



Pedagogical sequence Framework -

Project « Brabourgstone»

formular (modèle à dupliquer)

Teaching area	Mathematics Styles in architecture, Introduction to sculpture modelling, Work in stone (Practical lectures), Civic education
Theme	Golden cut in building techniques (Middle Ages)
Learning outcomes/competences	Student will be able to: <ul style="list-style-type: none">- resolve mathematical problems applying mathematical tools in different contexts- imagine the space, explain and describe spatial relations and proportions contributing to the aesthetics- present mathematical relations in different ways- explain geometric rules of symmetry, geometric translation and rotation- explain mechanisms of motive repetition- select and create the ornament by using geometric laws- shape the model of drawn ornament in gypsum- make the ornament (rosette) in stone applying the model copying tools- explain and argument social decisions on respecting the aesthetics in public space
The age of the students (required prior knowledge)	Students of the second, third and fourth grade of High school (16-18 years of age) Required knowledge of geometry (stereometry)



	and resolving of quadratic equation (golden cut)
Prevailing type of activity (field research, game, practical activities ...)	<p>Lecture and discussion about the methods and principles of construction in the history and now, economic activities people were dealing with, how they were processing the stone, the material they used to build their houses, why, which binding material they were using, which competences and skills were appreciated, then ruling aesthetic standards.....</p> <p>Introductory part of the topic is carried jointly with lessons of Croatian language and history.</p> <p>Literature research Explore written sources dealing with stonemasonry and construction, sculpture & plastic arts and golden cut as the standard of beauty and harmony. We find the rules in repetition of motifs. We compare with knowledge acquired by students at the lessons of modelling and styles in architecture.</p> <p>Local surrounding research and practical activities Supported by the teacher of stonemasonry structures, students collect information on construction activities on Brač. They research basic stonemasonry structural elements (capitals, lintels, beams, columns...) and geometric shapes in space, and describe their features. They perceive and note the cases of golden cut in their close surrounding and problems of tiling the surfaces. Reveal the motifs displaying repetitive pattern. Perceive the regularities related to ornaments and ornamentation.</p> <p>Acquired data processing Collected data, descriptive and photographic, are processed and analysed. Students reveal which mathematic geometric operations are hidden behind the problem of tiling the surfaces</p>



	<p>and creating the motifs which follow repetitive pattern. Step by step they reveal the beginning of the creation of the interlace pattern in the mathematical sense (geometric functions). Besides taking in consideration mathematical assumptions and terminology, the appearance of the homeland and the culture of life are analysed and connected by cause-effect principle.</p> <p>Students are provided more detailed information about geometric notions: isometry, symmetry, translation, rotation through analysis of pictures and structures sharing similar elements. They conclude that by applying these mathematic regularities, at the drawing and modelling lessons, they might create and draw their own motifs which use repetitive pattern - the ornaments.</p> <p>Creative response to a topic Stonecarving applying golden cut principle (shell nautilus, star in pentagon...)</p>
Key terms	<p>Styles in architecture</p> <ul style="list-style-type: none">- Golden cut- Classical age- Parthenon- Tiling of surfaces (mosaics, ornaments) <p>Introduction in sculpture modelling</p> <ul style="list-style-type: none">- Polycleitus, Praxiteles <p>Work in stone (Practical exercises)</p> <ul style="list-style-type: none">- Volume of geometric shapes- mass of geometric shapes <p>Civic education</p> <ul style="list-style-type: none">- Aesthetics

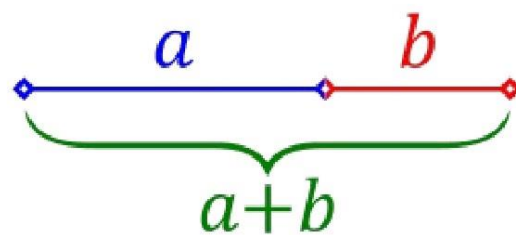


<p>Pedagogical scenario/ achievement of pedagogical sequences</p>	<p>Student Motivation for the Project – local surrounding research</p> <p>Watching historical buildings, Povlja lintel (<i>Povaljski prag</i>), Basilica of St. Laurence (<i>Bazilika sv. Lovre</i>) at Lovrečina, analysing the way of life and construction habits, and identifying geometric shapes and bodies (cuboids, cube, prism, cylinder), students perceived the regularities in construction and connected them with mathematics in historical context.</p> <p>Literature and online content research</p> <p>By using available literature and on line content, students have analysed the way of life on Brač in Middle Ages, and what people could use to help them in construction process.</p> <p>They studied mathematic patterns applied by people, aiming at facilitating their daily life and build their settlements and churches.</p> <p>Field research and practical activities</p> <p>Together with professors, students attend the field activities and lectures, photograph old churches, altars and other preserved facilities and objects from that period.</p> <p>Based on the collected data, students connect the mathematical knowledge with styles in architecture, modelling, stonemason structures and practical lectures.</p> <p>They have dedicated special attention to golden cut, approaching it through resolving quadratic equations, thus revealing the golden cut formulae:</p> <p>Golden cut is composition law in which the smaller part relates to the larger as the larger to the whole. In real situation, if we want to divide something in such a way, we shall divide it in 13</p>



equal parts and then further divide it at the scale 8:5, or sub-divide it in 21 equal parts and then further at scale 13:8, etc. The larger the number of the parts, closer we are to the exact golden cut, however none may never obtain the exact golden cut, since this number is in fact the approximation.

Golden cut theory had started already in the Classical age, but it reached full bloom during the Renaissance. After many centuries of the theory, the golden cut is considered to be the most perfect cut in the nature, fully perfect for human eye.



The line segment $a+b$ in respect to the line segment a , has the same relation as the line segment a in respect to the line segment b .

Based on the studied topics, students made their own works, in which they applied golden cut rule.

Students were explained the methods of constructing symmetries and rotation and geometric translation images.

Acquired data processing

In the classroom the students processed and applied acquired knowledge and continued their research. The connected mathematical constructions with drawing geometry, freehand drawing and modelling and with computer



	<p>drawing.</p> <p>They have made models which are going to be used for execution of the works in stone.</p> <p>Historical researches helped them to observe the presence of mathematical regularities in the aesthetics and they decided to use them for designing their works.</p> <p>Creative response to a topic</p> <p>Students carve the works in stone on the topic of golden cut (nautilus shell, star in pentagon...). They are also preparing for carving of interlace and rosette, which they have designed at their lessons of drawing, modelling and computer drawing, always applying already acquired mathematical competences.</p> <p>Public presentation of work</p> <p>Exhibition of the works in the school premises, along with corresponding drawings and schemes.</p>
Place of activities' realisation (classroom, outdoor area...)	Classroom, outdoor area (field work)
Teaching instruments and tools, necessary material	Computer, geometric tools, hammer, drawing set, stonecarving tools and measurement tools
Duration of the activity	10 school hours
Outcomes verification method	Analysis of students' works, students' explanations about their works made by application of golden cut rules
Material results/ demonstration of work and accomplished results	Public presentation of project activities, objects made by application of golden cut, schemes and drawings, photo exhibition