

TIME AS A FOURTH VECTOR FOR GENERATING NEW MODULES IN ARCHITECTURE

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ABSTRACT

The study examines the idea of liberalization from the constraints of the three dimensions, which in turn influenced the properties of the fourth dimension. It was necessary to seek a more comprehensive umbrella to introduce the properties of the vector on the four dimensions. In light of this change, the research seeks to establish rules to expand the scope of evolution in all stages of the architectural process. The main objective of the research is access to a curriculum that demonstrate the reality within the framework of new theories and philosophies by reformulating and developing coordinate systems and modules to serve all architectural applications by applying vector properties to the four architectural dimensions, Which in turn produced new units in the architectural formations on the level of planning and the formation of buildings.

KEYWORDS: Coordinate systems, time module, dimensions, vectors.

1. INTRODUCTION

The world is witnessing major developments in the construction industry. This development is following the rapid intellectual development led by a great constellation of contemporary architects. It was necessary to seek technological development behind the ideas of architecture to achieve them.

X, Y, Z is the most widely used coordinate system, but using it as dimensions is a major waste of the coordinate system, and consequently the time as a fourth dimension. So we have to define things correctly and put it on the right context.

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Under the current concept of time, which does not meet all the requirements of architects in all stages of the construction process, although emergence of many studies using the concept of time, but the current concept does not achieve all the desired goals. The research we are studying starts from a fundamental point; that converting the coordinate system from a dimension to a vector, and the impact on the fourth dimension.

The study of X, Y, Z and T as vectors is a big step in module image and morphological fields.

2. COORDINATE SYSTEMS BETWEEN DIMENSIONS AND VECTORS

The coordinates varied between simple and developed according to needs, and this is done by adding properties to increase the accuracy, flexibility and avoid the defects of the previous.

2.1. Simple Coordinates

The simple coordinates varied between two and three-dimensions with different ways to characterize the vacuum [1]. First type based on orthogonal lines such as Galileo and Descartes shown in Fig. 1. The others relied on curves such as the Gaussian Coordinates and polar coordinates which are easier to express than orthogonal coordinates as shown in Fig. 2.

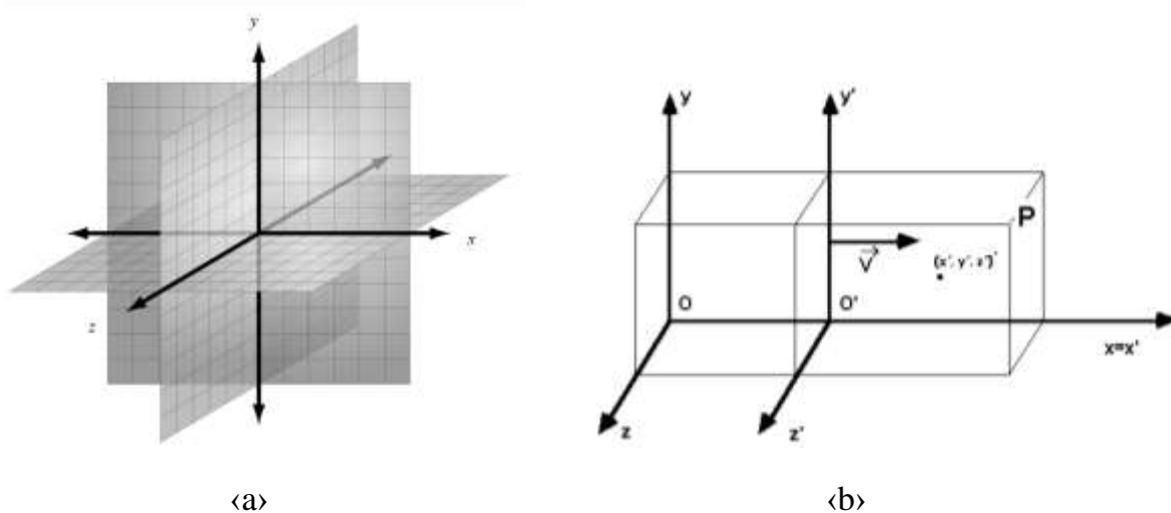


Fig. 1. <a> Descartes coordinates Galileo coordinates, [2].

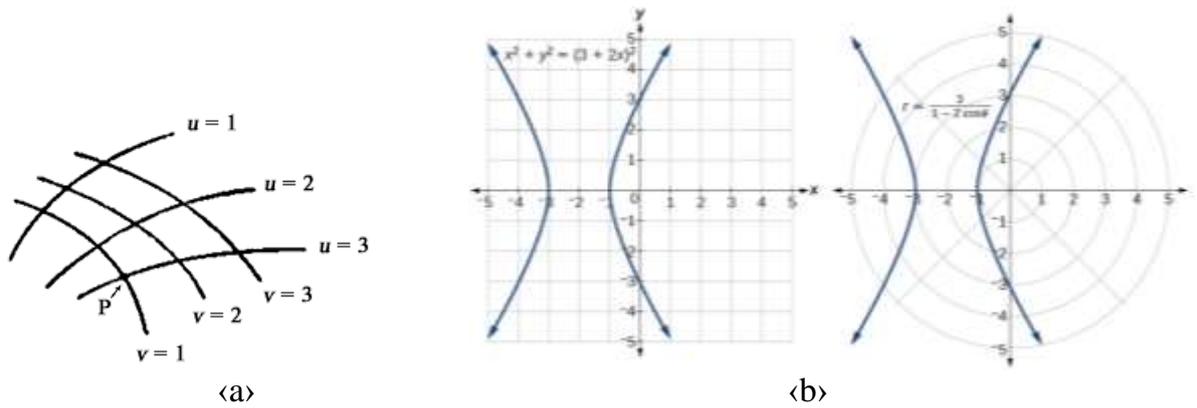


Fig. 2. (a) Gaussian coordinates, [3]. (b) Grid and polar coordinates, [4].

2.2. Developed Coordinates

The coordinates are developed by introducing properties on the method of attribution, including characterization through imaginary numbers such as the nodal coordinates, and introducing of logarithmic properties such as the logarithmic coordinates shown in Fig. 3.

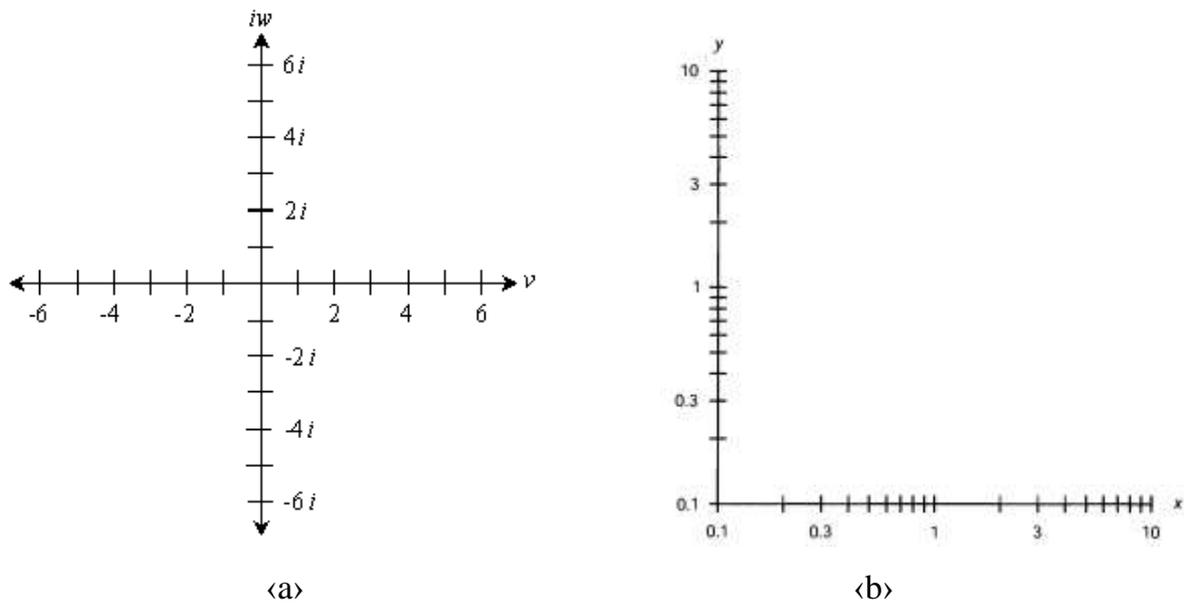


Fig. 3. (a) Nodal coordinates (b) Logarithmic coordinates, [5].

All types of coordinates have the same methods of description, that are the sign (+ or -) before the number or using equations, that means that all of them aren't dimensions, so these systems have the vector properties.

3. CONVERTING THE POWER OF TIME FROM THE FOURTH DIMENSION TO THE FOURTH VECTOR IN ARCHITECTURE

Firstly, the time is measuring the duration of any process, and is used as the fourth dimension, finally time will be a vector.

The time entered to each vector effects on its straightness and converts the three perpendicular plans to multiple curvature surfaces as shown in Fig. 4. The tangent slope of each curve gives equation of time for this surface.

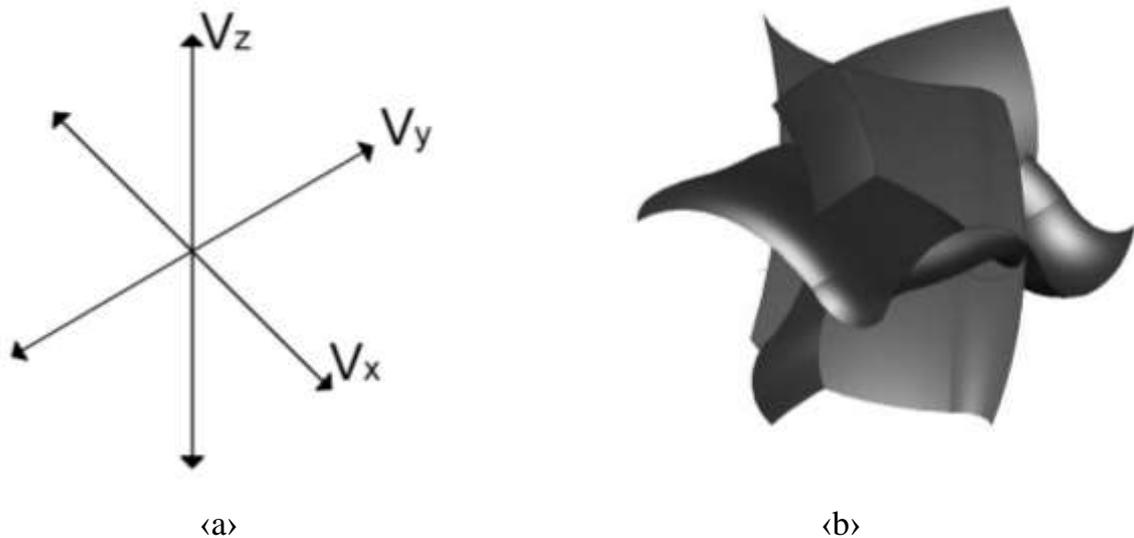


Fig. 4. <a> Perpendicular vectors. The effect of time, source – researchers.

3.1. Accuracy of Measuring Time

The second was the smallest unit to measure the time before using the moment that equaled 0.01 of a second.

In NIST, “The second was redefined as the duration of 9,192,631,770 energy transitions of the Cesium atom” [6].

3.2. Time as a Fourth Dimension

The expression of time began in the architecture at the carpenter center for visual arts designed by Le Corbusier that using the ramp to apply the concept of time [7], where the ascendant achieved progress in X, Y, Z and also in time, but the problem was to return to the first position. All the coordinates returned, but time is making new progress, as shown in Fig. 5.



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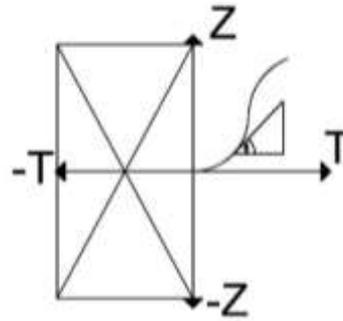


Fig. 5. <a> Ramp of Carpenter center for visual arts, [8].
 the progress in X, Y, Z and time in moving on the ramp.

The time took a partial development, as it expressed movement in architecture. Firstly the expressive movement as a habitat building by Moshe Safdie, and then the kinetic architecture such as Fisher's design of the Rotating Tower, as shown in Fig. 6.



<a>



Fig. 6. <a> Habitat building by Safdie, [9]. Rotating tower by Fisher, [10].

3.3. Effect of Entropy on the Time

The equation of entropy by Ludwig Boltzmann Eq. (1) where S is the entropy, K is the Boltzmann constant equal to 1.38065×10^{-23} J/K, and w is dynamic probability, which determines the entropy is uncompleted because the time is missing [11].

$$S=k.\log w \tag{1}$$

In entropy, we reached the zero-time phase that determines the positive and negative vector in time, where entropy increased in both directions, but differently as shown in Fig. 7.

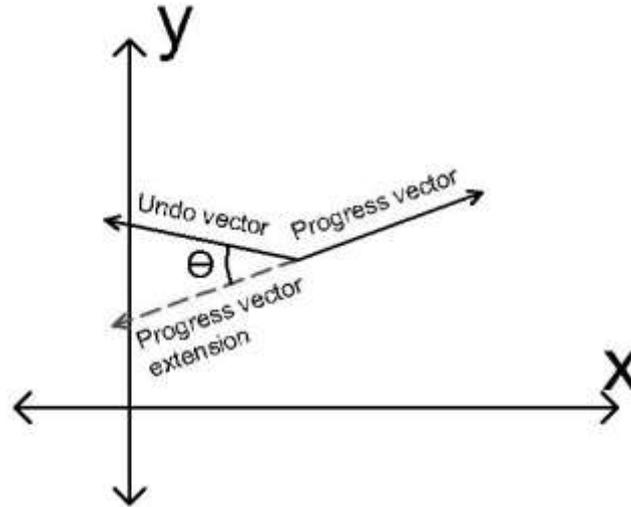


Fig. 7. Vectors of entropy.

The equation of entropy will be as Eq. (2) in case of increasing, but in case of decreasing will be as Eq. (3), where θ is angle between progress vector extension and undo vector.

$$S=k.\log w \tag{2}$$

$$S=k.(\log w).\sin \theta \tag{3}$$

4. GENERATING UNITS

The time follows the coordinate properties specially the vectors, so the merging will be in two conditions. The first one is the vector of the distance, which is the displacement and the vector of the time will be the duration. The second one is integration of displacement with the duration.

4.1. Integration of Displacement with Time

The first direct integration of displacement with time is velocity, and the second is acceleration shown in Eqs. (4, 5). We will use the first integration by using the light wave as ideal velocity. The special second integration is the gravity Eq. (6), which is used in reshaping of unit.

$$dx/dt=v \tag{4}$$

$$dv/dt=a \tag{5}$$

$$g=9.81 \text{ m/s}^2 \tag{6}$$

4.2. Producing a New Unit from Wave Properties

Two waves, the first one passed through the drilled membrane as shown in Fig. 8., and the other is reflected on the same membrane with an angle equal to half of the critical angle to find the intersection area as shown in Fig. 9.

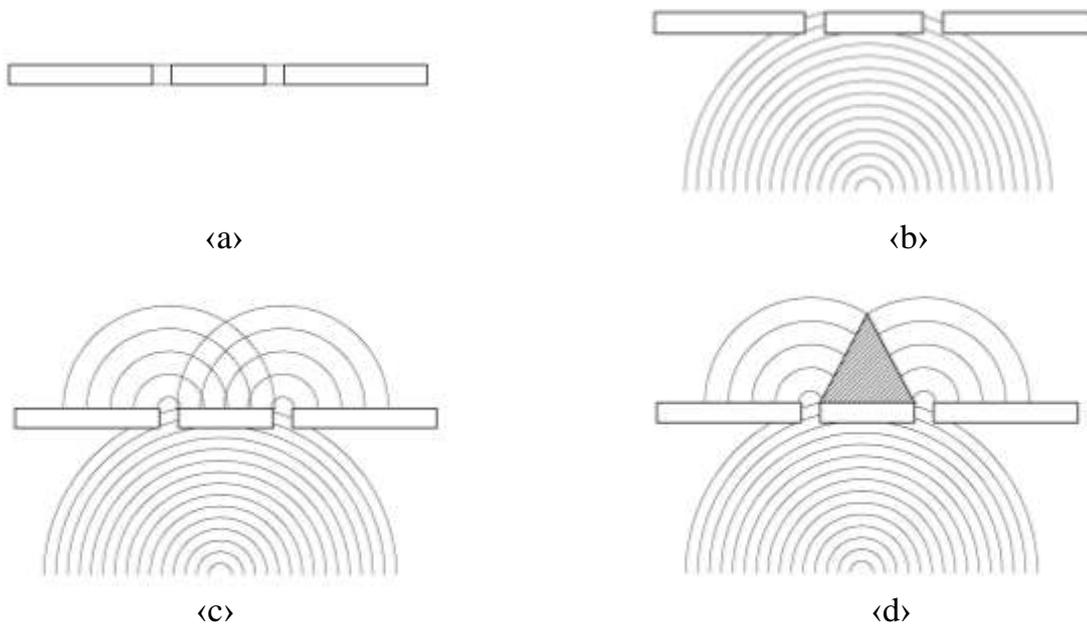


Fig. 8. <a> Drilled membrane. Movement of wave. <c> Interference of waves.
<d> Area of interference, source – researchers.

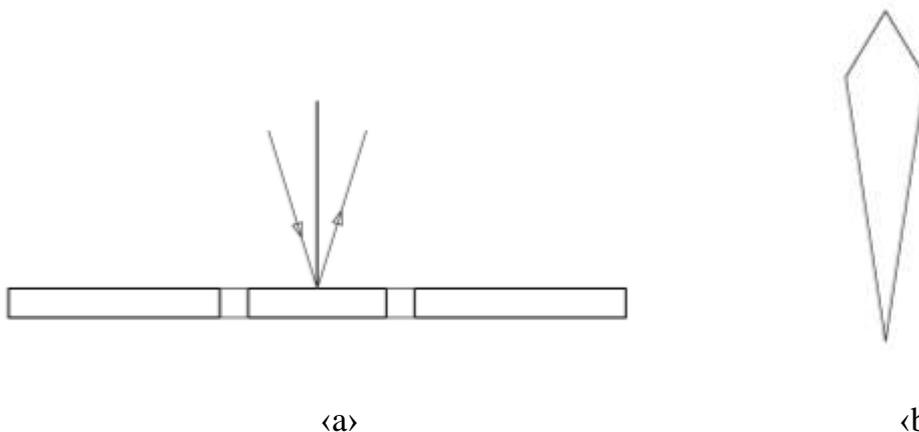


Fig. 9. <a> Reflection with half of critical angle.
 Intersected area "the produced unit".

The three advantages of the produced unit are special angles, unique shapes, and the ability for variety in replication.

4.3. Converting the Unit to a 3D Unit

The converting process is not easy in terms of preserving the angles. There are three scenarios for converting. The first scenario is extrude the shape of the unit, but this method abolishes the angle of the sides, and the second scenario is revolving the shape of the unit, also this method abolishes the angle, as shown in Fig. 10. The third scenario is repeating the unit as sides by using the critical angle, this is the best solution as shown in Fig. 11.



Fig. 10. The rejected methods, extrude and revolve.



Fig. 11. The ideal solution.

5. APPLICATION ON UNITS

The application will be in three cases, the first case is using the unit in 2D style. The second case is using the unit in a 3D shape as simple forming. The third is using the unit in a 3D shape with effects of vectors factors.

5.1. Using the Unit in 2D Style

In this case the effect of the mirror on the unit will be done on the small side as Shown in Fig. 12. This method will lead us to Walter Christaller's theory of planning, but with a better internal division as shown in Fig. 13.

The Christaller's theory divided the areas to hexagonal shapes to avoid waste and also for ease of internal division and integration [12].

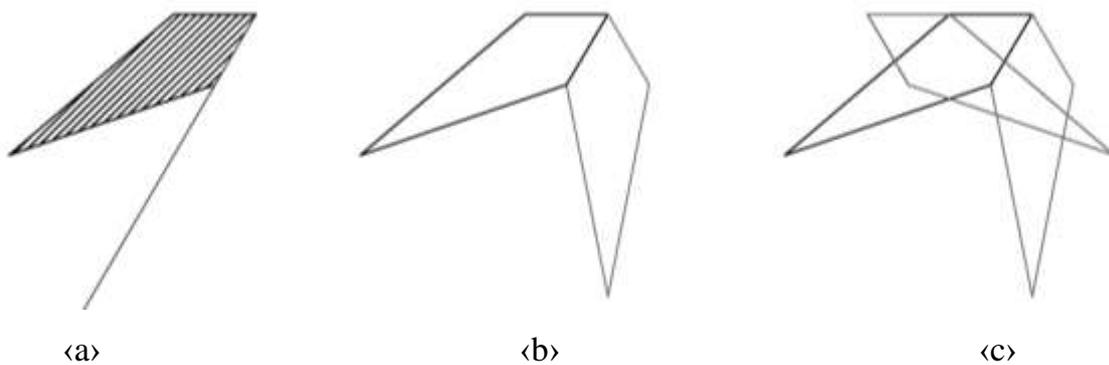


Fig. 12. <a> Mirror axe. First step. <c> Second step.

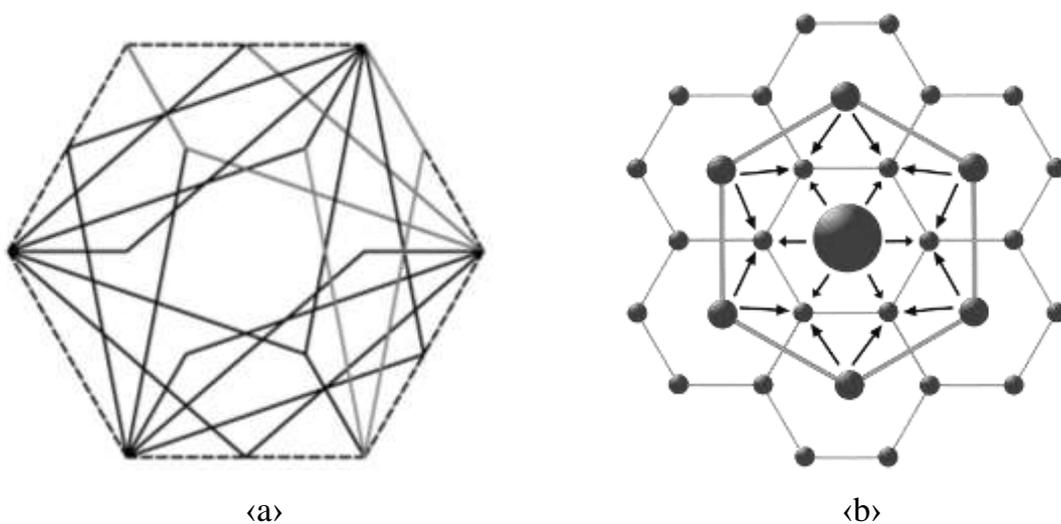


Fig. 13. <a> Final product.

 Walter Christaller's model, [13].

The advantages of new division are variety in shapes, different areas, and central distribution

5.2. Using the Unit in 3D Shape as Simple Forming

We obtain from the simple repetition of the 3D unit an infinite number of solutions because the sides of the unit are various and diversified as shown in Fig. 14.

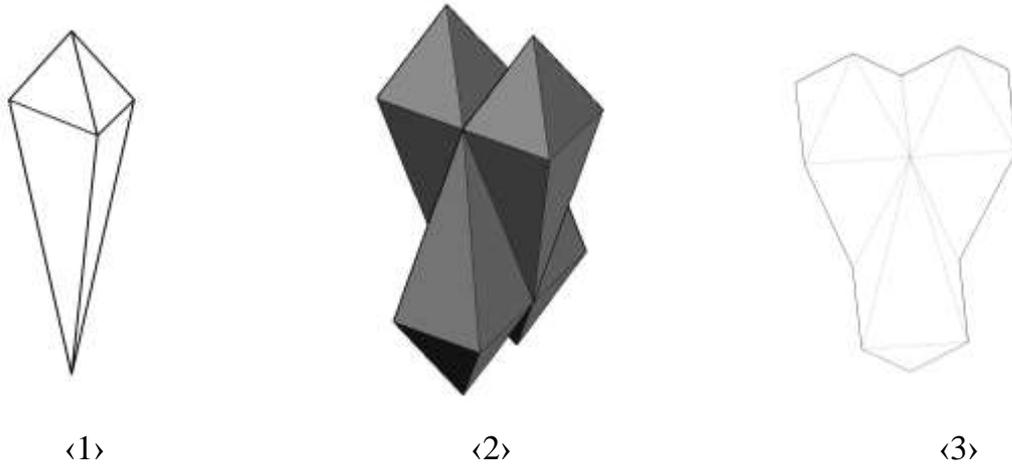


Fig. 14. Composition in 3D.

The applications of these shapes are endless and fertile ground for many different concepts, as examples of this are the faceted tower as shown in Fig. 15, Jinao tower Nanjing, China presented in Fig. 16. , and the Optic Cloak shown in Fig. 17, which is only three meters deep and was designed for disguising the energy center chimney.

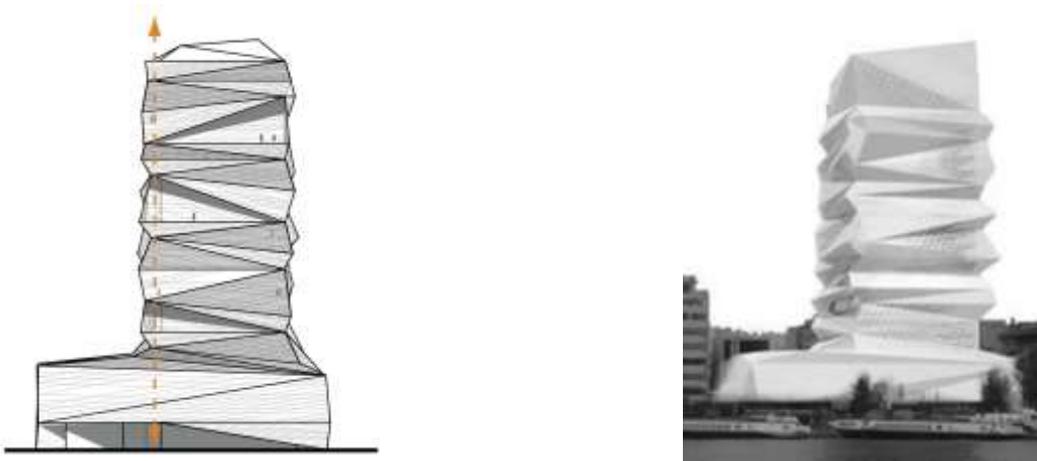


Fig. 15. Faceted tower, [14].



Fig. 16. Jiniao Tower, Nanjing, China, [15].



Fig. 17. The Optic Cloak of chimney, [16, 17].

5.3. Using the Unit in 3D Shape with Effects of Vectors Factors

The effect of entropy, the gravity as a second integration of distance with time, and coordinate systems between polar and logarithmic systems are factors affecting on the units sequentially. All processes that are applied with polar coordinates 25 north and 32 east that are Luxor's coordinates.

The effect of entropy invert the shape of each pyramid upside down, the gravity changes the height of each pyramid, and the logarithmic system cut the lower pyramid at the end of the upper pyramid base, as shown in Fig. 18. The final product is copied to get the double pylon as shown in Fig. 19.

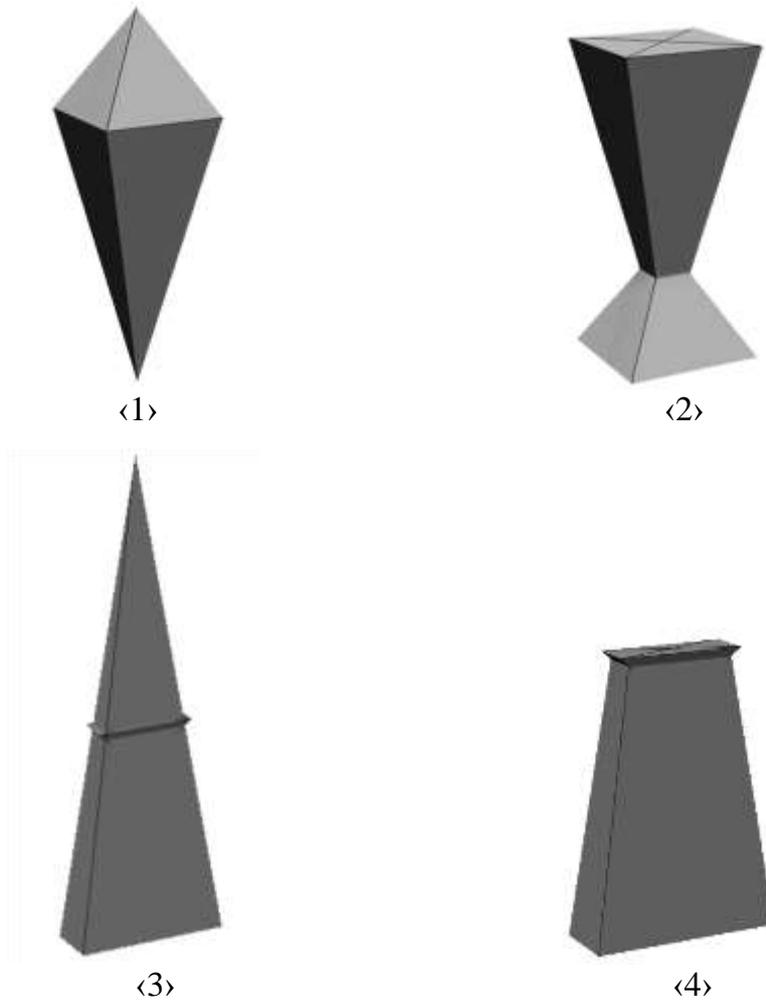


Fig. 18. Process sequence.

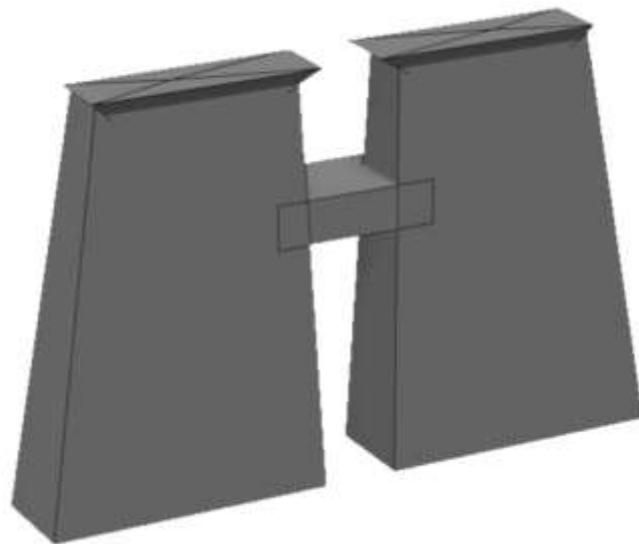


Fig. 19. Duplicate of product.

The pharaonic civilization was applying the vector of time in building shapes 6000 years ago. Through this great portal – time vector - we can rediscover all ancient civilizations.

6. CONCLUSIONS

All types of coordinates aren't dimensions, so these systems have the vector properties. The time follows the coordinate properties, specially the vectors. The vector of the distance is the displacement and the vector of the time will be the duration. The Integration of displacement with the duration in two steps have made a huge leap in the recruitment of the time vector and reshaping the units.

The three advantages of unit in 2D produced by waves properties are special angles, unique shape, and the ability for variety in replication.

The new division produced by the repetition of unit in 2D was distinguished by three more advantages than Walter Christaller's model, which are variety in shapes, different areas, and central distribution.

Through this great portal – time vector - we can rediscover all ancient civilizations by applying the mathematical conclusion reciprocally and create new methodologies in design by using the integration steps and effect of entropy.

The new vector serves different fields in architecture. On the urban level, a new composition of the units has been produced, and also at the level of the building whether by repetition or concluded by mathematical influences which reached to special shapes.

7. RECOMMENDATIONS

In case of units in 2D style : Integrating the new units that were derived to the urban level with the basic rules that are taught in the planning and urban design materials to enhance the ability of development of the students in this specialization.

The effect of vectors on units may be used in architecture education to strengthen the history and theories of architecture by mathematical applications as well as philosophical thoughts and inherited beliefs.

DECLARATION OF CONFLICT OF INTERESTS

The authors have declared no conflict of interests.

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الزمن كمتجه رابع لتوليد نموذج جديد فى العمارة

يتناول البحث فكرة التحرر من قيود الأبعاد الثلاثة التى بدورها تؤثر على خواص الزمن كبعدا رابعا حيث كان لزاما السعى إلى مظلة أشمل بإدخال خواص المتجه على الأبعاد الأربعة، وفى ظل هذا التغيير سعى البحث لوضع قواعد لتوسيع رقعة التطور فى كل مراحل العملية المعمارية، و الوصول الى منهج بغرض التدليل على الواقع فى اطار نظريات و فلسفيات جديدة بإعادة صياغة و تطوير نظم الاحداثيات والنموذج لكى تخدم كافة التطبيقات المعمارية من خلال تطبيق خصائص المتجهات على الأبعاد المعمارية الأربعة التى بدورها أنتجت وحدات جديدة فى التشكيلات المعمارية على كل من مستوى التخطيط و تشكيل الكتل.