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Diagnosing moisture damage in buildings and implementing countermeasures —

Part 1: Principles, nomenclature and moisture transport mechanisms

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design,* in collaboration with the Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment.*

A list of all parts in the ISO 22185 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The term “moisture damage” is interpreted in many ways. Cognisance of moisture damage is not always consistent between specialists (engineers, researchers, etc.) residents and building users, leading to confusion. For example, residents and building users would consider the occurrence of condensation on window glass or on the surface of a metal sash to be a prime example of moisture damage, but considering the durability of glass and metal materials, it is not always appropriate to call that “moisture damage”. Then again, supposing the condensation that occurs on the glass becomes the cause of an outbreak of moulds on the curtains, that would be called moisture damage. It is imperative to resolve the confusion by defining “moisture damage” and by demonstrating the criteria for diagnosing whether an occurring phenomenon in a building is moisture damage or not.

This document defines moisture damage in buildings and demonstrates criteria for diagnosing whether phenomena that occurs in a building is moisture damage or not, for a common understanding between residents, building users and specialists. It also demonstrates methods for the classification of moisture damage.

This document is the first part of a series of standards on moisture damage. In the following parts, a framework for investigating and taking countermeasures against moisture damage, and design methods of building for reducing moisture damage will be shown.

The basic ideas of this document are derived from Reference [6].

Diagnosing moisture damage in buildings and implementing countermeasures —

Part 1: Principles, nomenclature and moisture transport mechanisms

1 Scope

This document defines moisture damage and it specifies the moisture sources and the moisture transport mechanisms in buildings.

It includes a method for classification of moisture damage based on the relation of:

— materials and constituent materials,

— phenomena, and

— functionalities that can be affected.

This document deals with:

1) building damage that is induced by (gaseous/liquid/solid) water, and

2) damage to building components, human health, and property contained in the enclosure. This document makes no mention of warranties for building damage.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
condensation damage
damage (3.3) caused by water vapour condensing on a material resulting in the material's deterioration and reduced performance which then affect human health

3.2
critical relative humidity
limit for a material to maintain acceptable function throughout the time the material is exposed to the moisture state

Note 1 to entry: Temperature, exposure time, dirt, combination with other materials and varying moisture conditions also affect, in a complicated manner.

Note 2 to entry: The critical moisture condition can be expressed either as a critical relative humidity (RH_{crit}) or as critical moisture content (w_{crit}).

3.3
damage
phenomena that affect the function/performance of the building (structural resistance/architectural/functional depression of components, functional depression and malfunction of building equipment, decrease in value of property), aesthetics and that cause a deterioration in the living environment of the building, including human health

3.4
frost damage
damage (3.3) including surface cracks, peeling/exfoliation/delamination caused by the repeated freezing/thawing of moisture inside the materials or on a surface between a material and freezing water

3.5
moisture content
moisture mass per unit mass of dry materials, or moisture mass or volume per unit volume of materials

Note 1 to entry: Depending on the standard physical quantity, either moisture content (mass by mass) u [kg/kg], moisture content (mass by volume) w [kg/m^3], or moisture content (volume by volume) Ψ [m^3/m^3] is used.

3.6
moisture damage
damage (3.3) in the building originating in (gaseous/liquid/solid) water

3.7
salt damage
damage (3.3) due to salt, including corrosion of metal materials caused by touching with salt in the air, cracks in the concrete from the corrosion/expansion of reinforcing steel rod due to salt adhesion, and detachment, etc., caused by crystallized/deposited salt in ceramic materials

Note 1 to entry: Visible salt deposition on surfaces can cause aesthetic problems.

4 Moisture transport mechanism

To make moisture planning meaningful, the critical moisture levels shall be well defined. However, these boundaries are always more or less uncertain. The solution may be to introduce some degree of safety margin. The size of the safety margin that should be introduced depends on the severity of the impact of a moisture state above the critical one. In cases where the degradation rate can be controlled, it is sometimes even possible to allow moisture levels above the critical, if this does not affect the indoor climate, health or the expected lifespan of the material or the structure.

Moisture in building porous materials transfers as vapour or liquid.

Vapour transfers as diffusion and effusion caused by vapour pressure gradients, and as the diffusion caused by temperature gradient.

Liquid transfers as capillary flow caused by the gravity in capillary suction. For vertical direction, liquid transfers also by gravitation.

In the presence of gradient in total air pressure, liquid and vapour transfer due to the gradient in total air pressure in addition to the mechanisms described above. This is classified as a transfer by convection. Wind pressure and difference in air pressure caused by difference between indoor and outdoor air temperatures are typical examples that cause convective transfer of vapour and liquid through cracks in or between building materials and also through permeable porous material. Mechanical ventilation will also influence the gradient in total air pressure.

5 Moisture sources

Moisture sources in building can be classified by the time of generation as follows:

a) generated before construction;

b) generated during construction;

c) generated after construction.

Table 1 presents examples of moisture sources. The letters in the bracket (a, b, or c) denote that the moisture source can generate at the time categorised above.

Table 1 — Moisture sources' examples

Moisture sources	(a) Generated before construction	(b) Generated during construction	(c) Generated after construction
Precipitation	(a)	(b)	(c)
Vapour outside the building	(a)	(b)	(c)
Vapour inside the building	(a)	(b)	(c)
Water in soil (liquid and vapour)	(a)	(b)	(c)
Built-in moisture (initially contained in the material)	(a)	(b)	(c)
Leakage		(b)	(c)
Water from adhesive		(b)	(c)
Post occupancy water use, e.g. shower, baths, dishwasher, wet cleaning of floor			(c)

6 Moisture damage

In order to refer to moisture damage, a phenomenon shall satisfy both of the following two conditions.

(1) A phenomenon which causes damage.

(2) A phenomenon is directly related to (gaseous/liquid/solid) water.

This is the definition of moisture damage, which is described in Figure 1.

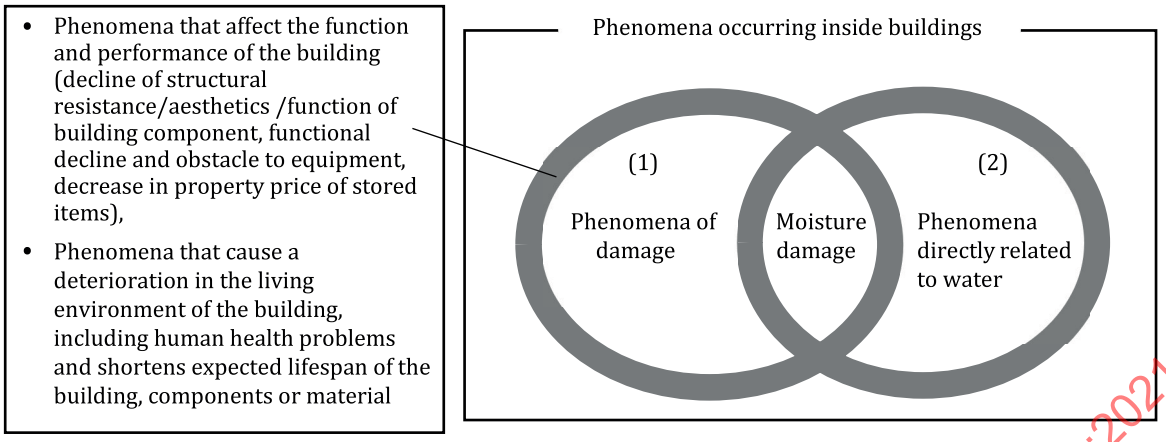

Figure 1 — Definition of moisture damage

7 Phenomena resulting from moisture

7.1 Algae/bryophyte

"Algae" is the generic term for a living being that performs photosynthesis on the earth other than bryophyte, fern plants, and seed plants, and includes blue algae (cyanobacteria) and green algae, etc. Bryophyte includes moss, liverwort and hornwort. When the materials are placed under the outside weather conditions, moisture content on the surface or the water droplets adhere to the surface may breed algae or bryophyte and may cause aesthetic problems. If the humid conditions are prolonged, it is more likely that algae and bryophyte are observed.

Related terms: condensation, high humidity.

7.2 Aesthetic changes

Wetting of a material that results in changes to pigments or accelerates other processes that result in staining or discolouration.

Related terms: wetting, condensation, colour fading, stain.

7.3 Condensation

Condensation is the change of the physical state of water from gas phase into liquid phase. Condensation occurs on a surface that is at or below the 'dew point' temperature.

Related terms: wetting, high humidity.

7.4 Corrosion

Corrosion means that a metal is altered or is consumed from the surface due to the rust by oxidization, or electrolytically by the differences of ionization tendencies. In some metals, when it rusts on the surface, it works as a protective film, and it does not spread any further.

Related term: rust.

7.5 Crack

Cracking that occurs when the amount of deformation of the object exceeds a critical limit. This is caused by the action of load, shrinkage or expansion due to temperature and humidity change. Particularly, it may reduce the proof stress or durability of materials such as concrete, mortar and plaster. This also

causes deterioration in appearance on the finished surface. In the field of painting and coating, small cracks and large cracks are called checking and cracking, respectively. Also known as “fissure”.

Related terms: expansion, shrinkage, peeling, exfoliation, delamination, adhesion loss.

7.6 Creaking

Increased noise or abnormal sounds generated by materials affected by change in moisture content. Doors, sliding doors, etc. do not open or roll smoothly, making gnawing or abnormal sounds. This is caused by deformation due to expansion or shrinkage of materials. In addition, the exterior material sometimes makes an abnormal sound due to expansion or shrinkage caused by temperature change.

Related terms: shrinkage, low humidity, expansion, high humidity, deformation, warpage.

7.7 Deformation

Change in the shape of an object due to stress from expansion or shrinkage.

Related terms: expansion, high humidity, shrinkage, low humidity, warpage, floating.

7.8 Dissolved destructive elements

Water transport of dissolved, destructive elements (e.g. salt, acid rain) which cause accelerated deterioration of building materials.

Related term: corrosion (electrolytic) of metal.

7.9 Dissolution

Refers to various materials where the performance is compromised due to water activity or moisture. In this document, it refers to materials that re-emulsify when in prolonged contact with water.

Related term: wetting.

7.10 Expansion

Increase dimension or volume of an object. This is due to physicochemical causes such as rise in temperature and humidity. In this document, this term mainly means that the volume of porous materials increases due to moisture absorption. Also, when moisture inside a material freezes, expansion occurs.

Related terms: high humidity, wetting, freezing, swelling, thrust up.

7.11 Floating

This means that a bonded surface, or a coated overlaid surface, disengages. For example, mortars applied to a concrete substrate or plastered foundation layers and tiles delaminate due to drying and shrinkage. This is also known as “skin separation”. It is also an indication of a state in which the inside of the material expands due to frost damage, peeling occurs and the surface rises.

Related terms: peeling, exfoliation, delamination, adhesion loss, freezing.

7.12 Floor squeak/floor squeaking

This is the squeaking sound that comes from the gap between the floor material and underlayment. Also refers to the rustling sound caused by the floor’s (mainly the flooring’s) joints. This is caused by shrinkage, expansion, floating or warpage of the material.

Related terms: expansion, warpage, shrinkage, floating.

7.13 Freezing

Freezing is the change of the physical state of water from liquid to solid. Water expands when it freezes and can cause damage to the material it is in. The repetition of freezing and thawing of moisture within the porous materials may cause cracking or peeling. Freezing of the inside of insulation material significantly lowers the performance of thermal insulation. In cold districts, freezing may occur in the openings, and lower the visibility of the window, or may prevent it from opening or closing.

Related terms: frost heave, crack/cracking, peeling, exfoliation, delamination, adhesion loss, expansion.

7.14 Frost heave

It refers to the heaving of soil. It occurs when the moisture in the soil freeze under low temperature and expand to heave.

Related term: freezing.

7.15 Wood decay

There exist many kinds of fungi in our living environment, but this document refers mainly to the decay fungi of wood. Decay fungi invade internal tissues of lumber, and cause discolouration, deformation and destruction. In case of structural materials, it leads to the decrease of durability and a tremendous damage. Some fungi dissolve mainly cellulose while others dissolve lignin, and even more exist with uncertain behaviour.

Related terms: mould, rot, fungi.

7.16 Gap

Change in the space between objects due to deformation such as shrinkage due to desorption or warping due to adsorption or absorption.

Related terms: shrinkage, low humidity, high humidity, deformation warpage.

7.17 Hardening

Refers to material property changes due to losing moisture.

Related term: low humidity.

7.18 High humidity

It means that the moisture level in the air is high and humid. It is expressed by either relative humidity or absolute humidity. There is no clear threshold to display high humidity, but if such condition continues, wood materials specifically are easy to expand under high humidity. It may also induce condensation and lead to condensation damage. Chemical substances are emitted at a faster rate if the material is moist (for example, smell from linoleum mats). The room air relative humidity increases in proximity to a surface with lower temperature and can result in condensation or exceed the critical relative humidity.

Related terms: expansion, condensation.

7.19 Low humidity

It means that the moisture level in the air is low and dry. It is expressed by either relative humidity or absolute humidity. There is no clear threshold to display low humidity, but if such condition continues, drying, shrinkage, cracks, and warpage may occur with the materials. Also, it may cause pain and unpleasantness in the throat, nose, or eyes of a human and problems with static electricity. It is also referred to as “extreme drying”.

Related terms: contraction, crack.

7.20 Mite

"Mite" is the generic term of small creatures belonging to Mite under Arthropod. Some of them suck blood by being parasitic to humans and animals. Others cause allergens by their dead bodies and feces. They breed under relatively humid environment and can cause respiratory diseases and allergy on a human body.

Related terms: high humidity, dust.

7.21 Mould

Mould is the generic term for fungi that do not produce fruit bodies. Mould grows in the presence of a food source, optimum temperatures and excessive moisture. Conditions suitable for growth depends on the type of mould. Mould can cause rot, deterioration and occupant health problems. Sometimes troublesome odour released from mould can be a sign of the moisture damage.

Related term: fungi.

7.22 Peeling/exfoliation/delamination/adhesion loss/spall

Cracks due to the occurrence of tensile stress inside the material, causing it to partially peel off. Also refers to destruction or separation at the adhesive layer. Representative examples include peeling of concrete due to corrosion of reinforcing steel bar, peeling due to freezing and thawing of porous material, and peeling of exterior tile from the adhesive layer. The falling of the peeled material is called "peeling off", (or "exfoliation") which may lead to severe damage such as in the case of the outer wall.

Related terms: carbonation, frost damage, crack/cracking.

7.23 Rust

It is generated when metals are in contact with water or moisture and become oxidized. In case of iron, red rust (Fe_2O_3) is generally formed.

Related terms: carbonation, expansion, salt adhesion, salt damage.

7.24 Shrinkage

Decrease of dimension or volume of an object. Object tightens and shrinks. In this document, this term mainly means that a material loses its moisture content as it dries and the volume or length decreases. The shrinkage stress in the substance due to drying causes cracks in the material depending on its restraint condition.

Related terms: low humidity, cracking, deformation, warpage.

7.25 Softening

Refers to material property changes due to absorbing moisture.

Related term: high humidity.

7.26 Thrust up/creeping up

This refers to the abutted materials (mainly plates) being raised up due to a loss of gap between them. This is caused by restrained materials expanding against each other, sometimes causing unevenness on the surface.

Related term: expansion

7.27 Unplanned bulk water entry

— Mechanical failure such as a plumbing leak.

— Water penetration through or into the building envelope/enclosure resulting in damage.

— Ground water penetration including floods, hydrostatic pressure, and from blocked drainage systems (sewer back up).

Related term: wetting.

7.28 Water-leakage

It refers to water penetration into the room or the surrounding building envelope. Examples of water leakage are:

— rainwater penetration from the defect of waterproof layer of roof or outer wall,

— water leakage from the seams of the aged piping,

— leaking seams between PVC wallpaper in bathrooms,

— leaking floor drainage in a bathroom or a kitchen.

7.29 Warpage

Bends in the plates (boards), tiles, etc. caused by the difference in the degree of deformation between the front and back surfaces of the material.

Related terms: expansion, shrinkage, low humidity, high humidity.

7.30 Wetting

Liquid water accumulating on a material that results in unexpected deterioration or loss of functionality.

Related terms: change in colour, condensation, high humidity.

7.31 Wrinkle

The surface of the material deforms to make fine creases. This is caused by repeated expansion and shrinkage due to changes in moisture content of the material surface, e.g. wallpaper surface.

Related terms: expansion, shrinkage.

8 Performance affected by moisture

8.1 Envelope or enclosure — Risk of water penetration, deterioration of components and systems — Important for designing for durability

8.1.1 Ability to support bonded materials

Substrate's (e.g. underlayment, base material or sheathing) ability to support bonded material through an anticipated range of humidity without deterioration resulting in delamination of the bonded material.

Base coating, exterior underlayment and interior underlayment are included in base materials. In the case of dry exterior construction, it is important to ensure the strength to hold exterior finishing materials. It is very important that the interior underlayment or base coating will not have a large crack caused by their expansion and shrinkage due to the change of temperature or humidity.

8.1.2 Airtightness

The performance of reducing airflow through a material, through connecting elements, cracks within materials and preventing airflow through a whole building envelope.

8.1.3 Capillary breaking layer

A capillary breaking layer is a material that has lower maximum capillary rise than the other layers/materials during the entire lifespan for the construction. Examples of materials that can be used as capillary breaking layer under normal conditions are:

— coarse-grained particle masses such as gravel, shingle and crushed aggregate;

— insulation material such as mineral wool, cellular plastic, hydrophobed haydite and foam glass;

— water tight materials such as PE-film, asphalt-based products and metal plates;

— air layer.

8.1.4 Durability

The ability of a building or building element to perform its functions to the required level of performance for its design service life under the influence of environmental actions, including expected climate changes.

8.1.5 Electrical insulation performance

Performance of electrical equipment could be compromised if the protective insulation becomes wet.

8.1.6 Environmental separation

Durability of the materials providing the control functions of water vapour transmission, air movement resistance, thermal resistance, rain penetration and water shedding surface, including their connecting elements, may be adversely affected by moisture requiring unplanned repairs or maintenance.

8.1.7 Function of components

Features of components refer to the performance or expected roles of the components used in the building. For example, in terms of moisture-proof, waterproof, thermal insulation, airtight, sound insulation, electrical insulation, etc., suitable materials and combination of materials are used to make specific performances.

8.1.8 Functionality

Mechanical equipment performance may be compromised if exposed to moisture and accumulated dust greater than originally intended. For example, if the adhered dust or freezing on ventilation equipment lowers the air flow, it will have a lower performance.

8.1.9 Moisture-proof performance/damp-proof performance

It refers to the performance of the material which is moisture-proof. The material with moist-proof function is mainly used on the wall structure of high humidity side in order to prevent condensation inside the wall structure. Plastic moisture-proof film and membranes, asphalt impregnated products, etc. are used as moisture-proof materials.

8.1.10 Thermal insulation performance

The material that resists the transfer of heat from a warmer to a cooler environment. The performance of thermal insulation is reduced when it is wet or frozen.

8.1.11 Waterproofing performance

It refers to the performance of a water-resistant material. Waterproof materials are mainly used on the exterior or on the outside of the thermal insulation layer to prevent water penetration from outside. It can mean that the material itself has water-resistant features, but the construction method or the shape of materials which also prevent water penetration can be said as water-resistant in a broader sense.

8.2 Occupant comfort and owner value — Aesthetics, satisfaction of users

8.2.1 Acoustic separation

Refers to the performance of material with noise isolation properties. When the interior door becomes warped and the gap between the door and frame allows noise transfer, it is considered that the isolation property has decreased.

8.2.2 Building aesthetics

Refers to the appearance both inside and outside of a building. In this document, if dirt, staining, discolouration, cracking or peeling are spoiling the appearance of a building, the apparent property value may be lowered.

8.2.3 Opening performance of windows and doors

The performance of materials that allow windows and doors to open smoothly may be compromised by the presence of moisture.

In the case of wooden doors, they expand under high humidity, and shrink under low humidity, which may lead to deformation and become more difficult to open or close. In cold districts, excess water may freeze blocking the operation of windows and doors. This could result in a safety issue for exit doors.

8.2.4 Occupant comfort

The physical space should leave people feeling both mentally and physically well. Also, health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. In this document, if you feel unpleasant or uncomfortable both physically and mentally attributable to thermal and air environment as a result of problems associated to moisture, it is considered that both comfort and health are harmed.

8.2.5 Property value

Visible deleterious effects of moisture, both aesthetic and material, will result in reduced appeal. Invisible problems in the building envelope originating from moisture and resulting in odour in the inhabited areas of the building will also reduce the property value.

8.2.6 Visibility (performance of transparent material)

Ability to see through glass will be compromised if the glass is obscured by condensation or frost. This may result in lower occupant satisfaction and may be a safety issue if a clear view to the exterior is required before opening a door.

8.2.7 Walkability of floor

Ease of walking on floors inside a building without slip or trip hazards.

If there is floating, warpage or deformation in the floor material, one may find it difficult to walk. Also, when the floor is wet, it becomes slippery, and becomes hard to walk.

8.3 Structure — Risk of collapse

8.3.1 Structural capacity and deflection

Many building materials, especially wood based, with a bearing function have decreased ability to withstand loads and deflections if affected by prolonged high-moisture conditions.

8.3.2 Structural support

Durability of the elements carrying the mass of the building may be adversely affected by moisture requiring unplanned repairs or maintenance.

9 Building components affected by moisture

9.1 Building equipment

EXAMPLE Ventilation duct, ventilation fan, heat exchanger.

9.2 Exterior finishing material

1) Wood/wood-based material

   EXAMPLE Siding, yakisugi plate, wood siding.

2) Metallic dry-type exterior

   EXAMPLE Coated steel sheet, folded plate, metal siding.

3) Resin, adhesive agent, etc.

   EXAMPLE Resin siding, resin mortar.

4) Paints

   EXAMPLE Water-based paint, oil-based paint.

5) Mineral material, wet cement mortar coating

   EXAMPLE Wall-plastering material, plaster.

6) Cement-based dry exterior

   EXAMPLE Fibre reinforced cement sidings, ALC (autoclaved lightweight concrete).

7) Ceramic exterior

   EXAMPLE Tile, rooftile, brick.

8) Other exterior finishing materials

   EXAMPLE Concrete.

9.3 Joint

1) Wet type

   EXAMPLE Mortar, sealing material.

2) Dry type

   EXAMPLE Joint rod.

3) Other joint materials

9.4 Hardware

1) Metal

EXAMPLE Flashing/drop, starter, shutter, shutter box, hanging bolt.

9.5 Interior finishing material

1) Wood/wood-based material

EXAMPLE Flooring, baseboard/skirting board, cornice, threshold, interior doors.

2) Resin, adhesive agent, etc.

EXAMPLE Vinyl cloth/PVC wallpaper, plastic.

3) Carpet

4) Tatami (Japanese traditional mat made of straw and rush)

5) Paint

EXAMPLE Water-based paint. oil-based paint.

6) Mineral materials, stone, gypsum, soil, etc.

EXAMPLE Gypsum board, wall plastering material, marble, tile.

7) Concrete

8) Other interior finishing materials

EXAMPLE Spray-applied finishing material, ALC, closet board.

9.6 Opening

1) Wood/wood-based material

EXAMPLE Wooden sash, wooden door, casing/architrave/trim.

2) Metal

EXAMPLE Aluminium sash, aluminium-resin composite sash, metal door.

3) PVC

EXAMPLE Resin sash, aluminium-resin composite sash.

4) Glass

EXAMPLE Window glass.

5) Other opening

EXAMPLE Glass fibre.

9.7 Piping

1) Metal

EXAMPLE Water supply pipe, waste pipe, hot water supply pipe, hot water circulating pipe, ventilation pipe.

9.8 Space

EXAMPLE Indoor space, building internal space, attics, crawl-space foundations.

9.9 Storage item

1) Curtains
2) Books
3) Clothes
4) Furnishings

   EXAMPLE Daily necessities.

5) Cultural items

   EXAMPLE Pictures, sculptures, potteries, wall paintings, hanging scrolls, old books, leather.

6) Other storage items

   EXAMPLE Bedding.

9.10 Structure/body structure

1) Wood/wood-based material

   EXAMPLE Column/pillar/post, beam, ground sill, side/ledger joist, band/rim joist.

2) Steel/metal

   EXAMPLE Steel column, steel beam, light weight steel beam.

3) RC (reinforced concrete)

   EXAMPLE Pillar/column, beam (rigid frame), wall (wall structure), foundation.

4) Other structural materials

   EXAMPLE Concrete block, brick, stone, autoclaved aerated concrete, lightweight aggregate blocks.

9.11 Substrate/underlayment/sheathing

1) Wood/wood-based materials

   EXAMPLE Furring strips, interior backing, structural plywood.

2) Metal

   EXAMPLE Ceiling backing material, interior backing material, metal furring strip.

3) Mineral materials, mortar, plaster, etc.

   EXAMPLE Gypsum board.

4) Other

   EXAMPLE Calcium silicate board, volcanic silicates fibre reinforced multilayer board.

9.12 Thermal insulation material

1) Fibrous insulation

EXAMPLE Glass fibre, rock wool, cellulose insulation, wood fibre thermal insulation material, hemp, flax.

2) Rigid cellular plastic insulation

EXAMPLE Extruded polystyrene foam, expanded polystyrene foam, rigid polyurethane foam, polyethylene foam.

3) Other thermal insulation materials

EXAMPLE Vacuum insulation panel, aerogel.

9.13 Waterproofing membrane

EXAMPLE Asphaltic roofing, felt, vapour breathable underlays, polyethylene film.

9.14 Wiring

1) Polyvinyl chloride, etc.

EXAMPLE Electric wiring.

10 Classifications of moisture damage

10.1 General

The following is a classification of phenomena that occur inside a building and may cause moisture damage or may be related to moisture damage. It consists of "materials and constituent materials", "phenomena", and "the functionalities that may be affected". These are summarized in Figures 2 and 3.

10.2 Constituent materials (sub-classification of materials)

1) Structure/body structure

EXAMPLE Wood, wood-based material, steel/metal, RC (reinforced concrete), other structures.

2) Joint

EXAMPLE Wet-type, dry-type, others.

3) Hardware

EXAMPLE Metal.

4) Opening

EXAMPLE Wood/wood-based material, metal, PVC, glass, other opening.

5) Interior finishing material

EXAMPLE Wood/wood-based material, resin, adhesive agent, carpet, tatami, paint, wallpaper, mineral materials, stone, gypsum, soil, concrete, others.

6) Storage item

EXAMPLE Curtains, books, clothes, furnishings, cultural items, others.

7) Exterior finishing material

EXAMPLE Wood/wood-based material, metallic dry-type exterior, PVC, adhesive agent, paint, mineral material, wet cement mortar coating, cement-based dry exterior, ceramic exterior, others.

8) Substrate/underlayment/sheathing

