Private University of Tacna (UPT)
School of Architecture
Syllabus 2027-I

1. COURSE

AR3B4. Heritage and Infrastructure (Mandatory)

2. GENERAL INFORMATION

2.1 Course	:	AR3B4. Heritage and Infrastructure
2.2 Semester	:	9^{th} Semester.
2.3 Credits	:	4
2.4 Hours	:	4 HT; 4 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Mandatory
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	AR3B3. Facilities Management. (8^{th} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Heritage and Infrastructure is the ninth course of the ten-course BIM I-X sequence, building on the authoring, coordination, scheduling, cost, sustainability, and facilities-management workflows developed through Facilities Management (AR3B3, prerequisite). It takes BIM methods beyond the conventional new-build vertical building: Heritage BIM (HBIM) for documenting and monitoring historic fabric, BIM's extension to horizontal/civil infrastructure and city-scale urban information modeling, and reality-capture techniques (laser scanning, photogrammetry) that ground any of these models in verified real-world geometry. Together with the recurring BIM Software Practicum, it equips students with the specialized BIM skill set needed for heritage conservation, infrastructure, and as-built documentation practice, immediately ahead of the sequence's integrative capstone course, AI-Assisted Automation.

5. GOALS

- Author a Heritage BIM (HBIM) model of a historic building element from laser-scan data, enriching it with semantic conservation data (material, decay condition, past interventions).
- Extend BIM authoring beyond the single building to horizontal infrastructure and city-scale urban information models, integrating building-scale BIM with city-scale GIS data.
- Capture real-world geometry through laser scanning and photogrammetry and use the resulting point clouds or meshes as a modeling and as-built verification reference inside a BIM authoring tool.
- Complete a sequence of guided, certification-aligned software exercises building toward a cumulative BIM practicum deliverable.

6. COMPETENCES

AG-A01) Evaluates the impact of architectural solutions on sustainable development, economy, health and safety, the legal framework, architectural-urban heritage, and the environment. (Usage)

AG-A06) Recognizes the need to learn independently and continuously, adapt to new and emerging technologies, and apply critical thinking in the face of technological change. (Usage)

AG-A07) Applies knowledge of mathematics, natural sciences, and information technology to architectural, urban, and interior design solutions. (Usage)

7. TOPICS

Unit 1: Heritage BIM (HBIM) (24 hours)	
Competences Expected: AG-A01	
Topics	**Learning Outcomes**
• Heritage BIM (HBIM): object-oriented modeling of historic buildings using non-parametric (discrete) and parametric libraries • Scan-to-BIM workflow: processing point clouds from laser scanning to create 3D models with semantic decomposition (walls, vaults, windows) • Semantic enrichment for heritage: adding conservation data (material type, decay grade, past interventions, monitoring history) to BIM objects • Digital twins for heritage: integrating real-time monitoring sensors (cracks, displacement, humidity, temperature) with HBIM • HBIM standards and guidelines: ICOMOS HBIM Guidelines, CIDOC CRM for cultural heritage data, and the integration of HBIM with conservation management plan data fields	• Describe the concept of Heritage BIM (HBIM) and explain how it differs from conventional BIM in terms of geometry representation and semantic data [Familiarity] • Create an HBIM model of a historic building element (vault, window, wall) from laser scan data, enriching it with semantic data (material, decay condition, past interventions) [Usage] • Evaluate a proposed HBIM workplan for a heritage project, assessing the level of detail required for documentation and the compatibility of data schema with monitoring needs [Assessment]
Readings : [MMP09]	

Unit 2: BIM for Infrastructure and Urban Modeling (24 hours)	
Competences Expected: AG-A07	
Topics	**Learning Outcomes**
• BIM for horizontal/civil infrastructure: roads, bridges, and utility networks modeled with alignment-based and corridor-modeling tools (Civil 3D, InfraWorks), distinct from vertical-building BIM authoring • City Information Modeling (CIM) and urban digital twins: integrating building-scale BIM with city-scale GIS data (CityGML, 3D Tiles) for planning and infrastructure coordination	• Describe how BIM methods extend to horizontal infrastructure and city-scale modeling, and identify the tools and data standards specific to each scale [Familiarity] • Model a piece of infrastructure (road segment, utility corridor) using alignment-based BIM tools, and integrate it with an urban-scale GIS dataset [Usage] • Evaluate an infrastructure or city-information model for data interoperability between building-scale BIM and city-scale GIS systems [Assessment]
Readings : [Cos+18]	

Unit 3: Reality Capture for BIM: Point Clouds and Photogrammetry (24 hours)	
Competences Expected: AG-A06	
Topics	**Learning Outcomes**
• Laser scanning workflows: terrestrial and handheld scanner data capture, registration of multiple scans, and point-cloud cleanup • Photogrammetric reconstruction: structure-from-motion processing of overlapping photographs (drone or handheld) into dense point clouds and textured meshes • Working from point-cloud or mesh references inside a BIM authoring tool: underlay referencing, scan-based dimension checking, and as-built verification against design models	• Describe how laser scanning and photogrammetry capture real-world geometry as point-cloud or mesh data usable inside a BIM authoring tool [Familiarity] • Register a set of scans or photographs into a point cloud, and use it as a reference to verify or model an as-built condition in BIM [Usage] • Evaluate a reality-capture data set for registration accuracy and its adequacy as a reference for as-built BIM modeling [Assessment]
Readings : [Luh+19]	

Unit 4: BIM Software Practicum (24 hours)	
Competences Expected: AG-A06	
Topics	**Learning Outcomes**
• Guided, graded software exercises in the BIM tool(s) specific to the course's theme (authoring, coordination, scheduling, analysis, or FM platforms), building toward a cumulative course deliverable • Practice aligned with vendor or industry certification exams (Autodesk Certified Professional, buildingSMART openBIM) relevant to the course's software focus	• Describe the practicum structure for the course's BIM software focus and the deliverable it builds toward [Familiarity] • Complete a sequence of guided exercises in the course's BIM software focus, building toward a cumulative practicum deliverable [Usage] • Evaluate the student's own practicum deliverable against the software proficiency expected for the course's BIM theme [Assessment]
Readings : [Wey11]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

********* EVALUATION MISSING ********

10. BASIC BIBLIOGRAPHY

[MMP09] Maurice Murphy, Eugene McGovern, and Sara Pavia. "Historic building information modelling (HBIM)". In: *Structural Survey* 27.4 (2009), pp. 311–327.

[Wey11] Robert S. Weygant. *BIM Content Development: Standards, Strategies, and Best Practices*. 1st. Wiley, 2011.

[Cos+18] Aaron Costin et al. "Building Information Modeling (BIM) for transportation infrastructure – Literature review, applications, challenges, and recommendations". In: *Automation in Construction* 94 (2018), pp. 257–281.

[Luh+19] Thomas Luhmann et al. *Close-Range Photogrammetry and 3D Imaging*. 3rd. De Gruyter, 2019.