Proportion and Traditional Architecture

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Ideas and opinions from some of our supporters
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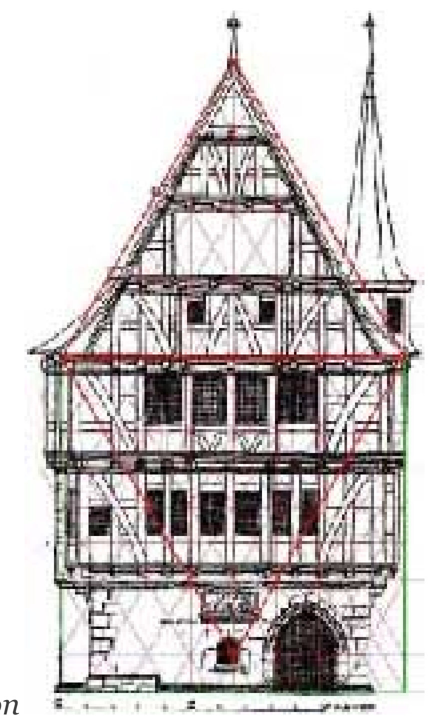
1. Introduction



1.1 There is no objective scientific basis in modern construction
Twentieth century architecture sought above all to be "scientific", but it managed only to achieve the status of a pseudo-science.   Guiding ideas like "*Form follows function*" or "*Less is more*" found broad acceptance with architects, those who teach architecture, and building owners.

But contrary to the belief and pride in the objectivism of modern sophisticated sciences, these mottoes are not only vague and arbitrary, but also inaccessible to objective discourse in science.   In terms of human perception and information processing, such mottoes are, if generalised as done during the last eighty years, simply wrong.

Everybody knows how the zeitgeist can blind the awareness of mankind during entire periods, even if the truths are evident beyond all doubt.   Erich FROMM spoke of the phenomenon of a *folie à million* that supported Nazism in Germany. The guiding ideas in architecture changed the preferences of those in the 20th century and crushed the beauty of the built environments that still existed everywhere early in the 20c. In terms of Gestalt Psychology, "archetypic gestalt pragnanz" (aesthetic quality) was an ever present quality that evolved since the earliest days of humankind and complied with a deep understanding of people's intrinsic needs. Old environments contributed a permanent warming-up of the mind to endure the hard conditions of life of preindustrial man. In the century just past, ugliness and facelessness crept up and spread around the world like metastasizing tumours.

Mainstream attitudes in the 20c disregarded the fact that aesthetic qualities are largely based on objective facts, and that the assumption of "*de gustibus non est disputandum*" is essentially mistaken. To a large extent, judgments on beauty and ugliness can be based on systematic arguments.

Beauty always has holistic qualities, since it is constituted by a *figurative balance of order in diversity*. Beauty or gestalt pragnanz is holistic in the way that *all figurative principles and levels are well tuned* to each other. *Beauty lies in ensemble effects, and proportion has a key function in constituting them because it guides the intermediation between order & diversity, together with other unifying principles*. This statement can be grounded on firm science and fits to establish teachable *systematic design principles* that must evolve in the future.

Beauty is not only the spice and luxury of life, but it is a prerequisite of ecological survival because it supports human life in all superior aspects - as ARISTOTLE said, to "maintain the just measure". The effect of pseudo-scientific mottoes can be beheld in the perhaps half a billion buildings erected on the face of the earth since 1925, the time of the birth of the "International Style". The philosopher H. GADAMER (1960) spoke of the desecration of beauty on earth in the 20th century, and we can add that this desecration was largely by architecture. In contrast, traditional architecture architypically embodied the opposite.

There was a time in our past when one could walk down any street and be surrounded by harmonious buildings. Such a street wasn't perfect..., but it was alive. The old buildings smiled, while our new buildings are faceless. The old buildings sang, while the buildings of our age have no music in them.
The designers of the past succeeded easily where most today fail because they saw something different when they looked at a building. They saw a pattern in light and shade. When they let pattern guide them, they opened their ability to make forms of rich complexity. The forms they made began to dance.
(HALE 1994, 1)

These patterns were, as HALE argues in large parts of his book, guided by proportions.

1.2 "The Balance of Order in Diversity": Promoting science and practical design

If such a balance is lacking, beauty cannot be perceived. Ugliness, if not monstrosity, is visible. This formal criteria "Order in Diversity" (Unity in Manifoldness) is helpful for any advancement of scientific and practical insight and design work. Besides, this old philosophical insight is a well-proven basic quality of health and stability in ecology and in any life-system. Of course, arguments exact interdisciplinary thinking (E.P. ODUM 1973, 2005), and the use of systems theory is well recommended. We also have to deal with, as Edmund HUSSERL called it, "the things that matter" ("Zu den Sachen selbst"). The only legitimation of science is the lifeworld (HUSSERL). Dealing with beauty in architecture demands working with an *operational knowledge of perception, information processing, emotion, and mental health* in connection with the figurative qualities of built environment.

"Beauty" is the pre-condition of aesthetic pleasure and can be characterized as one of the most human and ecologically innocuous capacities of man. If we perceive clarity in a more or less complex and elegant form, our life forces and creativity become strengthened. Beauty allows our perception to be free to play in directing our attention and awareness without major disturbances to this or that. *The figurative unity evolves on a ground of unifying principles or patterns - by means of algorithms of visual math as an objective ground*. Objectivity is complementary to the wide field of subjectivity, which must be sufficiently rich to prevent mental handicaps and diseases.

Objective science of form must be founded on geometry, symmetry, fractal mathematics, and topology as part of its elementary pillars; like the other figurative principles and levels of gestalt pragnant form, they are patterns constituted by visual algorithms characterized by variations, modulations, and other alterations of repetitive patterns. Everybody accepts this principle in music but not in architecture.

1.3 Proportion as a guiding pattern for establishing beauty (gestalt pragnanz)

Proportion is strongly linked to geometry (although non-geometric procedures for proportion are possible). Practical geometry in the building crafts were almost self-guiding methods of regular and statically proved design.

Proportion geometry regulates primarily the *extensional order* of buildings. Symmetry controls *invariants of figurative relations* in regard to mirror axes, rotation, strechings, or shrinkings; mirror symmetry (or trompe l'oeil asymmetry) is by far the most important symmetric pattern in architecture; in architectural ornament, all 17 two-dimensional symmetry groups can be important (the 230 three-dimensional symmetry groups are less important). Although they are totally different figurative principles, proportion and symmetry are complementary (even if buildings are not symmetric).

An obvious example of a symmetrically multi-determined figure is the circle, basically constituting the vast majority of proportion geometry inherent in traditional architecture. More than 99% of the regulating lines I use for proportion analysations are derived from the most simple regular geometric figures, the polygons with 3, 4 and 5 corner points situated on a circle.

Topology represents *positional relationship without regard to extension* (e.g. networks, knots, guilloches); in arts, topology is the constituting principle of ornamentation (which is essentially to beauty in architecture).

Fractal features are needed to create *ordered diversity* in many figurative levels of architecture, particularly in texture, colours, ornaments, light & shade (the only regularly moving features in architecture), and others. Without micro- and meso-fractality man will not acknowledge beauty in architecture. However, "faked fractality" is worse than none. N. SALINGAROS (1999) was right to criticize the neglect of fractal patterns in modern architecture.

Other important figurative levels are polyhedric qualities, grouping effects of wall openings, wall and roof arrangements, patina and "common fate", and many other "Gestalt laws" of Gestalt Psychology. The figurative principles and levels have properties of patterns. They assist our perception to reduce the large amounts of information perceived in every sight – say – 2 million bits to 200 bits, into patterns that can be processed by our short-term memory within fractions of a second (Fig. 1, details in LANGHEIN 2000, 2002, 2004). The promotion of*information reduction* (and filtering) is probably one of the most important functions of proportion in particular and of aesthetic perception in general.

Fig 1. Stages in information reduction of a typical German townhouse facade. After BUTTLAR, 1973.

2. Mediation of Patterns of Proportions as the Prerequisite of Beauty

Within the balance of perceived order & diversity, *proportion* primarily takes the*part of order*, but at the same time it *mediates* between the two poles of order and diversity as well as between pattern levels. This is a "*mediation by patterns*" that creates a *unified or balanced perceptual effect* for the whole form and each of its figurative levels. Fig. 2 (a proportioned, but in regard to figurative levels one-dimensional building of Oswald UNGERS) demonstrates that proportion without*counterbalancing patterns* does not properly support beauty. *It is the visual interplay of order principles like proportion and symmetry with the counterbalancing diversity principles like grouping, light & shadow, the fractality of material texture and colours, rhythm and other patterns that creates in perception the ensemble effect of beauty.*

The neglect of proportions in modern architecture, the disregard of unified diversity, including fractal qualities, and the lack of "human dimensionality" are the main reasons for the ugliness, the shapelessness and missing "kindness" of modern architecture.

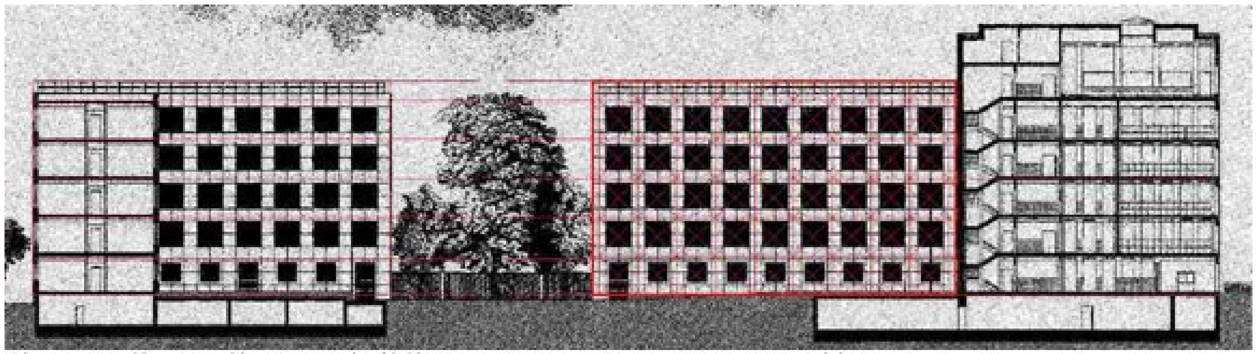


Fig 2. Berlin Family Court building, 1993-95. O. M. Ungers, architect.

Fig. 2 shows a modern proportioned building, the Family Courthouse in Berlin of Oswald UNGERS of 1993-95. We can learn two essential characteristics of beauty (gestalt pragnanz):
Although well-proportioned, this building substantially lacks pattern diversity (on all principles & levels), although the architect is without doubt one of best of modern "conventional architecture";

Aesthetic perception requires stepwise simplifications by reducing a large amount of architectural features to a small number of super-signs, as long as the basic order of the façade can be grasped by perception and short-term memory. According to BUTTLAR et al. (1973), four to six reduction steps are required to "establish" aesthetic perception of the architectural language, since the aesthetic pleasure starts with the subsequent information enrichment.
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The form vocabulary in Fig. 2 is relatively meagre so that perception has neither freedom for sign reduction and enrichment nor for play between principles and levels.

3. Further Remarks on Perception and Information Processing

An operational understanding of proportion and other visual patterns is deeply related to perception and information processing. HALE (1994) expresses this already in the title of his book, "The Old Way of Seeing":

The difference between our age and the past is in our way of seeing. Everywhere in the buildings of the past is relationship among parts: contrast, tension, balance. Compare the buildings of today and we see no such patterns. This disintegration tends to produce not ugliness so much as dullness, and an impression of unreality. The principles that underlie harmonious design are found everywhere and in every time before our own; they are the historic norm. &mnsp; (HALE, 2)

Perception and its extraordinary capacity of performance essentially depends upon proportion. In a famous statement of 1712, LEIBNIZ speaks of the acoustical perception of music; the same principles can be applied to the research of visual perception: "Music is a hidden arithmetic exercise of the mind unconscious that it is calculating, because it does many things by way of unnoticed perceptions which with clear perception it could not do...". LEIBNIZ correctly states that the perception processes information in a systematic way, particularly by the unconscious identification of mathematical patterns, of ordered contrasts, tensions, motions etc: this validates the last paragraph of section 2 above.

4. Traditional Architecture, Perception and Proportion

4.1 The loss of beauty and traditional friendliness in the built environment

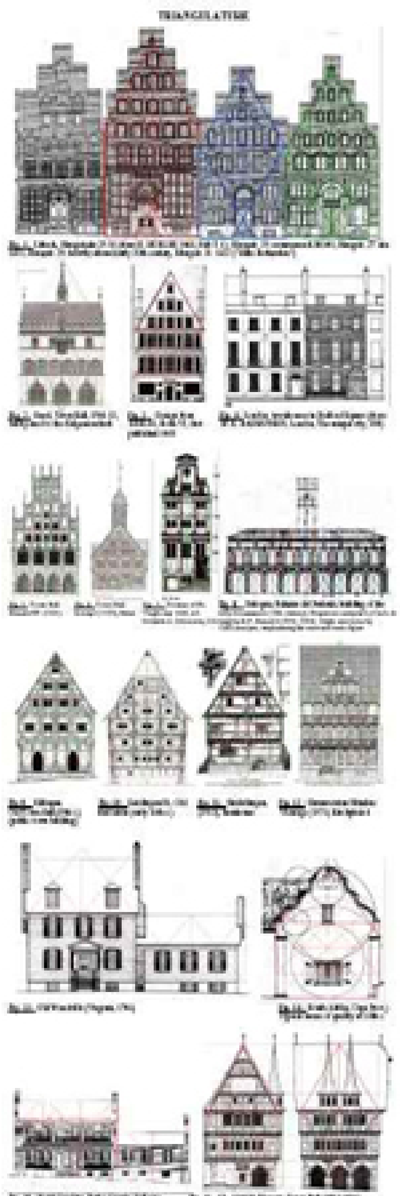

Fig 3. (click to enlarge PDF)
Triangulature in traditional bldgs

Almost as a norm, traditional architectural worldwide corresponded to the objective criteria of beauty and friendliness to man (see Fig. 3 to Fig 7). Making systems or Gestalt analyses of traditional architecture may contribute to a practical manual of well-tuned beauty or gestalt pragnanz in architecture. It would be possible to reach such insight by means of such analyses (1) to establish *sets of design tools*, based on systems, which would increase, not restrain the freedom of design, and (2) to find a systems path to a future *architectural language*that includes beauty rather than systematically excludes it.

Beauty in modern architectural design is lost because designers are not sufficiently aware of patterns, responsiveness, or dimensionality. The form and fractal language of 20th century architecture is extremely poor. Façades are no longer faces, more grimaces. Ancient vernacular architecture was often characterized by*unobtrusive* elegance, modesty, and nobleness. Proportion additionally is a characteristic of *authenicity* of (traditional) architecture and habitats.

It looks as if ancient builders knew of the autonomy or "inner laws" of the *façades* as a kind of "interior design of people's habitat" for promoting a common feeling of life. Although buildings are 3D objects, the 2D surfaces, i.e. the façades are optically pre-eminent in comparison to the 3D form qualities of buildings. This must be explained within a future theory of architecture and visual habitat. Additionally, we should not disregard the dimensional ratio between the human eye level to the size of modern buildings.
Therefore, the faces (façades) of buildings were designed with particular care, particularly in closed settlements. Between the Gothic period and 1830 the builders of townhouses and palaces in Europe and America normally exhibited mastery in the patterned design of façades, which was, step by step, lost in the following hundred years. Architecture has a permanent impact on the basic conditions of human life, almost 24 hours every day, and traditional architecture took care of this.

4.2 Unity of proportion established best on geometry, practical geometry

The *beauty of proportions* is based on the simple geometry of regular polygons. Man subconsciously recognises the *clarity or crystalline-like order* in proportioned architecture, derived from regular geometry. The majority of the thousands of treatises on art and architecture that appeared in Antiquity and between 1450 and 1850, stressed the importance of proportion for beauty, as did the philosophy of Antiquity, Middle Ages and Modern times.
The vast majority of pre-1830 architecture was proportioned (and patterned), and particularly in vernacular architecture, proportion geometry was derived from polygons (& polytopes). I work with some 250 angles to *establish regulating lines* (RL), and suppose that perhaps 500 angles can be derived from regular polygons with 3 to 10 corners, including rectangles with their ratios, tesselations etc. Thus a powerful range of measures was available for the preindustrial builder, without requiring the study of mathematics.

The clarity of perfect geometry thus becomes transferred into the design of architecture, and the most efficients means for transfering are the regulating lines, arches, and circles. As mentioned, they are derived from the polygons, their diagonals, rectangles with ratios of side lengths to diagonals, bisectors (and triangles within such rectangles), combinations and tesselations of these three polygons. The crosswise positioning (of the equilateral triangle to the hexagon, of square to octogon, pentagon to decagon) enlarges the potential of ratio of sides to diagonal, bisectors, rectangles, tesselation and combinations of polygons (such as 1 1/2 or two squares, vertically or horizontally placed).

A revealing example of the oral tradition of builders' geometry is told by P. FRANKL (1960, 724). The method of practical geometry to double the square is mentioned by VITRUVIUS in Book IX, Introduction, 4, referring "to PLATO, who in Meno puts the demonstration in the mouth of Socrates". Then the description disappears in the literature during 1,500 years, only to reappear in M. RORICZER's "Geometria deutsch" (1486). *In the meantime, builders used the doubling of the square in the construction of millions of buildings*, without documentation in writing.

The application of practical geometry did not create major difficulties for the practical minds of ancient craftsmen and artists. Many of the several thousands of treatises of architecture and other crafts during the period between 1450 to 1850 deal with practical rules of craft geometry, derived from the circle and regular polygons.

Thus summarizing, I would state that perfect visual beauty can be based on simple geometric figures, regular polygons or solids. An interesting quote which can be found in the first Encyclopaedia Britannica of 1773 states just this: "Architecture, being governed by proportion, requires to be guided by rule and compass."

4.3 Triangulature, Quadrature and Quinture in practical geometry
It can be proved that the majority of traditional architecture can be explained in itsextensional order by the above sketched rules derived from the regular triangle, square, and pentagon, or their polytopes and duplications (hexagons, octagons, decagons etc.), sometimes their tesselations, and seldom by regular polyhedra (Platonic and Archimedean solids).
Musical proportions can be translated into regulating lines in the same manner. Other systems developed on a mathematical basis are possible, but they do not carry the "guarantee of quasi-automatic unity" in the design. The rules of ancient proportions were and are easy to learn. The masters received the privileges of the Artes Liberales, and therefore kept this knowhow in secrecy (particularly between Vitruvius and the 15th century).

5. Traditional Folk and High Architecture and its Categories
Traditional architecture was normally proportioned either by systematic means or with the help of a highly developed feeling of form and the ability to transform this into shape, as I can show in many hundreds of proportion analyses.
My research work shows that we can logically, based on proportion analyzations extended to architecture of the continents of Europe and America, categorize traditional architecture in the following way (if we do not take religious architecture into account):

1. Traditional vernacular architecture (TVA)
2. Traditional high architecture (THA), and
3. Traditional semi-high architecture (TSHA), particularly townhouse architecture.

TVA varied predominantly by space, and THA with time, TSHA with space and time.

My research method is directed to identify type and typologies, and in doing so, I repear proportion analyses of buildings that apparently belong to the same type. So I have worked out around 50 analyses of Swiss Quadrature farmhouses or even a greater number of East Coast colonial American architecture, in order to increase the degree of probability of the encountered solutions in my analyses prepared hitherto.

6. Principles of Proportion and Polygonal Proportion "Mesh" Systems in Architecture

6.1 The three proportion systems of pre-industrial architecture

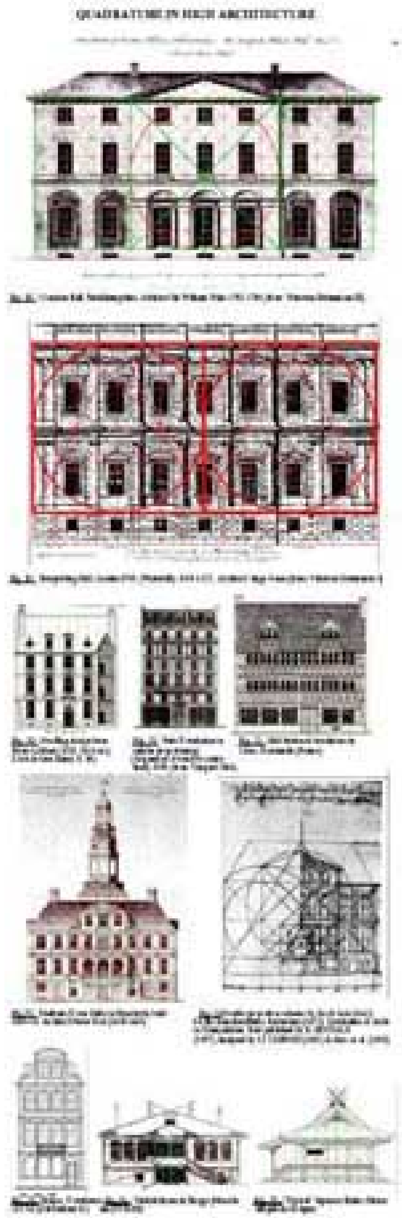

Fig 4. (click to enlarge PDF)
Quadrature in high architecture

In architecture since prehistory, the three most important geometric proportion systems for entire buildings systems worldwide seem to be *Triangulation, Quadrature*, and*Quinture* (the proportions of Golden Mean). The geometry is based on regular polygons with 3, 6, 9 or 12 etc. corners on the circle (*Triangulature*), with 4, 8, 12 etc. corners (*Quadrature*), or with 5, 10, 20 corners (*Quinture*), their diagonals, bisectors, triangels with rectangles with side ratios, angles in tesselations and combinations, etc.

This could result in 300 to 500 angles, useable for geometric construction with cords alone (cords could be used simultaneously as tape measure, compass, and rules (see fig. 18 in D. PEDOE 1976, 67). The use of the three systems is relatively well documented in the case of discussions and expertise on the constructional "crises" of the cathedrals of Milan of 1399/1400 (FRANKL 1960, 62-86, and J. ACKERMAN 1949), Chartres and Girona (FRANKL 1960, 57-62).

The Quadrature was probably the most used proportion system, and the most flexible too, because it allows various combinations of integers in the horizontal and vertical line. Diagonal regulating lines could also be created. However, the Quadrature could never match the static advantages of Triangulature, used by Gothic master masons (who themselves used Quadrature solutions if suitable).

The Pythagorean Theorum could be ascribed to Quadrature proportions. It appears that Quadrature proportion systems were predominant in Roman Antiquity, the Middle Ages until the Gothic, in Hindu, Buddhist, and Islamic civilizations, and in the vernacular architecture of many regions throughout history. However, examples of Triangulation and Quinture can also be found since prehistory in early civilizations such as Egypt.

6.2 Mesh of Regulating Lines and Regulating Arcs

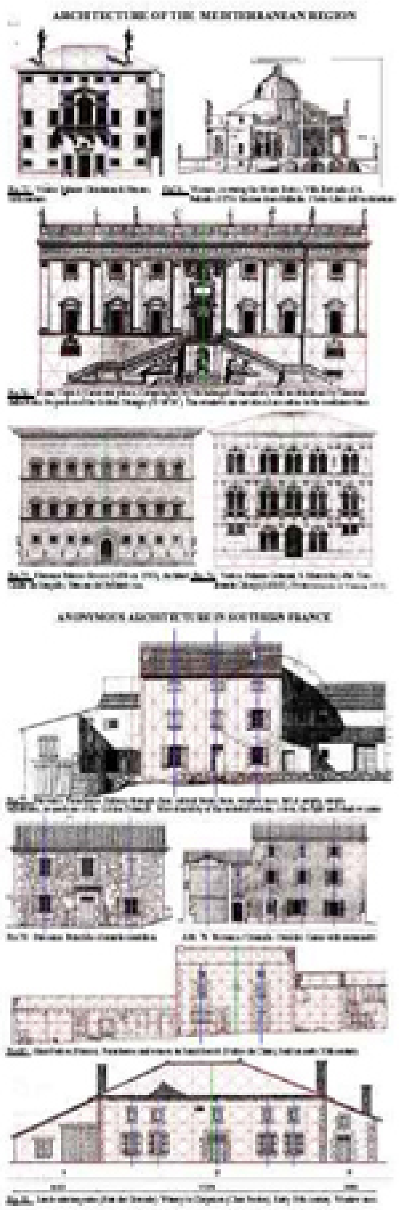

Fig. 5 (click to enlarge PDF)
Mediterranean building

The configurative arrangement of proportion settings can most simply be translated by means of grid or mesh of regulating lines (RL), as demonstrated by HALE (1994, 545-557), M. C. GHYKA (1977ff), George JOUVEN (1979, 1960, 1985), and meany others. In the case of façade proportions, the alignment of the grid or *mesh of regulating lines* (RL) can be oriented either (1) to borders and edges of the entire building, or (2) to their division e.g. into 3 or 4 parts, or (3) to regularly arranged window axes, as being often used in territories around the Mediterranean Sea, and particularly systematised in French townhouse and palace achitecture, or (4) to other arrangements. The use of the RL grids (or travces of it) can be found in antique buildings (L. HASELBERGER), in the lodge portfolio of VILLARD DE

HONNECOURT, in C. CESARIANO (1521), in many construction drawing Baroque architects, in the designs of H. BERLAGE and many other early modernist architects.

The decisive form-generating principle lies in the angles of the diagonal meshes, which often also define the orthogonal grids. My list of some 250 angles I indentified and work with is not yet fully published (LANGHEIN 2002, 92-93). GHYKA, JOUVEN, HAMBRIDGE and others give hints.

For beginners, it is not easy to understand that the proportion mesh does not define every architectural detail. Further, the system's character of all proportional relations may be more important than the exactness in all details.

6.3 Triangulature

The equilateral triangle can be found of in prehistoric ground plans in Europe (e.g. Lepinski Vir in Serbia, 4,000 BC; R. HELM (1952), F. SCHUBERT (1993, 2002). Nonetheless, in its "pure" form, Triangulature is strangely rare in extant vernacular architecture: I found none in Central Europe while analysing more than one thousand measured drawings of farmsteads.

Contrary to this, Gothic high architecture was completely dominated by "pure Triangulature", not only because of the symbolic meaning of the three in PLATO (Timaeus) and in Christianity, but also because of the overwhelming superiority of its statics for the construction of vaults and arches. The geometrical construction of the regular triangle was easy.

6.4 Quadrature

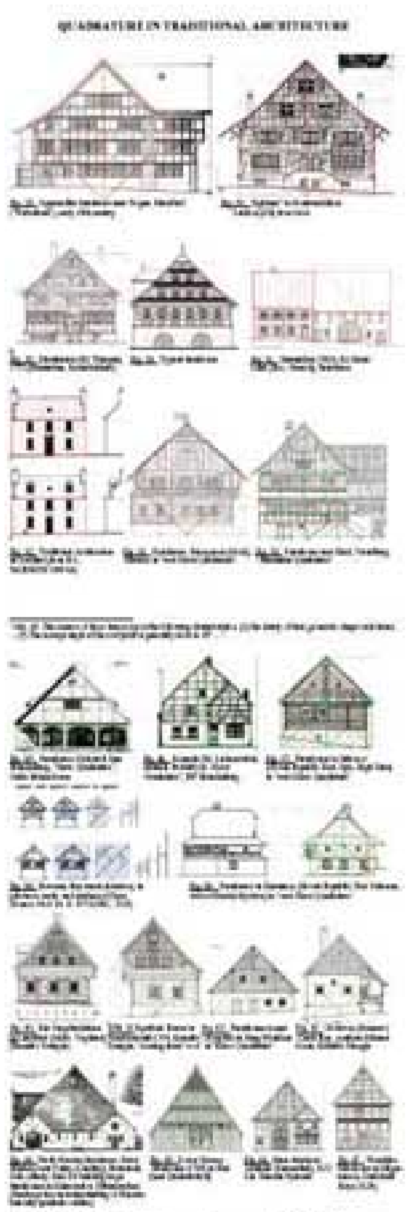

Fig 6. (click to enlarge PDF)
Quadrature in traditional bldgs

Quadrature proportions are probably most used in vernacular and high architecture, particularly in the Alemannic countries of Switzerland, southwest Germany, west Austria, west Slavic areas from the Baltic Sea to the Balkans (even where the Slavs disappeared 600 to 1200 years ago), Frisia, Scotland, and colonial New England, etc.), and outside Europe in Asia.

Quadrature proportions always include the proportions of the so-called Knauth Triangle (63°26'6", 53°7'48", 48°53'50" etc), tesselation configurations of squares and octagons, and other angle functions. Quadrature proportions often give us the atmospheric impression of calmness, prosperity, and overall satisfaction with life, as can be typically encountered in German-speaking Switzerland, with its placid lifestyle. We can still find there today one of the most admirable timber-framed architctures of the world, in quantities unimaginable for non-Europeans.

The method of proportion also partly depended on the materials used for construction. Vernacular architecture built with wood or natural stone was configured as "standing" or "lying" squares or Knauth rectangles. The*sophisticated beauty* of these houses cannot be praised enough. R. NAISMITH (1989, 65) wrote of the Quadrature of Scottish houses, describing the "clarity of their geometric shapes and forms" that "possess the orderly dignity and balance of Scottish character" — they "look strong and sturdy", etc.

6.5 Quinture

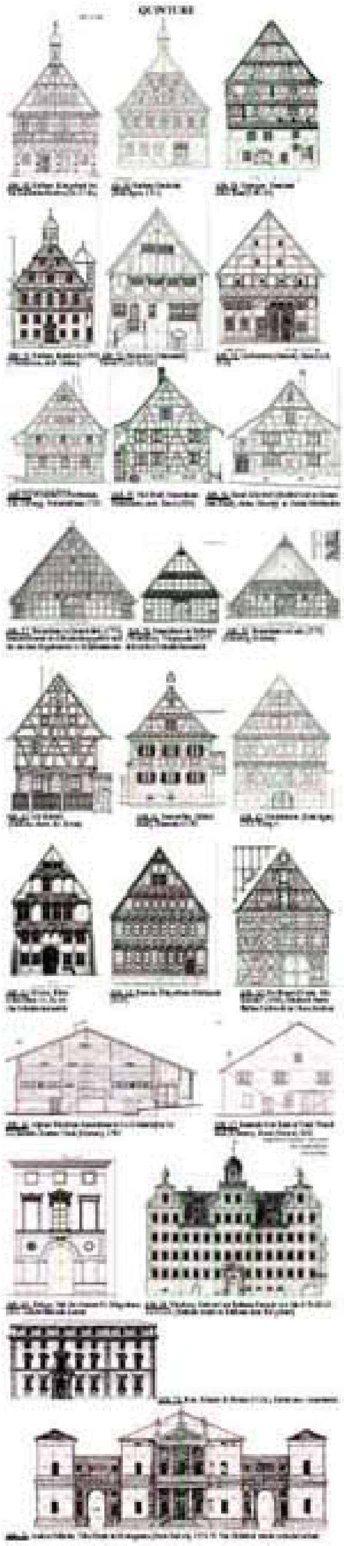

Fig 7. (click to enlarge PDF)
Quinture in traditional building

The Quinture is based on the pentagon and pentagram. It is the *proportion of the Golden Mean* (GM). Quinture is one of the three proportion systems, but many attribute probably too much mystery around the Golden Mean.

I still cannot make a final decision whether the Golden Mean seems to be more beautiful than other proportions. In some cases, it canot be denied. In European vernacular architecture, Quinture proportions almost never appear, as described by L. PACIOLI, but they do appear very frequently as the "*Golden Triangle*" (e.g. 51°49'38" and corresponding angles); the angle of 54°, preferred in Renaissance, appears sometimes in Traditional High Architecture and Traditional Semi-High Architecture in the 16th to 18th centuries. It is however, *totally misleading* to assume that the Golden Mean is the "only" proportion system that is capable of adding aesthetic value, as Le CORBUSIER did with his Modulor, or still worse, proportion itself.

The pentagon and pentagram were treated as the great secrets of the Pythagoreans. Luca PACIOLI claimed that the pentagon proportion belong to the *Divina Proportione*(Divine Proportions). Outside architecture, HAMBIDGE's "Dynamic Symmetry" (1920) demonstrates, in his proportion analyses of Greek vases, that there is beauty inherent in the Golden Section.

There are surely many mathematical riddles connected with the Quinture, e.g. the Fibonacci Sequence, and others described by R. LAWLOR (1989). Enigmatic Golden Mean features can be seen everywhere in enigmatic forms of nature, music, and the fine arts and cultural traditions. The pentagon and pentagram have very contradicting symbolic meanings in many civilizations.

Quinture proportions can be found in most ancient Egyptian pyramids, in Greek architecture, Renaissance architecture and in many house types of European vernacular architecture. Interestingly, a *proportion border* cuts Switzerland along its language borders. Swiss Romande farm and village houses often follow the Golden Triangle (often 38°19'22") and contrast sharply to the German-Swiss Quadrature houses in settlements and the countryside.

The Golden Mean is constituted by the section ratios derived by cutting diagonals within the pentagon (m:M), and is well-described in books. However, I doubt that the Golden Mean has an overall superior significance in architecture, which may well be the case in music and in other fine arts.

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Literature

ACKERMAN, James S. (1949), "*Ars sine scientia nihil est.* Gothic theory of architecture at the cathedral of Milan", in: Art Bulletin 31, 84-111

BUTTLAR, Adrian von (1973) et al., "Die Schönheit der Stadt - berechnet", in: Süddeutsche Zeitung103, pp 151-152
CESARIANO, Cesare (1521, 1981), *De Lucio Vitruvio Pollione De ARchitettura libri demem traducti de Latino in Vulgare affigurati: commentati,* [...] Como (A Gall, ...)
DASMANN, R.F. (1972, 1984), *Environmental Conservation*, New York
DEVLIN, Keith (1994, 2000), *Mathematics. The Science of Patterns*, New York (Scientific American Library)
FRANKL, Paul (1960), *The Gothic. Literary sources and interpretations through eight centuries*, Princeton, N.J. (Princeton University Press)
GADAMER, Hans-Georg (1960), *Wahrheit und Methode, Grundzüge einer philosophischen Hermeneutik*, Tübingen (Mohr)
GHYKA, Matila C. (1977, 200?), *The Geometry of Art and Life*, New York (Dover)
HALE, Jonathan (1994), *The old way of seeing. How architecture lost its magic (and how to get it back)*, Boston (Houghton Mifflin Comp.)
HELM, Rudolf (1952), "Maßverhältnissse vorgeschichtlicher Bauten", in: Germania 30, pp 69-76
JOUVEN, Georges (1979, 1986), *L'Architecture cachée. Tracés harmoniques*, Paris (Dervy)
— (1985), *La forme initiale. Symbolisme de l'architecture traditionelle*, Paris, (Dervy)
— (1960), *Rhythm and architecture*, New York (Dover)
LANGHEIN, Joachim (2004), "Allgemeine Proportionstheorie im Praxitest und visuelle Mathematik. Argumentationspotential der Gestaltpsychologie, Aspekte der Praktischen Geometrie und praktische Erfahrungen mit Computeranalysen", in: Florian Huber & Rolf C.A. Rottländer eds., Ordo et Mensura VIII, pp 219-248
— (2002), "Auf dem Wege zu einer allgemeinen Theorie der Proportion. Forschungsperspektiven für das 21. Jahrhundert ("Werkstatt-Bericht")", in: Florian Hubert & Rolf C.A. Rottländer eds., Ordo et Mensura VII, pp 76-97
— (2000), "Was ist Proportion ...?", In: Rolf C.A. Rottländer ed., Ordo et Mensura VI, pp 201-221
— (1986), Metageographie als humanökologische Geography, PhD thesis in geography, University of Heidelberg
LAWLOR, Robert (1989², 1995²), *Sacred Geometry. Philosophy and Practice*, New York (Thames & Hudson)
NAISMITH, Robert J. (1989), *Buildings of the Scottish Countryside*, London (V. Gollancz)
ODUM, Eugen P. (19713, 2005), *Fundamentals of Ecology*, Philadelphia (W.B. Saunders 1971), Belmont, CA (Thomas Brook/Cole)
RORICZER, Mathäus/Mathis (1486, 1998), *Das Bächlein von der Fialen Gerechtigkeit; Geometria deutsch, Hüttgenwald* (Guido Pressler)
SALINGAROS, Nikos (1999), "Architecture, Patterns, and Mathematics", in: Nexus Network Journal1 (1999), pp 75-85
SCHEPERS, Josef (1973-), *Haus und Hof westfälischer Bauern, Münster/W.* (Aschendorff)
SCHUBERT, Franz (2002), "Untersuchungen zur Maß- und Entwurfslehre keltischer Hausbauten", in: F. Huber & R.C.A. Rottländer eds., Ordo et Mensura VII, pp 109-119
— (1994) "Zur Maß- und Entwurfslehre keltischer Holzbauten im Oppidum Manching". In:Germania 72, pp 133-192, Beilagen 4-21

Footnotes

1. *Traditional Vernacular Architecture (TVA)*

In Europe, the TVA seem to be regionally rooted, adapted to natural space and locally available building materials. Vernacular construction types reached in many areas of Europe and Asia, evolving from oldest times, a high degree of maturity (SCHEPERS 1973, 38) "seldom granted to human produce". Until 1830, TVA changed mainly with space, sometimes with very sharp "proportion borders" identifiable with these tools, particularly in and around Switzerland because of the excellent regional documentation of TVA and TSHA. TVA was in Europe seldom object of written manuals or treatises on architecture. Their building technique was based on orally transmitted knowhow.

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2. *Semi-High Architecture (TSHA)*

THA changed with time (styles), TSHA partly with space, partly with time. Since antiquity, THA was object of manuals and treatise on architecture; education in TSHA and THA was was in essential parts also orally transmitted, particularly during the Middle Ages, and ancient knowhow appears in part with or at the time of the upcoming Renaissance more and more in written, although essential parts of practical geometry of the builders remained to be orally transmitted as part of professional insider knowledge. Religious architecture generally has the most sophisticated proportions. The geometry that contributed to the formal perfection of religious architecture was both visible and invisible.

The relationship between TVA and TSHA in Europe depended on the size of the settlement. As a rule it could be said that the mutual influences were reduced the larger and more fortified the settlement was in the period 1000 and 1800, but different from region to region. For example, Gothic townhouses of Lübeck, proportioned according the equilateral triangle, had not the slightest relationsship with the proportions of Saxonian farmhouses of the countryside around. Lubeck^{o}s townhouse proportions had the international appearance of many other medieval Hansa federation cities, like Brugge, Wismar, Rostock, Danzig, and Riga. The pure equilateral triangle appeared almost never in true vernacular architecture of that period.

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3. *Traditional High Architecture (THA)*

THA was designed by single personalities who mostly remained unknown still in early Gothic, and became more and more known until the last building projects of Gothic style. The characteristic of Renaissance was the freedom of design, disegno. Baroque: freedom of design, one architect; breaking rules.

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4. *Ancient masons and carpenters*

The ancient masons or carpenters used these tools to compose, by simple means, simultaneously the whole and of parts. They could do it with regulating lines or regulating arcs (circles) or both. HALE has written with inspiration on regulating lines and arcs:

"*In every Gothic church, he writes, the shape [of the vesica piscis] is repeated like an incantation wherever one looks, where it becomes an enclosing geometry of regulating arcs. The geometry of a Gothic building is an efflorescence of overlapping circles*." (HALE, 77)

In non-religious buildings, regulating lines, circles and curves were derived from hundreds of proportion codes deduced from these three proportion systems, to create harmonious architecture in high and folk architecture. HALE again:

"*To explore the regulating lines in a building is to delve into the guiding thoughts, the connections, the happy coincidences, that make up its design, for these lines organize the geometry of forms. The lines are usually, but not always, hidden; they may come to the surface in gables... or elements*". (*ibid*., 45).

"*The regulating lines merely connect the parts; to read them is not to solve the mystery but to be presented with more and more mysteries. We are all well equipped with an unconscious... ability to recognize such relationships and to figure them out during the design process...*".

"*The most common type of regulating lines is the diagonal connecting key points on a rectangle. The eye relates any element placed along that line to whole even if the line is invisible... Lines* *parallel to it might become the roof slope. The roofline, carried through space to the ground beyond the building, might determine the location of a gate or an outbuilding, or it might point to a natural object such as a boulder*."

From any point on the diagonal, lines parallel to the sides of the rectangle create two new rectangles of the same shape. For shapes to relate to one another, at least three key points have to fall on the regulating lines. One of those points may be the invisible centre of the overall shape."

(HALE, 45-48).

"*Analysis of regulating lines can be useful to one's own work when some part of the design doesn't seem to fit*." (*ibid*, 52)

In my opinion, regulating lines and circles can be extremely useful at any stage of the design procedure to produce beauty and magic in architecture. This doesn't depend on mimicry or imitation but on a creative play with new forms.

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