of inspection because of weather conditions. It was therefore necessary to look for signs such as streaks or stains and inquire about them. Inquiries also had to be made about exterior conditions for those items concerned with landscaping features when the ground was covered with snow.

It was also difficult to determine the performance of mechanical, electrical, and plumbing installations by visual observation alone. It was necessary to obtain this information from the maintenance staff and users of the building. It was of considerable value to have the building superintendent present during the investigation. Much valuable information was revealed by him that would not have been apparent from observations and might have been overlooked, particularly in rooms containing mechanical equipment.

This initial study was confined to the development of a check list for the performance of buildings and its application to the investigation of an actual building. The object was to examine the check list by using it in the field to see if defects or items of good performance could be discovered in the building. In such work an attempt must be made to determine the causes of apparent defects while on the site where all conditions can be observed. If this is not possible, a complete record must be made, noting all details for later analysis but this method is not recommended as it often necessitates additional visits to the site for further information. Good results, therefore, will be obtained by a competent inspector with prior experience in building construction supervision, a good knowledge of the basic properties of materials, and considerable design experience. This could require the formation of an evaluation team.

The check list proved to be comprehensive in scope and a valuable aid in ensuring a systematic and complete examination in its use on the school. It remained to be determined, however, if this check list would be applicable to buildings of greater complexity and of greater size. This formed the basis for the second stage of the project.

A full report on the use of the check list on the Toronto school is in the DBR/NRC Library and may be consulted there by those interested.

SECOND FIELD TRIAL

Before the second phase of the field work was begun on the buildings selected for examination, their plans and specifications were studied quickly to determine whether the Check List would require any modifications to suit them. As a result, a few minor editorial changes were made in anticipation of difficulties that might arise in the sequence of observations in multi-storey buildings. It was recognized, in addition, that one of the major shortcomings of the Check List was the difficulty of correlating the observations made of physical performance with the descriptive information about the materials and components examined. For this reason it was decided to reduce the amount of detail included in Section One (Building Identification and Description) and to include the necessary descriptive information in Section Two (Physical Performance) where it could be directly related to the observations made.

A further refinement was the division of Section One into two parts - one dealing with building identification and the other with general descriptive information. It was possible in this way to separate the two different types of information as well as to organize the descriptive items in a manner more directly related to the order in which the physical observations were made.

The Check List as used in the field work was therefore composed of four sections:

Section One:	Building Identification
Section Two:	Building Description
Section Three:	Physical Performance, and
Section Four:	Functional Performance.

Studies of three buildings were then made, starting with Regent Park South, then the W. R. Grace Building and finally the M. M. Robinson Secondary School.

CONCLUSIONS FROM SECOND PHASE

The Check List for the Performance of Buildings was used in the examination of three buildings of varying types and design and it was found to be suitable for each of them. It was used in addition for a more particular purpose, that of tracing the extent of defects in a building attributable to a specific condition; it was also found suitable for this purpose.

One point that emerged from the use of the Check List in the buildings examined to date is the importance of the interviews with personnel responsible for building maintenance and repair. Much valuable information was revealed in every instance which was not discernible to the examiner during the observations of physical performance. This points to the desirability of conducting the interviews either before the examination of the building or preferably to having one of the maintenance personnel present during the inspection of the building.

Another consideration is the amount of time involved in studying the performance of a building using the complete check list. At least a full week is required to complete all the items in the check list for a moderately large building. It is hardly reasonable to expect that architects, engineers, contractors or users of buildings would be able to devote that much time for this type of activity.

The examinations to date, however, were conducted by persons not familiar with the building being studied. Considerable time was therefore required to become familiar with the building. In the examination of a building by persons who were directly involved with its design, construction or use, it would be possible to use only the last two sections of the Check List - Section Three (Physical Performance) and Section Four (Functional Performance). This would considerably shorten the time taken. If, in addition, the examination were conducted for a particular purpose, as was the case at the M. M. Robinson Secondary School, it could be completed in a matter of hours.

In summary, therefore, the studies to date indicate that:

- (a) the Check List is suitable for the examination of buildings of various types, sizes and complexity;
- (b) its use aids in ensuring a thorough examination of a building;
- (c) valuable information concerning the performance of buildings can be obtained from their examination using the Check List as a guide;
- (d) the form of the Check List permits its use in whole or in part and therefore makes it suitable for a variety of uses and users; and

- (e) the interview technique is extremely important and can be used to advantage to shorten the time necessary for observations of physical performance.

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 - (a) F. C. Etherington, Chief Architect.
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 - (c) N. Warning and C. Hill, Architectural Assistants.
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 - (b) A. Brown, Building Superintendent.
 - (c) Mrs. R. Devry, Head Kindergarten Teacher.
Mrs. M. Felker, Teacher.
M. Sandler, Teacher.
M. Young, Teacher.
3. The Bell Telephone Company of Canada, Toronto.
 - (a) H. D. L. Morgan, Regional Architect.
 - (b) F. E. Smith, Electrical and Mechanical Engineer.
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Mr. G. Banz, M.R.A.I.C.	Project Architect for Regent Park South.

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A CHECK LIST FOR THE PERFORMANCE OF BUILDINGS

A Check List for the Performance of Buildings has been developed to assist in the systematic examination of the physical and functional performance of buildings after they have been in use for a period of time. It is divided into four sections, each of which can be used independently:

1. Section 1: Building Identification
2. Section 2: Building Description
3. Section 3: Physical Performance
4. Section 4: Functional Performance.

Explanatory notes are provided to aid the observer in recording information for most items on the list. Many items require no explanation; they are listed with no covering notes.

By reviewing the items in the list along with these instructions, it should be possible to apply the Check List in the examination of a building in a logical and orderly sequence. A condensed list (with explanatory notes deleted) has been prepared to facilitate a speedy and efficient building investigation. This has been issued as NRC 9364 and is available from the Publications Section, Division of Building Research, National Research Council, price 10¢.

Section 1: Building Identification

This section provides information necessary for identifying the building according to its type for future reference or comparative analysis with other work. The design consultants, contractor, dates of construction, environmental climatic conditions, statistical and design data of the building are also included in this section.

Section 2: Building Description

This provides a brief description of the building being examined as necessary background material against which the information on physical and functional performance can be evaluated. This section is of importance where the building is being examined by persons other than original designers or owners. It may also be of value where records of the performance of many buildings are being retained by designers, owners, or a research organization.

Section 3: Physical Performance

This is a list of those elements and components that should be examined to determine the effectiveness of their resistance to deterioration through the building's use, such as normal wear and tear, atmospheric conditions, and weathering.

Section 4: Functional Performance

This section has been developed to determine, through critical evaluation, the degree to which the building satisfies the functional requirements for which it was originally designed, or the uses to which it may be proposed to convert it. The staff should be interviewed to obtain information on building maintenance problems, repairs, or mechanical system that are not readily noticed from visual observation alone.

SECTION 1: BUILDING IDENTIFICATION

The information in this section should be obtained from the architect, owner, or organization controlling the use of the building.

1.1. Building Identification

1.1.1. Name of building

Give the formal name of the building if there is one.

1.1.2. Address

Give the name of the street, court, etc, on which the structure faces, the street number of the structure, the municipality and province.

1.1.3. Building type

This entry classifies the structure according to its use, as a hospital, school, apartment, office building, etc.

1.1.4. Owner

Give the name and address of the owner of the building or his agent.

1.1.5. Architect

Give the name and address of the architect, designer, or party responsible for the design of building.

1.1.6. Consultants:

- (a) structural
- (b) mechanical, heating, ventilating
- (c) electrical
- (d) others

Give the name and address of the consultants listed. For item (d), include such special consultants as (i) acoustical, (ii) landscape, (iii) town planner, (iv) lighting, etc.

1.1.7. Contractor

Give the name and address of the building, general contractor, or party responsible for the construction of the building.

- 1.1.8. Construction dates:
(a) Commencement
Give the date of the commencement of excavation.
(b) Completion
Indicate the date that final approval was given by the architect or owner for completion of construction.
- 1.1.9. Additions or major renovations
List dates of all major additions or renovations to the original structure. By whom were they authorized or carried out?
- 1.2. Climatic Conditions
- For items 1.2.1. to 1.2.4. inclusive, record the data from the Climatological Atlas of Canada* for the municipality in which the building is situated.
- 1.2.1. Temperature
(a) Winter design temperature
(b) Summer design temperature.
- 1.2.2. Relative humidity
(a) Mean January vapour pressure
(b) Mean July vapour pressure.
- 1.2.3. Precipitation
(a) Mean annual total precipitation
(b) Maximum 24-hour rainfall.
- 1.2.4. Wind
The direction of prevailing winds influences the weathering characteristics of the exterior of the building. It is therefore necessary to determine:
(a) computed maximum wind gust speed
(b) direction of prevailing winds.
- 1.2.5. Air pollution
Describe any particular problems or sources of air pollution in the vicinity of the building.
Are there any anti-air pollution regulations in force in the locality?

* Available from Division of Building Research, National Research Council, Ottawa. Order No. NRC 3151, Price \$1.00.

1.3. Statistical and Design Data

1.3.1. Areas

(a) Area of site

Calculate the area of the site in square feet or acres.

(b) Ground floor area

Calculate the ground floor area of the building in square feet. Measurements are taken to the outside face of the exterior walls.

1.3.2. Total floor area

Enter the total floor area in square feet. Take measurements to the outer face of the exterior walls for all floors including those below grade and penthouses or attics with habitable space.

1.3.3. Cubic contents

Calculate the cubic contents in cubic feet. The area is to be measured to the outer faces of the exterior walls and the height from the underside of the lowest floor to the finished roof surfaces, including floors below grade and penthouses or attics with habitable space.

1.3.4. Total cost

Calculate the total cost of the building, including such provisions as mechanical, electrical, plumbing and heating services, special built-in equipment and furnishings and site improvements. Do not include professional fees.

1.3.5. Cost per square foot

1.3.6. Cost per cubic foot

1.3.7. Total planned occupancy

Indicate the planned capacity for which the building was originally designed.

1.3.8. Total car parking facilities

1.4. Illustrations

1.4.1. Site plan

1.4.2. Ground floor plan

1.4.3. Typical floor plan

1.4.4. Elevations (drawings or photos)

1.4.5. Typical wall section

SECTION 2: BUILDING DESCRIPTION

The information contained in this section should be obtained from the drawings and specifications of the building to be examined.

2.1. Building Description

2.1.1. Size and Shape

(a) Basic Shape

Give the length and width in feet and inches measured to the outer face of the exterior walls. If the building is not rectangular, indicate the shape as circular, oval, semi-circular, etc., giving length and width dimensions.

(b) Projections

Most buildings are not simple shapes but have projections to the basic shape. Give the over-all dimensions only. Indicate if the structure is attached or detached.

(c) Additions

Give the shape of additions. Include major over-all dimensions. Indicate if the addition is attached or detached.

2.1.2. Number of storeys

Enter the total number of storeys above grade and the number of levels below grade.

2.1.3. Height above grade

(a) Principle facade

Give the height measured in feet and inches from the finished grade on the side of the principle entrance to the uppermost finished roof deck.

(b) Projections or additions

Give the height measured in feet and inches from the finished grade to the uppermost finished roof deck of all major projections or ancillary buildings.

2.1.4. Depth below grade

Give the depth of the building, measured in feet and inches, from the finished grade on the side of the principle entrance to the lowest floor level below grade.

2.1.5. Facilities

List the number and types of different rooms or units provided in the building.

2.2. Soil Conditions

2.2.1. Nature of soil and bearing capacity

Describe the nature of the soil on which the building is erected with respect to the type of soil and bearing capacity.

2.2.2. Test borings

Give the results of test borings if they are available.

2.2.3. Water table level and time of year when measured

2.3. Construction and Finish

2.3.1. Foundations

(a) Materials and sizes

Describe the materials and sizes used for foundation construction and any special type of design for:

- (i) footings
- (ii) foundation walls
- (iii) basement floors

(b) Give the footing depth below grade

(c) Give the type of material used for waterproofing or dampproofing on the exterior foundation walls and floors

(d) Describe the type of substructure drainage provided

(e) Indicate the type of exposed connections used for exterior structural framing members to the foundations.

2.3.2. Structure above grade

Describe the type of structural system provided and indicate if any unusual concepts were used. Include a description of column and beam coverings, if any.

2.3.3. Exterior wall construction

Describe briefly the exterior wall construction, listing different assemblies where applicable.

2.3.4. Floor construction

Describe subfloor construction and method of installing finish flooring for all different types of floor construction in the building.

- 2.3.5. Interior wall or partition construction
Describe major interior wall or partition construction and method of attaching or installing finishes.
- 2.3.6. Roof construction
Describe roof construction and method of securing roofing materials to the structure.
- 2.3.7. Ceiling system
Describe method of ceiling suspension, noting special types of attachments. Describe type of ceiling, material, and finish.
- 2.3.8. Stair construction
Describe the types of stair construction used.
- 2.3.9. Acoustical control
Describe special types of acoustical control and use of soundproofing.
- 2.3.10. Provision for natural light
Indicate if any special provisions for natural light are provided, such as clerestory, top, or unique side lighting.
- 2.3.11. Sun protection devices
Describe special sun protection devices used, such as louvred overhangs, screens, baffles, exterior shades or other devices for control of sun penetration through the windows.
- 2.3.12. Built-in furnishings
Special built-in fixtures should be noted, such as cabinets, cupboards.
- 2.4. Installations and Services
- 2.4.1. Electrical Services
- (a) light fixtures
Describe major light fixture installations, including height and spacing of fixtures
 - (b) fire alarm, door bell, intercommunication, and telephone services
Indicate if such services have been installed.
 - (c) others
Describe other electrical installations

2.4.2. Heating, ventilating, and air-conditioning systems

(a) heating system

Indicate the type of heating system as steam, hot water, hot air or electric. Include type of heating units in rooms. Indicate the type of fuel as oil, gas coal, or electricity.

(b) mechanical ventilation and air conditioning systems

Describe in general terms the type of system for mechanical ventilating and air-conditioning.

2.4.3. Plumbing installations

Describe the layout of the piping system in general terms, paying particular attention to those areas where pipes are exposed. Any specific piping enclosures should be noted.

2.4.4. Specialized installations

Describe specialized installations in the building such as:

- (a) vertical lifting apparatus - elevators
- (b) special material handling equipment
- (c) special safety devices
- (d) filtration equipment and pumps for pools, etc.

SECTION 3: PHYSICAL PERFORMANCE

This section is arranged so that the building under examination can be inspected in a logical and orderly sequence. The sequence of items is such that the inspection may be started from the exterior, observing features of landscaping and each facade in order, then observing the interior spaces in an orderly manner. Before the actual study at the site, however, there are a number of instructions that should be considered.

- (i) For a complete study of the building to be examined Sections 1 and 2 of the Check List should be completed as necessary background material against which the data on physical and functional performance can be evaluated.
- (ii) A simple listing of all items in Section 3 (similar to the condensed Check List (NRC 9364) should be prepared deleting those items that are not applicable to the building under study. Preprinted pads for this purpose are available from the Publications Section, Division of Building Research, National Research Council.
- (iii) For all items pertaining to the building, the actual material and finish should be noted opposite each item. This information can be obtained from the drawings or specifications.
- (iv) It is useful to have small-scale floor plans of the building with the exterior elevations and interior rooms numbered in the order in which the inspection is to be carried out. These room numbers can be used in making notes of observations made. The locations of major defects or of items photographed can also be plotted on these plans for future reference.
- (v) Discussions with the maintenance staff or building superintendent are helpful before the actual inspection begins. This should lead the inspector to the most serious areas or make him aware of the major failures or good features in the building. If the interviews are carried out before the actual observations of items on the Check List, major failures or defects will not be overlooked and the conditions of the materials can be noted under the appropriate item.

(vi)

Some of the items, such as condensation and air leakage, may not be detected at the time of the inspection because of weather conditions and it may be necessary to look for signs such as stains or streaks and inquire about them. Inquiries also may have to be made about exterior conditions for those items concerned with landscaping features when the ground is covered with snow.

During the inspection of mechanical facilities it may be difficult to determine the performance of mechanical, electrical, and plumbing installations by visual observation. It may be necessary to obtain this information from the maintenance staff. Hence, much valuable information may be revealed that would not have been apparent from observations alone and would have been overlooked particularly in rooms containing mechanical equipment.

(vii)

Large buildings, such as apartments or offices, with many repetitive areas may only require observations of a typical space or room as well as those areas that are unique. Assuming that the building is well maintained, it will be hard to locate defects unless the inspector is aware of them beforehand. Major defects or failures of materials or equipment usually repeat in a large number of typical installations in one building. Thus any serious failure of material, hardware, equipment or assembly is usually known to the building superintendent and can be observed by study of a small number of rooms in a large structure with repetitive areas.

Order of Examination

Items 3.1 to 3.5 in the Check List for exterior observations are to be used for each facade of the building. Similarly, items 3.7 to 3.14 for interior observations are to be used for each interior space in the building. The other items are of a more specialized nature and are applicable only to particular part of the building.

In making the inspection of the physical performance of a building the following order of examination is suggested.

Exterior:

- (i) Start with the principle entrance elevation of the building observing each elevation.
- (ii) Inspect the ground adjacent to the wall of the building.
- (iii) Inspect the exterior wall surfaces from the ground. The use of binoculars is helpful in examining high areas. Note any vantage points on the building such as windows, fire escapes, or offsets from which closer examination of the more distant wall areas may be made. This is particularly important in multi-storey buildings.
- (iv) Examine the roof, parapets, flashings, openings, and other items on the roof as indicated on the Check List.
- (v) From the roof go down through the building and examine exterior wall surfaces and appendages from vantage points noted from the ground. Re-examine at closer range any defects noted in the inspection from the ground.

Interior:

- (i) Inspect the building interior with the superintendent in charge of the building if this can be arranged. Check deteriorated or damaged conditions known to him or observed during the inspection.
- (ii) Check the status of items reported as a result of any previous inspection.
- (iii) Inspections may be started either on the uppermost floor or in the basement. One floor should be completely inspected before continuing to another. Reference to the Check List will assist in assuring that all items are inspected.
- (iv) Proceed through each room in an orderly manner, examining the walls, floors, ceilings, and installations as noted on the Check List.

Procedure of Examination

Examine each assembly as a unit, then examine the various materials of the components that make up the assembly and then any surface finishes. For example, in examining a door opening it should be checked as a unit for plumbness, twist, or sag. Then the frame, trim, door, hardware and sill materials should be examined for defects. Finally, note defects in the paint, varnish, or other surface treatments. In making notes of the observations made, the number of the item in the Check List need only be recorded and the comment as well as any notes on photographs taken or sketches made.

Since the purpose is to evaluate the performance of materials and assemblies, three types of performance should be noted. These are:

- (i) items that are in a state of deterioration or that are not performing in a satisfactory manner; note also replacement items indicating complete failure of a component;
- (ii) items that are in good condition and performing as expected; and
- (iii) items that are performing exceptionally well, taking into account the abuse they are subjected to either through exposure to weathering or intensive use.

Inspection Record

The following items should be recorded daily, during the inspection of the building.

- (i) Date of inspection
- (ii) Inspection made by
- (iii) Visit numbers
- (iv) Climatic conditions at time of inspection of physical performance:
 - (a) light conditions
 - (b) temperature
 - (c) precipitation
- (v) Persons interviewed and positions held
- (vi) Photographs taken
- (vii) Sketches made

SECTION 3: PHYSICAL PERFORMANCE

A. EXTERIOR OBSERVATIONS FOR EACH FACADE

3.1. Siting and Landscaping

3.1.1. Planting

- (a) sodding
- (b) shrubbery
- (c) flower beds
- (d) trees - location and distance of trees close to the building. (species, height, girth and condition).

Examine the ground areas for evidence of erosion, subsidence, and poor drainage. Lawn areas should be inspected and conditions indicating the need for repairs such as re-sodding, regrading, etc., noted.

Note the degree of protection provided for planted and sodded areas.

Dead or diseased trees and shrubs should be noted. Note type of tree or shrub and if destroyed by natural causes or physical injury. Cases where limbs interfere or rub on wires or buildings should be noted. Because of potential damage to exterior surfaces, vines on buildings should be observed.

Note all trees that are located close to the building, as tree roots may be a possible source of damage to weeping tile and other subsurface drainage as well as displacing foundation footings.

If the investigations are made during the summer months, most of the information can be obtained from the observations. During the winter months, however, information may have to be obtained from the maintenance staff, if snow covers the ground.

3.1.2. Surface areas

- (a) paved walks
- (b) driveways
- (c) parking areas

- (d) exterior steps
- (e) exterior ramps
- (f) others

Defective conditions commonly found on paved areas such as spalled surfaces, uneven and blistered surfaces, cracks, and deteriorated joints should be observed. Note also loose expansion joints and poorly drained areas. Indicate if sufficient parking space is provided and the ease of entrance and egress. Displacement of exterior step or ramp footings, deterioration and damage to treads or nosings should be noted. For item 3.1.2.(f) other surfaced areas include patios, terraced and ornamental paving. Excessive damage or deterioration of these areas should be noted.

- 3.1.3. Ornamental features
 - (a) fountains
 - (b) pools
 - (c) sculpture
 - (d) others

Observe the condition of any ornamental features and indicate if fountains and pools have adequate protection from litter or refuse accumulation. Pools in this section refer to small garden pools or reflecting pools but not swimming or wading pools.

- 3.1.4. Fences and walls
 - (a) fences
 - (b) free standing walls
 - (c) retaining walls

Observe the condition of free standing fences or walls noting cracking, chipping, efflorescence, loose joints, broken boards or wire strands, loose or missing caps. Walls out of plumb or displaced should be reported.

3.1.5. Installations and services

(a) bridges and culverts

Observe the condition of bridges or culverts on the property. Note if ditches drain properly and if the interior of culvert pipes are free of refuse and litter.

(b) flagpoles

Free standing flagpoles should be securely anchored. It is therefore necessary to check for loose base connections, loose guy wires or other forms of anchorage.

(c) lampstandards

Observe the condition of the base and stem of the lampstandard as well as the finish.

(d) hydro or television towers or poles

Check the structure for loose or damaged members. Report on the condition of the finish.

(e) lawn sprinkler system

Inquire about the operating condition of the installation. Visible fixtures should be examined and any loose or damaged fittings reported.

(f) floodlighting

Inquire about the operation of the equipment. Check all visible fixtures for damage. If possible check effect of floodlighting on building appearance at night.

(g) other exposed equipment

Other items include electrical substations and enclosures, storage tanks, etc.

3.2. Foundations

3.2.1. Grade at foundation wall

Note the degree of subsidence or heaving of the soil, standing water or excessive dampness at the foundation wall.

3.2.2. Foundation wall

Observe and note the condition of all foundation walls, or exposed footings above grade. Note cracking, staining, spalling, chipping, blistering, peeling, or other forms of deterioration of the foundation wall material.

3.2.3. Exposed dampproofing or waterproofing

Look for any cracks, holes, chips, blistering or other defects in dampproofing or waterproofing that may have become exposed.

3.2.4. Exposed flashing above grade

Flashing should be examined for evidence of damage, breaks, looseness, dried out membranes, and open joints. Indicate if the flashing stains the material below.

3.2.5. Areaways

Indicate if gratings or other protective devices are used and if they protect the areaway from accumulation of litter, dirt or refuse. Note any cracking, chipping, or bending of the walls and look for signs of poor drainage such as standing water or staining of the walls.

3.2.6. Connections to foundations

Note rotting, cracking, or loosening of wood connections in metal shoes.

Note corrosion, blistering, or peeling of paint of exposed metal connections to concrete footings.

3.2.7. Drains

Note condition of drains, screens, and gratings. Indicate if there is effective protection to prevent the entrance of debris and note if the area around drains are sloped adequately so that there is no standing water on the area drained.

3.2.8. Applied fittings

- (a) hose-bibs
- (b) water taps
- (c) fire hydrants
- (d) others

Observe and note if such fittings as hose-bibs, metal anchors, water taps, fire hydrants, or other

attachments are securely anchored to the foundation wall. Look for staining or discolouring of the material below the point of anchorage to the wall. Check the operation of the fittings.

3.2.9. Foundation wall openings

Note the condition of access panels, hatches, vents, grilles. For door or window openings refer to items 3.4.1. and 3.4.2.

3.3 Exterior Cladding

3.3.1. Materials and applied finishes

Describe the various cladding materials, method of installation and any exposed structural members on each facade. Observe the condition of each with reference to such conditions as oil-canning, bending, checking, cracking, spalling, splitting, chipping, erosion, flaking, loosening, discolouration, staining, efflorescence. Describe the severity of each condition, of the actual cladding material, and note the condition of surface treatments such as paint, varnish, plastic film, or enamel. Look for peeling, pitting, flaking, blistering, etc.

3.3.2. Connections or joints

Note any appreciable movement or separation of the cladding units at the joints. Indicate if the sealing compound or jointing materials have dried out, powdered, or become loosened, or if any openings have occurred at the joints. Note if metal anchors, bolts, or other forms of attachment stain the cladding material. These conditions should be examined carefully.

3.3.3. Expansion joints

Observe the condition of the jointing material and note whether it completely fills the joints.

3.4. Elements on the facade

3.4.1. Wall mounted equipment

Under this item include such equipment as:

- (a) exterior light fixture brackets and light fixtures
- (b) exterior conduit boxes and wire
- (c) bells and alarms
- (d) coverplates
- (e) handrails
- (f) flagpole brackets
- (g) fire escapes
- (h) others

Examine these elements for breakage, distortion, rust, corrosion, or loose joints or connections. Examine surface treatments for peeling, flaking, or cracking. Check the rigidity of the elements securely mounted at the wall. Indicate if there is serious rust or dirt staining on the exterior cladding material immediately below the mounting.

3.4.2. Canopies and roof overhangs

Examine the materials and surface finishes for deterioration and check structural connections for rigidity. Check the joint between the canopy and wall surfaces for faulty flashing. Note any staining of wall surfaces adjacent to the canopy.

3.4.3. Soffits and fascias

Examine the soffits and fascias of roof overhangs and canopies and note loose material, cracking, splitting, and staining. Observe the condition of mounted fixtures.

3.4.4. Balconies, porches, verandahs

Note any deterioration of the materials and finishes and check structural connections. Observe the condition of floor materials for checking excessive wear, cracking, or splitting, and note if the floor is uneven or sagging. Inspect railing and supports for loose or broken members or connections. Note method of drainage.

3.4.5. Downspouts or rainwater leaders

Note loose joints, bent or broken sections, and loose or missing wall brackets.

3.4.6. Exterior steps and/or ramps

Note any sagging or unevenness in the steps or ramps and check the condition of materials for the steps or ramp as well as railings. Inspect railings and supports for loose or broken members or connections.

3.5. Wall Openings

3.5.1. Door openings

(a) Frames

Examine frames for distortion and opening of joints. The materials should be examined for cracking, splitting, warping, or corrosion. Note if the frames appear to be loose and if there are any noticeable loose attachments, such as stops, and observe the condition of surface treatments.

(b) Trim

Observe the condition of the material and note if there is any cracking, peeling, or staining of the finish. Note if the trim is loose or if there has been movement from the frame or wall attachments.

(c) Sills or thresholds

Metal sills should be examined for rust or corrosion. Wood and precast stone or concrete sills should be examined for cracks or chipping. Indicate if sills or thresholds are excessively worn, loose, broken, or not level. Note signs of rain penetration.

(d) Doors

Observe the condition of the doors. Indicate twisting or warping, peeling of finishes, excessive damage, cracks, etc. Note if the doors open with ease.

(e) Hardware

Examine such items as panic bars, handles, knobs, closers, push plates, locks, kick plates, and hinges. Note defective missing, or loose hardware, and hardware that is not operating properly.

- (f) Glazing, louvres, grilles, and screens.

Observe corrosion, breakage, distortion, and poor surface finish. Check the ease of operation for moveable units. Inspect glazing for breakage, cracks, dried or loose glazing compound.

- (g) Caulking and sealing compound

Inspect caulking or sealing compounds at junction of door frames and exterior wall materials for loose or dried condition.

3.5.2. Window Openings

- (a) Frames

Examine frame for distortion and opening of joints. The materials should be examined for cracking, splitting, warping, or corrosion.

Note if the frames appear to be loose and if there are any noticeable loose attachments, such as stops, and observe the condition of the surface treatments.

- (b) Sash or ventilators

Observe the condition of the opening sash or ventilators. Note twisting or warping, excessive damage, cracks.

- (c) Sills

Metal sills should be examined for rust or corrosion. Wood or precast stone or concrete sills should be examined for cracking or chipping.

- (d) Trim

Observe the condition of material and note if there is any cracking, peeling, or staining of the finish.

Note if the trim is loose or if there has been movement from the frame or wall attachments.

- (e) Glazing, louvres, screens, and grilles

Observe corrosion, breakage, cracks, dried or loose glazing compound.

(f) Caulking and sealing compounds

Inspect caulking at junction of window frames and exterior wall materials for loose or dried condition.

3.5.3. Other openings

Note the condition of access panels, hatches, vents, grilles, and openings other than doors and windows. Refer to items 3.5.1. and 3.5.2. for the type of observations to be made for these openings.

B. OBSERVATIONS ON THE ROOF

3.6. Roofing, Roof Mounted Equipment, and Projections Above the Roof

3.6.1. Roofing

Examine built-up roofing for cracks, breaks, and open joints. Areas of blistering or alligatoring should be examined carefully. Look for exposed or dried felts and cracking. Flat roofs should be checked for miscellaneous objects stored or lying about that may have caused damage. Note poorly drained areas where there is standing water.

Shingle roofs should be inspected for loose, damaged, cracked, cupped, missing, or turned-up shingles.

3.6.2. Flashings

Examine flashings at:

- (a) copings
- (b) parapets
- (c) eaves
- (d) vents
- (e) drains
- (f) scuttles
- (g) chimneys
- (h) valleys and ridges
- (i) expansion joints
- (j) intersection of roof with walls
- (k) other projections

Note damage, breaks, looseness, dried out membranes, and open joints. Inquire about roof leaks and defects of the flashing material that cannot be readily observed.

3.6.3. Chimneys, caps, and screens

Masonry chimneys should be examined for loose or damaged bricks and joints.

Metal stacks should be checked for corrosion or rust. Anchors, attachments and guy wires should be inspected for the condition of the materials and their tightness. Caps should be inspected for breaks, cracking, chipping, or looseness. Screens should be examined for evidence of corrosion or rust.

3.6.4. Eaves troughs and gutters

Examine for evidence of damage, loose joints, breaks, loose fasteners, and adequate slope toward downspouts.

3.6.5. Roof drains

Roof drains should be examined for damage, missing or corroded strainers.

Note any standing water that may indicate blockage.

3.6.6. Roof mounted equipment

Examine vents, fittings, hoppers, or fans for proper performance. Check that all mountings are secure and that no materials have been damaged by wind or water.

3.6.7. Penthouses

Refer to items 3.3 to 3.6 and make the same observations of any penthouse structure. Also examine skylights, ladders, flag poles, column stub covers, antennas or catwalks.

C. INTERIOR OBSERVATIONS FOR EACH ROOM OR SPACE

3.7. Floors

3.7.1. Material and applied finish

Check floors for sagging, unevenness, indentations, and areas of excessive wear. Note any cracking and check applied finishes for loose units, open joints, buckling or cupping, or discolouration.

Check hardwood floors for opening joints, warping, buckling, or raised or lowered portions.

Concrete floors should be examined for cracking, spalling, crazing, and dusting. Small round patches of cement grout on the floor may indicate that the floor was recently drilled for core samples or the under floor and bed or fill was examined on slab-on-grade concrete floors. Inquire about this condition and ask if there is excessive vibration of the floor.

3.7.2. Baseboard and trim

Wood baseboard and trim should be examined for damage, excessive wear, warping, splitting, or cracking. Indicate if the trim is tightly secured to the wall. Metal trim should be examined for excessive wear, rust, or corrosion. Resilient tile trim should be examined for excessive wear or bulging.

3.7.3. Expansion joints

Observe the condition of the joining material and note whether it completely fills the joint, if it is dried and cracked, or been recently refilled.

3.7.4. Floor fittings

This item includes any feature that is built into the floor such as drain covers, grilles, etc. Metal covers or frames should be examined for evidence of rust or corrosion. Connections or attachments to floors should be checked to ensure that they are securely fastened.

3.8. Walls

3.8.1. Material and applied finish

Examine walls for bulges, unevenness, or plumbness. Note any cracks or damaged portions of walls. Plastered surfaces should be examined for cracks, loose segments, staining, and water penetration. The source of moisture or leaks resulting in spalling, efflorescence, and staining should be located, if possible.

Painted surfaces should be inspected for peeling, checking, chalking, spots worn thin by washing, stains, and discoloured areas. Pay particular attention to lower wall areas subject to damage by people brushing against them and by furniture and furnishings. Inspect movable partitions for loose, cracked, or broken panel sections, and open joints.

Marble, tile, travertine, and other masonry finishes should be examined for cracks, checks, loose or missing sections, and joints that require repainting.

Inspect joints for loose mortar.

Examine seals around pipes passing through walls for cracks and openings.

3.8.2. Trim

This item covers all trim or mouldings attached to the wall, except trim around door and window openings. Include such items as dado trim or moulding, trim around fireplace openings and mantels. Trim should be examined for damage, cracks, rust, corrosion, looseness or surface treatment in poor condition.

3.8.3. Applied fittings

This item includes built-in fixtures such as shelves, bookcases, cupboards, counters, cabinets, firehose cabinets, and metal lockers, mailboxes, milk boxes, and coat hooks attached to walls. Examine woodwork or metal trim for staining, scratching, warping, splitting, excessive wear, and surface finish in poor condition. Inspect connections or wall mountings, hinges, handles, and other hardware.

3.9. Wall Openings

3.9.1. Door openings

(a) Frames

Examine door frames for deteriorated finish. Observe worn spots resulting from handling and washing. Indicate if the frames appear to be loose, or if there are loose attachments, if the frame is not square, or if the joints are opening.

(b) Trim

Observe the condition of the material and note if there is any cracking, peeling, or staining of the finish. Indicate if the trim is loose or if there is any apparent movement from the frame or wall attachments.

(c) Door

Observe the condition of the doors, indicate warping, peeling of finishes, excessive scuffing, cracks, etc. Indicate if the door swings with ease and without obstruction.

(d) Sills or thresholds

Examine sills or thresholds for excessive wear, damage, or looseness.

(e) Hardware

Examine such hardware as:

- (i) panic bars
- (ii) push plates
- (iii) locks and handles
- (iv) kick plates
- (v) door stops
- (vi) door closers
- (vii) hinges

Note defective or missing hardware and hardware that functions improperly.

(f) Glazing, louvres, grilles, and screens

Screens and grilles should be inspected for corrosion and damage; screens or frames for deteriorated paint and improper operation. Inspect glazing for breakage, cracks, dried or loose glazing compound.

(g) Condensation on doors

Examine the interior side of all exterior doors for condensation or staining indicative of condensation. If the building inspection is carried out during the summer months the building superintendent may have to be consulted as to the excessive condensation of these areas.

(h) Excessive air leakage at doors

Examine all exterior doors for signs of excessive air leakage or air drafts such as dust streaks or moving drapes or blinds.

3.9.2.

Windows

(a) Frames

Examine frames for deteriorated finish. Observe worn spots resulting from handling and washing. Indicate if frames appear to be loose, if there are loose attachments, if the frame is not square, or if joints are opening.

(b) Sash

Observe the condition of the sash. Indicate warping, peeling, or finishes, cracks, etc. Indicate if the sash operates with ease.

(c) Sills

Examine sills for wear, damage, or looseness.

(d) Trim

Observe the condition of the material and note if there is any cracking, peeling, or staining of the finish. Indicate if the trim is loose or if there is any apparent movement from the frame or wall attachments.

(e) Hardware

Examine such hardware as locks, hinges, handles, rotor openers, and pulleys. Note defective or missing hardware and hardware that functions improperly.

(f) Glazing, louvres, grilles, and screens

Screens and grilles should be inspected for corrosion and damage; screens or frames for deteriorated paint and improper operation. Inspect glazing for breakage, cracks, dried or loose glazing compound.

(g) Condensation on windows

Examine the interior side of all exterior windows, drapes and blinds for condensation or staining indicative of condensation. Inspect sills for provisions of condensate drain-off. If the building inspection is carried out during the summer months, the building supervisor may have to be consulted as to excessive condensation of these areas.

(h) Excessive air leakage at windows

Examine all windows, or other exterior wall openings for signs of excessive air leakage or air drafts such as dust streaks or moving drapes or blinds.

3.9.3. Other openings

Examine all openings other than doors and windows, such as vents, grilles, and louvres, for proper functioning, damage, deterioration, corrosion, and poor surface finish.

3.10. Ceilings

3.10.1. Surface material and applied finish

Examine ceilings for unevenness, cracks, or sagging. Where ceilings are painted, note peeling or flashing of the paint film. Look for staining, corrosion, or other signs of water leakage from piping or sources of water above the ceiling.

For tiled ceilings note any loose or missing tiles or excessively large joints.

3.10.2. Trim

Observe the condition of the material and note if there is any cracking, peeling, or staining of the finish. Indicate if the trim is loose or if there is any apparent movement from the frame or ceiling attachments.

3.10.3. Ceiling openings

Examine all ceiling openings such as hatches or skylights for evidence of water penetration, deterioration, or damage. Make observation similar to those for wall openings, item 3.9.

3.11. Electrical Installations

3.11.1. Light fixtures

- (a) incandescent
- (b) fluorescent
- (c) spot lamps
- (d) neon lights
- (e) others

Light fixtures should be examined for damage and deteriorated finish. Note whether or not fixtures are securely attached to the ceiling or wall.

Inquire about the lighting level and efficiency of the installation. Note height and spacing of fixtures.

3.11.2 Outlets and switches

Examine outlets and switches for loose, broken, or missing coverplates and screws. Observe the condition of the finish and note any cracking or chipping.

3.11.3 Panel boxes

- (a) service entrance
- (b) distribution switchboard
- (c) fuses

Examine panel box fuse panels and other metal electrical equipment or service boxes for loose, broken or missing hardware, and deteriorated finish of the exposed portions of the boxes.

3.11.4. Conduits and wiring

Examine exposed electrical conduits and wiring for loose, broken or missing attachments and deteriorated finish of the covering or insulation.

3.11.5. Electrical fixtures

- (a) bells or fire alarms
- (b) clocks
- (c) others

Examine all wall mounted electrical fixtures for loose, broken, or missing attachments and faulty connections.

3.11.6. Telephone equipment

Examine telephone panel boxes and other telephone junction boxes for loose, broken, or missing hardware, and deteriorated finish of the exposed portions of the box.

3.12. Mechanical Ventilation and Heating Equipment

3.12.1. Heating units

- (a) radiators
- (b) baseboard units
- (c) unit heaters
 - (i) vertical
 - (ii) horizontal
- (d) cabinet heaters

Check the items listed above for: loose connections, leaks, improper operation, loose or missing insulation, corrosion, defective hardware, valves or gauges, broken or missing parts, loose or defective mountings, and excessive noise or vibration. Check whether valves, fittings, and other controls are readily accessible. Note any corrosion or other surface defects of the metal or wood radiator covers.

- 3.12.2. Hot-air units and ventilators
- (a) supply registers
 - (b) return grilles
 - (c) wall or ceiling diffusers
 - (d) combination supply return ceiling diffusers
 - (e) unit ventilators

Check the items mentioned above for loose connections, improper operation, corrosion, broken or missing parts and mountings, and excessive noise or vibration.

- 3.12.3. Exposed piping and ductwork
- (a) piping and ductwork
 - (b) sleeves and rings
 - (c) hangers or collars

Check all joints in exposed piping and ducts for tightness and leaks. Inspect wall mounted collars on pipes for secure mounting.

Examine duct insulation or covering and note cracked, defective, or deteriorated finish.

- 3.12.4. Automatic controls
- (a) thermostats
 - (b) other controls

Examine units for proper mounting and operation.

3.13. Plumbing Equipment

- 3.13.1. Plumbing fixtures
- (a) washbasins (lavatories)
 - (b) service and slop sinks
 - (c) waterclosets
 - (d) urinals
 - (e) bidets
 - (f) shower stalls
 - (g) toilet partitions

Examine the above-mentioned fixtures for chips, cracks, or broken portions. Observe the condition of stoppers in washbasins and sinks. Examine faucets, soap dispensers, and flush valves for leaks, improper operation, corrosion, and necessity for replating or replacing. Note if there are excessive leaks or stains on or around plumbing fixtures.

3.13.2. Floor drains

Examine floor drains for corrosion. Check for loose or missing screens.

3.13.3. Exposed piping

Examine exposed pipes for leaks or stains. Inspect wall mounted collars on pipes for secure mounting.

3.13.4. Other plumbing installations

- (a) fire extinguisher systems
- (b) sprinkler systems

Inquire about the operation of these systems. Observe the condition of piping and attachments.

3.14. Stairs and Balustrades

3.14.1. Stair structure, Stair treads and risers, Nosings and non-slip inserts, Railings and balustrades

Examine stairs, railings, and balustrades for excessive wear, cracks, chips, loose, broken, or damaged sections. Check that treads are level and that nosings and non-slip inserts are secure. Inspect all surface finishes for flaws, cracks, peeling, or flaking. Note any cracks where treads and risers meet, where stairs meet floors or landings, and between stringers and walls.

D. SPECIALIZED SPACES

3.15. Mechanical Equipment Rooms

3.15.1. Floors

3.15.2. Walls

3.15.3. Ceilings

3.15.4. Openings

For items 3.15.1. to 3.15.4. make observations similar to those outlined for items 3.7, to 3.10. inclusive.

3.15.5. Provision for

- (a) ventilation
- (b) drainage
- (c) vibration isolation and sound isolation
- (d) storage
- (e) accessibility to equipment
- (f) lighting
- (g) humidity control

Check the suitability and adequacy of the provisions for the features listed above and note any modifications that have been made to overcome shortcomings in the original design.

3.16. Attics, Crawl Spaces, Cellars, Basements, Construction Spaces, and Duct Spaces

3.16.1. Floors

Note the condition of floors as outlined in item 3.7.

3.16.2. Walls

Note the condition of walls as outlined in item 3.8.

3.16.3. Structural members, and

3.16.4. Underside of roof or floor above

Examine exposed structural members and the underside of roof or floor above for deflection, cracking, splitting, rotting, corrosion, termite damage, dampness, condensation, loose connections, or connectors, open joints, leaks, and the condition of insulation.

- 3.16.5. Provision for
(a) ventilation
(b) accessibility
(c) lighting

Note the suitability and adequacy of provisions for ventilation, accessibility and lighting. Record modifications made to the original design.

- 3.16.6. Piping, wiring, and ductwork
Examine piping, wiring, and ductwork for corrosion, leaks, loose joints, missing or frayed insulation, damage, and faulty or loose brackets or other supporting devices.

E. MECHANICAL EQUIPMENT

3.17. Operation of Mechanical Equipment

Check the operation of mechanical equipment for the following faults: loose connections, leaks, improper operation, loose or missing insulation, corrosion, defective hardware, valves or gauges, broken or missing parts, loose or defective mountings and excessive noise or vibration. Note any modifications that have been made to overcome shortcomings in the original design.

- 3.17.1. Heating, ventilation and air-conditioning equipment
- (a) Motor driven fans
For fans note oil leaks, frayed or damaged electrical connections, and the condition of safety guards. Observe the operation of the motors and condition of belts.
 - (b) Pumps
For pumps examine mountings, vibration, motor and electrical controls, valves and piping.
 - (c) Hot water heaters
For hot water heaters examine mountings, fuel supply lines, insulation, temperature and pressure relief valves, controls and gauges.

(d) Humidifiers

For humidifiers examine float assembly, spray nozzles, eliminator plates, pans and screens, and controls.

(e) Refrigeration compressors

For refrigeration compressors examine mountings, operation for excessive vibration, freon level, oil lever, purge unit, oil separators, controls, belts, couplings, oil heater, belt guard, motor, and electrical controls.

(f) Air compressors

For air compressors examine motor and electrical controls, filter, air drier, belts, belt guards, relief valve, pressure regulator, valves, controls, gauges, and tank.

(g) Water coolers and spray panels

Check the operation of these units and note leaks or excessive water damage to surrounding area.

3.17.2. Boiler room facilities

(a) Boilers and burners

For boilers examine the breeching, draft regulators, tubes, doors, base gauges and controls, relief valves, combustion chamber, pressure regulating valves, and low water cut offs.

(b) Pumps

For pumps examine mountings, vibration, motor, and electrical controls, valves and piping.

(c) Hot water heaters and storage tanks

For hot water heaters examine mounting, fuel supply lines, insulation, temperature and pressure relief valves, controls and gauges.

(d) Incinerators

For incinerators examine breeching screens, doors, chute, draft regulators, and fire box.

3.17.3. Other specialized rooms

Examine electrical transformer rooms or vaults, elevator motor rooms or equipment for purposes related to the function of the building.

Examine cold rooms or rooms in which special conditions of temperature and relative humidity must be maintained. The observation to be made would follow the pattern of item 3.16. modified as required by the characteristics of the room.

SECTION 4: FUNCTIONAL PERFORMANCE

This section has been arranged in outline form to be used as a guide when evaluating the performance of the functional and aesthetic design and operation of a building. An attempt has been made to break down the over-all design into smaller elements which can then be studied and evaluated individually.

The design of a building can be approached from a number of points of view and likewise in judging the design performance. The guide outline has been produced in a brief and general nature with the purpose of encouraging the inspection team to approach its task with a flexible program which can be adapted to a form which best suits the individual building.

In this section we emphasize the value of an inspection team over that of an individual. Depending upon the depth of study desired, an individual can produce a valuable report. To obtain the maximum value, a team composed of members who are competent to analyze planning, aesthetic value, performance of engineering components of the building and the operational performance of the building is necessary.

The importance of interviews with various members of the staff must not be overlooked. Although it can be said that the layman is not trained to judge design criteria, we must remember that these are the persons who occupy the space and who are most influenced by the design. If the design does not function satisfactorily in its relation to them, it cannot be judged a complete success. The team members must evaluate the information received during these interviews and differentiate between the items which reflect design conditions and those which are only individuals' preferences.

SECTION 4: FUNCTIONAL PERFORMANCE

It is suggested that each of the items listed be considered on the basis of three points:

- (1) What are the requirements of the area or operation under study?
- (2) Have these changed since the building was designed? Why?
- (3) How well does the design fill these requirements?

4. Functional and aesthetic performance

4.1. Exterior

4.1.1. Circulation

- (a) of staff; considering means of transport, relation to other traffic, weather, etc.
- (b) of visitors; considering convenience and relation to other traffic, etc.
- (c) of material; considering space requirements versus space used; traffic layout, etc.

4.1.2. Expansion - Space and Provision For

4.1.3. Environment

- (a) general appearance of building
 - massing, use of materials, aesthetic
 - design, ageing of materials, etc.
- (b) landscaping
 - design and maintenance
- (c) orientation of building
 - sun control, fenestration
 - wind
 - snow
 - rain
- (d) surrounding property
 - visual effect?
 - effect on design? of building
- (e) special purpose areas
 - parking
 - play
 - storage
 - supervision and security
 - other

4.2 Interior

4.2.1. Circulation

- (a) of staff;
 - entrance and exits
 - work routine
- (b) of visitors;
 - reception area
 - access to appropriate area
- (c) of material; receiving and distribution;
 - during use
 - shipping process

4.2.2. Flexibility of Layout

- ease of expansion

4.2.3. Environment

4.2.3.1. Visual

- (a) lighting
 - natural
 - artificial
- (b) colour
 - effective use
- (c) space
 - size and shape
 - relationship of spaces
 - efficiency of use
- (d) materials, textures, patterns, etc.,
 - ageing of materials
- (e) view
 - inside/inside
 - inside/outside
 - supervision

4.2.3.2. Acoustic

- (a) sound transmission
 - within rooms
 - between rooms
 - from exterior
- (b) vibration

4.2.3.3. Thermal

- (a) heating
 - interior areas
 - perimeter areas
 - visual effect of units
 - convenience of controls

- (b) cooling
 - interior areas
 - perimeter areas
 - visual effect of units
 - convenience of controls
- (c) ventilation
 - interior areas
 - perimeter areas
 - visual effect of units
 - convenience of controls
- (d) humidity
 - actual R.H. versus design R.H.

4.2.3.4. Special Equipment or Special Areas

- (a) convenience of location
- (b) convenience of operation and efficiency

4.2.3.5. Maintenance and Service

- (a) building and materials
 - efficiency and ease of, cost, etc.
- (b) equipment; access to