

SuPeRBE Training Material

Macro Area of Expertise:

Risk Assessment At Building Scale

Hazard: Drought(D)

Macro Area of Expertise MAE10.4:

Building Component: Fittings and Furnishings (D6)

Risk Category: Sanitary Fittings (D6.1)

Level of competence: 3

DROUGHTS

General Information

- *“A period of abnormally dry weather long enough to cause a serious hydrological imbalance.”* (IPCC)
- Natural phenomenon intensified in recent decades by climate change and unsustainable land practices
- Human-induced climate change has contributed to increases in droughts due to increased atmospheric evaporative demand induced by increased temperature, decreased relative humidity, and increased net radiation
- More regions are affected by drought with increasing global warming



PHYSICAL DRIVERS OF DROUGHTS

Main drivers:

Reduced precipitation: Long periods of below-average rainfall weaken soil moisture and surface water availability.

High temperatures: Intensify evaporation from soil and water bodies, accelerating drying.

Soil characteristics: Sandy or degraded soils drain water quickly and retain less moisture.

Vegetation loss: Deforestation or poor land management reduces soil stability and water retention.

Atmospheric circulation patterns: Phenomena like El Niño, persistent high-pressure systems, or altered jet streams limit moisture inflow into a region.



DROUGHTS & BUILDING SANITARY FITTINGS

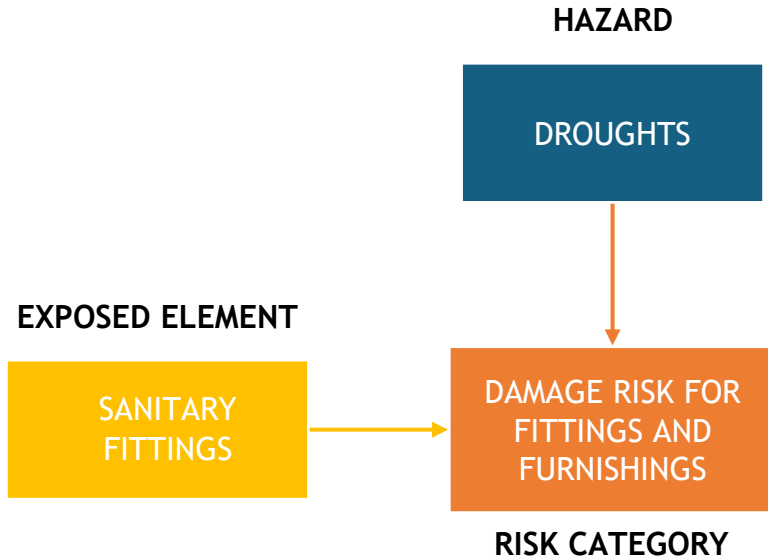
Key impacts

- Reduced water availability limits normal operation of toilets, taps, showers, and other fixtures.
- Pressure drops in the water network affect flow performance and user comfort.
- Buildings face higher reliance on stored water, increasing risks of service interruptions.
- Sanitary systems may require retrofits (low-flow, water-saving devices) to maintain functionality during droughts.
- Drought conditions increase operational costs and complicate maintenance of plumbing systems.

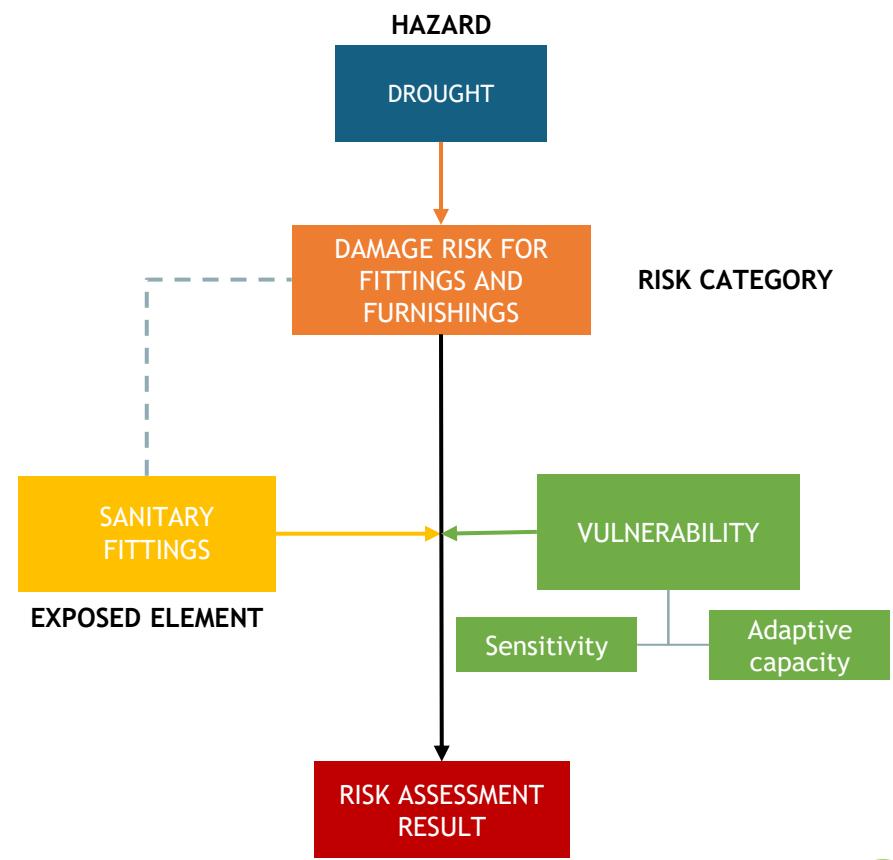


RISK ASSESSMENT FOR SANITARY FITTINGS AND FURNISHING

- **Hazard:**
Droughts
- **Exposed element:**
Sanitary fittings

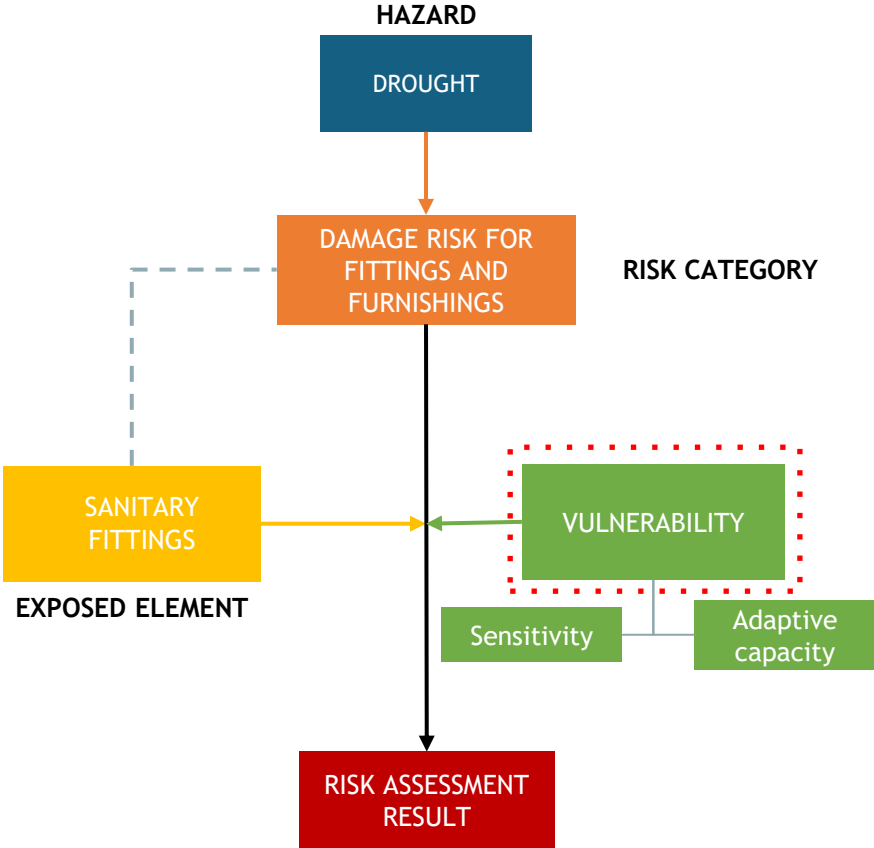


IMPACT CHAIN



CRITERIA

D6.1 Sanitary Fittings		
Code	Criteria	INDICATOR
D6.1.1	Water saving fixture	Share of water fixtures equipped with water saving solutions
D6.1.2	Water reporting	Availability of solution to track the building's water consumption in real time and inform the end users



D6.1.1 WATER SAVING FIXTURES

Description:

Assesses the extent to which the building is equipped with water-saving sanitary fixtures (e.g., low-flow faucets, dual-flush toilets, efficient showers) that reduce potable water consumption and improve resilience during periods of limited water availability.

Objective:

Measure and promote the installation of fixtures that minimize water use while maintaining normal building functionality, helping the building operate effectively even when drought conditions restrict supply.

Relevance:

Water-saving fixtures directly reduce overall demand, easing pressure on municipal systems during droughts and lowering operational risks for the building. Efficient fittings support long-term water conservation, enhance resilience, and contribute to sustainable resource management.



D6.1.1 WATER SAVING FIXTURES

Indicator:

Share of water fixtures equipped with water saving solutions = 18%

Benchmarks:

HIB

Optimal value (0): 100%

Critical value (1): 0 %

Normalised value: 0.81

Vulnerability Level: **RATHER NEGATIVE**



D6.1.1 WATER SAVING FIXTURES

Calculation step by step

Step 1: Define the scope

- Identify the building(s) to be assessed.
- List all sanitary fittings/fixtures to include: toilets, urinals, faucets/taps, showers, bidets, etc.

Step 2: Set the “water-saving fixture” criteria

- Use local regulations or recognized labels (e.g. WaterSense, EU eco-labels) to define what is “water-saving”. For each fixture type, specify the maximum flow/flush rate or technology that qualifies, e.g.:
- Toilets: $\leq X$ L/flush or dual-flush.
- Urinals: $\leq Y$ L/flush or waterless.
- Faucets: $\leq Z$ L/min with aerator or flow restrictor.
- Showers: $\leq W$ L/min with low-flow showerhead.

D6.1.1 WATER SAVING FIXTURES

Calculation step by step

Step 3: Collect data

Use:

- Plumbing design drawings and schedules.
- Product datasheets and technical specifications.
- Procurement/installation records.
- On-site survey to confirm installed models.



Low-flow showerhead with shut-off button

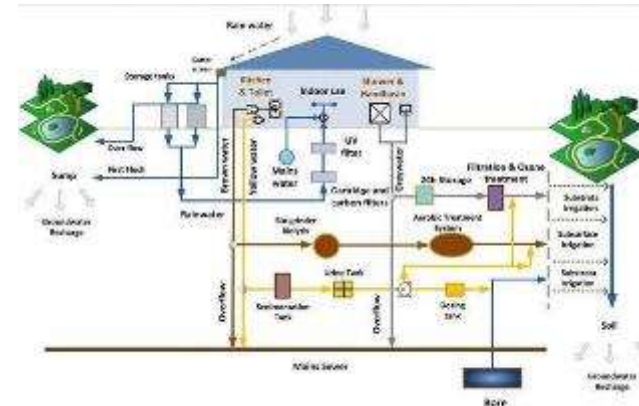
Shut-off button prevents air from being pushed out of the showerhead, reducing water flow.



Step 4: Create the inventory

For each fixture type:

- Count total fixtures installed $\rightarrow N_{total}$
- Count water-saving fixtures that meet the criteria $\rightarrow N_{ws}$



D6.1.1 WATER SAVING FIXTURES

Calculation step by step

Step 5: Calculate the indicator

$$\text{Share of water saving fixtures} = \frac{\text{Number of water saving fixtures}}{\text{Number of total water fixtures}} \times 100$$

$$\text{Share of water saving fixtures} = \frac{28}{150} \times 100$$

$$\text{Share of water saving fixtures} = 18.6\%$$

D6.1.1 WATER SAVING FIXTURES

Calculation step by step

Step 9: Normalize the result:

The value is normalised applying the following formula:

$$X_{norm} = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$

where:

x_i : value of the indicator

x_{min} = critical indicator value (corresponding to score 1)

x_{max} = optimal indicator value (corresponding to score 0)

Normalisation values	Description
0.1	Optimal (No improvement necessary)
0.3	Rather positive
0.5	Neutral
0.7	Rather negative
0.9	Critical (Could lead to severe consequences)

D6.1.1 WATER SAVING FIXTURES

Calculation step by step

Step 7: Normalize the result:

For the “higher is better” indicators (higher the numerical value of the indicator, the higher the performance level.), the value is normalised applying the following formula:

$$X_{norm} = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$

$$X_{norm} = \frac{100 - 18.6}{100 - 0}$$

$$X_{norm} = \frac{81.4}{100}$$

$$X_{norm} = 0.81$$

Rather Negative

Normalisation values	Description
0.1	Optimal (No improvement necessary)
0.3	Rather positive
0.5	Neutral
0.7	Rather negative
0.9	Critical (Could lead to severe consequences)

D6.1.2 WATER REPORTING

Description:

Assesses whether the building has systems capable of monitoring and displaying real-time water consumption to support efficient use and early detection of abnormal demand.

Objective:

Ensure that building occupants and facility managers have timely access to accurate water-use information, enabling proactive water management and reducing vulnerability during drought conditions.

Relevance:

Real-time monitoring improves water efficiency, helps identify leaks or excessive consumption, and supports conservation strategies—critical for maintaining building functionality under increasing drought stress.



D6.1.2 WATER REPORTING

Indicator:

Availability of solution to track the building's water consumption in real time and inform the end users = 2

Benchmarks:

HIB

Optimal value (0): 5

Critical value (1): 0

Normalised value: 0.6

Vulnerability Level: **NEUTRAL**



D6.1.2 WATER REPORTING

Calculation step by step

Step 1: Define the building water system boundaries

- Identify all water supply entry points (main meters, sub-meters if existing).
- Include domestic water, irrigation, cooling towers (if any), and service areas.

Step 2: Inventory existing metering infrastructure

Evaluate whether the building has:

- Main utility meters
- Sub-metering (by floor, usage type, apartment, or equipment)
- Smart meters (digital, online, automated)
- Manual meters only
- Document age, accuracy, and data accessibility.

D6.1.2 WATER REPORTING

Calculation step by step

Step 3: Define the building water system boundaries

For each meter, determine:

- Data frequency (real-time, hourly, daily, manual monthly)
- Automation level (automatic reading vs manual)
- Integration into a building management system (BMS) or cloud platform
- Historical data storage (months or years)

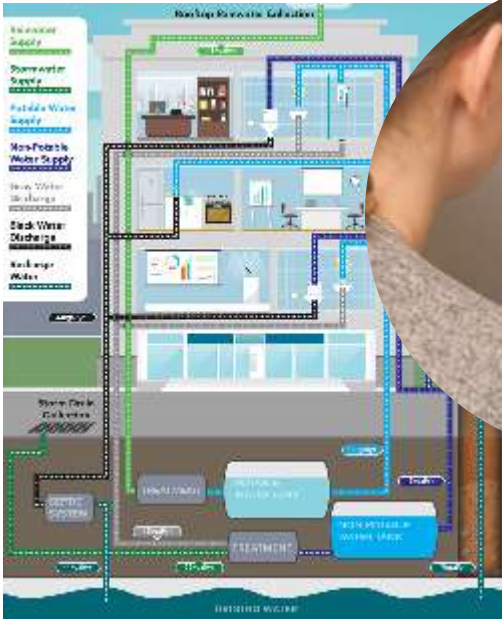
Step 4: Give a Score (0-5)

Score	Description
0	No reporting capacity: No metering beyond basic utility billing; no internal monitoring or feedback.
1	Minimal reporting: Basic metering with checks, no digitalization. Building level
2	Partial monitoring (not automated):Some sub-meters installed but no automated or real-time data.
3	Automated building-level monitoring: Automated readings at building level , but not per use-type or per unit.
4	Advanced monitoring with occupant information: Automated smart metering + some sub-metering + occupant feedback.
5	Fully integrated smart water management (ISO 46001-aligned): Full automated metering system with building-wide segmentation, analytics, and user engagement.

D6.1.2 WATER REPORTING

Calculation step by step

Example:



Water reporting of the building:

2: Partial monitoring(not automated).Some sub-meters installed but no automated or real-time data.

D6.1.2 WATER REPORTING

Calculation step by step

Step 5: Normalize the result:

The value is normalised applying the following formula:

$$X_{norm} = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$

where:

x_i : value of the indicator

x_{min} = critical indicator value (corresponding to score 1)

x_{max} = optimal indicator value (corresponding to score 0)

Normalisation values	Description
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D6.1.2 WATER REPORTING

Calculation step by step

Step 5: Normalize the result:

For the “higher is better” indicators (higher the numerical value of the indicator, the higher the performance level.), the value is normalised applying the following formula:

$$X_{norm} = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$

$$X_{norm} = \frac{5 - 2}{5 - 0}$$

$$X_{norm} = \frac{3}{5}$$

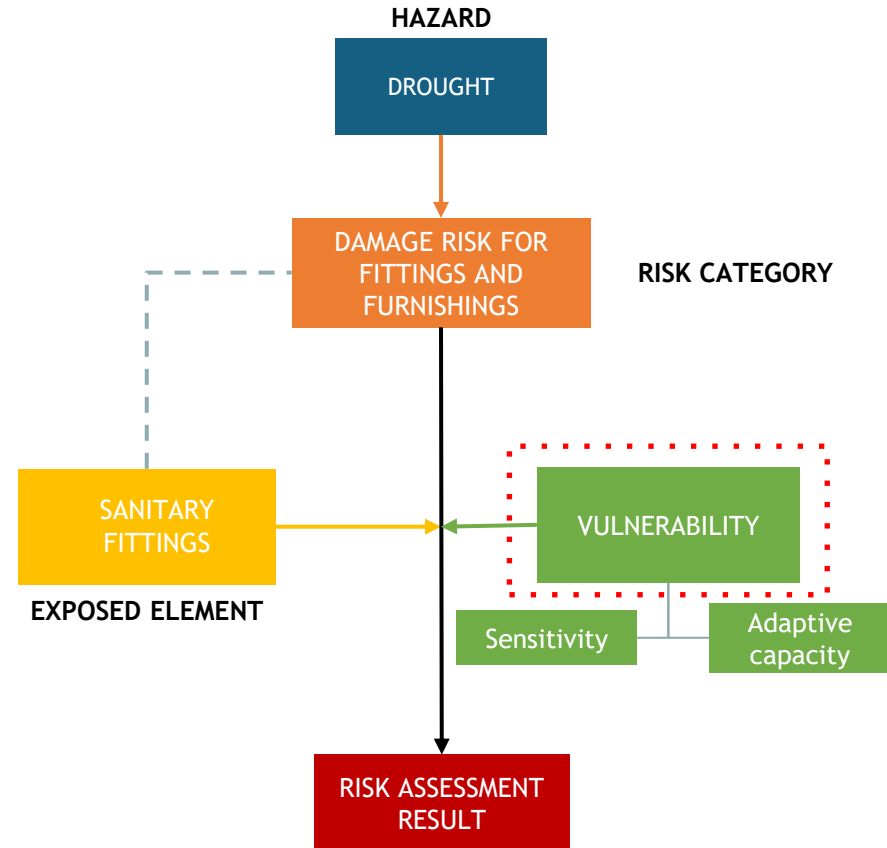
$$X_{norm} = 0.6$$

Neutral

Normalisation values	Description
0.1	Optimal (No improvement necessary)
0.3	Rather positive
0.5	Neutral
0.7	Rather negative
0.9	Critical (Could lead to severe consequences)

OVERALL VULNERABILITY

D6.1 Sanitary Fittings			
Code	Criteria	Value	Weight
D6.1.1	Water saving fixture	0.81	0.50
D6.1.2	Water reporting	0.71	0.50



OVERALL VULNERABILITY - VULNERABILITY VALUE VV

Normalised score Weight

$$VV = \sum_{i=1}^n (I_i \times W_i)$$

$$Vulnerability (Vv) = (0.81 \times 0.50) + (0.6 \times 0.5)$$

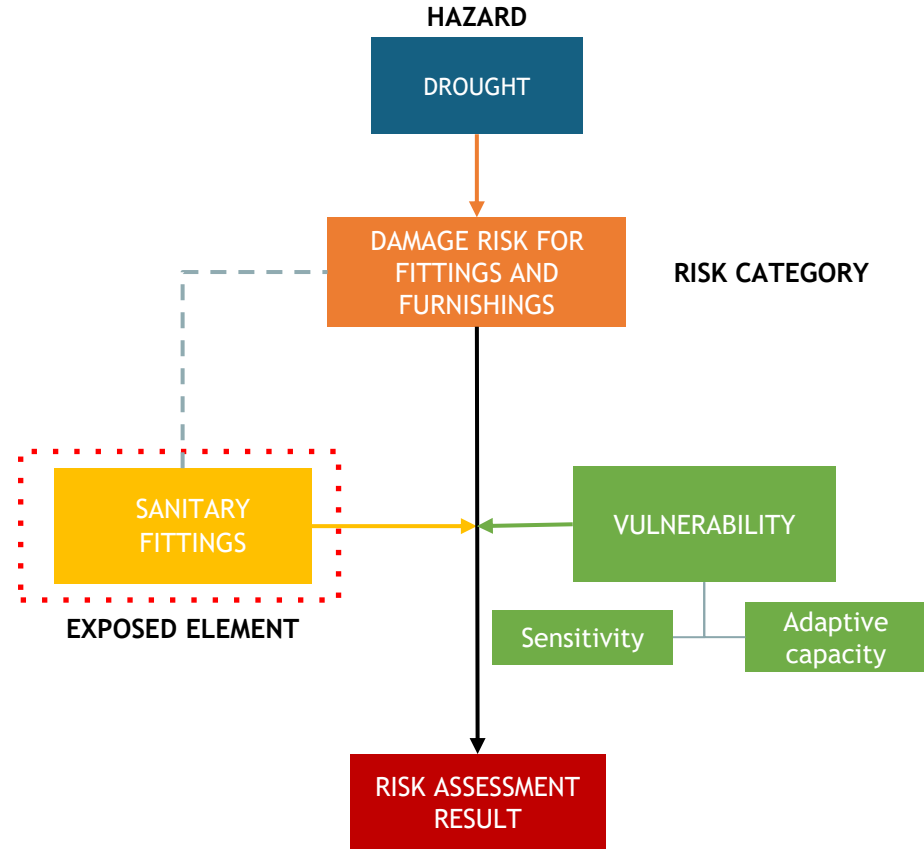
$$Vulnerability Value (vV) = 0.7$$

Vulnerability Level = **RATHER NEGATIVE**

OVERALL EXPOSURE

The value of the “Exposure Level” for a Risk Category shall be assigned based on:

- The number or total surface area of the Exposed Element in relation to the building component (Macro-Category)
- Repetition or distribution of the Exposed Element across the building (e.g. isolated vs. continuous presence)



OVERALL EXPOSURE

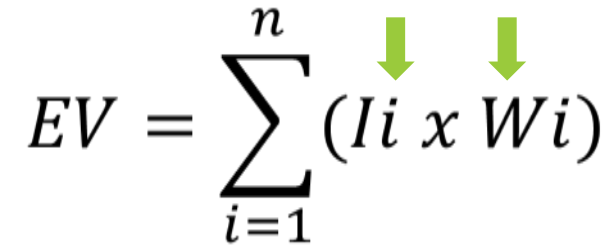
Being a qualitative indicator, the Exposure Index is specified by categorical normalised values referring to the exposure level, as shown in the following table.

Exposure Level Normalized Value	Description
0.1	Very few isolated Exposed Elements or total surface area <5% of the related building component (Macro Category)
0.3	Few Exposed Elements or total surface area less than 15% of the corresponding building component (Macro Category)
0.5	Moderate number of Exposed Elements or total surface area between 15% and 30% of the corresponding building component (Macro Category)
0.7	Numerous Exposed Elements or total surface area between 30% and 60% of the corresponding building component (Macro Category)
0.9	Exposed Elements dominate the relevant building component (Macro Category) or total surface area >60% of the related building component (Macro Category)



OVERALL EXPOSURE (EXPOSURE VALUE - EV)

Normalised score Weight

$$EV = \sum_{i=1}^n (I_i \times W_i)$$


Exposure Value (EV) = 0.7

HAZARD LIKELIHOOD

Hazardous event		Slow-on set process		Hazard Value (HV)
Frequent	Likely to occur often in a life time (every 10 years)	Very likely	Very likely to occur in the next 10 years	1 - 0,9
Probable	Likely to occur several times in a lifetime (every 25 years)	Likely	Likely to occur in the next 10 years	0,89 - 0,66
Occasional	Likely to occur some times in a lifetime (every 50 years)	As likely as not	As likely as not to occur in the next 10 years	0,65 - 0,33
Remote	Unlikely but still possible to occur in a lifetime (every 100 years)	Unlikely	Unlikely to occur in the next 10 years	0,32 - 0

Hazard Value (HV) = This information is provided by SECAPs or by experts' judgment

For example, Hazard Value (HV) = 0.8 (Probable)

RISK ASSESSMENT

Risk Category: Furnishing & Fittings (D6) Exposure: Sanitary Fittings

- Hazard Value = 0.8
- Exposure Value = 0.7
- Vulnerability Value = 0.7

- W_{HV} weight of HV  0.25
- W_{EV} weight of EV  0.25
- W_V weight of VV  0.5

$$HV^{W_{HV}} \times EV^{W_{EV}} \times VV^{W_V}$$



RISK LEVEL = 0.72
RATHER NEGATIVE