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HANDS, BRAINS, HITECH BETWEEN ARCHITECTURE AND ARCHAEOLOGY
OR
WHAT AN ARCHITECT CAN EXPECT FROM ARCHAEOLOGY

ARCHITECTURE, Architecture as profession
ARCHAEOLOGY, Archaeology in architecture is very important
WORK, Handwork in archaeology
BRAINS, Brains in work
SCIENCE, Use of brains instead hands
HITECH, Hitech helps a lot, but it can not change the brains
CONCLUSIONS, Sustainable co-operation, which can not be successful without handwork, at the end

We all know all the statements as follow: but use of them between architecture and archaeology, in co-operation, they can show much more results than we think. Sustainable work of both professions, where no one is more important than other, is needed. Especially tomorrow, when more possibilities of technique and technology will be available, less material can exist because of its decay in time, but: all the details found will be more and more important.

ARCHITECTURE

Architecture as profession

Architecture means to build: man's house for living, for working and for enjoying and resting, as well for human beings as for animals and machines. Architecture means designing: details, architecture itself and town planning.

Elements of architecture are as follows: the first idea, planning in concretisation, construction, composition, design and aesthetics.

The first idea is the most important because of planning, making decisions in whole.

Construction means putting together all the elements to build a construction. It depends on use of the building, on wishes of investors and of users, on location and on local circumstances, on which materials used, and how materials are used in the composition.

Composition is result of all needs, possibilities and circumstances, including skillness and intuition of builder. Result represents use and aesthetics: but even aesthetics depends on all mentioned elements.

Result of architecture is nor an idea, nor plan or even building: result of architecture is good, successful and pleasant being, work or pleasure of **the user**. And user can be animal, man or machine.

Architecture or results of it can be found more or less above the ground.

ARCHAEOLOGY

Archaeology in architecture is very important: archaeology from the viewpoint of an architect

Archaeology discovers disappeared or hidden architecture, mostly covered by the earth. It is very precise, responsible and hard work, with a lot of possible faults or misunderstandings. Knowledge of architecture is in archaeology much more important than we think.

The main work of archaeologists is searching, but questions: where, what, how and why open all the diapason of his work.

Where to excavate is the major question, and it can not be answer to coincidental findings.

What to excavate is hard to say: here can be of great importance high technology with all kind of technical possibilities of detection.

How to excavate is professional question: it is not matter of other professions, unless if they help with their technical support.

Why to excavate is essential question, with very simple answer: for understanding our past, our culture. But - the main question is therefore why to do it where, what and how! And this is complex problematic, not touching only one or two professions, but it is wider than we can see.

Technical elements in archaeology are mainly searching and reconstructing.

WORK

Searching

We can search blindly: and we can find something coincidentally. Result can be poor, definitely.

We can search by logic: if there is trace of one element, there could be another too. Result is better than in blind excavating, but it depends on number of other elements.

Order can be of great help: if there are three elements in row, there exists possibility to find other elements in the same row, or in other rows, logically connected to the first one. There is no one order, and there can not be expected only one system of orders. Order is not a list of recipes: it is logical system, following the main idea. Way to success is open if we can understand it.

Order is scientific discipline, and it can be very simple or very sophisticated and hard to understand.

The system work only can bring results, in the connection to new technologies and with use of all accessible technical support.

BRAINS

Reconstructing

Archaeology or results of it can be found more or less out of the earth, in-depth and invisible.

Handwork in archaeology

Handwork is the basic element of archaeology and the most important, at least it is the most accurate. The problem is in time: work is very long-term, and it can lasts...

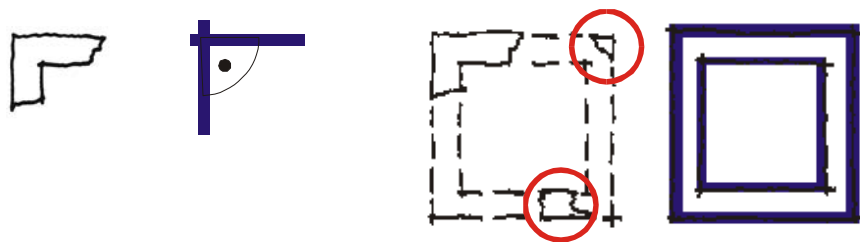
Brains in work

Brains are essential part of distinction between animal and human being. Use of brains can shortened the time of searching, definitely.

Brains can be used very closely to the order, to logic and to knowledge. Without those elements even brains are out of use.

Order is not a recipe, it shows the way only. Not even the order can not be successful without cooperation with other categories. Order can help a lot, but it can not replace other categories, and it can not be the most important.

Finding of a corner:

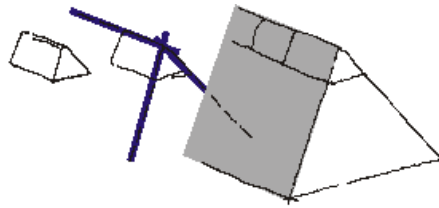


1 The corner can assure two thing only: right angle and two directions.

More findings in excavation: another corner, part of a wall etc can show more. Expectations can be successful if we follow findings to the end.



2 A part of the circular wall: we can determine its centre, and of course radius. Theoretically it is circle, but other methods have to be used for final result.



3 Triangular part of stone has been found: prof Contu restored the roof. With one finding only, this is speculation, but it could be real restoration of the building. Inclinations and two hips of the roof are definitely elements of possible building in Sardegna, near pozzo sacro (Contu 1998).

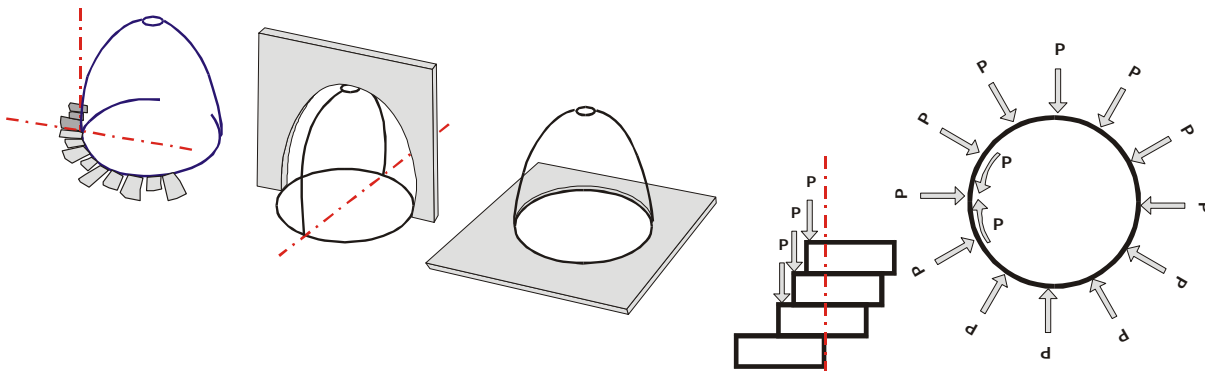
Order can show the way, it can not assure results, because a lot of circumstances can appear in time of building.

Logic can not assure final results, but it can help in detail. We can suppose something, if the building ran without outer influences.

We can expect that missing object can be absent by hazard: but it can be missed because of need or other possibilities.

In simple cases it is true and logic can be used as the system, but on complex problems it is less successful.

Knowledge can be used in system and partially. Knowledge is close connected to the logic, as well as with order: and only all three categories together can be successful.

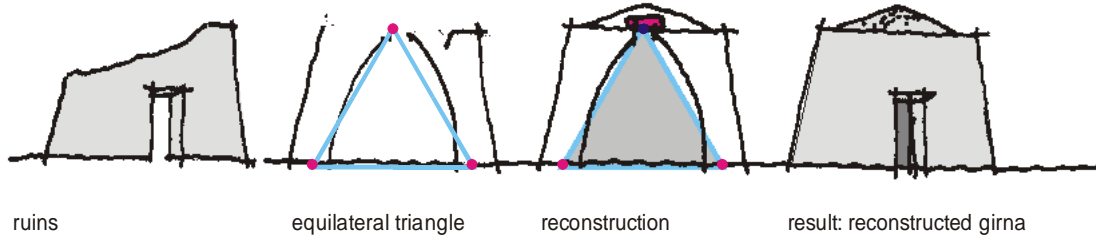


4 Corbelling, for instance has its own principles. The first is stratifying, putting one stone above another in cross section; in ground plan it is circle, because there are no problematic edges. Result is a cone in three dimensions (Zupančič 2003).

Theoretically there is equilateral triangle in use, with its height, which is equal to square root of three by two.



5 Replacing missing elements with help of geometry: the roof of barraca de vinya (El Pont de Vilomara, Catalunya, Spain) can be finished by prolonged elements till the top.



6 The girna (Malta) can be build into its original and typical shape with help of equilateral triangle and its height (Square root of three, by two). Other elements and details can be take on place by experience, by comparison to other objects.

One can expect to find real girna, and comparison to other giren is proof for the used way.

Experience is complex work of hands, brains, logic and observation. We can observe the object in whole, in details and in its use and work in the location. Comparison is the only way to use observation as successful category. The final touch of experience is feeling: but it depends on each man himself.

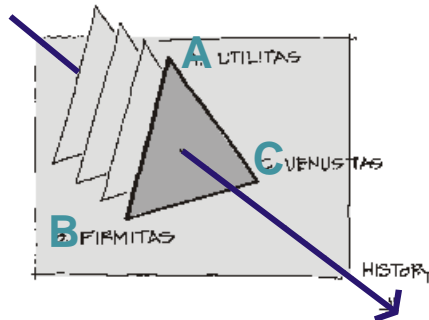
There are many other principles, from understanding the history to implementation of all other professions, although it seems to be with no connection to matter. Maybe detail, maybe a part of an idea or a thought can be way out of the problem.

SCIENCE

Science: use of brains, instead hands

Science is technical category, all-through proofed and the most accurate. It is complex system of theoretical and practical work, where theory represents basis and practice of its use.

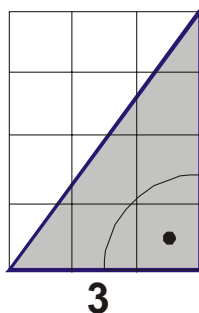
Theory:



7 O'Gorman's interpretation of Vitruvian triangle, moving through the time, between **use, construction and beauty** (O'Gorman 1998)

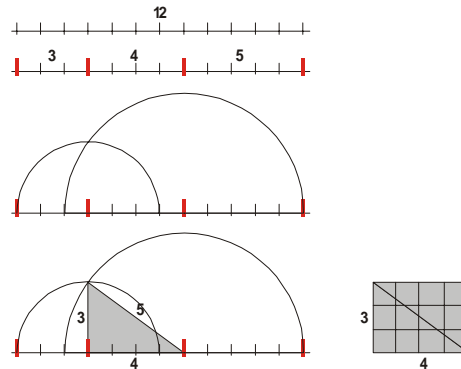
Geometry:

There are several triangles, and each represents some theoretical principle. Triangle is plane figure with three straight sides, any three points not in straight line (Oxford Advanced Dictionary 1986).



$$\begin{aligned}
 3^2 + 4^2 &= \sqrt{9 + 16} \\
 &= \sqrt{25} \\
 &= 5
 \end{aligned}$$

8 Pythagora's triangle: addition of both short sides square, is equal to longer side, square.



9 Egyptian triangle: right angle can be constructed in plain desert with use of a rope, divided by three, four and five units, all together 12 units. If we connect all three sides with help of three points, short sides enclose right angle.

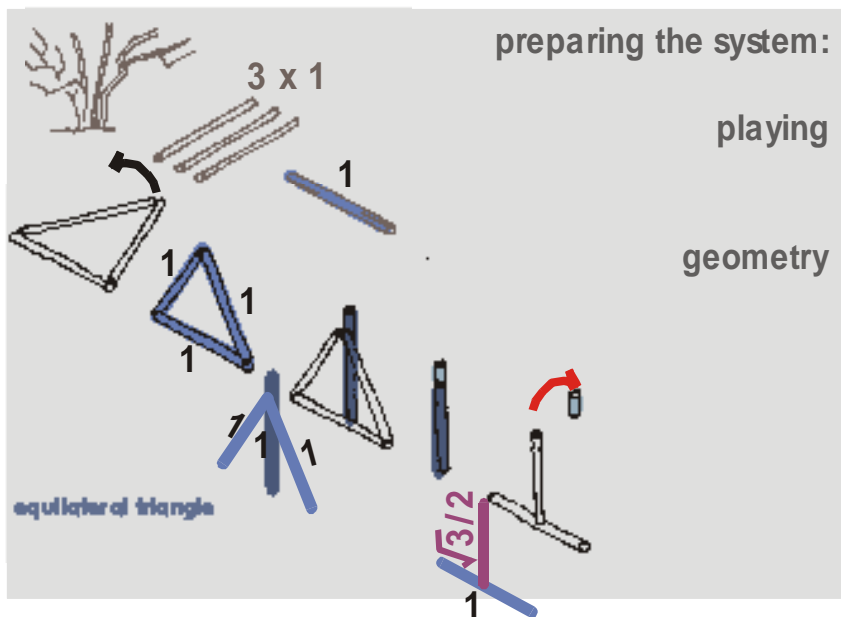
Rectangle with sides 3 and 4 has diagonal, equal to 5.

The most common use Today is old television screen, Yesterday the pyramids were built in this system.

equilateral triangle is geometrical element with three sides with equal lengths, and three equal angles. three times 60 degrees is equal to 180 degrees.

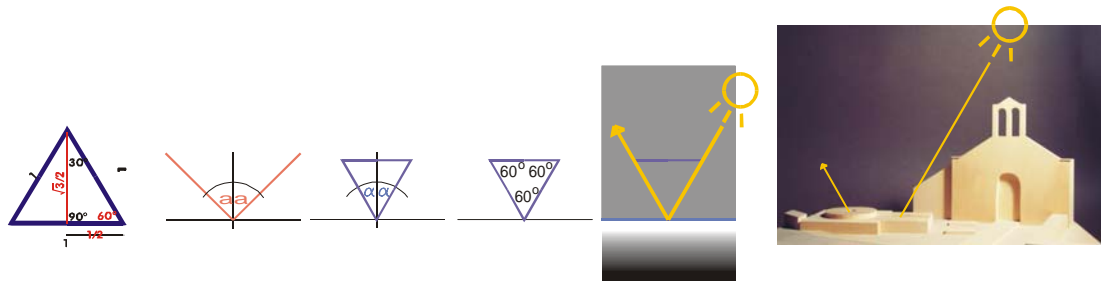
where the side is equal to 1, height is equal to square root of three, by two.

10 Equilateral triangle: it has three sides of the same length. Its height is equal to baseline time square root of three, by two. If the baseline is one, height is square root of three, by two.

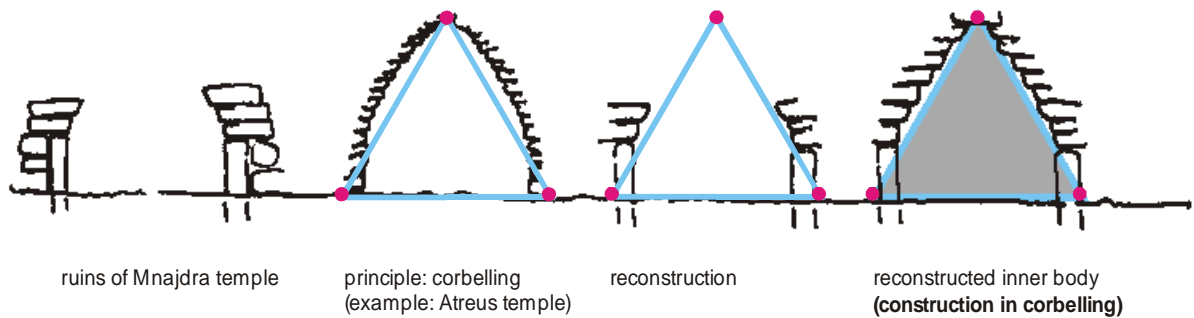


11 Understanding of this principle in practice: it can be constructed with help of three sticks with the same length. Height of this triangle is half value of square root of three. On the other side, three sticks are the most common plaything, the most simple toy of small shepherds. And stone shelters, built in

corbelling, are the work of skilled shepherds later. Principle of the toy is no more plaything, it is usable and very important construction of vernacular architecture, even Today.



12 Opposite direction of equilateral triangle, its use: angle of incidence is equal to angle of reflection. Intermediate axe has right angle to reflection surface. If reflection surface is water, axe is vertical. This is very important for the Sun beam, reflected in the water surface. This was used for the miracle of sacred well, 'pozzo sacro' Sant'Anastasia in Sardinia, Sardegna in Italy, where twice a year the Sun is coming out of the earth (Zupančič, Ljubljana 2003). For intelligent people this is physical phenomenon, for unlearned people it is miracle.



13 Knowledge of geometry, physical phenomenon, knowledge and experience, all together: Mnajdra is a temple in Malta from third Millennium BC: groundplan can be seen Today only. With help of corbelling principles, knowledge of physics and some experience, original construction can be restored. The outer shape is matter of speculation, and no proof exist for any reconstruction.

Dating methods:

There are several technical methods to define the age of architecture.

Architecture can be made of mud, clay, burned clay - bricks; of straw, wood or of wooden composites; stone without any cement or mortar and with adhesive materials; of iron and steel; of technological made composites - steel, concrete, combination or inforced composites. There is no need to define the age of new or objects with well known origin. Anyway, we need to know the age of older and the oldest architecture, mostly in stone.

The most important methods are close connected to the radiation and nuclear techniques.

Methods, most in use are as follows: Radiocarbon method, Uranium - Thorium method, Thermoluminescence analyse, Archaeomagnetism (Riederer 1988). For architecture and its origins are suitable more or less the first three methods. Here are short descriptions, very simplified for information only:

Radiocarbon method

This is method, using free carbon, mostly in organic compositions, but also in lime and lime covers.

This is method, exact between 100 and 100.000 years old constructions (Berger 1979). For architecture it is less suitable, but can be use where exist organic elements (fabrics, leather), and where calcareous sinter over stone is found.

Uranium - Thorium method

This method can be applied on compositions, where calcarium water ran over harder stone, or calcarium sediments are found. It has built-in Uranium in its crystal-net, and the age can be counted

with help of $^{230}\text{Th}/^{234}\text{U}$, Thorium and Uranium (Schwarz 1983) from 50 000 and 300 000 years (Riederer 1988).

Thermoluminescence analyse

Thermoluminescence can be used for dating inorganic materials, on the basis of changing electron shells through influence of radiation of environment (Aitken 1985). For this analyse are very important mostly electrons of silicate components (Quartz), and result can be seen as the light.

Results are depending of ground moisture, can be influenced by radioactive elements in neighbourhood, but with eliminating those influences it can be exact up to 5 percent (Riederer 1988).

Locating methods:

It is very important to locate exact position of the excavated elements, especially if it is large excavating ground, or excavating runs under the time pressure.

Very exact method is GPS system (Global Positioning System), basing on number of satellites. From 2000 this method is very exact (up to some meters), when US Army stopped (planned) disturbing of this data system.

GPS is important also on some hidden locations, or abandoned locations, where excavations could follow later in time and classical triangulation methods can not be used.

HITECH

Hitech helps a lot, but it can not change the brains

Hitech can help a lot: in all the ways of our work, where engineering devices can be used. It can not replace the brains, handwork only. The future is on hitech, with all the possibilities about x-rays, radar, laser, all kind of radiation etc. Aerial and in-depth photography can show things we can not imagine, although it is derived and developed from military industries. At least it is the only positive use of war production.

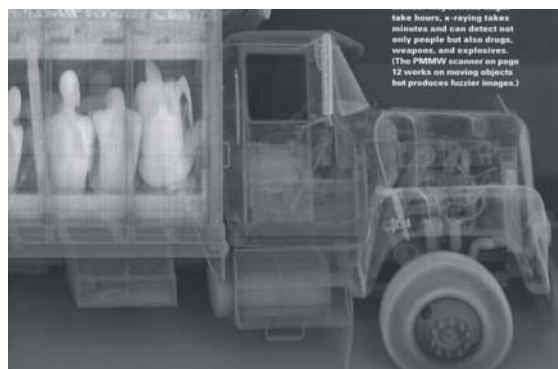
Some un-destructible methods are as follow:

X-rays:

X-rays are mostly in use in medicine, for close work with bones and teeth, because those elements of human body are not permeable for x-rays (Roentgen).

X-rays can be observed, or saved on photographic plate.

X-rays can be seen through thick materials too: fabric, plastic and even through thin sheet of vehicles.



14 Backscatter x-ray machine can look through thin surfaces for producing detailed images of what lies behind them: hidden things or people can be seen in truck.

More sophisticated machines PMMW work on moving objects, but produces fuzzier images (National Geographic 2003). PMMW or Passive millimetre wave imaging are developed for scanning immigrations to United States.

Some machines for searching human bodies in hidden places measure carbon dioxide levels, elevated by human respiration. Those machines are in archaeology not in use.

Beta ray radiography:

Backdiffused beta radiation can be used for quick radiographic mapping of heavier elements. Suitable extended area beta ray sources can be either those containing long lived pure beta ray emitting nuclides like ^{35}S , ^{147}Pr , ^{204}Tl , ^{32}P , or can be simply be neutron irradiated metal foils like indium or dysprosium. The beta ray diffusion radiographs were compared with optical micrographs and partially with alpha track etch autoradiographs. This method offers a quick survey of the surface topography of large areas (Rant 1991).

The method is suitable more or less for structural and textural characteristics of flat and smooth sections of ore and rock slides. This method can be used in some cases for archaeology too, but has to first be calibrated with some other methods.

Non-destructible methods on the ground:

Some methods are using several systems of searching different object under the ground. They are using the principles of magnetism, electric resistance etc.

They are very effective for wider areas, where archaeological remains are expected, and excavation is not suitable by several reasons.

In Sagalassus, for instance, all the town plan can be seen, and from classical Antique are two early Christian temples clearly recognised (by their groundplan shapes as well as of the direction East - West).

Non-destructible methods from the air:

Aerial archaeology or aerial photography is very usable, but effective by special light, time and position. It is very quick method, but architecture can be observed by proper time (season, time of the day, cloudy or sunny weather, with typical shadows etc).

Airborne mapping and archaeology:

This method is possible with help of GPS (Global Positioning System) navigation and other techniques, mostly LIDAR.

LIDAR (Light Direction And Ranging) is based on scanning a pulsing laser over the ground. Monitoring of direction and incoming reflected pulse, with time of its flight, determination of each hit on the ground can be done.

Airborne archaeology can be composed by all the possible photo techniques: visible, infra-red or thermal sensing (Bewley 2002).

Architecture is showing its elevation only, and ground plans can be understood after professional work or measuring, drawing, and restoring missing elements. Some details can be from the air very simply determined, while they are hiding from the ground.



15 The multi-cellular sheepfolds on open land, with common grazing for a large number of farms can be seen in Tyddyn Grasod, Henryd, Conwy (Wales UK). From the ground can be seen the walls only, neither the shape and position nor the use.

From the air can be recognised entrance as funnel, the main hall and individual pens: the sheep are gathered communally from the mountain and sorted into the pens of each farm (Crew 1996)

Some details can be visible with help of shadows from the air only, because differences of the height are very small.

Special time is very important: in summer can be some elements visible while in winter can be observed other. Complete information can be done after long-term observation, which is depending on

objective data, defined by author (time of the day, season, position of the sun..) and on subjective data (for instance snow and its thickness, special effects of the light etc).



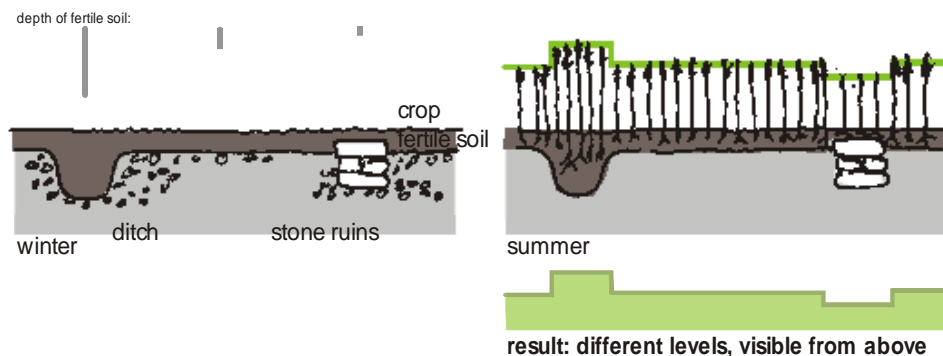
16 Darja Grosman: double ditch enclosure near Dolenja Prekopa (Slovenia) in summer and in winter. Differences are clearly shown on the photos (Slapšak 2001).

Groundplan can be seen through the ground, even it is in use for other activities Today: more - some groundplans can be identified by ageing, appearing in time.



17 Roman villa in Cromwell, Nottinghamshire UK. Classical Roman villa is overlaid by a late prehistoric settlement, bordering the floodplain of the river. The third architectural complex: a large oblong enclosure can be much older, but date is unknown until detail excavating (Wilson 2000).

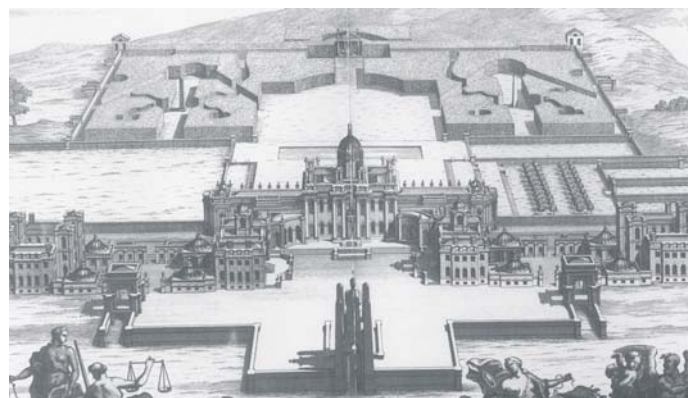
It is very interesting that overacting is used for presenting reality. This can be man's work or by nature. The crop can help a lot: differences in soil fertility depend on ground materials. If there is stone or thicker stratum of fertile soil, height of the crop varies (Wilson 2000).



18 Positive and negative marks on growth of the crop: positive over a ditch, and negative (shorter crop) over wall foundation or concentrated stone in-depth.
 Result can be clearly seen: but from air only.
 On the other side man's work helps a lot. It can be matter of reality, or overacting of some data.



19 Drawing from 1689: *Die Ehre des Herzogtum Krain*, and view from above of several castles and towns. For better illustration of architecture, overacting is mostly used, especially of height for the hills and their slopes (Ljubljana, SI).



20 Aerial photo from the days without airplanes: green architecture was in renesance very often, but not visible. Riddles and hiding places were very popular from baroque times, and drawings only could show their results. Example Castle Howard UK, from 1725 (JSAH 2003).

There are a lot of other, more sophisticated methods, using satellites and other elements of hitech. Most of them are result of military and war industry: but at least it is the only use of this inhumane and destructible methods of power in our time.

CONCLUSIONS

Sustainable co-operation is needed, but it can not be successful without handwork, at the end
 Handwork exists as the first and the last possibility, but use of brains, including high techniques and high technologies can help a lot.
 Future is on hitech, but the final touch is human hand, even in hitech, indeed.

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