

**ENVIRONMENTAL RISK ASSESSMENT AND
MITIGATION ON CULTURAL HERITAGE
ASSETS IN CENTRAL ASIA**

ERAMCA

ERASMUS+ CBHE PROJECT NR. 609574



Deliverable D3.4

**Design of a Laboratory to Support Teaching and Training
Activities**

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1. Introduction

The deliverable D3.4 entitled “Design of a Laboratory to Support Teaching and Training Activities”, is elaborated by UNIOS, leader of the development Work Package type with ref. no. WP3 entitled “Design of a Master in Environmental Risk Assessment and Mitigation on Cultural Heritage Assets”, for the project entitled “ERAMCA – Environmental Risk Assessment and Mitigation on Cultural Heritage assets in Central Asia”, in the framework of an ERASMUS+ Capacity Building in the field of Higher Education grant with the reference number 609574-EPP-1-2019-1-IT-EPPKA2-CBHE-JP.

This report provides a detailed description of a hardware and software to be provided in a specific laboratory for each of the Central Asia Partner Country Universities and a detailed estimation of the implementation costs and possible co-founding of the Partner Countries.

The equipment list is established by implementing the interdisciplinary approach i.e. by considering the specific disciplinary requirement in the field of restoration, structures, seismic engineering, geomatics, geotechnics and hydrogeology. This approach guarantees the growing up of new professional activities and new teaching suggestions. This fact will satisfy the need to increase the skill of local teachers and to drive them toward a more attractive interdisciplinary work and exchange of knowledge.

The new laboratory that ERAMCA project tend to realize in Central Asia Partner HEIs under the deliverable D3.4, will offer a high-level integration of the existing basic laboratories and the place where students could develop their own solutions to the complex problems of the cultural heritage conservation by considering the environment actions.

2. Objectives

As far as the needs of the Central Asia Partner HEIs are concerned, the ERAMCA project plays an important role to the improvement of the staff of the universities (both teachers and technicians). It provides them with the opportunity to build up a specialised laboratory on the thematic of the project and to offer to the new generation of students the possibility to face “at home” the most up to date approach to the environmental risk assessment and reduction on cultural heritage assets by considering the real situation and constraints of their own country. The laboratory will enable the students to experiment the most advanced solution in modelling natural and artificial interactions with existing buildings and urban centres.

The important role is assigned to practice activities (as described in detail in D3.1 deliverable) inside an ad-hoc equipped laboratory, planned in terms of hardware and software needed to give to the future students the most upgraded skill in the fields of simulation and design of possible solutions laboratory that will sustain and increase the quality of the teaching activity.

The laboratory equipment that is setup, covers the interdisciplinary approach to complex problems of environmental risk assessment and mitigation on cultural heritage assets both from a theoretical and practical point of view. The equipment list is divided in two main lists:

- the list of mandatory (basic) equipment (funded by ERAMCA project)
- the list of ancillary equipment (possibly funded by local Universities)

The list of mandatory (basic) equipment (M) is the list of equipment for which the procurement is ensured within the budget of the ERAMCA project (up to 60.000,- EUR), while the list of ancillary (A) equipment represents the equipment intended for possible co-founding of the Central Asia Partner Countries.

The list consists of item description (hardware and software) with technical specifications (or features) and item costs and number.

The ERAMCA project requirements, as described in Work Package type with ref. no. WP3 entitled “Design of a Master in Environmental Risk Assessment and Mitigation on Cultural Heritage Assets” are oriented in forming the unique and equal set of equipment i.e. laboratory at four Central Asia partner universities, namely KPITTU, TTU, TTPU and SamSACII in order to support the Course development.

The items prescribed for the laboratories at Central Asia partner universities and required for the Course development are selected based on the recommendation of the disciplinary teams, which were divided with respect to the following areas of expertise: restoration, structural engineering, seismic engineering, geomatics, geotechnics and hydrogeology. As a first step, the equipment already in possession of the Central Asia partner universities is assessed as described in the following section.

3. Existing Laboratory Equipment

The existing interaction between the classroom and the laboratory teaching and the corresponding laboratory equipment at Central Asia Partner universities is described within Work Package ref. no WP2 entitled “Identification of actual educational portfolio in environmental risk assessment and mitigation on Cultural Heritage in Partner Countries” (lead organization: KPITTU). As for an example, in Fig. 1 presented is the preparation and shake table testing of unreinforced masonry assemblages at TTPU.



Figure 1. Preparation and shake table testing of unreinforced masonry assemblages at TTPU

With respect to WP2's deliverable D2.4 entitled "Assessing basic knowledge for Civil, Building, Environmental engineers and architects" report, the existing laboratory equipment available to students and teachers at KPITTU consists of the building physics, surveying, structure and material (steel, concrete) testing equipment which is beneficial from structural/seismic engineering and geomatics demand from the point of view of ERAMCA project Course.

The use of laboratory to support the teaching activities available at TTU primarily covers the area of conservation and restoration and seismic/structural engineering i.e. art, sculpting, ecology and structural design.

In 2020 the laboratory of TTPU increased its testing capabilities by acquiring, among else, the testing equipment for physical properties of structures and structural materials (seismic/structural engineering). In addition, at TTPU the assessment of structural building models and components in seismic environments with an earthquake simulator is at hand (See Fig. 1). Other laboratory capabilities involve building physics, surveying (geomatics) and soil testing (geotechnics).

At SamSACII the laboratory capabilities are covering the structure performance and the material properties testing (including the seismology and geology area), building physics, surveying, water supply and sewage (sanitation) and heat and gas supply.

The assessment of the laboratory capabilities at Central Asia partner universities, with respect to WP2's deliverable D2.4 entitled "Assessing basic knowledge for Civil, Building, Environmental engineers and architects" report, indicated the strong points of each of the partner universities, with accompanying additional capabilities.

With respect to disciplines covered by the Course i.e. restoration, structural engineering, seismic engineering, geomatics, geotechnics and hydrogeology, none of the laboratories possesses the full capability of joining them altogether. Therefore, as described in the following sections, the equal set of laboratory items (mandatory and ancillary) to support the Course development is assembled, for all four partner universities.

4. Mandatory (Basic) Equipment

In Table 1 given is the laboratory equipment budget line of mandatory (basic) equipment, the procurement of which is ensured within the ERAMCA project budget.

Table 1. The mandatory (basic) equipment budget line

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
GENERAL				
Indoors/Classroom Activities Computers	Desktop Computer - Tower Specifications: Processor: Intel Core i5, 9th Generation, 6C/6T, 9M cache or equivalent; Memory: min 1x16 GB DDR4; Storage: min. 1x512GB SSD; Graphics Integrated Intel UHD 6300 or equivalent; Optical DWD/RW; Ethernet Integrated: RJ 45 100/1000M, HDMI; Speaker 2Wx1; Media Reader 7in1 Card Reader; Power 210W 85%; Keyboard USB Traditional Keyboard; Mouse USB; Operating System Windows 10 Pro 64.	10	800,00	8.000,00
Indoors/Classroom Activities Computers	Desktop Computer - PC Monitor Specifications: Display Size: min 27"; Resolution: QHD Wide 2560x1440px or equivalent; DP, HDMI, VGA.	10	200,00	2.000,00

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
Indoors/Classroom Activities Computers	<p>Laptop Computer Specifications: Processor: min. Intel Core 17, 10th generation, 4C, 8M cache or equivalent; Display: min. 15,6", 1920x1080 FHD 16:9, LED anti-glare; Memory: min. 8GB; Storage: min. SSD 512 GB; Video: Intel Iris plus or eq.;</p> <p>External Ports: USB 3.1 Gen, USB 2.0 Gen, HDMI; Audio: Stereo Speakers, integrated microphone; Webcam: 720p HD; Operating System Windows 10 Pro 64.</p>	1	900,00	900,00
Outdoors/Field Activities Computers	<p>Laptop Computer Specifications: Processor: min. Intel Core 17, 10th generation, 4C, 8M cache or equivalent; Display: min. 15,6", 1920x1080 FHD 16:9, LED anti-glare, Touchscreen, Foldable; Memory: min. 16GB DDR4 3200 MHz; Storage: min. SSD 512 GB M.2 Nvme; Video: GEFORCE MX330, 2GB RAM GDDR5 or equivalent;</p> <p>External Ports: USB 3.1 Gen, USB 2.0 Gen, HDMI; Audio: Stereo Speakers, integrated microphone; Webcam: 720p HD; Bluetooth, Digital Pen; Operating System Windows 10 Pro 64.</p>	1	1.200,00	1.200,00
Indoors/Classroom Activities Computers	<p>All in one Laser Printer Specifications: All in one laser printer, copier and scanner.</p>	1	200,00	200,00
<u>SEISMIC AND STRUCTURAL ENGINEERING</u>				
Indoors/Classroom Activities Software	<p>MATLAB with toolboxes Features: MATLAB software for engineers and scientists, academic license, including the basic programming platform and toolboxes (signal processing, curve fitting, optimization and/or system identification)</p>	10	700,00	7.000,00
Outdoors/Field Activities Measuring instruments	<p>Seismograph Features: 4 component Plug and Play classroom Seismograph (1 vertical Geophone and 3 Accelerometers) with compatible educational software. Integrates sensitive Earth monitoring sensors with easy to use software. Data can be accessed from any RS in the world, making it a good solution for seismically active earthquake areas and quiet regions alike. Perfect for viewing micro-tremors and the larger events. Applicable also for all professional and government activities, including commercial, research and funded projects.</p>	1	800,00	800,00
Indoors/Classroom Activities Software	<p>SAP 2000 v22 (10 licences) Features: Integrated Software for Structural Analysis and Design Basic option with Annual MNT Fee (for 3 years) Note: Based on 10 licences</p>	1	3.240,00	3.240,00
<u>GEOMATICS</u>				
Indoors/Classroom Activities Computers	<p>Autodesk Students and educators can get free one-year educational access to Autodesk products and services, renewable as long as you remain eligible</p>	10	0,00	0,00

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
Outdoors/Field Activities Measuring instruments	Terrestrial laser scanning system Accuracy not exceeding 3 mm; Internal GPS; specific scan of an area; touch screen to adjust functions and start scanning, even without external Wifi devices (smartphone batteries flat); biaxial compensator; HDR with parameterization function on a specific area and night mode; INTERFACEABILITY WITH EXTERNAL SYSTEMS (peculiarities in the future to upgrade the system); File size at resolution of 7.7 mm @ 10 mt and HDR2x weight not exceeding 200Mb BLK weighing 800MB	1	25.000,00	25.000,00
Indoors/Classroom Activities Computers	MicroSurvey STAR*NET 10.0 (v10.0.15.974) Note: Based on 10 licences	1	150,00	150,00
Indoors/Classroom Activities Computers	QGIS A Free and Open Source Geographic Information System	10	0,00	0,00
<u>HYDROGEOLOGY/GEOTECHNICAL ENGINEERING</u>				
Indoors/Classroom Activities Software	Rockscience licence Features: Academic Bundles for 5 years, for the analyses of different geotechnical problems (rock and soil slope stability, tunnelling, etc.). The licence should be renewed after 5 years	1	2.540,00	2.540,00
Indoors/Classroom Activities Software	Visual MODFLOW Flex Website: https://www.waterloohydrogeologic.com/products/visual-modflow-flex/	1	1.600,00	1.600,00
Outdoors/Field Activities	Mechanical profilometer Features: Barton Comb, for the roughness estimation of rock discontinuities and the evaluation of JRC parameter) – length of 30 cm	1	100,00	100,00
Outdoors/Field Activities	Schmidt Hammer Features: sclerometer for rocks, for the estimation of rock matrix compressive strength and the JCS parameter of a rock discontinuity) – reference standard: ASTM D5873 00, UNI EN 12504-2	1	500,00	500,00
Outdoors/Field Activities	Soil Penetrometer, pocket type Features: for field classification of cohesive soils - consistency, shear strength, approximate unconfined compressive strength, range 0-5 MN/m ²)	1	300,00	300,00
Outdoors/Field Activities	Pocket Shear Vane (Torvane) Features: for measuring cohesive soils undrained shear strength (CU), consists of a cylindrical body with a torsional spring and three interchangeable vanes of different sizes depending upon the expected strength of the soil (ranges: 0-10 N/cm ² , 0-2 N/cm ² , 0-25 N/cm ²)	1	400,00	400,00
<u>CONSERVATION AND RESTORATION</u>				
Outdoors/Field Activities Measuring instruments	Thermal imaging camera (low to medium cost) including software for thermographic processing data Features: IR Resolution: 640 × 480 pixel; Thermal Sensitivity/NETD: <30 mK @ 30 °C; Optics: 42°	1	4.370,00	4.370,00

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
Outdoors/Field Activities Measuring instruments	Diagnostic Scope Features: Camera diameter: 8.5 mm; Length: 1.2 m; Display 7"; Images and Video Resolution 800 x 600 [1200 x 720] pixel; Rotation 180°	1	1.700,00	1.700,00
Subtotal			44.700,00	60.000,00

NOTE: Upgrades and improvements should be considered in time of purchase.

5. Ancillary Equipment

In Table 2 given is the laboratory equipment budget line of ancillary equipment intended for possible co-founding of the Central Asia Partner Countries.

Table 2. The ancillary equipment budget line

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
GENERAL				
Indoors/Classroom Activities Digital Display	Digital Flipchart Display Specifications: Display technology: Liquid Crystal Display (LCD) with DirectLED backlight; Panel Size 43"; 16:9 aspect ratio; interface: 1920 x 1080 pixels - FHD HDMI input: 3840 x 2160 pixels - 4K UHD; Refresh rate 60 Hz (@ UHD); Supported orientation Landscape and Portrait; Video Input 1x HDMI 2.0, Touch Output 1x Touch USB (Type-B), Data Input 2x USB 2.0 (Type-A), Communication 1x RJ45 LAN and Wi-Fi, Audio Output 2x Integrated Speakers 5W.	1	3.000,00	3.000,00
SEISMIC AND STRUCTURAL ENGINEERING				
Outdoors/Field Activities Measuring instruments	Ambient Vibration Measurement Device Menhir-Komfort-Paket 6-Ch Features: Menhir Schwingungs-Messgerät; Komfort Paket 6 Kanal; Tri-axiales Geophon nach DIN 45669-1; interne Li-Ion Batterie 6,8 Ah; Ethernet (LAN) und Wi-Fi (WLAN); M2M-Mobilfunk-GSM / LTE (Sie benötigen eine SIM-Karte!); 8 GByte Datenspeicher (industrielle SD-Karte); Kalibrierzertifikat (Werkskalibrierung); externe Stromversorgung mit 3m Kabel; Ethernet Kabel; Nivellierschrauben rund nach DIN 45669-2; robuster Tragekoffer; Montageschlüssel; internes Sub-1 GHz (868 MHz) Modul; Smart Data Center "Connect" Accessories: P SU-EU3 DC Netzteil für Menhir; 24V 20W; Wert im Gerätepreis enthalten; SATELITH-3A ; Externer Sensor f. Menhir; 3 Achsen Geophon, 3m Anschlußkabel; SW_SDCPRO_M_FIX ; Smart Data Center Professional; Fix Tarif 12 Monate fest; Zahlung jährlich im Voraus	1	13.000,00	13.000,00
GEOMATICS				
Outdoors/Field Activities Drone	Camera Drone Features: 48 MP photos, 4K/60 fps at 120 Mbps, 8K Hyperlapse, Smart Photo, Ocu Sync 2.0 transmission HD feed, remote controller screen in real time.	1	1.060,00	1.060,00

Area	Items	Quantity	Itemized Cost (EUR)	Total Cost (EUR)
Outdoors/Field Activities	Digital camera for terrestrial acquisitions	1	3.000,00	3.000,00
Indoors/Classroom Activities Computers	Agisoft Metashape Standard Educational Licence	10	50,00	500,00
HYDROGEOLOGY/GEOTECHNICAL ENGINEERING				
Indoors/Classroom Activities Software	Hydro GeoAnalyst Website: https://www.waterloohydrogeologic.com/products/hydro-geoanalyst/	1	5.490,00	5.490,00
Indoors/Classroom Activities Software	AquaChem Website: https://www.waterloohydrogeologic.com/products)	1	1.483,00	1.483,00
CONSERVATION AND RESTORATION				
Outdoors/Field Activities Measuring instruments	Mini data logger for temperature and humidity Features: Temperature: -20 to 70°C; Humidity: 0 to 100%RH	1	250,00	250,00
Outdoors/Field Activities Measuring instruments	Humidity and Temperature USB Datalogger Features: Temperature: -40 to 70°C; Humidity: 0 to 100%RH; Datalogging interval: 2 seconds to 24 hours	1	150,00	150,00
Outdoors/Field Activities Measuring instruments	Digital pin type moisture meter Features: Moisture measurement range: 7.9% to 99% WME (pin measurement); Dry (green)-7-16.9; At Risk (yellow) 17-19.9; Wet (red) — 20-99.9; Depth of moisture: Pin up to 0.5 in (12.7mm)	1	250,00	250,00
Outdoors/Field Activities Measuring instruments	Laser Distance Measure Features: range 0.2 – 40m; accuracy +/- 2mm	1	100,00	100,00
Subtotal			27.833,00	28.283,00

NOTE: Upgrades and improvements should be considered in time of purchase.

6. Concluding Remarks

The preparation of the deliverable D3.4 entitled “Design of a Laboratory to Support Teaching and Training Activities” involved the design of mandatory (basic) and ancillary equipment for the laboratories which support the practical courses and the final project of the deliverable D3.1 entitled “Definition of a Master in Cultural Heritage Conservation in Central Asia” in the framework of development Work Package type with ref. no. WP3 entitled “Design of a Master in Environmental risk assessment and mitigation on Cultural Heritage assets” (lead organization: UNIOS).

The WP3 is developing in conjunction with the development Work Package type with ref. no. WP4 entitled “Design and implementation of didactic tools for Cultural Heritage Conservation” (lead organization: POLITO).

The laboratory equipment lists created using the (inter)disciplinary team approach (restoration, structures, seismic engineering, geomatics, geotechnics and hydrogeology) offers the possibility to teachers and students to integrate their own knowledge with different disciplines and to acquire the most advanced technical equipment and solutions to offer real training activities to future students.

7. References

- ERASMUS+ KA2– Cooperation for innovation and the exchange of good practices – Capacity Building in the field of Higher Education. Application Form. Call for Proposals 2019 - EAC/A03/2018. Environmental Risk Assessment and Mitigation on Cultural Heritage assets in Central Asia / ERAMCA. Detailed description of the project.
- Erasmus+ project card [Internet]. Erasmus+ - European Commission. 2020 [Accessed: 28 January 2021]. Available at: <https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/609574>.
- ERAMCA project main web-site [Internet]. Eramca.com. 2020 [Accessed: 28 January 2021]. Available at: <https://www.eramca.com/>
- Work Package WP3 “Design of a Master in Environmental risk assessment and mitigation on Cultural Heritage assets”: Deliverable D3.1 “Definition of a Master in Cultural Heritage Conservation in Central Asia”
- Work Package WP2 “Identification of actual educational portfolio in environmental risk assessment and mitigation on Cultural Heritage in Partner Countries”