ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

CRISP

CaRatterIzzazione dei Siti delle Stazioni Sismiche Permanenti

Site Characterization of the Permanent Seismic Stations

USER MANUAL

01/2022

Edited by: Stefania Pucillo, Giovanna Cultrera, Alessia Mercuri, Chiara Ladina & CRISP Working group

Index

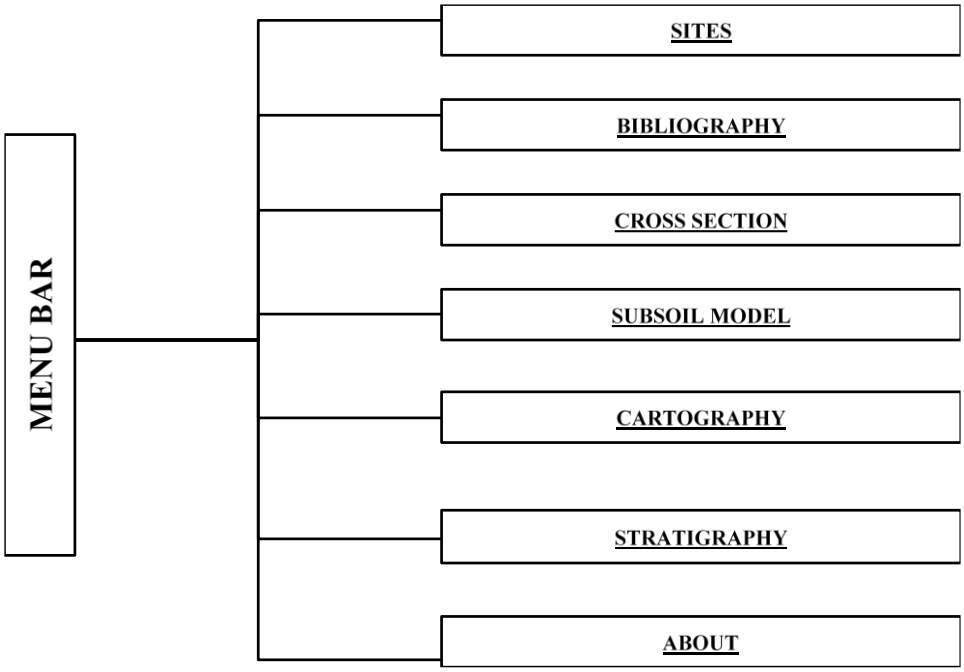
LEGEND for used styles

[ ] → sections of the site described in the following chapters
BOLD CAPITAL UNDERLINED → Main section
BOLD CAPITAL → Subsection (browsing or not)
- **Bullet bold black** → text, figure or file downloadable
- **Bullet bold blue** → text field with drop down list

CAPITAL BLUE → Enumeration Values from drop down list
CAPITAL BLACK ITALIC → table or downloadable file

Note: by convention, the comma is the thousands separator and the point is the decimal separator

MENU BAR



SITES

Principal menu for accessing the database.

- **LIST:** list of the sites on Crisp archive. For details see SITE.
- **SEARCH**: form for most common queries on database contents.

BIBLIOGRAPHY

Bibliography referenced in the database.

- **Id**
- **Title:** Document title
- **Identifier type:** DOI, ISBN, ISRC
- **Identifier:** persistent identifier or handle
- **Url:** link to repository

CROSS SECTION

List of the archived geological cross sections. For details see CROSS SECTION.

SUBSOIL MODEL

Geophysical and geotechnical properties to define the subsoil model. For details see SUBSOIL MODEL.

CARTOGRAPHY

List of stored digital maps. Maps can be imported and stored as WMS service or raster image to be georeferenced using the Geo-polygon tool. They are clipped on a square of 5 km x 5 km centered on the site coordinates.

- **Cartography Type:** Type of cartographic document available for each site:
  - GEOLOGIC: Geologic map
  - TOPOGRAPHIC: Topographic map
  - AERIAL IMAGE: Images from several platforms
  - TECTONIC: Tectonic features
  - LANDSLIDE: Landslide maps; eg. IFFI (Inventario Fenomeni Franosi in Italia), or PAI (Piano stralcio per l'Assetto Idrogeologico), others
  - LITHOLOGICAL: Lithological map
  - MOPS: Map of areas with homogeneous seismic response. Map of areas described in terms of their geological and lithological characteristics
  - OTHER: Insert here other maps not described above
- **Spatial reference system:** List of the more common Reference system used in Italy is presented, but all EPSG systems are allowed.
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Scale:** Scale of detail of the map with respect to the portion of earth surface it represents.
  Sheet: Sheet number from Istituto Geografico Militare Italiano (IGMI) topographic framework.
- **Cartography Title**

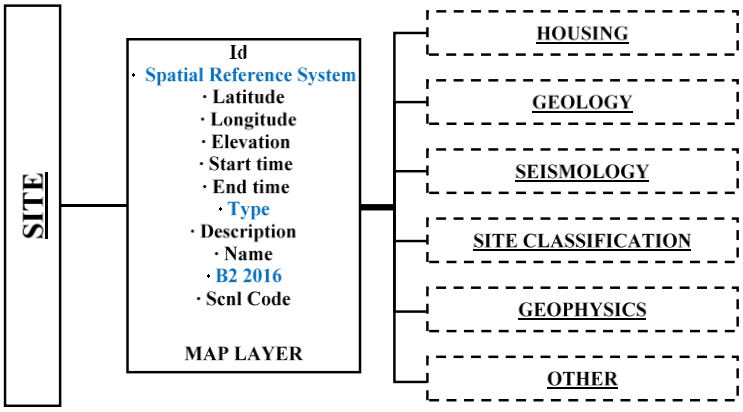
STRATIGRAPHY

List of all the available punctual information of stratigraphic logs. For details see STRATIGRAPHY.

ABOUT

- **DOCUMENTATION:** documents on website structure and contents.
- **CREDITS**

SITE



SITE

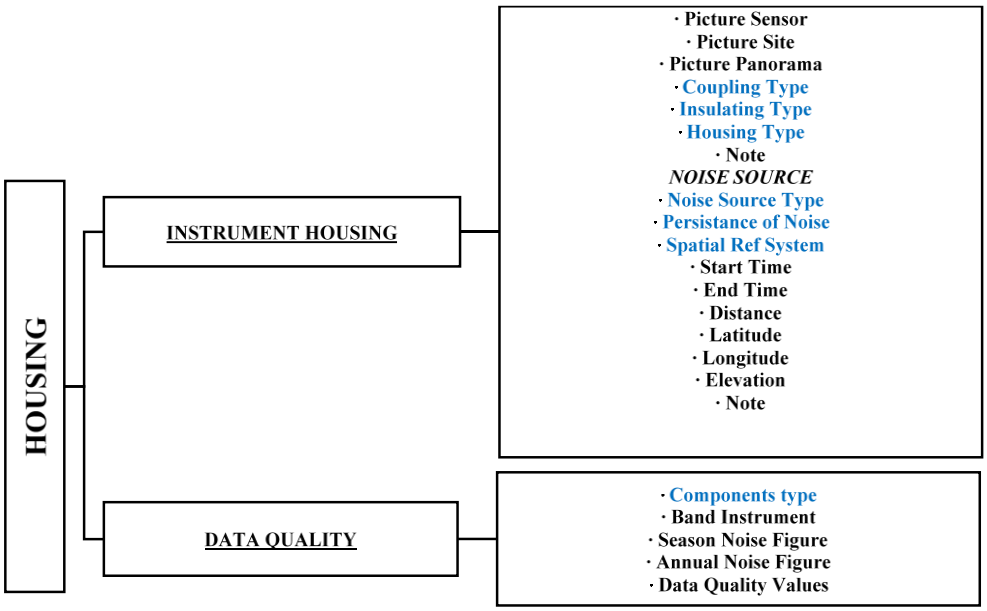
Main webpage for a single site containing all information represented in different sections.
The uppermost section contains the basic information of instrumentation and channel (stream) of the site and the related station.

- **Id:** site identifier in the database
- **Spatial Reference System:** A list of the more common Reference system used in Italy is presented, but all EPSG systems are allowed
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Latitude:** Latitude [°]
- **Longitude:** Longitude [°]
- **Elevation:** Height above sea level [m]
- **Start Time:** Begin date of the station installation.
- **End Time**: Closing date of the station.
- **Type:** Permanent or temporary deployment
  - PERMANENT
  - TEMPORARY
- **Description:** Locality name and District
- **Name:** Site name
- **Scnl Code**: This code identifies uniquely the seismic station following the standard from FDSN (International Federation of Digital Seismograph Networks): *NetworkCode*: Two-characters' code identifying the network; *StationCode*: Station code as registered at International Station Registry (max 5 character); *LocationCode*: Two-characters' numeric code to identify different sensors located within into, or close by, the same site.

MAP LAYER

Digital maps on a square of 5 km x 5 km centered on the site coordinates. It also shows site position and any other archived geological or geophysical survey within a 5 km distance from site (borehole, cross section and so on). CRISP provides maps as WMS service from the ISPRA server. See CARTOGRAPHY in the Menu bar.

HOUSING



INSTRUMENT HOUSING

Description of how and where the sensor has been installed.
For more information about Insulating Type, see file in ABOUT→ DOCUMENTATION.

- **Picture:** Pictures of the site where the sensor is installed. 3 photos are required, if possible:
  1) **Sensor**: the equipment in particular with zoom on the sensor;
  2) **Site**: the installation site;
  3) **Panorama**: panoramic picture showing the environment and the elements around the site.
- **Coupling Type**: How the sensor is coupled with the ground.
  - PILLAR: Concrete pillar, wherever it is (vault, mine or other)
  - BURIED: Buried sensor, covered with soil or sand or other
  - FLOOR: Sensor placed on the floor
  - OTHER: Insert here all other cases
  - GROUND: Placed directly on the ground (not buried)
- **Insulating Type:** Attribute to specify the thermal insulating efficiency.
  - EXCELLENT: Thermal and electromagnetic and baric screen, sealed and waterproof IP4 (protected from small wires and screws greater than 1 millimeter) or IP54 (protected from limited dust ingress and from water spray from any direction, limited ingress protection).
  - GOOD: The thermal building is present and well done, but the result is not as accurate as the excellent case because there could be a little air passage between the external environment and internal air gap.
  - MEDIUM: The insulation building is present but it is not well done. The thermal insulation and waterproofing are not enough and considerable air passage is allowed between the external environment and internal air gap.
  - ABSENT: The insulating building closely around the sensor is absent at all.
- **Housing Type:** Specify the surroundings where the seismometer is installed.
  - FREE_FIELD: Sensor installed on the free-field. Is considered for sensors located on the surface. It includes also the sensor on the surface in the meadow at a few meters from a building or in the courtyard/garden.

- BUILDING: Seismometer installed INSIDE the building. If it is outside, even a few meters or in the yard, consider other choices (Free_Field or Vault or other entry). See further details in the section "1. Building" below.
- BOX: Outdoor installation with shelter for seismic instrumentation, with iron, brick or concrete frame (single floor)
- CAVE: Underground seismic station: natural cave or artificial cavity such as a mine or an abandoned tunnel. See further details in the section "2. Cave" below
- BOREHOLE: Small-diameter vertical well (bore), hosting a sensor or series of sensors
- VAULT: Hole with concrete case (with metal cover or other cover) hosting the sensor
- OTHER: All other cases (e.g. bridge)

1. Building:

Detailed description of *housing Type=BUILDING*, including the type of building, the floor where the sensor is installed, the frequency of the building (transversal and longitudinal frequency), building orientation, position of the sensor and vulnerability class.

- **Building Type:** Specify the type of building in which the sensor is installed.
  - MANSORY MASSIV: Massive stone, manufactured stone
  - STEEL: A strong metal that is a mixture of iron and carbon, used for making things that need a strong structure
  - MONUMENTAL: Very big building: church, cloister, monastery, tower, castle
  - ENEL_BOX: Small building (generally one storey) of the Italian Electric Power Company (ENEL)
  - OTHER: Another type of building not present
  - MASONRY_SIMPLE: Building made of brick and pieces of stone: simple stones, adobe
  - RC FRAME: Building with reinforced concrete structure
  - WOOD: Wood structure
- **Installation floor**: Indicate a floor where the sensor is installed

-1	for the basement
0	for the ground floor
1	for the first floor
...	other floor

- **Number of Storeys:** Total number of storeys of the building (1 for "one-storey", understood as only one floor above ground; 2 for "two-storeys", understood as two floors above ground, etc..).
- **Frequency of building:** Natural frequency of the building (fundamental mode) [Hz]
- **Transversal Frequency:** Frequency of transversal mode of building vibration (short side of the building) [Hz]
- **Longitudinal Frequency:** Frequency of longitudinal mode (long side of the building) [Hz]
- **Building Orientation:** Indicate degrees of the longitudinal axis of the building. If square building, indicate the orientation of the wall closest to the sensor. [°]
- **Internal Location:** Indicate the position of the sensor with respect to walls of the room.
  - WALL: close to the wal
  - CORNER: close to the corner
  - CENTER: in the middle of the room
- **Vulnerability Class:** Class of vulnerability following EMS98 Class Type. For more information about Vulnerability-European Macroseismic scale (EMS-98) see ESC Working Group Macroseismic Scales, "European Macroseismic Scale 1998", G. Grünthal (Ed.), ISBN N° 2-87977-008-4, Luxembourg 1998.
  - A: EMS98 Class Type A (masonry building rubble stone, fieldstone, adobe-earth brick, simple stone, etc.)

- B: EMS98 Class Type B (masonry building simple stone, or unreinforced with manufactured stone units, or reinforced concrete frames without resistant design, etc.)
- C: EMS98 Class Type C (masonry building massive stone, or unreinforced with RC floor, or reinforced concrete frames without resistant design, etc.)
- D: EMS98 Class Type D (masonry building reinforced or confined, or reinforced concrete frames with moderate level of resistant design, etc.)
- E: EMS98 Class Type E (reinforced concrete frames with high level of resistant design, steel structures, etc.)
- F: EMS98 Class Type F (reinforced concrete frames with high level of resistant design, walls with high level of resistant design, steel structures, etc.)

2. Cave

Detailed description of *housingType=CAVE* where the sensor is installed, including thickness of upper rock, lateral thickness, distance from outside and bibliography.

- **Thickness of Upper Rock:** Thickness of rock above the sensor [m]
- **Lateral Thickness of Rock:** Minimum thickness of the rock between the cavity side where the sensor is installed and the outside [m]
- **Distance from Outside:** Distance of the foot path between the sensor and the outside [m]
- **Bibliography:** Indicate a bibliographical reference for cavity underground with author, title, journal, year restriction and attached file.
- **Note**: Description of the station housing with information not included in the other classes.

NOISE SOURCE

Presence of noise sources that influence or can influence the seismic signal, described with attributes (building, pole, tall trees, etc). All noise sources have to be pointed out anyway, even if, at first sight, their influence on seismograms, in terms of noise, is not noticed.

- **Noise Source Type**: Point out ALL possible noise sources, even if, at first sight, their influence on seismogram, in terms of noise, is not noticed
  - ENGINE: Engine
  - POLE: A long, cylindrical, often slender piece of different materials such as wood, metal, etc.
  - FENCE: A barrier enclosing or surrounding a field, yard, etc., usually made of posts and wire or wood.
  - POWER_GENERATOR: Power generator, turbine
  - PUMP: An apparatus or machine for raising, pushing in or out, or compressing fluids or gases…
  - COASTLINE: If the sensor is within 4 Km from nearest coast
  - WATER_CONDUIT: Water pipe (tube, collector...), small rivers, canals
  - SOLAR_PANEL: solar panel usually for powering the station
  - ANTENNA: antenna or parable for data transmission
  - GPS PILLAR: pillar for Global Position System antenna
  - AIR_CONDITIONING: Air conditioning system or fridge
  - BELL: Bells
  - BUILDING: Building nearby
  - VILLAGE: Small town, village, small residential area
  - TOWN: Town, small city
  - HIGHWAY: Highway
  - RAILWAY: Railway
  - TRAIL: narrow street, rural road
  - TALL_TREE: Tall tree
  - DROP: Drop dripping on the sensor or in proximity
  - GATE: A movable barrier, usually on hinges, closing an opening in a fence, wall, or other enclosure
  - FREE_OBJECT_CLOSE: Precarious objects near the sensor. For example little poles or other waste material, chairs, tables and furniture, and a precarious shelf.
  - THERMAL_INSTABILITY: Thermal instability in the proximity of the sensor is noticed, for example air flows or near heat source

  - ELECTROMAGNETIC_NOISE: Thermal instability in the proximity of the sensor is noticed, for example air flows or near heat source
  - PRESENCE_OF_METAL: Presence of metal in the pillar or within a meter from the sensor
  - ROAD: A long, narrow stretch or way of land with a leveled surface, made for traveling by motor vehicle, etc.
- **Persistence of Noise:** Indicate if the noise is permanent and regular, only during the day or occasional, rare, continuous or seasonal
  - DAILY: Noise source only during the day (example sawmill or other anthropic daily activity)
  - OCCASIONAL: Noise source occasionally in the day, example ten trains every day
  - RARE: Rare event, for example stadium, crowded only on Sundays
  - CONTINUOUS: Noise source always present (example an engine in function both day and night or a big river)
  - SEASONAL: Ambient seismic noise presents only in certain seasons (as little as 1-2 months or 3 or 4). Examples: attendance of a summer holiday resort, boiler for radiators turned on only in winter, seasonal river, etc.
- **Start Time:** Insert the start Time of seismic noise due to a specific source (historic of non-periodic noise) Examples: the factory closes at a time [hh:mm:ss]
- **End Time:** Insert the end Time of seismic noise due to a specific source (historic of non-periodic noise) Examples: the factory closes at a time [hh:mm:ss]
- **Distance:** Distance between the noise source and the sensor. Concerning the "Thermal instability", indicate the distance only if a clear source of heat in the proximity is identified. If the thermal instability is only due to air current or to a non thermal insulation of the sensor, DO NOT indicate the distance [m]
- **Latitude:** Latitude of the noise source [°]
- **Longitude:** Longitude of the noise source [°]
- **Elevation:** Longitude of the noise source [m]
- **Spatial Ref System:** Reference system used to define the coordinates.
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Note:** Description of the Noise Source with the information not included with other parameters..

DATA QUALITY

Analysis of the seismic signal for checking noise level, transmission problems, gaps, inconsistencies in the transfer function, etc. Diagrams or parameters that indicate the DATA quality, not always and not necessarily represent the site quality.

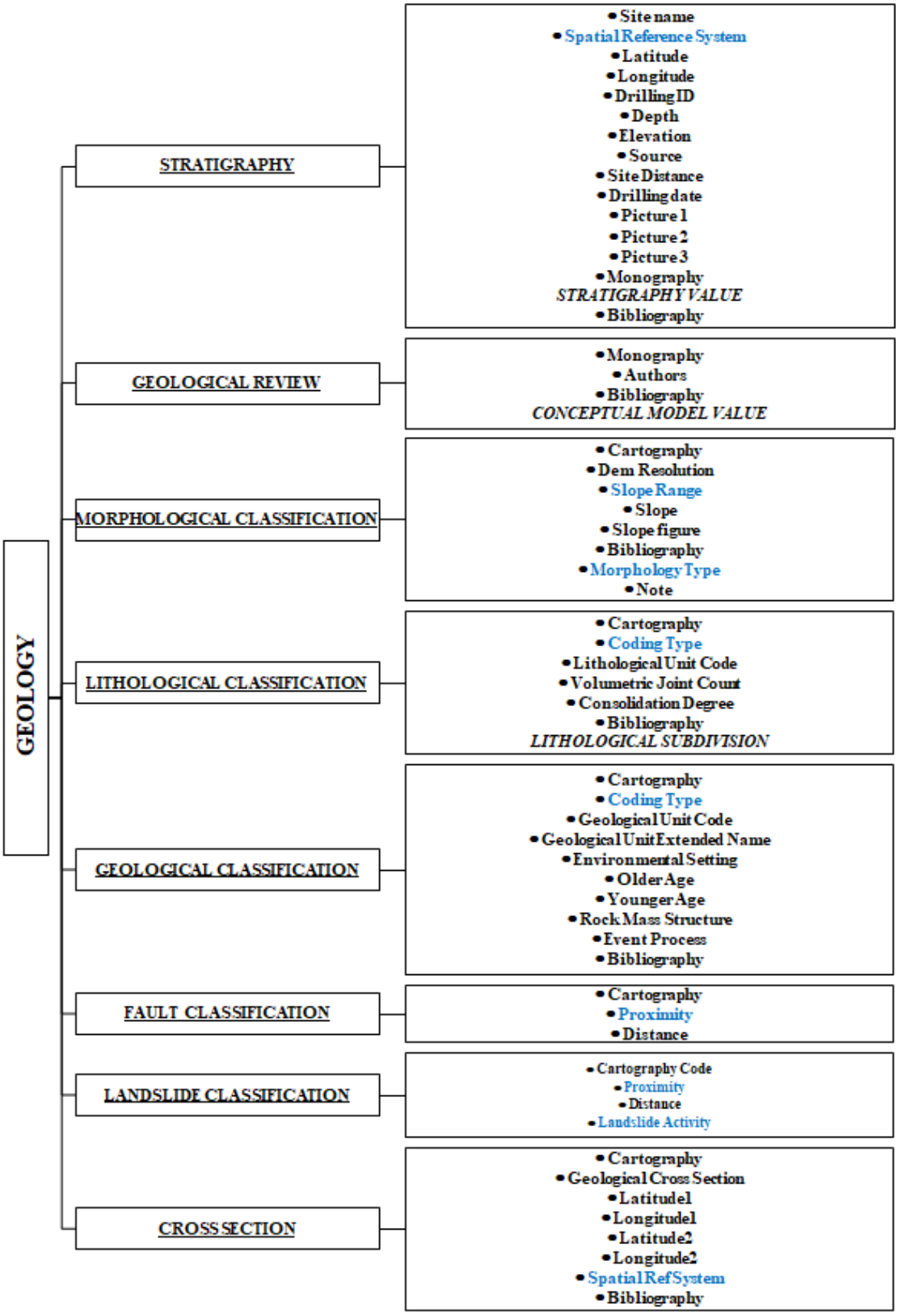
- **Component type:** Component of the analysed seismogram
  - E: Est -West component.
  - N: North-South component.
  - Z: Vertical Component.
  - H: horizontal component
- **Band Instrument:** Frequency-band code. The first letter specifies the sampling rate and the response frequency-band of the instrument, the second letter specifies the family to which the sensor belongs (SEED Reference Manual, 2012).
- **Seasonal Noise Figure:** Figure of spectrograms showing the annual trend of seismic noise as a function of months
- **Annual Noise Figure:** Figure showing the annual trend of seismic noise in terms of Power Spectral Density (PSD) as a function of frequency (one figure for each component). It also shows the curves of 10th and 90th percentiles, the Peterson reference curves. The color scale indicates the Probability Density Function (in percentage).

DATA QUALITY VALUES (table)

Table with the PSD values of the annual noise: frequency, moda, 10th, 90th percentiles.

- **Frequency:** The Frequency chosen to calculate the PSD [Hz]
- **Amplitude Db:** VALUES indicating the moda of the daily PSD at the selected frequencies [dB].
- **n10_th_Percentile**: VALUES indicating the 10th percentile of PSD at the selected frequencies [dB].
- **n90_th_Percentile**: VALUES indicating the 90th percentile of PSD at the selected frequencies [dB].

GEOLOGY


GEOLOGY
STRATIGRAPHY
• Site name
• Spatial Reference System
• Latitude
• Longitude
• Drilling ID
• Depth
• Elevation
• Source
• Site Distance
• Drilling date
• Picture 1
• Picture 2
• Picture 3
• Monography
STRATIGRAPHY VALUE
• Bibliography
GEOLOGICAL REVIEW
• Monography
• Authors
• Bibliography
CONCEPTUAL MODEL VALUE
MORPHOLOGICAL CLASSIFICATION
• Cartography
• Dem Resolution
• Slope Range
• Slope
• Slope figure
• Bibliography
• Morphology Type
• Note
LITHOLOGICAL CLASSIFICATION
• Cartography
• Coding Type
• Lithological Unit Code
• Volumetric Joint Count
• Consolidation Degree
• Bibliography
LITHOLOGICAL SUBDIVISION
GEOLOGICAL CLASSIFICATION
• Cartography
• Coding Type
• Geological Unit Code
• Geological Unit Extended Name
• Environmental Setting
• Older Age
• Younger Age
• Rock Mass Structure
• Event Process
• Bibliography
FAULT CLASSIFICATION
• Cartography
• Proximity
• Distance
LANDSLIDE CLASSIFICATION
• Cartography Code
• Proximity
• Distance
• Landslide Activity
CROSS SECTION
• Cartography
• Geological Cross Section
• Latitude1
• Longitude1
• Latitude2
• Longitude2
• Spatial Ref System
• Bibliography

STRATIGRAPHY

This section includes the punctual stratigraphic information, derived from well logs and continuous cores, obtained from authoritative national repositories. Italian data are available from several sources, such as: Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA; https://www.isprambiente.gov.it/en/databases/data-base-collection/soil-and-territory/geognostic-and-geophysical-data, seismic microzonation (https://www.webms.it/) or geognostic investigations carried out for the characterization of the station sites.

- **Site name**: Alphanumeric unique code that identifies the site station.
- **Spatial Reference System:** Reference system of coordinates of stratigraphic log
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Latitude:** Latitude of coordinates of stratigraphic log, expressed in decimal degrees in the geodetic reference system defined in Spatial Ref System. [°]
- **Longitude:** Longitude of coordinates of stratigraphic log, expressed in decimal degrees in the geodetic reference system defined in Spatial Ref System. [°]
- **Drilling ID:** Alphanumeric unique code identifying each available stratigraphic information
- **Depth:** The depth of the log [m]
- **Elevation**: Height above sea level [m]
- **Source:** Type of wells
- **Site Distance:** Distance of the stratigraphic log to the station [m].
- **Drilling date:** Date of the drilling execution [dd/mm/yyyy]
- **Picture 1:** Picture of the stratigraphic log, if available: image or link of available WMS service.
- **Picture 2:** Picture of the stratigraphic log, if available: image or link of available WMS service.
- **Picture 3:** Picture of the stratigraphic log, if available: image or link of available WMS service.
- **Monography**: Report containing information on the execution of the drilling and the stratigraphic log.
- **Bibliography**

STRATIGRAPHY VALUE (table)

Descriptive attributes of the different stratigraphic units identified in the well logs at different depths.

- **Top Depth:** Top depth of the stratigraphic unit [m]
- **Bottom Depth:** Bottom depth of the stratigraphic unit. [m]
- **Unit description:** Lithological description available for the stratigraphic unit

GEOLOGICAL REVIEW

This section summarizes the major geological features of the seismic station site. These features are synthesized in a short illustrative report containing the geological setting, the geological cross-section passing through the site and the conceptual model of subsoil lithostratigraphy and their lithotechnical properties.

- **Monography**: Documentation describing the geological setting, lithostratigraphic model and lithotechnical properties of the subsoil deposits of the station site
- **Authors:** List of names of authors contributing to the geological review.
- **Bibliography**

CONCEPTUAL MODEL VALUE (table)

The table summarizes the lithotechnical characteristics of the depositional units of the proposed conceptual stratigraphic model for the site. The proposed model is constrained by the available stratigraphic data.

- **Range of Interest:** Distance from the station for which the geological model is considered valid [m]
- **Lithology:** Description of rock types (lithified and non-lithified)

- **Lithological Class**: Subdivision of rock types
- **Maximum Thickness:** Value of the maximum thickness of the lithology in the considered range of interest [m]
- **Minimum Thickness**: Value of the minimum thickness of the lithology in the considered range of interest [m]
- **Real Thickness:** Value of the lithology thickness at the seismic station [m]
- **Rock Mass Structure:** Description of the structural characteristics, such as level of stratification, rate of fracturing, that affect the rock mass
- **Fractured:** Presence (yes) or absence (no) of fractures
- **Strike:** direction of the intersection line between the horizontal plane and a bed or other geological surface, measured in a clockwise direction from the North. By definition, it is perpendicular to the dip direction. It can assume values between 0° and 180°. [Degrees]
- **Dip angle:** angle of inclination of a bed or other geological surface, measured downward from the horizontal plane, referred to the dip direction. It can assume values between 0° (horizontal) and 90° (vertical). [Degrees]
- **Dip direction:** direction, projected on the horizontal plane, of the steepest angle of descent of a bed or other geological surface, measured in a clockwise direction from North. By definition, it is perpendicular to the strike direction. It can assume values between 0° and 360°. [Degrees]
- **Age Of Deposit MIN:** Corresponds to the oldest geological time of the deposit. Different hierarchical orders of geochronological units (e.g. Period, Epoch, Stage) can be indicated in this field.
- **Age Of Deposit MAX:** Corresponds to the youngest geological time of the deposit. Different hierarchical orders of geochronological units (e.g. Period, Epoch, Stage) can be indicated in this field.
- **Consistency:** Qualitative estimation of the loose sediment or the rock stiffness. The estimation is carried out through discrete classes among lithoid, cohesive, incoherent or compositions of these terms.
- **Environmental Setting:** Physical environment where the natural processes that lead to the genesis of stratigraphic layers.
- **Compactness Degree:** Qualitative estimation of the level of compaction of the loose sediment or the rock by classes ranging from low to high.
- **Layer Number:** Indicates the position, from top to bottom, of a layer within the stratigraphic Conceptual Model.

MORPHOLOGICAL CLASSIFICATION

In these fields are stored the data resulting from morphological analysis of the site based on open access databases of Digital Elevation Models, topographic maps and satellite and aerial photos or obtained from scientific literature.

- **Cartography Title:** Indicates the name of the Digital Elevation Model or of the topographical map of reference for the morphological analyses.
- **Dem Resolution:** Resolution of the Digital Elevation Model (DEM) used for the analysis [m]
- **Slope Range:** Classes of values from DEM analysis. The three proposed slope ranges are in according with the Italian building code (NTC 2008- NTC 2018) and are used to assign a topographic class to the site:
  - ANGLE_LE15: ANGLE < 15°
  - ANGLE_GT15_LE30: 15°< ANGLE <= 30°
  - ANGLE_GT30: ANGLE > 30°
- **Slope:** Value of the slope below the site, extracted from the slope map obtained from digital terrain analysis of the DEM. [°].
- **Slope Figure:** Slope and ridge map image prepared for the station
- **Bibliography**

TYPE OF MORPHOLOGY

The field describes the landform of the site where the seismic station is installed. Different options are available (Basin, Relief, Other, None). Additional attributes are included for Basin and Relief morphological types.

- **Morphology Type**
  - BASIN: This class groups all morphological elements that represent a flat or "nearly flat" shape such as: valley, basin, plain, terrace, plateaux, fan
    - **Basin Position Type**: Site location relative to the entire basin. The evaluation of this descriptive attribute is generally based on observation of satellite images (e.g. Google Earth), supported by direct information or morphological models available for the area. It has two options:
      - CENTRE
      - EDGE
  - **Wl:** Closest distance of the site to the edge of the valley [m].
  - **Hl**: Thickness of the deposits below the station [m].
  - **Hb**: Maximum thickness of the deposits in the basin [m].
  - **Wb**: Length of the 2D cross-section passing through the site [m].
  - **Aspect Ratio**: Ratio (M/m) between the values of the Maximum (M) and minimum (m) axes representative of the basin.
  - **Bibliography**
  - RELIEF**:** this morphological type is used when the site is located on a topographic relief. The geometric attributes of the relief mainly come from morphological analysis on Digital Elevation Models.
    - **Relief Position Type**: Position of the station relative to the relief. Different choice options are available among bottom, ridge, saddle and hillside.
      - BOTTOM: If the station is at the base of the relief;
      - RIDGE: If the station is in the uppermost part of the relief, topographically highest position of the relief (top, summit);
      - SADDLE: If the station is in a low point on a ridge;
      - HILLSIDE: If the station is between the summit and the base of the relief
  - **Height Vertical Drop**: relative difference in elevation between the upland summit and the lowland of the relief. [m].
  - **Width**:shortest horizontal dimension of the relief. [m].
  - **Length**: longest horizontal dimension of the relief. [m].
  - **Direction**: trend of the maximum elongation of the relief. [°].
  - **Bibliography**: References used to define the geometrical parameters of the relief.
  - OTHER**:** Other type
- **Note**: Additional information about the morphology type described

LITHOLOGICAL CLASSIFICATION

This section is dedicated to the description of the lithological attributes of the unit mapped in the site. The attributes derive from the authoritative national repositories. Italian data are available from several sources, such as the database of the lithological map of Italy in scale 1:100.000 managed by ISPRA (https://www.isprambiente.gov.it/en/services/cartography/geological-and-geothematic-maps). The fields, the descriptive attributes and the lithological terminology used are in agreement with the European ISPIRE directive. The contents of this section may also be compiled according to the national standards of classification and representation used for Seismic Microzonation studies (https://www.webms.it/) or surveys carried out for the characterization of the station sites.

- **Cartography Title:** Indicates the name and the representation scale of the lithological map used to identify lithostratigraphic units outcropping at the site.
- **Coding Type:** Indicates the classification system used to define the lithological units. Options:

  - ISPRA 2010: from ISPRA coding used in the Italian Lithological map 1:100.000 (https://www.isprambiente.gov.it/en/services/cartography/geological-and-geothematic-maps)
  - Microzonation: Italian Seismic Microzonation guidelines from National Civil Protection Department (https://rischi.protezionecivile.it/en/seismic/activities/emergency-planning-and-damage-scenarios/seismic-microzonation; https://www.centromicrozonazionesismica.it/en/download-en/category/3-linee-guida)
  - Other
  - None
- **Lithological Unit Code:** Alphanumeric code that identifies the lithological unit according to the classification system selected in coding type
- **Volumetric Joint Count:** Represents the average number of joints present in the rock mass volume considered. Can also be expressed with a range of values.
- **Consolidation Degree:** Used for specifying the degree of consolidation of the deposits, by distinguishing rock from unconsolidated material.
- **Lithologic Class:** Subdivision of rock types.
- **Lithologic Description:** Description of rock types, lithified and non-lithified
- **Number of Lithology Subdivision:** Indicates the number of different lithotypes, consolidated and unconsolidated, that compose the lithological unit outcropping at the site
- **Bibliography**

LITHOLOGICAL SUBDIVISION (table)
In the table are described the attributes of each component (lithotype) that composes the stratigraphic unit outcropping at the site station:
- **Item Count**: Counter for the progressive number of lithologies considered for each lithological class.
- **Proportion:** Qualitative expression of the abundance of a specific lithotype compared to the others that constitute the stratigraphic unit.
- **Role**: Indicates the role that a specific lithotype plays in the lithostratigraphic unit.
- **Material**: Description of each lithotype that constitutes the lithostratigraphic unit.

GEOLOGICAL CLASSIFICATION

This section is dedicated to the description of the geological attributes of the unit mapped in the site. The descriptive fields contain the attributes derived from the authoritative national repositories. Italian data are available from several sources, such as the database of the geological map of Italy in scale 1:100.000 managed by ISPRA (https://www.isprambiente.gov.it/en/services/cartography/geological-and-geothematic-maps). The fields, the descriptive attributes and the geological terminology used are in agreement with the European ISPIRE directive. The contents of this section may also be compiled according to the national standards of classification and representation used for Seismic Microzonation studies (https://www.webms.it/) or surveys carried out for the characterization of the station sites.

- **Cartography Title:** Indicates the name and the representation scale of the geological map used to identify geological units outcropping at the site.
- **Coding Type:** The field indicates the normative reference code used for the Geological classification. Options:
  - ISPRA 2010: from ISPRA coding used in the Italian Geological map 1:100.000 (https://www.isprambiente.gov.it/en/services/cartography/geological-and-geothematic-maps)
  - Microzonation: Italian Seismic Microzonation guidelines from National Civil Protection Department (https://rischi.protezionecivile.it/en/seismic/activities/emergency-planning-and-damage-scenarios/seismic-microzonation; https://www.centromicrozonazionesismica.it/en/download-en/category/3-linee-guida)
  - Other
  - None

- **Geological Unit Code:** Alphanumeric unique code that identifies, into the database, the geological unit outcropping the site.
- **Geological Unit Extended Name:** Formal name of the geological unit.
- **Environmental Setting:** Physical environment where the natural processes that lead to the genesis of geological units take place.
- **Age (Older - Younger):** Lower and upper geologic time reference of the geological unit. Geochronological units of different hierarchical order can be indicated in this field (e.g. Period, Epoch, Stage).
- **Rock Mass Structure:** Description of the structural characteristics, such as level of stratification, rate of fracturing, that affect the rock mass.
- **Event Process:** Natural process that leads to the genesis of a geologic unit.
- **Bibliography**

FAULT CLASSIFICATION

This section contains information on the existence of faults within a distance of 50 m from the considered site (without considering their kinematics or activity). This information comes from published sources such as geological maps, tectonic maps, fault databases (e.g. ITaly HAzards for CApable faulting catalogue - ITHACA, Database of Individual Seismogenic Source - DISS) or from scientific papers.

- **Cartography Title:** Indicates the name and representation scale of the geologic or tectonic map from which the fault information was extracted. The field may also contain an indication of the fault database used for the description.
- **Proximity:** Proximity of the site to tectonic features. It has been chosen the distance of 50 m to define the attribute "fault proximity":
  - T (TRUE) if the site is within 50 m of the geological structure
  - F (FALSE) if the site is located at a distance bigger than 50 m from the geological structure.

Distance: Exact distance between the station and the fault. The field is filled only if the attribute Proximity is TRUE. [m]

LANDSLIDE CLASSIFICATION

This section contains information on the proximity of the site to any landslides mapped in published sources such as Italian Landslide Inventory (IFFI Inventory; https://www.progettoiffi.isprambiente.it/en/inventory/), regional hydrogeologic management plans or geomorphological-geological maps. Proximity is defined within a distance of 1 km.

- **Cartography Title:** This is a code to distinguish the single cartographic map inside the geodatabase with a drop down list. There mustn't be two maps with the same cartography code inside the database.
- **Proximity:** Two options:
  - T (TRUE) if the station site is located at a distance less than 1 km from the landslide
  - F (FALSE) if the station site is located at a distance more than 1 km from the landslide
- **Distance:** If the attribute LandslideProximity is TRUE, write in this field the exact distance of the station to the landslide. If the station is installed on the landslide, write 0. Example: 250 m [m]
- **Landslide Activity:** The class defines the activity of the landslide. FONTE: GNGFG (1987). Cartografia della pericolosità connessa ai fenomeni di instabilità dei versanti. A cura di Carrara A., Carton A., Dramis F., Panizza M. & Prestininzi A. Boll. Soc. Geol. It., 106, 199-221.

  Option: active, quiescent, inactive, no_information. Example: active
  - ACTIVE: If they are associated with processes in place to detect the movement.
  - QUIESCENT: Inactive forms at the moment, for which however there is evidence showing that they are an objective possibility of reactivation, as they have not exhausted their potentialities of evolution.

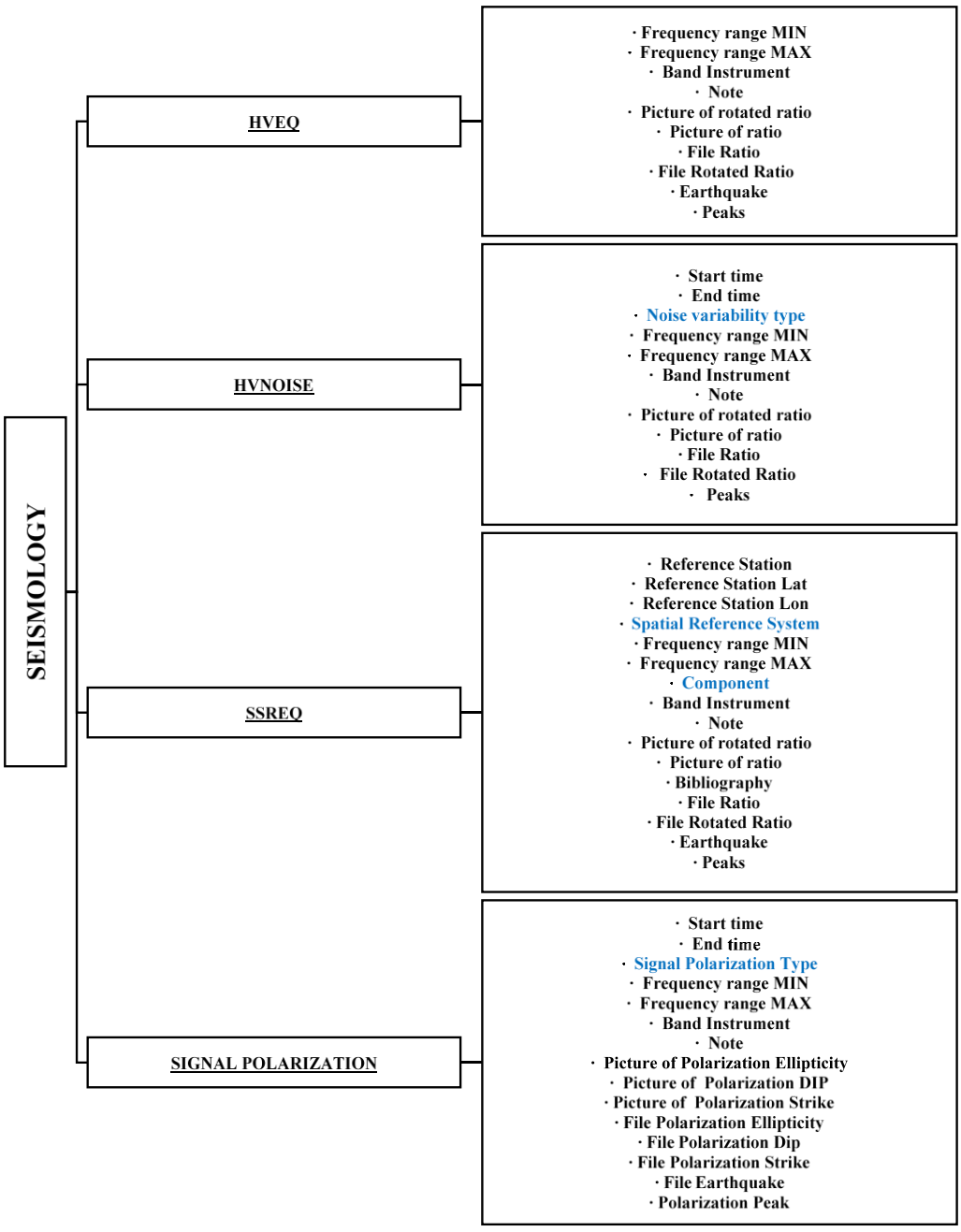
- INACTIVE: If the morphogenetic agent is no longer present at the time of detection, since it has exhausted its activities
- NO INFORMATION: No information for landslide activity

CROSS SECTION

These fields are dedicated to storing information about geological cross sections, if available. The cross sections show the stratigraphic setting and the geometric relationships of the geological or lithological units throughout a 2D sketch of subsurface in the area around the site (A and B indicate the two ends).

- **Cartography Title:** Indicates the name and the representation scale of the geologic map describing the geological units identified in the macro area.
- **Geological Cross Section:** Dedicated field to storage the geological cross section image.
- **Site Name:** Site Name selectable by site inside database through a drop down list.
- **Latitude1:** Latitude of A point [°]
- **Longitude1:** Longitude of A point [°]
- **Latitude2:** Latitude of B point [°]
- **Longitude2:** Longitude of B point [°]
- **Spatial Ref System:** Reference system of the A and B endpoints of the geological cross-section.
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Bibliography**

SEISMOLOGY



HVEQ

Average of the horizontal-to-vertical spectral ratios (H/V) calculated on selected seismic events. It is also available the H/V computed after rotating the horizontal components from 0° to 180° with 10° bins.

- **Frequency range MIN:** Minimum frequency of the signal frequency range considered in the analysis. [Hz]
- **Frequency range MAX:** Maximum frequency of the signal frequency range considered in the analysis. [Hz]

- **Band Instrument:** Frequency-band code. The first letter specifies the sampling rate and the response frequency-band of the instrument, the second letter specifies the family to which the sensor belongs (SEED Reference Manual, 2012).
- **Note:** Documentation: general remarks on the analysis results
- **Picture of rotated ratio:** Picture representing the analysis results in jpg or pdf format.
- **Picture of ratio:** Picture representing the analysis results of spectral ratio for the average horizontal component (see table Ratio) [jpg, png]

FILE RATIO (table)
Values describing the average spectral ratio for the average horizontal component.
- **Frequency**: Frequency values describing the final H/V single curve calculated as the geometric mean of all individual curves derived from all the selected time windows. [Hz]
- **Amplitude**: Average spectral ratio calculated as the geometric mean of the spectral ratios for all the events (or selected windows).
- **Standard Deviation Up** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean minus 1 standard deviation
- **Standard Deviation Down:** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean plus 1 standard deviation

FILE ROTATED RATIO (table)
Values describing the spectral ratio computed at different rotated components.
- **Frequency**: Frequency values [Hz]
- **Angle:** Angle of values [°]
- **Amplitude:** Amplitude values

EARTHQUAKE (table)
List of the hypocentral parameters and magnitude of the selected earthquakes used for the analysis.
- **latEq:** latitude of the earthquake location [°]
- **lonEq:** longitude of the earthquake location [°]
- **depthEq:** depth of the earthquake location [km]
- **origin Time:** origin time of the earthquake [dd/mm/yyyy hh:mm:ss]
- **MagEq**: Magnitude of the earthquake [Ml, Mw]

PEAK (table)
Peaks values starting from the lower frequency.
- **Number of peak**: Number of peaks showing H/V amplitude higher than 2
- **Peak Frequency:** Frequency related to the selected peak [Hz]
- **Peak Amplitude:** Amplitude related to the selected peak
- **Direction of Max Amplitude:** value of the rotation angle associated with the maximum amplitude level [°]
- **Frequency Band Min:** Minimum frequency value defining the amplified frequency band [Hz]
- **Frequency Band Max:** Maximum frequency value defining the amplified frequency band [Hz]

HVNOISE

Average of the horizontal-to-vertical spectral ratios (H/V) calculated on ambient noise. It is also available the H/V computed after rotating the horizontal components from 0° to 180° with 10° bins.
- **Start Time:** Start time of the performed analysis (not the beginning time of the cut signal [dd/mm/yyyy hh:mm:ss]
- **End Time:** End time of the performed analysis (not the ending time of the cut signal [dd/mm/yyyy hh:mm:ss]

- **Noise Variability Types:** Daily, seasonal or other types of variability systematically recognized on ambient noise during the analysis
  - DAYTIME
  - NIGHT
  - SEASONAL
  - RANDOM
  - ANTHROPIC
- **Frequency Range Min:** Minimum frequency of the signal frequency range considered in the analysis[Hz]
- **Frequency Range Max:** Maximum frequency of the signal frequency range considered in the analysis [Hz]
- **Band Instrument:**Frequency-band code. The first letter specifies the sampling rate and the response frequency-band of the instrument, the second letter specifies the family to which the sensor belongs (SEED Reference Manual, 2012).
- **Note:** Documentation: general remarks on the analysis results
- **Picture of rotated ratio:** Picture representing the analysis results
- **Picture of ratio:** Picture representing the analysis results of spectral ratio for the average horizontal component (see table Ratio).

FILE RATIO (table)
Values describing the average spectral ratio for the average horizontal component.
- **Frequency**: Frequency values describing the final H/V single curve calculated as the geometric mean of all individual curves derived from all the selected time windows. [Hz]
- **Amplitude**: Average spectral ratio calculated as the geometric mean of the spectral ratios for all the events (or selected windows).
- **Standard Deviation Up** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean minus 1 standard deviation
- **Standard Deviation Down:** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean plus 1 standard deviation

FILE ROTATED RATIO (table)
Values describing the spectral ratio computed at different rotated components.
- **Frequency**: Frequency values [Hz]
- **Angle:** Angle of values [°]
- **Amplitude:** Amplitude values

PEAK (table)
Peaks values starting from the lower frequency.
- **Number of peak**: Number of peaks showing H/V amplitude higher than 2
- **Peak Frequency:** Frequency related to the selected peak [Hz]
- **Peak Amplitude:** Amplitude related to the selected peak
- **Direction of Max Amplitude:** value of the rotation angle associated with the maximum amplitude level [°]
- **Frequency Band Min:** Minimum frequency value defining the amplified frequency band [Hz]
- **Frequency Band Max:** Maximum frequency value defining the amplified frequency band [Hz]

SSREQ

Average of the standard spectral ratio (SSR) calculated using a reference site separately on selected seismic events. SSRs using the reference site are calculated after rotating the horizontal components by steps of 10° from 0° to 180°. For each angle, the amplitude spectrum of the rotated components is calculated, then smoothed and divided by the reference station smoothed spectrum for each angle.

- **Reference Station:** ID of the station chosen as a reference site.

- **Reference Station Lat:** Latitude in decimal degrees of the reference site [°]
- **Reference Station Lon:** Longitude in decimal degrees of the reference site [°]
- **Spatial Reference System:** A list of the more common Reference system used in Italy is presented, but all EPSG systems are allowed
  - ED_1950_UTM_ZONE33
  - GCS_MONTE_MARIO_ROME
  - GCS_WGS_1984
  - WGS_1984_UTM_ZONE_32N
  - WGS_1984_UTM_ZONE_33N
- **Frequency range MIN:** Minimum frequency of the signal frequency range considered in the analysis. [Hz]
- **Frequency range MAX:** Maximum frequency of the signal frequency range considered in the analysis. [Hz]
- **Component:**
  - E: Est -West component.
  - N: North-South component.
  - Z: Vertical component
  - H: Horizontal component
- **Band Instrument:** Frequency-band code. The first letter specifies the sampling rate and the response frequency-band of the instrument, the second letter specifies the family to which the sensor belongs (SEED Reference Manual, 2012).
- **Note:** Documentation: general remarks on the analysis results
- **Picture of rotated ratio:** Picture representing the analysis results
- **Picture of ratio:** Picture representing the analysis results of spectral ratio for the average horizontal component (see table Ratio).
- **Bibliography:** Bibliography references for the selection of the reference site

FILE RATIO (table)

Values describing the average spectral ratio for the average horizontal component.

- **Frequency**: Frequency values describing the final H/V single curve calculated as the geometric mean of all individual curves derived from all the selected time windows. [Hz]
- **Amplitude**: Average spectral ratio calculated as the geometric mean of the spectral ratios for all the events (or selected windows).
- **Standard Deviation Up** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean minus 1 standard deviation
- **Standard Deviation Down:** Amplitude standard deviation of H/V individual curves derived from all the selected time windows, mean plus 1 standard deviation

FILE ROTATED RATIO (table)

Values describing the spectral ratio computed at different rotated components.

- **Frequency**: Frequency values [Hz]
- **Angle:** Angle of values [°]
- **Amplitude:** Amplitude values

EARTHQUAKE (table)

List of the hypocentral parameters and magnitude of the selected earthquakes used for the analysis.

- **latEq:** latitude of the earthquake location [°]
- **lonEq:** longitude of the earthquake location [°]
- **depthEq:** depth of the earthquake location [km]
- **origin Time:** origin time of the earthquake [dd/mm/yyyy hh:mm:ss]
- **MagEq**: Magnitude of the earthquake [Ml, Mw]

PEAK (table)
Peaks values starting from the lower frequency.
- **Number of peak**: Number of peaks showing H/V amplitude higher than 2
- **Peak Frequency:** Frequency related to the selected peak [Hz]
- **Peak Amplitude:** Amplitude related to the selected peak
- **Direction of Max Amplitude:** value of the rotation angle associated with the maximum amplitude level [°]
- **Frequency Band Min:** Minimum frequency value defining the amplified frequency band [Hz]
- **FrequencyBand Max:** Maximum frequency value defining the amplified frequency band [Hz]

SIGNAL POLARIZATION

Frequency-dependent analysis of time series to investigate the predominant direction of motion in the horizontal plane, for both ambient noise and earthquake signals.

- **Start time:** Start time used in the analysis [dd/mm/yyyy hh:mm:ss]
- **End time:** End time used in the analysis [dd/mm/yyyy hh:mm:ss]
- **Signal Polarization Type:** Polarization analysis form Noise or Earthquake
  - EARTHQUAKE
  - NOISE
- **Frequency Range Min:** Minimum value considered in polarization analysis [Hz]
- **Frequency range Max:** Maximum value considered in polarization analysis [Hz]
- **Band Instrument:** Frequency-band code. The first letter specifies the sampling rate and the response frequency-band of the instrument, the second letter specifies the family to which the sensor belongs (SEED Reference Manual, 2012).
- **Note:** general remarks on the analysis results
- **Picture of Polarization Ellipticity:** Picture representing polarization analysis results in terms of ellipticity values.
- **Picture of Polarization DIP:** Picture representing polarization analysis results in terms of dip values.
- **Picture of Polarization Strike:** Picture representing polarization analysis results in terms of strike values.

FILE POLARIZATION ELLIPTICITY (table)
Table reporting ellipticity values obtained through polarization analysis (output file of WavePol program).
- **frequency**: Frequency value [Hz]
- **value**: Ellipticity value [0-1]
- **freq Of Occurrence**: Frequency of occurrence of the value [Hz]

FILE POLARIZATION DIP (table)
Table representing dip values given by polarization analysis (output file of WavePol program).
- **frequency**: Frequency value [Hz]
- **value**: Dip. value [°]
- **freq Of Occurrence**: Frequency of occurrence of the value [Hz]

FILE POLARIZATION STRIKE (table)
Table with strike values of polarization analysis (output file of WavePol program)
- **frequency**: Frequency value [Hz]
- **value**: Strike value [°]
- **freq Of Occurrence**: Frequency of occurrence of the value [Hz]

FILE EARTHQUAKE (table)
List of the hypocentral parameters and magnitude of the selected earthquakes
- **latEq:** latitude of the earthquake location [°]
- **lonEq**: longitude of the earthquake location [°]

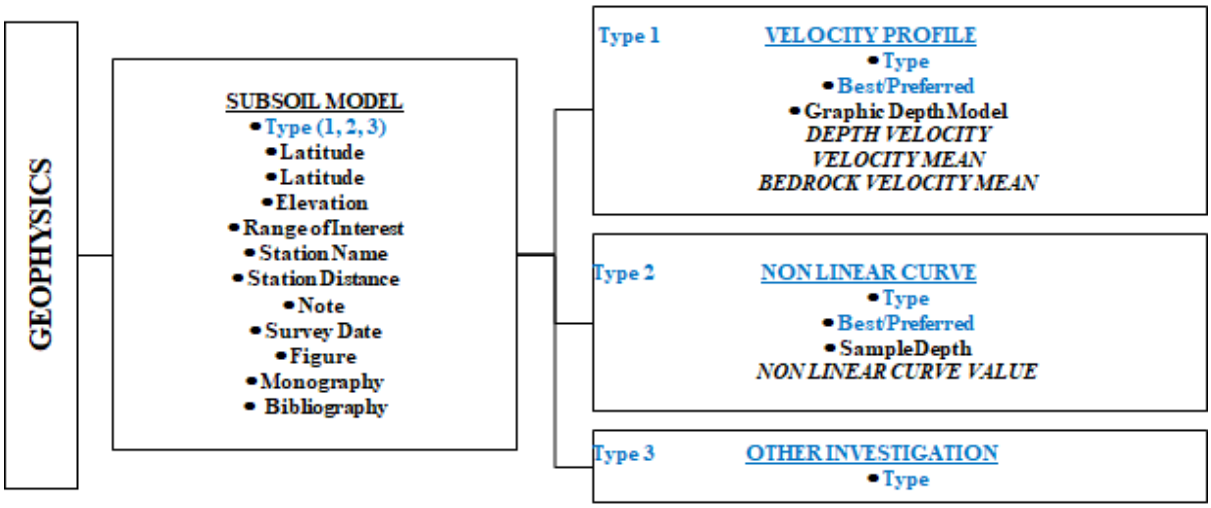
- **depthEq**: depth of the earthquake location [m]
- **originTime**: origin time of the earthquake [dd/mm/yyyy hh:mm:ss]
- **MagEq**: Magnitude of the earthquake

POLARIZATION PEAK (table)

Summary table of frequency peaks of maximum polarization. Peak properties (ellipticity, strike, dip, frequency) are reported.

- **Number**: Numeration of frequency peaks showing polarization, starting from the lower frequency.
- **directionOfPrincipalAxis**: Azimuth of the major polarization axis, or strike, in degrees from North [°]
- **ellipticity**: Ratio between the length of the semi-minor and semi-major axes. Zero implies linear particle motion, unity implies circular particle motion.
- **Dip Angle:** Tilt of the major axis, or dip, measured in degrees downwards from the horizontal [°]
- **frequency**: Frequency of the observed peak [Hz]

GEOPHYSICS



SUBSOIL MODEL

Geophysical and geotechnical properties to define the subsoil model.

- **Subsoil Model Type:** The available geophysical and geotechnical investigations used for the definition of the subsoil model. This field includes three types:
  1) VELOCITY PROFILE
  2) NON LINEAR CURVE
  3) OTHER INVESTIGATION
- **Latitude:** Latitude of the investigation in WGS84 geodetic reference system [°]
- **Longitude:** Longitude of the investigation, WGS84 geodetic reference system [°]
- **Elevation:** Height of the investigation above a given level, usually sea level [m]
- **Range of Interest:** Spatial radius of interest for which the geological model and the parameters deducted are valid [m]
- **Station Name:** code of the target station inside the database
- **Station Distance:** Distance between the available geophysical and geotechnical investigations and the target station used for the definition of the subsoil model [m]
- **Note:** Documentation: general remarks
- **Survey Date:** Survey date for the subsoil model [dd/mm/yyyy hh:mm:ss]
- **Figure:** Picture representing the analysis results of Subsoil Model Type.
- **Monography:** Monograph file to be attached
- **Bibliography**

1) VELOCITY PROFILE

Subsoil velocity profile as function of the depth (z), in terms of shear wave (Vs) and/or compression wave (Vp) velocities.

- **Velocity profile type**: Type of investigation used to measure the velocity profile. It is possible to choose more than one option simultaneously.
  - DH: Down-Hole test
  - CH: Cross-Hole test

  - SCPTU: Seismic piezocone test
  - SDMT: Seismic dilatometer test
  - MASW: Multichannel analysis surface wave using active source
  - SA: Ambient noise seismic array (linear or 2D configuration)
  - SR: Seismic refraction
  - SRR: Seismic reflection
  - ST: Seismic tomography
  - OTHER: Other investigations that provide the measurement of the Velocity Profile.
  - COMPOUND: Compound Velocity is a combined velocity profile inferred by an expert user from all the available information. All the surveys used to derive the velocity profile should be listed in Compound Velocity. For example DH, SR, SA means that the velocity profiles was derived combining down hole and seismic refraction data with ambient noise array
- **Preferred:** The attribute identifies if the velocity profile is considered as the best evaluation from expert opinion.
  - YES
  - NO
- **Graphic Depth Model**: Image for bidimensional (2D) Vs and/or Vp velocity profile (e.g. results from 2D seismic tomography).

VELOCITY MEAN (table)

Average velocity model at some fixed depth in correspondence of the studied seismic station, selected by the operator from the Best Velocity Profile.

- **Velocity mean type:** Average shear wave velocity following a reference seismic code (EC8, NTC08, NTC18, NEHRP, etc.).
  - VS30: Travel-time average of shear-wave velocity Vs over the first 30 m depth. It should be computed in accordance with the following expression, as reported in EC8 and NTC18:

$$V_{S30} = 30 / \Sigma_{i=1}^{N} \frac{h_i}{V_{S,i}}$$

    where i=1...N, h_i and $V_{S,i}$ are thickness (m) and shear-wave velocity (m/s) of the i-layer, up to 30 m.
  - VSEQ: average of shear-wave velocity (m/s) weighted on thickness of surface layers down to the layer with Vs>= 800 m/s (engineering bedrock). If bedrock depth is larger than 30 m, VSEQ is set equal to Vs30. It should be computed in accordance with the following expression, as reported in NTC18:

$$V_{S,eq} = H / \Sigma_{i=1}^{N} \frac{h_i}{V_{S,i}}$$

    where i=1...N, h_i and $V_{S,i}$ are thickness (m) and shear-wave velocity (m/s) of the i-layer, up to the depth of engineering bedrock (if smaller than 30 m).
  - OTHER: This field indicates other definitions of the VelocityMeanType (Vs5, Vs10, Vs20... where the fixed depth is 5, 10, 20 m …).
- **Value**: Average shear wave velocity following the reference code (EC8, NTC08, NTC08rev, etc.) selected in VelocityMeanType. [m/s]
- **Depth**: Maximum depth of the average shear wave velocity [m]
- **Note**: general remarks

BEDROCK VELOCITY MEAN (table)

This field estimates depth, velocity end type of the bedrock (the solid rock underlying unconsolidated surface materials, such as soil

- **Bedrock type:** Bedrock is commonly used by geologists to refer to any rock/soil/consolidated which has not undergone the meteoric processes of perversion and degradation or tectonic deformations. The type bedrock from which VelocityMean was estimated can be seismic, geological or other.

  - SEISMIC: geological unit that controls the lowest (fundamental) resonance frequency peak through the impedance contrast with the upper layers.
  - GEOLOGICAL: Solid rock, non altered, or in outcrop at the base of less rigid rock/soil or loose sediment.
  - OTHER: Other possible type
- **Value**: Estimates value of the depth of the bedrock velocity. [m/s]
- **Depth**: Estimate an evaluation of the depth of the bedrock. [m]
- **Note**: general remarks

DEPTH VELOCITY (table)
Six column table describing the 1D subsoil velocity profile layered with depth. In case of more than one velocity profile for the same investigation, it is selected as the most reliable profile.

- **depth Top:** top depth of each layer in the subsoil velocity profile, starting from the surface. [m]
- **depth Bottom:** bottom depth of each layer in the subsoil velocity profile, starting from the surface. When depth TOP equal to depth BOTTOM, it means that both fields indicate the depth of a punctual measurements [m]
- **Vs:** Shear wave velocity [m/s]
- **Vp:** Compressional wave velocity [m/s]
- **VS Error:** error associated to the shear wave velocity estimation, defining a group of reliable velocity model. [m/s]
- **VP Error:** error associated to the compressional wave velocity estimation, defining a group of reliable velocity model. [m/s]
- **Depth Top Error:** error associated to the DepthTop of the layer. [m]
- **Depth Bottom Error:** error associated to the DepthBottom of the layer- [m]

2) NON LINEAR CURVE

Subsoil non linear curves as a function of the shear strain (γ), in terms of stiffness modulus (G), normalized stiffness modulus (G/G0, where G0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio (Ru = Δu/p', where Δu is the excess pore pressure and p' is the mean normal effective stress). In case of more than one non linear curve for the same sample, it is selected as the most reliable curve.

- **Non linear curve type:** type of investigation used to measure the NonLinear Curve from laboratory analysis.
  - RC: Resonant Column test
  - CTS: Cyclic Torsional Shear test.
  - DSDSS: Double Specimen Direct Simple Shear test.
  - OTHER: Other investigations that provide the measurement of the Nonlinear Curve
- **Preferred:** it identifies if the curve is considered as the best evaluation from expert opinion.
  - YES
  - NO
- **Sample Depth:** Depth of the analyzed sample.

NON LINEAR CURVE VALUE (table)
The Nonlinear Curve is described by a five column table (i.e. γ, G, G/G0, D, Δu/p'). In case of more than one nonlinear curve for the same sample, it is selected as the most reliable curve.

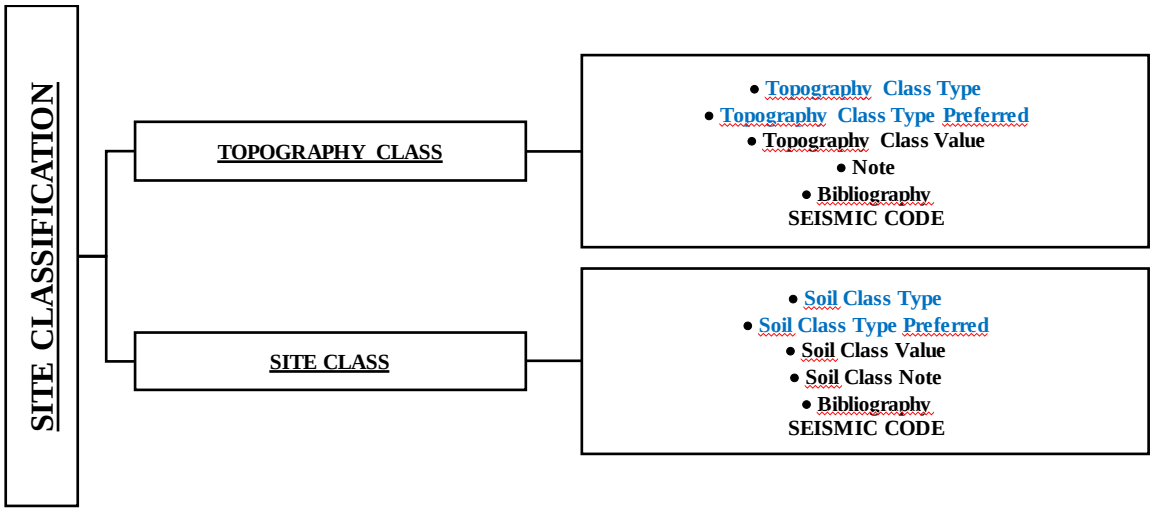
- **Shear strain:** Shear strain (γ). [%]
- **Stiffness Modulus:** Stiffness modulus (G). [MPa]
- **G/G0:** Normalized shear modulus (G/G0, where G0 is the small strain modulus). [dimensionless]
- **Damping Ratio:** Damping ratio (D). [%]
- **Pore Pressure:** Describe the excess pore pressure ratio (Ru = Δu/p', where Δu is the excess pore pressure and p' is the mean normal effective stress). [dimensionless]

3) OTHER INVESTIGATION

Geophysical and geotechnical parameters not provided by VelocityProfile and NonLinearCurve. It could include geological information.

- **Other investigation type:** Type of the Other Investigation.
  - BH: Borehole log.
  - CPTU: Piezocone test.
  - DMT: Flat dilatometer test.
  - SPT: Standard penetration test.
  - DPSH: Dynamic probing super heavy test.
  - VT: Vane test.
  - SLAB: Static laboratory test.
  - AN: Ambient noise measurement
  - ET: Electrical tomography
  - TDEM: Time domain electromagnetic method.
  - KAPPA: Kappa analysis, where kappa is the high-frequency attenuation factor.
  - Q: Quality factor
  - OTHER: Other investigations useful for the subsoil model seismic characterization

SITE CLASSIFICATION



TOPOGRAPHY CLASS

Topographic categories according to a specified Seismic Building Code, representing different interval values of slope and morphologic elements.

- **Topography Class Type:** data type used for the attribution of the topography class value.
  - CARTOGRAPHY
  - GIS ANALYSIS
  - DEM
  - SPECIFIC STUDY
  - OTHER
- **Topography Class Type Preferred:** it identifies if the value is considered as the best evaluation from expert opinion.
  - NO
  - YES
- **Topography Class Value:** alphanumeric code for the topographic classification.
- **Note:** References and strategies used to define the topography class
- **Bibliography**

SEISMIC CODE

Seismic design code (such as EC8, NTC08, NTC18, NEHRP etc.) used in the definition of the topography class.

- **Seismic Code Type:** Seismic code adopted for site classification.
  - EC8: EC8 (2004) prEN 1998-1, Eurocode 8: design provisions for earthquake resistance of structures, Part 1.1: general rules, seismic actions and rules for buildings, CEN, EuropeanCommittee for Standardisation, Brussels.
  - NTC08: NTC08 (2008). Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Decreto Ministeriale del 14 gennaio 2008, Supplemento ordinario alla G.U. n. 29 del 4 febbraio 2008.
  - NTC08.REV: NTC08rev (2014). Bozza di revisione delle Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Parere del Consiglio Superiore dei Lavori Pubblici n.53/2012, espresso nell'Adunanza dell'Assemblea Generale del 14 novembre 2014.

  - NTC18: NTC18 (2018). Aggiornamento delle Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Decreto Ministeriale del 17 gennaio 2018, Supplemento ordinario alla G.U. n. 42 del 20 febbraio 2018 (https://www.gazzettaufficiale.it/eli/gu/2018/02/20/42/so/8/sg/pdf).
  - NEHRP: NEHRP Recommended Seismic Provisions for New Buildings and Other Structures FEMA P-750 / 2009 Edition (https://www.nehrp.gov).
  - OTHER: Provide reference of the selected seismic code.
- **Note:** Documentation, general remarks
- **Bibliography**

SITE CLASS

Soil class according to a specific Seismic Building Code; it is also called "Ground Type" in EC8 (2004) or "Site Class" in some national building codes.

- **Soil Class Type**: Type of information used to assess site classification.
  - GEOLOGY: Geological data
  - ARRAY_MEASUREMENT: Array measurements
  - BOREHOLE: Borehole data
  - GEOTECHNICAL: Geotechnical measurements
  - CROSSHOLE: Cross Hole data
  - DOWNHOLE: Down Hole data
  - MASW: Multichannel Analysis of Surface Waves
  - OTHER: Other measurements
- **Soil Class Type Preferred:** it identifies if the value is considered as the best evaluation from expert opinion.
  - NO
  - YES
- **Soil Class Value:** alphanumeric code for ground type in terms of site class, according to the selected Seismic Code.
- **Soil Class Note:** Strategy used in the SiteClass definition.
- **Bibliography**

SEISMIC CODE

The SeismicCode indicated the seismic design codes (such as EC8, NTC08, NTC18, NEHRP etc) used in the definition of the site class.

- **Seismic Code Type:** Seismic code adopted for site classification.
  - EC8: EC8 (2004) prEN 1998-1, Eurocode 8: design provisions for earthquake resistance of structures, Part 1.1: general rules, seismic actions and rules for buildings, CEN, EuropeanCommittee for Standardisation, Brussels.
  - NTC08: NTC08 (2008). Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Decreto Ministeriale del 14 gennaio 2008, Supplemento ordinario alla G.U. n. 29 del 4 febbraio 2008.
  - NTC08.REV: NTC08rev (2014). Bozza di revisione delle Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Parere del Consiglio Superiore dei Lavori Pubblici n.53/2012, espresso nell'Adunanza dell'Assemblea Generale del 14 novembre 2014.
  - NTC18: NTC18 (2018). Aggiornamento delle Norme tecniche per le costruzioni, Ministero delle Infrastrutture e dei Trasporti, Decreto Ministeriale del 17 gennaio 2018, Supplemento ordinario alla G.U. n. 42 del 20 febbraio 2018 (https://www.gazzettaufficiale.it/eli/gu/2018/02/20/42/so/8/sg/pdf).
  - NEHRP: NEHRP Recommended Seismic Provisions for New Buildings and Other Structures FEMA P-750 / 2009 Edition (https://www.nehrp.gov).
  - OTHER: Provide reference of the selected seismic code.
- **Note:** Documentation, general remarks
- **Bibliography**