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THE DERIVATION OF A UNIT-MATRIX SYSTEM, OF URBAN DESIGN  
AND ITS APPLICATION IN NEW TOWN DEVELOPMENT

by

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B. Arch., Delhi University, 1963

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Professor

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## I. INTRODUCTION TO HYPOTHESIS.

Present is the age of scientific and technological advancement. Man is in quest and search of new synthesis. Consequently, intensive search and research is on in all fields, to derive new theories and optimum methodologies for aiding the further betterment of mankind. In this innovation, the profession of "planning" is no exception and is in pace in this massive thirst and thrust for socio-economic and physical improvement of the society and its environment.

The field of "planning" is primarily comprised of two sub-disciplines; socio-economic planning, and physical development or urban design. Although much has been accomplished in recent times in socio-economic planning in terms of the evolution of new theories, methodologies, means and modes, the same is not true for urban design aspect of planning. In the absence of new theories and methodologies, the field of urban design continues to lean on antiquity for guidance and direction. The various principles and concepts derived and employed to shape the urban space in ancient time, with minor adjustments, continue to mould contemporary urban environment, although the set of conditions for which such principles and concepts were established, has radically changed through continuous socio-economic and technological development. Consequent to lack of established principles and methodologies, urban design is primarily conceived as a work of art, which has no limit in terms of perfection and so lacks performance standards. The result is persistent chaos and confusion in the field.

The purpose of this study is to promote the general uplift of the urban design field by deriving a methodological approach based on scientific principles, as a basic tool for urban development. The study hypotheses consists

of evolving a unit-matrix system as a mode of urban design and applying this mode as a mean for developing new towns. For this purpose, the form "#", which is deep rooted in mankind's thoughts, beliefs, and myths, as well as in his planned environment, is hypothetically adopted as a basic module. This basic module would be analysed for various urban design criteria, in order to derive it's merits and demerits. On the basis of this evaluation, the basic module would be reformed and improved upon in such a way that it's demerits are eliminated while it's merits are further enhanced. This improved module would formulate the optimum unit in the proposed unit-matrix system. The derived unit would be applied as a matrix for designing various urban spaces varying from the smallest urban element dwelling, to the whole city itself. The designs of these urban spaces would then be integrated into an organic whole, again employing the derived unit as the matrix. The city plan thus obtained, would be analysed and evaluated in order to establish the ambiguity of the derived unit-matrix system as a basic approach in designing the new town.

The study should provide the much needed basic tool and methodological approach for urban design in general and for the new towns in particular. The system approach resulted from the study should lead to desired flexibility and phasing in the designs of new towns, thus putting the new town development on a firmer footing. Such an approach would also minimize the risk of going astray during new town development, which involves huge sums of money and long periods of development.

The unit, matrix and spatial models resulted from the study should open a new vista in new town development in future. The towns produced on the basis of the derived system, would be "eftenopias", the accomplishable "utopias".

## II. SIGNIFICANCE OF THE FORM "#".

The form '#' is a quadrilateral symmetry, composed by the intersection of a pair of parallel straight lines by an other pair of parallel straight lines, at or near right angles. The form divides the space in divisions numbering 9, the highest single digit number which in it's idiomatic sense also means the highest point, degree or mark in skill, taste, efficiency or achievement. The origin of the Form is lost in antiquity and is not tracable. The Form is conceived by many as the earlier version of the Indian mythological symbol 'Swastika' which has attained universality with the advent of time. The Form continues to formulate the replica of Swastika even in present day Tibbet. Thus the interpretation of Swastika, which in ancient and modern sense is equivalent of "good luck" in a religious or magico-religious connexion is also attributable to the Form<sup>1</sup>.

### A. Significance of the Form in Mankind's Scientific and Mystic Knowledge:

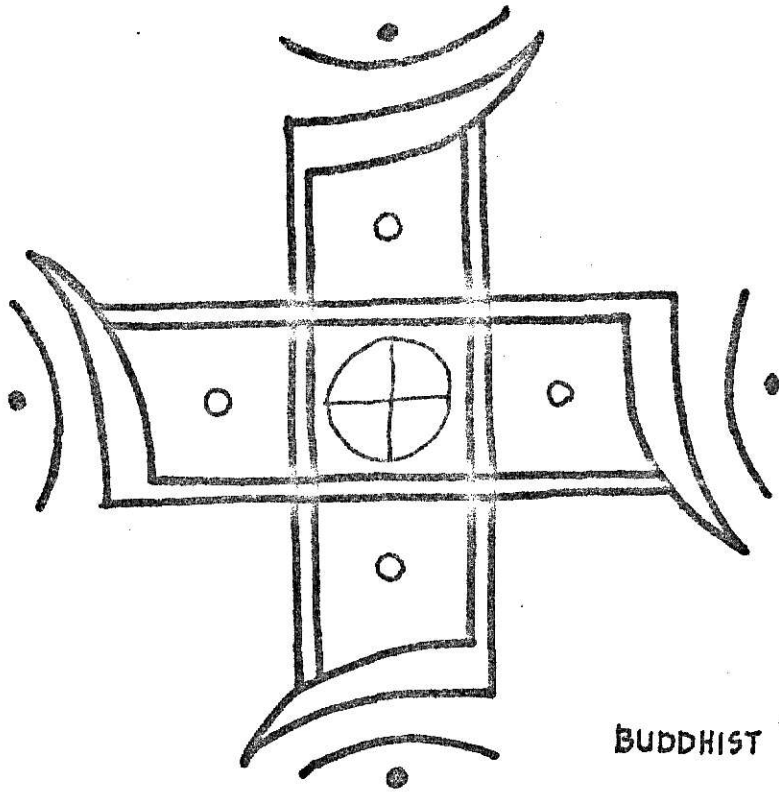
The Form, which is traceable in various civilizations and professional fields, has influenced man's thoughts and beliefs since the time immemorial.

#### (a) The Form in Science and Thoughts:

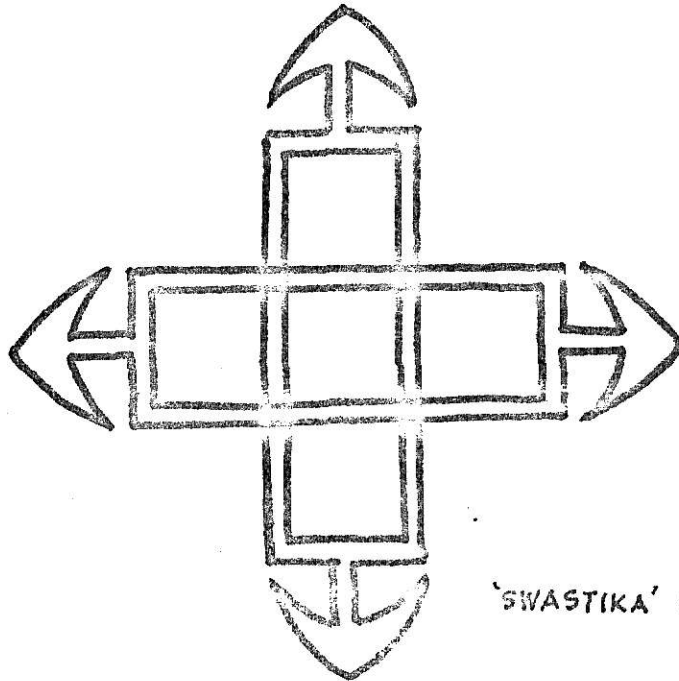
The Form carries varied but significant meanings in many languages and professions. It formulates the European party game 'Tic-Tac-Tau', and is a replica of the ancient Indian indoor game 'Chaupar'. In Chinese language which is pictorial in character, the Form denotes 'Yin' meaning 'well'. In United States, the Form represents 'serial number'. In the language of computer, the Form denotes 'micro-memory'. In adding machines, the Form represents 'non-add'. In biology, the Form symbolises 'secondary homonym'. In medical science, the Form stands as a sign for 'fracture'. In music, the Form

**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH DIAGRAMS  
THAT ARE CROOKED  
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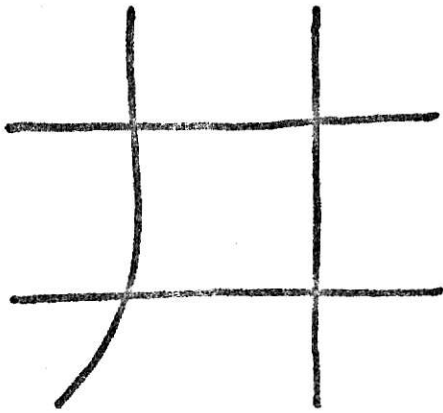
BUDDHIST 'SWASTIKA', TIBBET



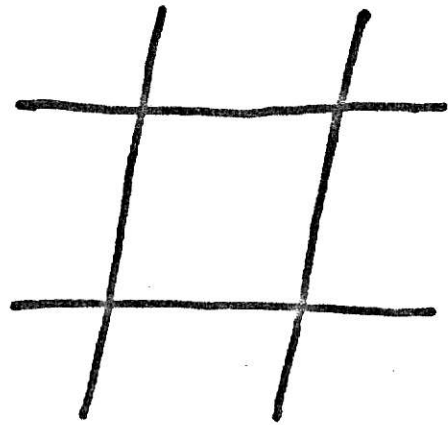
'SWASTIKA' ON ANCIENT HINDU COINS

Graphic: 1

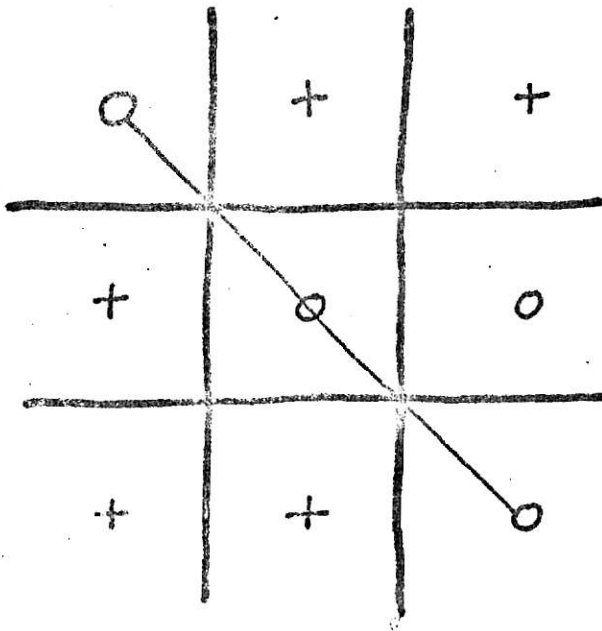
THE FORM "# AS A CONCEPT OF SWASTIKA



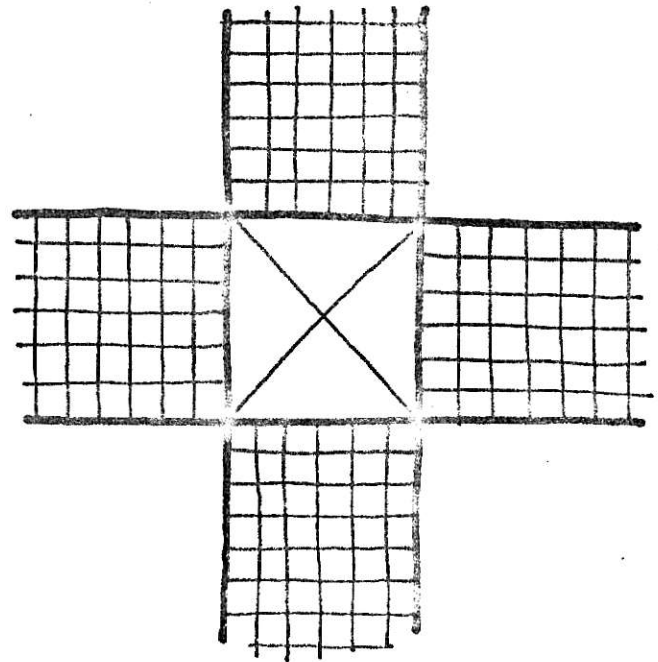
THE CHINESE CHARACTER  
CHIN' (WELL)



SIGN FOR 'NUMBER' IN ENGLISH  
LANGUAGE



EUROPEAN PARTY GAME OF TIC-TAC-TOU



INDIAN INDOOR GAME 'CHAUPAR'

Graphic: 2

VARIED INTERPRETATIONS OF THE FORM "#"



means 'sharp or quarter note'. In palmistry, the Form indicates 'safety and over-coming of obstacles'. In mathematics, the Form formulates the 'magic square of 3'. In Buddhist logic, the Form comprises the 'Wheel of Logical Reasons' for deriving logical fallacies in their strictest sense and in order to establish their number and system<sup>2</sup>. In Indian astrology, the Form is employed as a tool for making predictions and forecasts<sup>3</sup>.

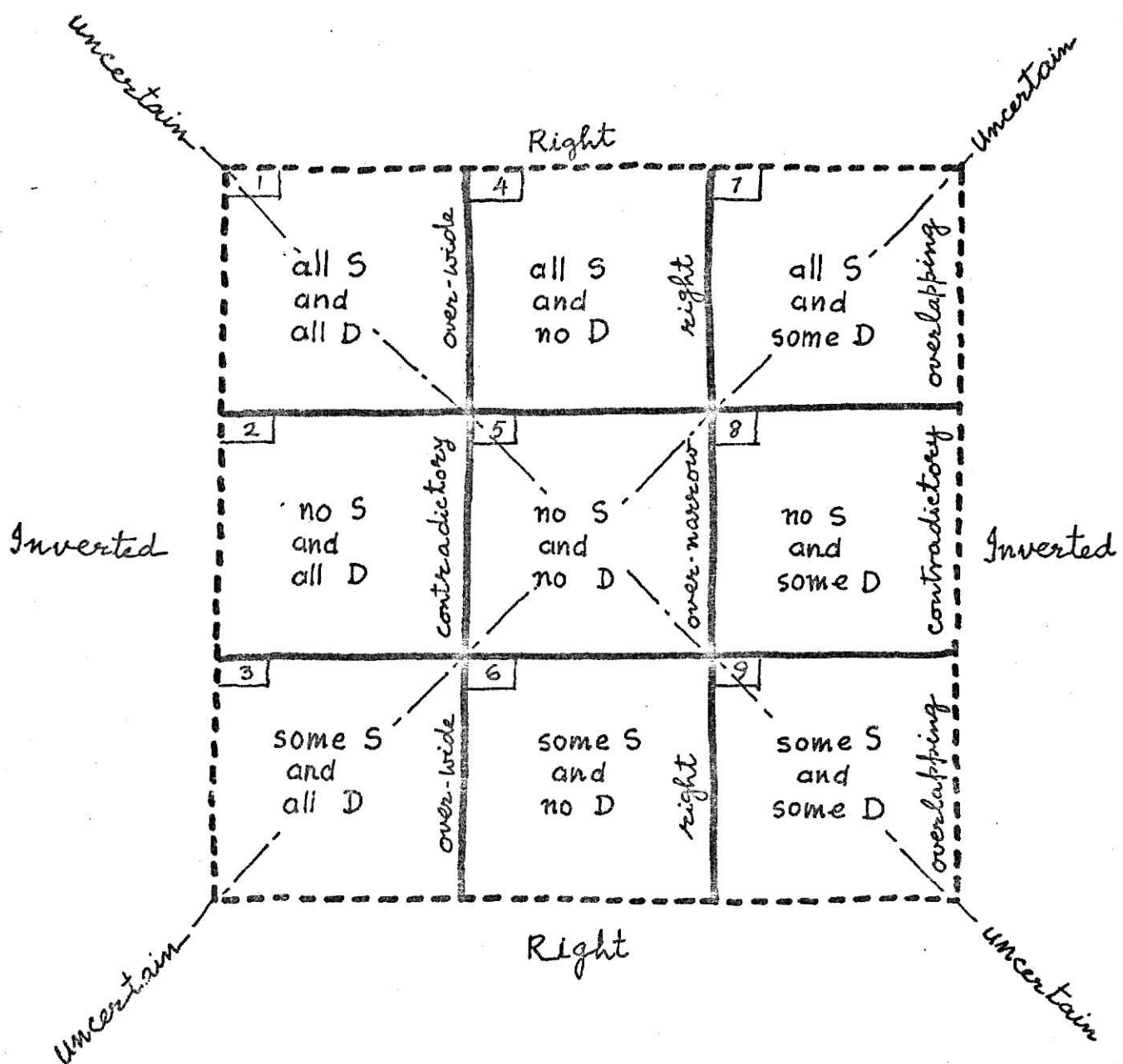
The Form is employed as an imaginary nine-fold square to guide the writing of Chinese character. The nine-fold square invented by an anonymous writer of T'ang dynasty, has been employed as the most useful, because it prevents rigid symmetry and helps to achieve a balanced asymmetry. At the same time, it makes the writer aware of negative and positive spaces. Each part of the character touches one of the nine squares, thus achieving harmony between the two elements and the whole. The Form in such instance functions as a guide to filling the space correctly, but not to produce a geometric pattern<sup>4</sup>.

The intensive application of the Form in various disciplines, suggests it's significance as a basic sign and tool for mankind's philosophical and scientific expressionism.

#### (b) The Form in Art and Architecture:

The Form is very much traceable in ancient art and architecture. In many early civilizations as well as in folk art, the Form is transcribed into human form. The Trojans adopted the Form in their sculptures as a whorl for interpretation of cardinal directions and seasons<sup>5</sup>.

The Form stands as a basic symbol in both Hinduism and Christianity, and greatly influences their respective religious architecture.



S = PRESENCE IN SIMILAR INSTANCES

D = PRESENCE IN DISSIMILAR INSTANCES

THERE ARE NINE POSSIBLE POSITIONS OF REASONS BETWEEN SIMILAR AND DISSIMILAR INSTANCES

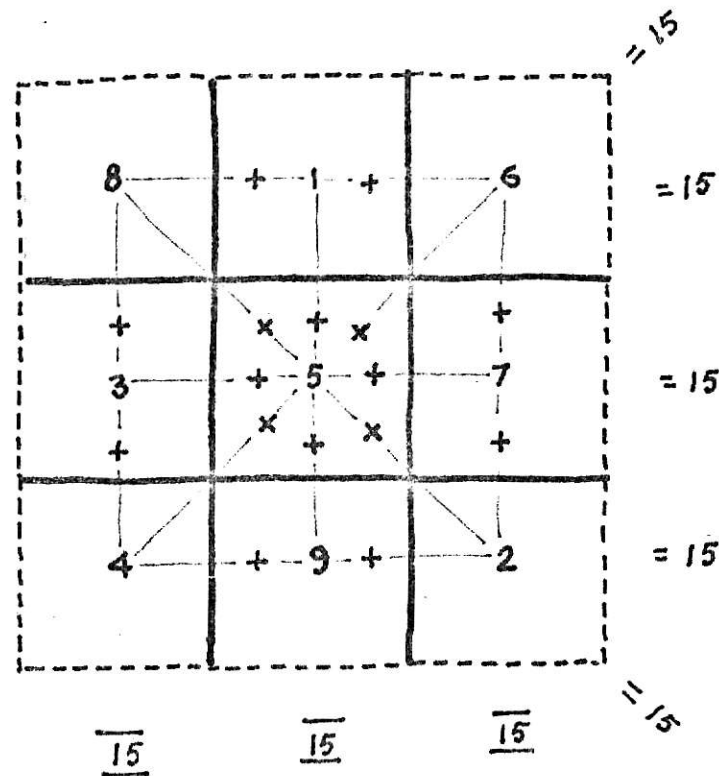
'4' AND '6' ARE RIGHT REASONS

'2' AND '8' ARE MAXIMUM FALLACIES

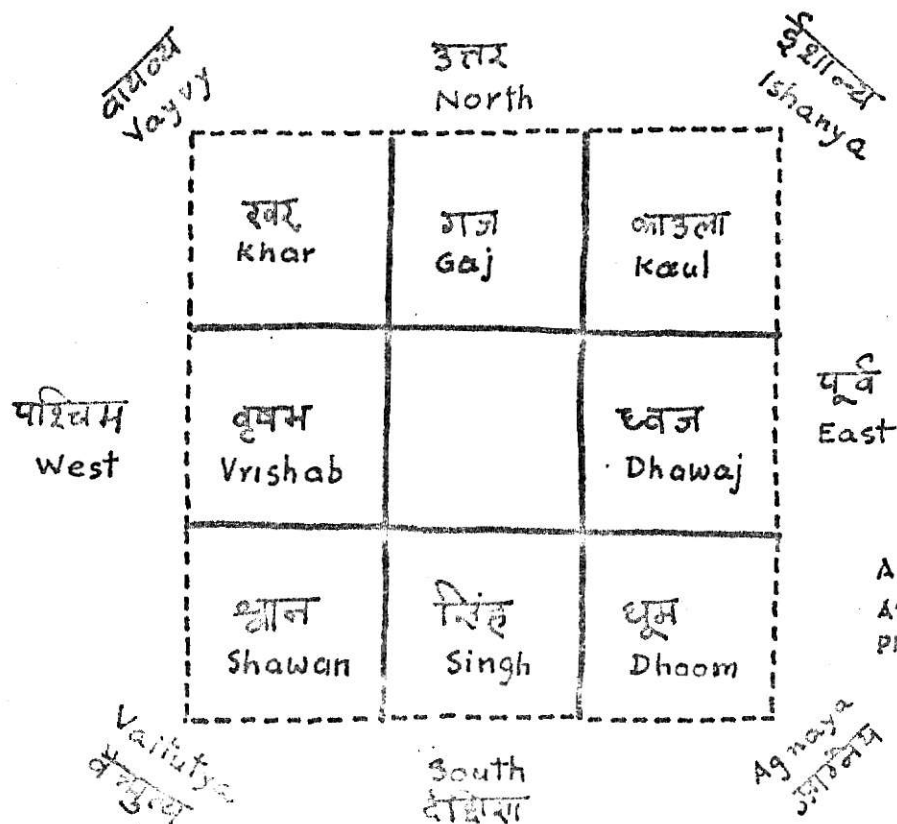
1, 7, 5, 3 AND 9 ARE UNCERTAINTIES

Graphic: 3

THE FORM "#" AS DIGNAGA'S "WHEEL OF LOGICAL REASONS"  
IN BUDDHIST LOGIC



THE MAGIC SQUARE OF '3'

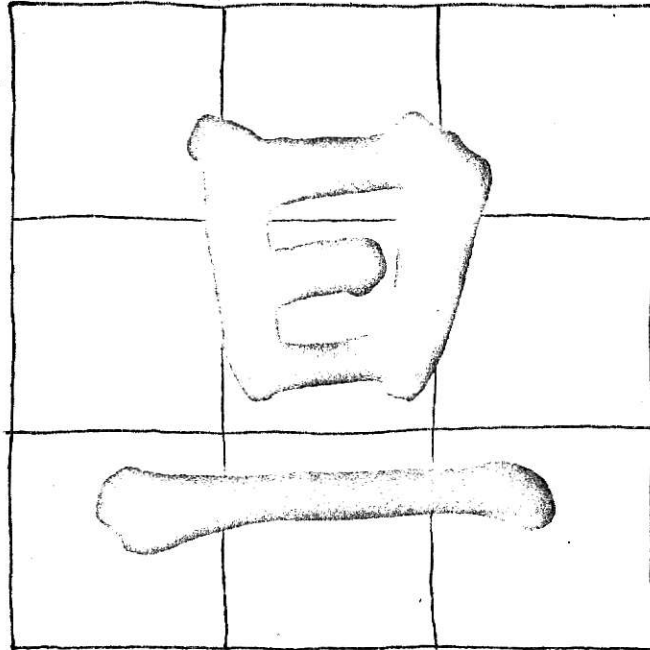


A BASIC TOOL IN INDIAN  
ASTROLOGY FOR MAKING  
PREDICTIONS AND ANALYSIS

Graphic: 4

## THE APPLICATION OF NINEFOLD SQUARE IN MATHS. AND ASTROLOGY

"TAN"(SUNRISE)



THE FORM '旦' FORMULATES A NINE-FOLD SQUARE FOR GUIDING THE FILLING OF SPACE CORRECTLY IN THE WRITING OF CHINESE CHARACTER

Graphic: 5

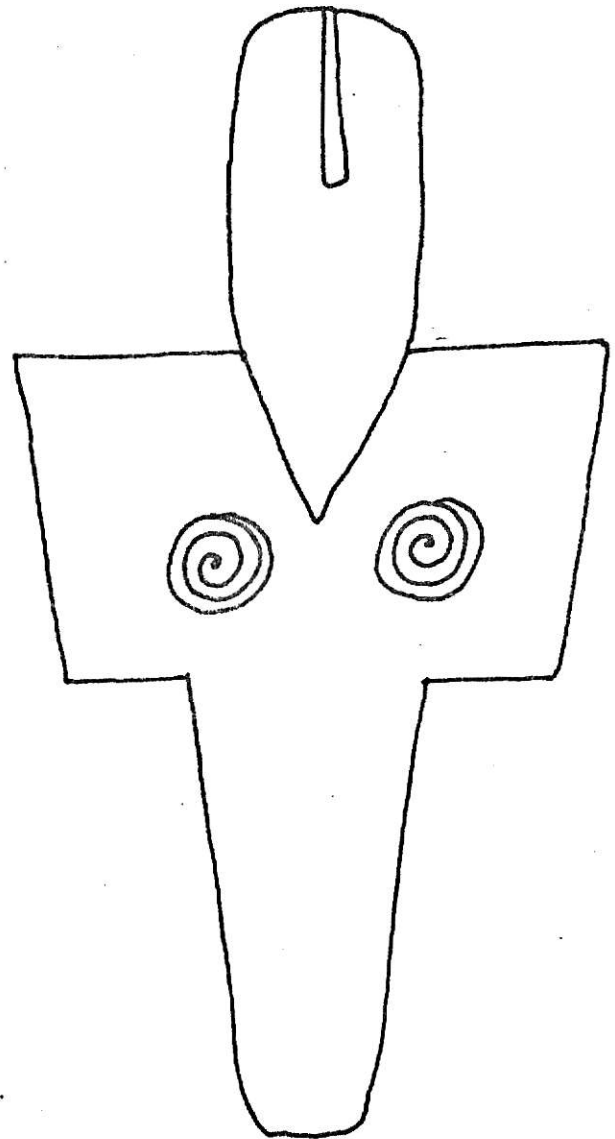
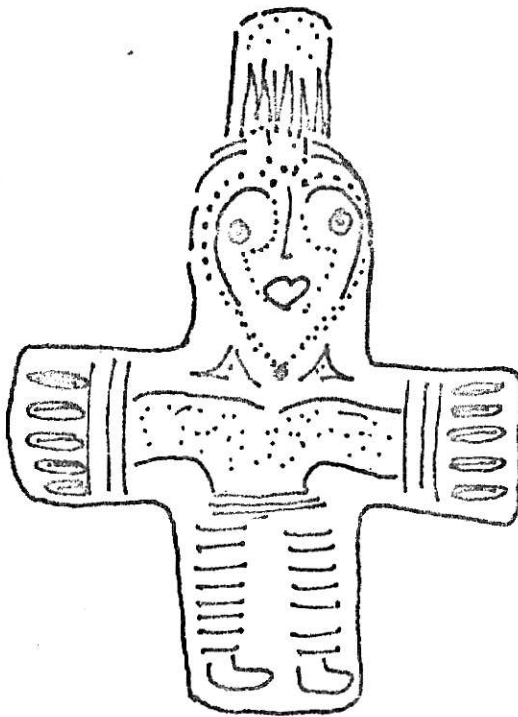
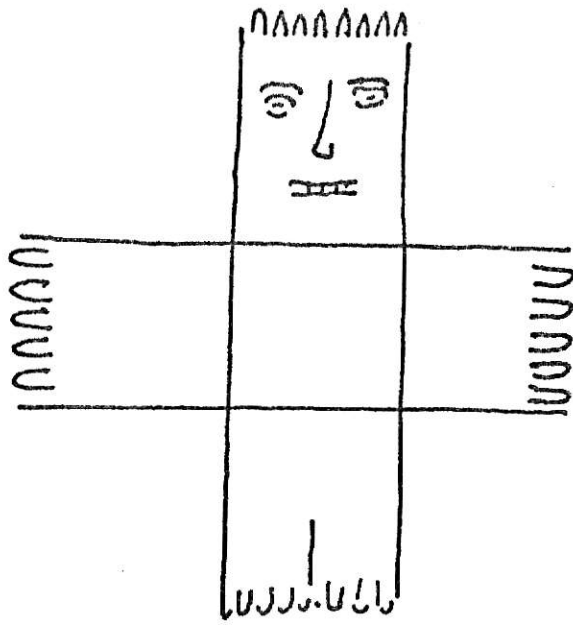
FORM '旦' AS APPLIED TO GUIDE THE WRITING OF CHINESE CHARACTER

In Hinduism, the Form with a wheel in the central panel representing the cyclic nature of the universe, symbolizes the Hindu Cross<sup>6</sup>. The Form also formulates the basic form of Hindu temple plan. The form of Hindu temple responds more than any other sanctuary to the designation of "Devalaya" (abode of God) because it is not like the Christian church or Mohmedian mosque built to accommodate an assembly of worshippers for common prayers and rituals. It is built solely and exclusively to house the symbol or image of divinity<sup>7</sup>. Also the supreme power Brahama is conceived as surrounded by deities. The Form is employed as a basis of the plans of these temples, to emphatically locate the symbol or image of the God in the central panel of the Form and putting the deities in the peripheral panels. The Form is also traceable in numerous 'Yantras' (matrixes) established in Hinduism just before the Medieval Period, for conceiving and drawing for carving the figures of Gods and Goddesses on temple walls. In Tibbetan Buddhism the Form comprises an object of worship, with the devotee meditating by concentrating at the core panel of the Form.

In Christianity, the Form Symbolises the crucification of Christ. The Form formulates the basic shape of plan in church architecture. The Form is generally known as 'Bramante Form' after the name of the Renaissance architect who initiated it's application in church planning. A fitting tribute to the Form was given by Michelangelo, the renowned artist, architect, and planner. He after attempting various forms in the designing of New St. Peter, returned to Bramante and conceded, "Whoever departs from Bramante, departs from the truth"<sup>9</sup>.

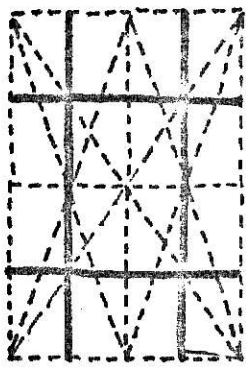
(c) *The Form in Myths and Beliefs:*

The Form has influenced mankind's beliefs and myths from time immemorial,

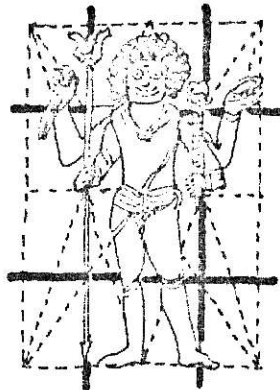


Graphic: 6

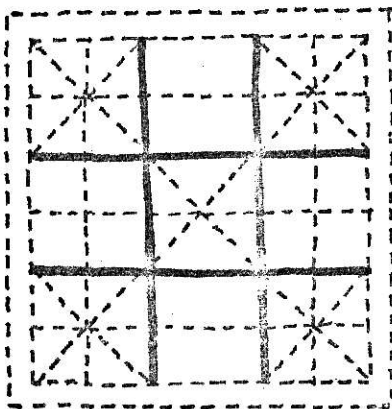
THE FORM "H" AS THE MATRIX OF MAN



BHAIRAVA YANTRA  
(FOR DRAWING STAND-  
ING IMAGES)



APPLICATION  
OF THE YANTRA



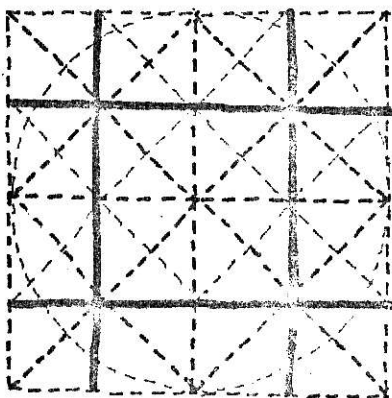
TORANA LAKSHMI YANTRA  
(FOR DRAWING SITTING  
GODDESS)



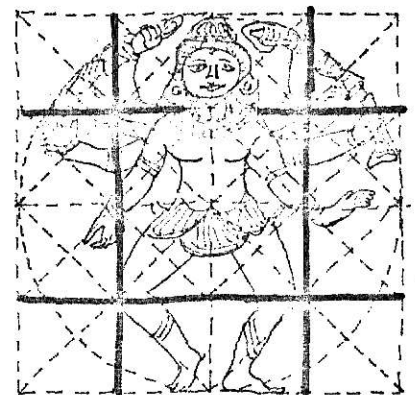
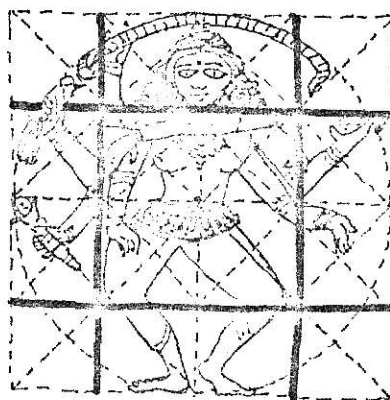
APPLICATION OF THE YANTRA  
IN DRAWING 'GAJALAKSMI'



IMAGE OF 'SUBHALAKSMI' MADE  
ACCORDING TO YANTRA



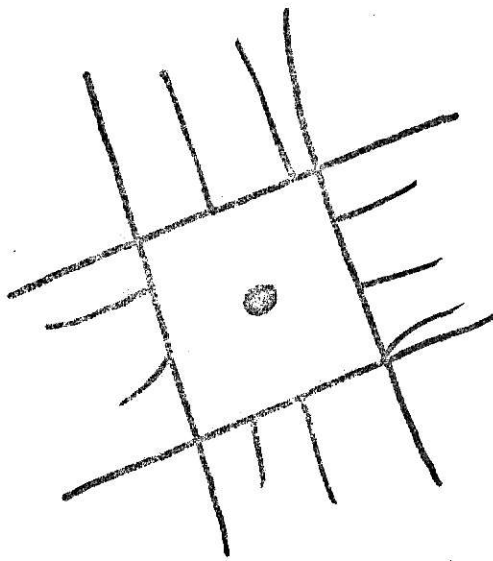
NATAMBARA YANTRA  
(FOR DRAWING DANCING  
FIGURES)



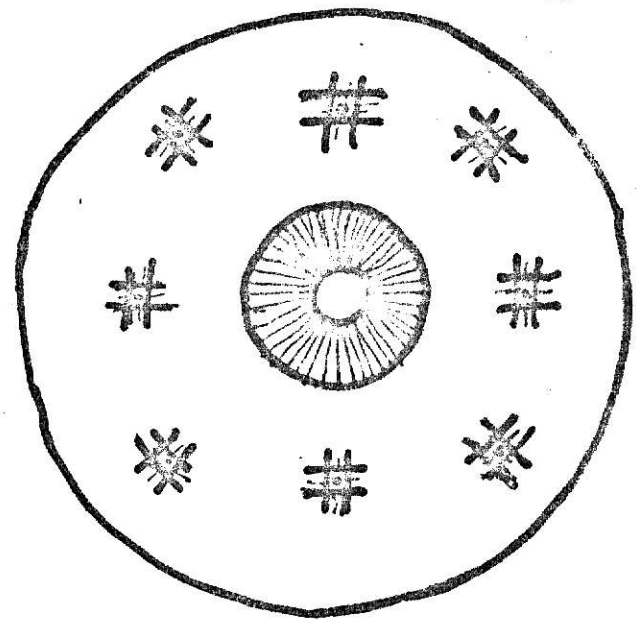
EXAMPLES OF THE APPLICATION OF THE YANTRA

Graphic: 7

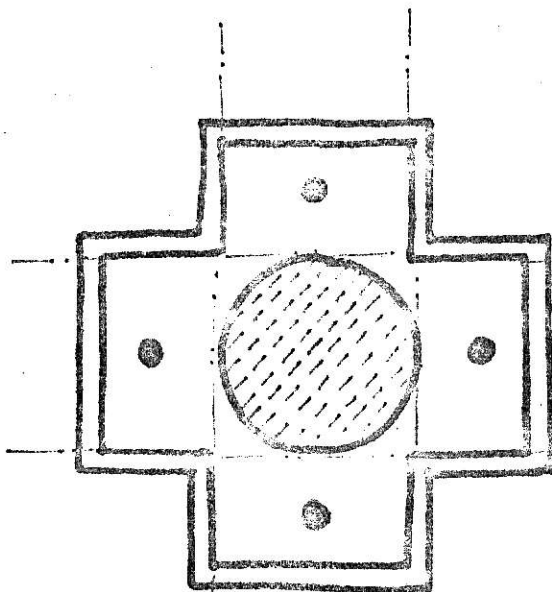
THE FORM "#" AS A MATRIX OF HUMAN PROPORTIONS  
IN ANCIENT HINDU "YANTRAS"



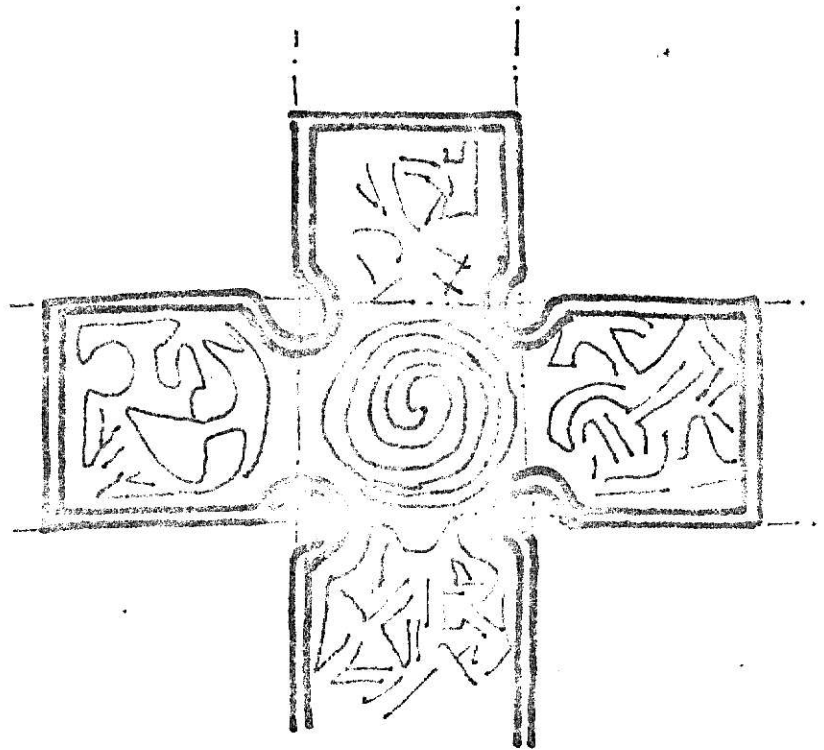
TROJAN WHORL



TROJAN SYMBOL FOR DIRECTIONS AND SEASONS



HINDU "CROSS"

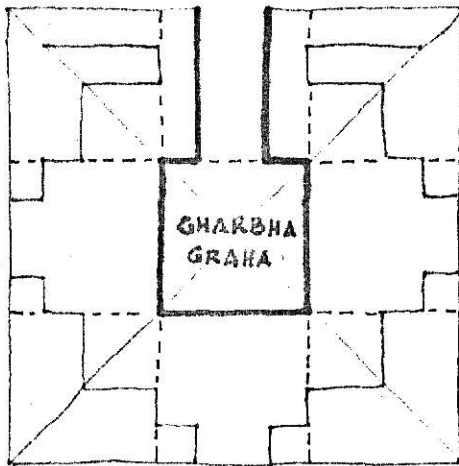


SCOTISH CHRISTIAN "CROSS"

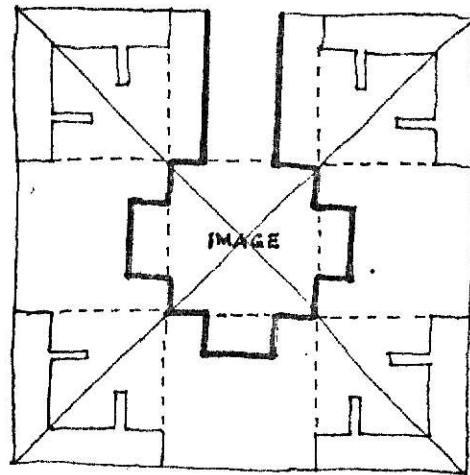
Graphic: 8

THE FORM "井" IN RELIGIOUS MYTH AND BELIEFS

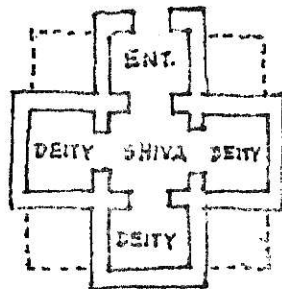




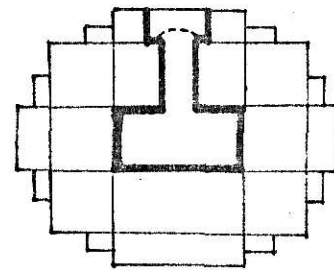
SANASARVATOBHADRA PITHA  
GROUND PLAN OF MANJUSRI  
TEMPLE ACCORDING TO SILPASARNI



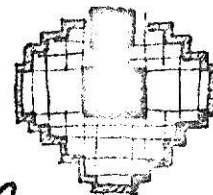
SAMBHADRA PITHA  
GROUND PLAN OF RATANSARA TEMPLE  
ACCORDING TO SILPASARNI



CONCEPTUAL PLAN  
OF HINDU TEMPLE

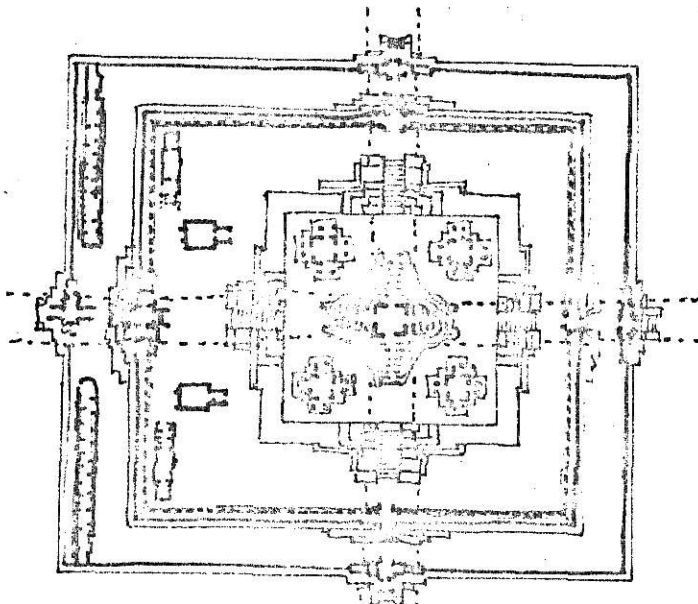


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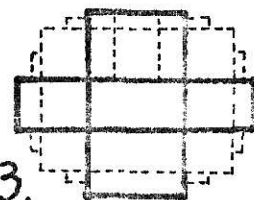


2.

TYPICAL PLANS OF  
ANCIENT HINDU TEMPLES



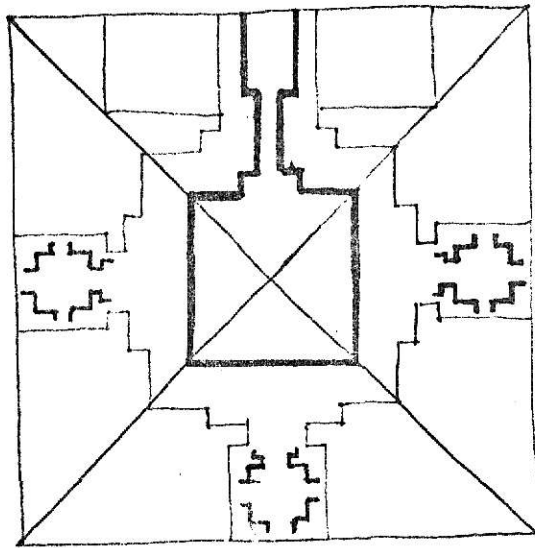
PLAN OF PHIMEANAKAS TEMPLE,  
ANGKOR.



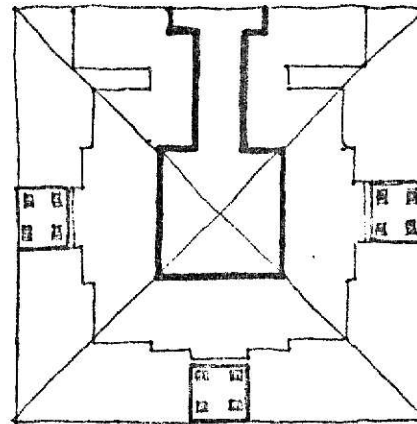
3.

Graphic: 9

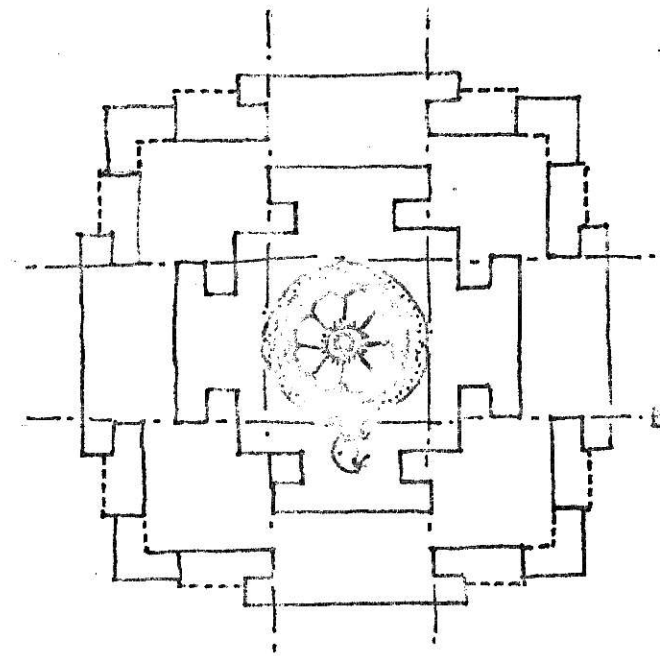
THE FORM "H" AS THE PHILOSOPHY OF HINDU TEMPLE  
ARCHITECTURE



BHADRA PITHA  
GROUND PLAN OF KAILASA TEMPLE  
ACCORDING TO SILPASARNI



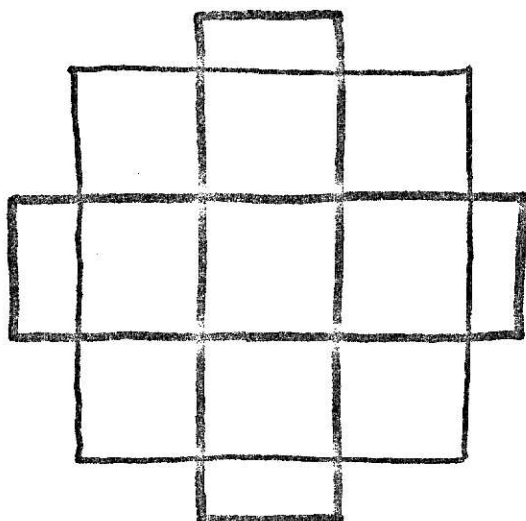
SAMAKESTRA PADMAPITHA  
GROUND PLAN OF MAHAMERU TEMPLE  
ACCORDING TO SILPASARNI



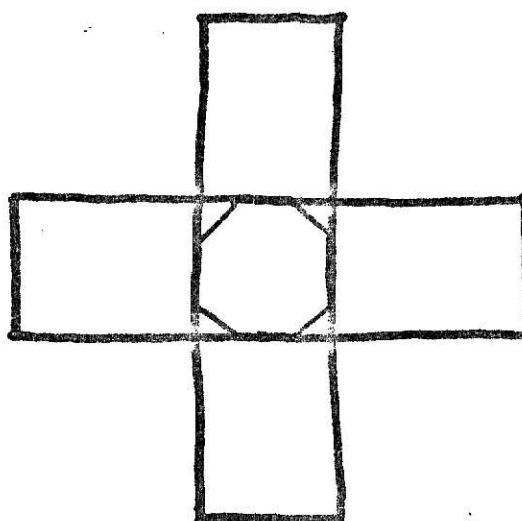
BHIRAVA YANTRA

Graphic: 10

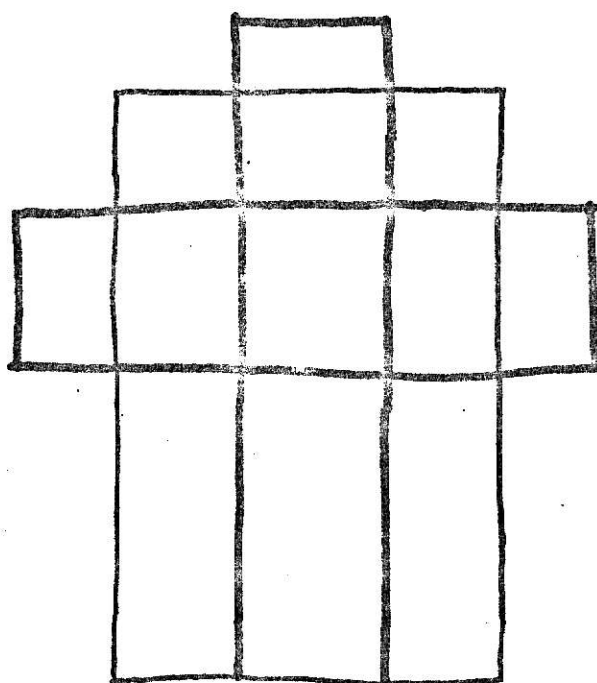
FORM "AS" MATRIX OF HINDU TEMPLE ARCHITECTURE



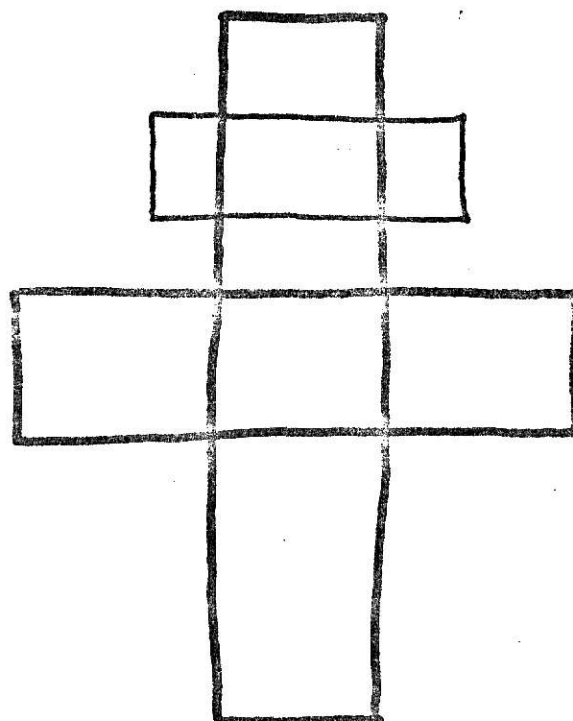
ST. PETER'S BY BRAMANTE



CHURCH OF S. SIMEONE



MICHELANGELO'S PLAN FOR ST. PETER'S



CATHEDRAL OF SALISBURY

Graphic: 11

THE FORM "#" AS A MATRIX OF CHURCH  
ARCHITECTURE

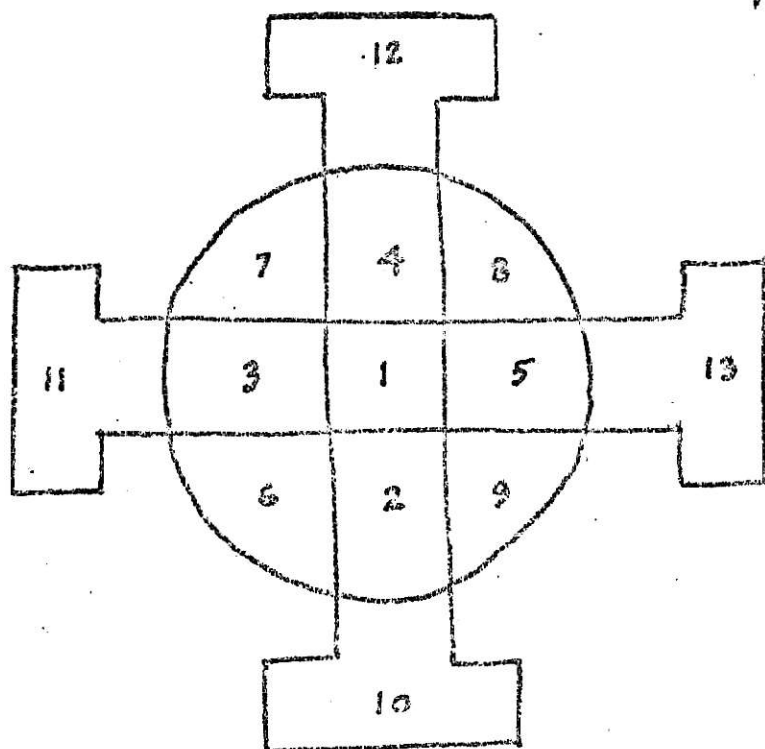
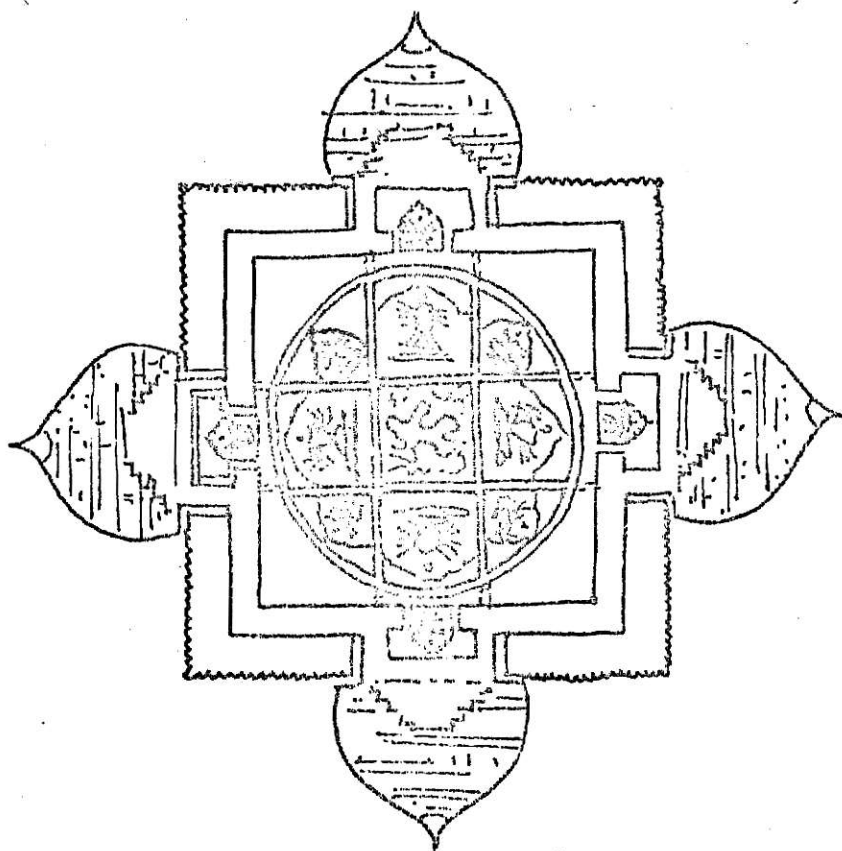
as is evident by it's complicity in the rituals of many civilizations which developed independently without being influenced by each other in different parts of the world during different periods.

#### Tibbet:

Tibbetan meditation is not a state of emotional ecatsy but a consciously directed creative process of extremely precise by which a psychic experience is realized in visible form. The Form formulates the basis of many of the 'Manhalas' which are painted to serve as the basic technical aid in this kind of ritual meditation. 'Mandalas' are representation of the cosmos, chiefly characterized by a concentric organization of geometric shapes, each of which contains an image of a deity or an attribut of a deity. They are symbols representing the efforts to reunify the self<sup>10</sup>. Thus the Form as a basic shape of 'Manhalas' as conceived in Buddhist mythology, formulates a psychocogramm; a scheme of disintegrating from one to many and from many into one.

#### China:

In Chinese myth, the Form was employed as a means of representing mythological beliefs related to cardinal directions during T'any dynasty (A.D. 618-907). The four cardinal directions were represented by animals bounded by sea and each marked by a mountain. According to beliefs of Ch'in and Ham dynasties, each of these mountains is formed of one part of P'-an-Ku; his head in the east, his left arm in the south, his right arm in the north, and his feet in the west<sup>11</sup>. All these parts are concentric to the body of P'-an-Ku, which occupies the central panel in the Form. Thus the Form is adopted in these beliefs to represent a mytho-cardinal concentric relationship in space.



- 1 GOD; FATHER-MOTHER POSITION SIGNIFYING THE MYSTIC UNION OF COMPASSION AND WISDOM
- 2 CONQUEROR OF WISDOM
- 3 CONQUEROR OF PRIDE AND GREED
- 4 CONQUEROR OF LUST AND PASSION
- 5 CONQUEROR OF ENVY
- 6 CONQUEROR OF EVIL FORCES WITHIN BODY
- 7 CONQUEROR OF MISERY AND MISFORTUNE
- 8 CONQUEROR OF UNTIMELY DEATH
- 9 CONQUEROR OF FALSE OR ILLUSORY GOD
- 10 GODDESS OF EARTH
- 11 GODDESS OF WATER
- 12 GODDESS OF FIRE
- 13 GODDESS OF AIR

Graphic 12

MANDALA OF HJIGS-BYED, CONCEIVED  
AS THE FORM "#"

### North America:

In North America, the Form is evident in tribal myth prior to White settlement. In the 15th Century folk painting called "Codex Borgia", the Form is employed as a matrix to represent the myths of the American Indians<sup>12</sup>. In this work, the Great Mother is placed in the central panel of the Form, giving birth to deities from every joint of her body. The four winds are in the corner panels. The Form in this case is adopted to emphatically express the principal subject, the 'Great Mother' in relation to secondary elements, namely the four winds and the four rains.

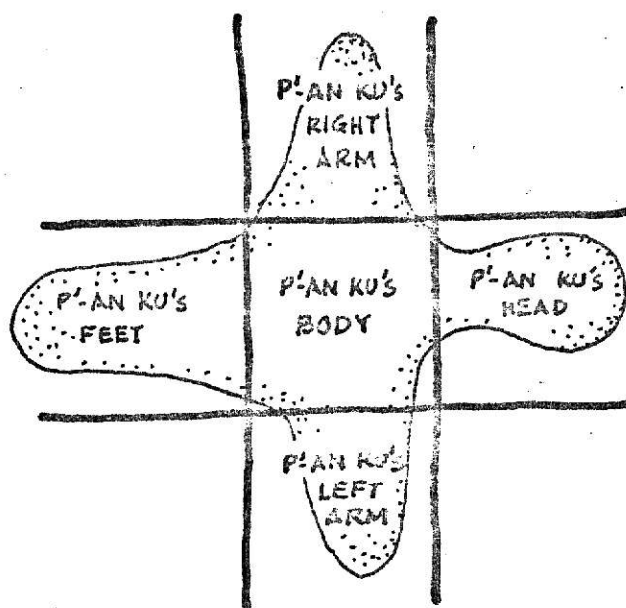
### Mexico:

In Azetecs civilization which prevailed in Mexico prior to it's being explored by the White world, the Form to represent the five World Regions, in space. In this graphical presentation, the cardinal directions depicted by the side panels of the Form, are associated with the four sons of Ometecuhtli who created the world. They are also connected with the four 'suns' which preceded the present world and which all ended in destruction. The fifth region, which is the present world, is depicted in the centralized location. The four corner panels are occupied by strong winds or earthquakes<sup>13</sup>. The synopsis of the total presentation is that the present world would also end in earthquakes like it's preceding four world regions.

Numerous other examples can be traced in which the Form formulates the basis of mankind's philosophical thoughts and mythological beliefs. The analysis of these various examples leads to the generalization that the Form formulates a psychonogram to emphatically express concentric relationship between related elements. Also the intensive and frequent application in various professional fields as well as in different civilizations, distinguishes



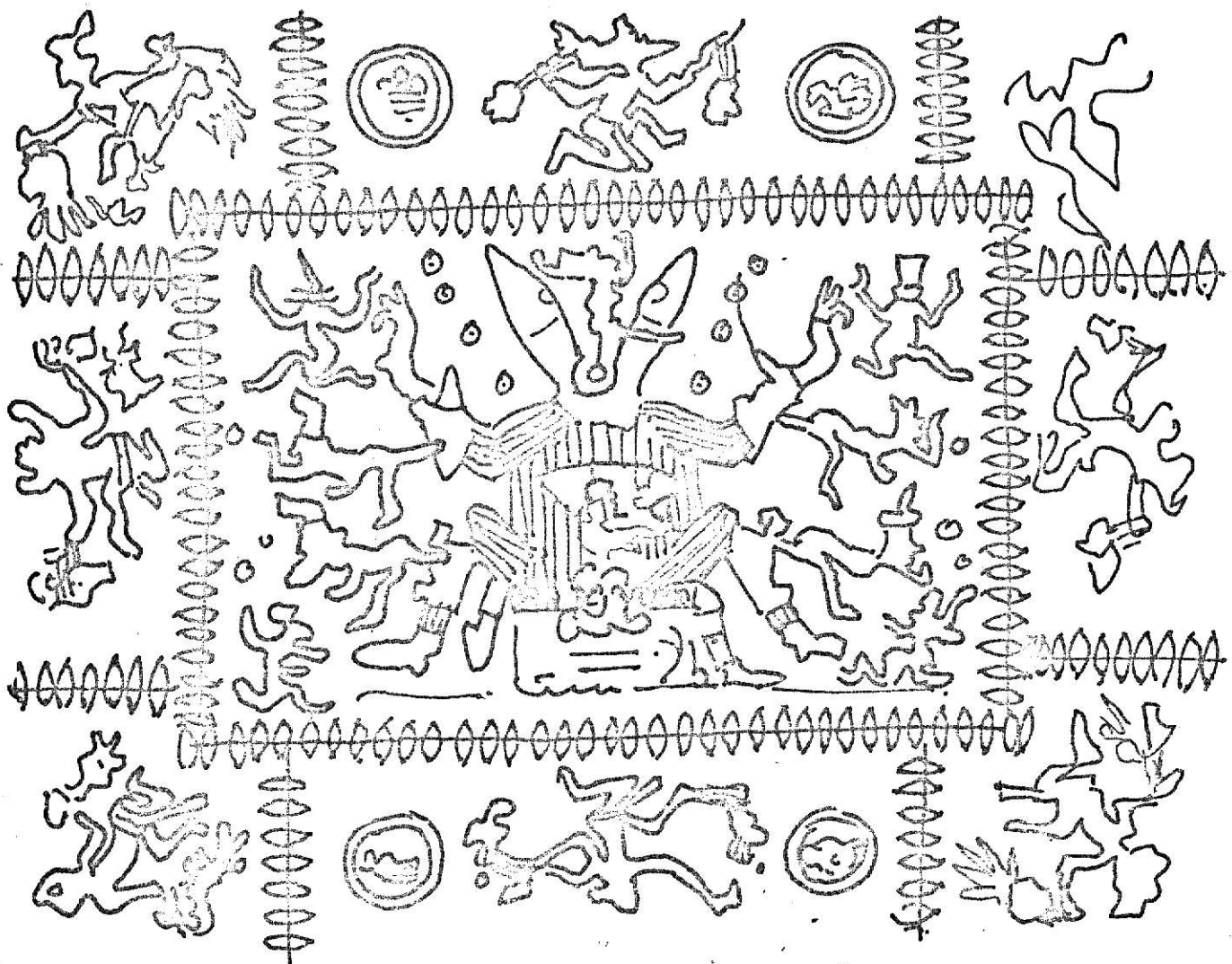
BRONZE MIRROR OF T'ANG DYNASTY (A.D. 618-907) DEPICTING CHINESE MYTHOLOGY



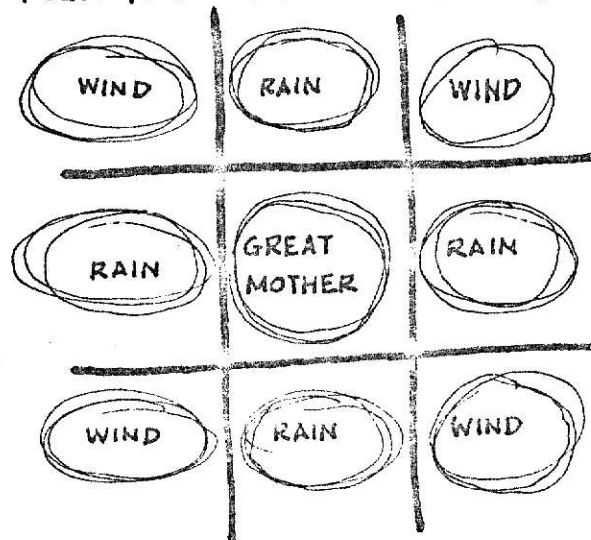
SPATIAL INTERPRETATION OF THE MYTHOLOGICAL CONCEPT

Graphic 13

FORM "井" IN CHINESE MYTHOLOGICAL CONCEPT



15 TH. CENTURY FOLK PAINTING "CODEX BORGIA"

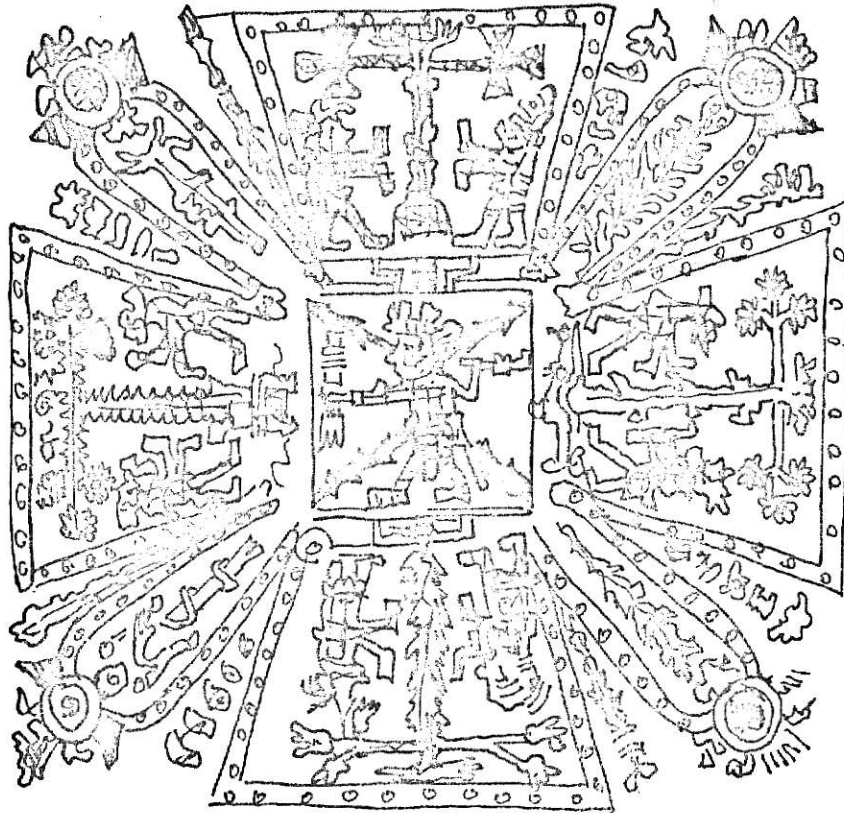


INTERPRETATION

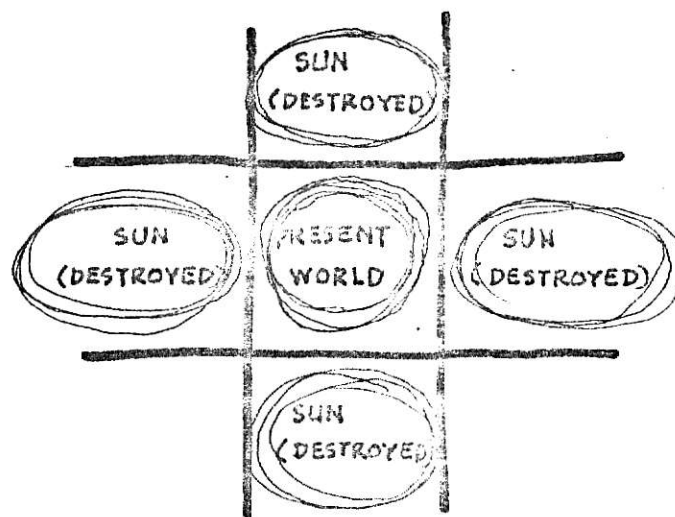
Graphic: 14

THE FORM "#" AS A BASIS OF EARLY NORTH AMERICAN MYTHOLOGY





MEXICAN MYTHOLOGICAL PRESENTATION "MIXTEC" OF A.D. 1350,  
(IN LIVERPOOL MUSEUM)



INTERPRETATION AND CONCEPT OF "MIXTEC"

Graphic: 15

FORM "#" AS A BASIS OF MEXICAN MYTHOLOGY

the Form as an easily conceivable, understandable, and adoptable sign, symbolise the land.

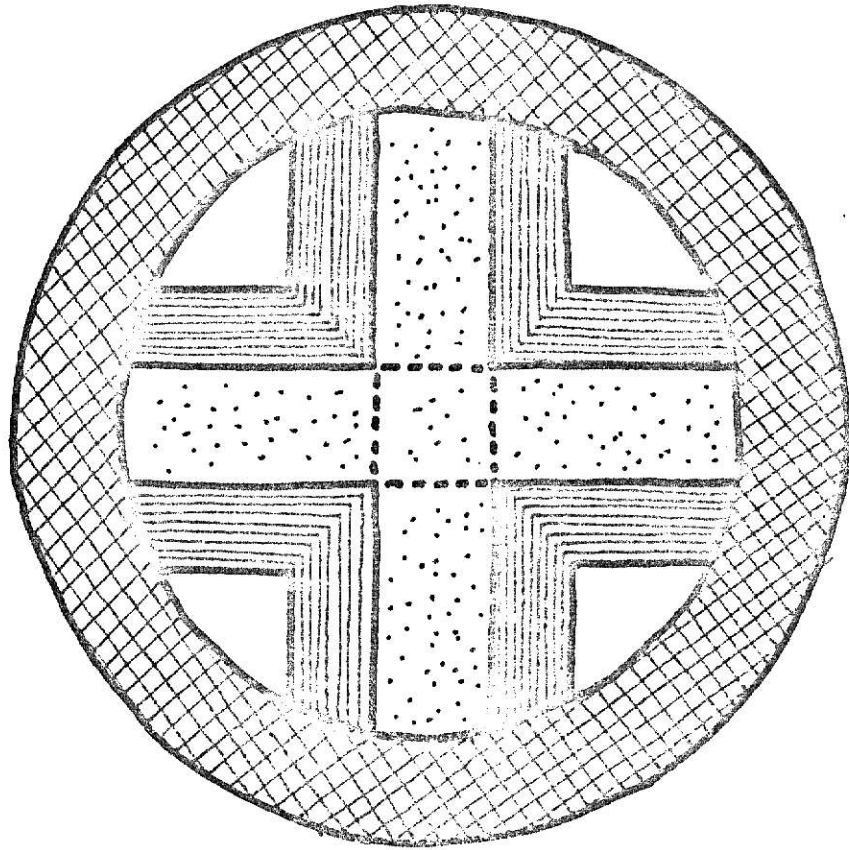
Communities are concentric organic entities which originate, develop, and thrive around their nuclei. The form '#' which is frequently applied in myths and beliefs to emphatically express the concentric cosmic relationships and space organization, also forms the basis of planned urban development since earliest times. In early civilizations, man was predominantly influenced by methodological beliefs and rituals, and the scientific principles were incorporated with these myths. The application of the Form in community development, initiated primarily to satisfy mankind's ritual needs and also to site and orientate the community scientifically with respect to cardinal directions.

a. Form as 'Myth' in Urban Development:

The Form is traceable in mankind's theory and practice of urban development during all the phases of history, and in almost all the parts of the world, as is evident from the following case-studies:

India:

The Form provides the basis of the modular grid of Hindu city planning as laid down in ancient scripture "Manasara", written at about the beginning of Christian era. The city plan on the basis of this modular grid, is a perfect compromise between pre-established inflexible units imposed by external authority, and a hierarchical system of intersquared units. It places Brahma, the supreme power and creator of the universe, in the 'forbidden city' of nine squares, surrounded by eight chief deities, which form a link to thirty six squared minor celestials. This coercive module has been made acceptable as



Graphic: 16

THE FORM "#" AS THE BASIC STRUCTURE OF  
ORIENTAL HIEROGLYPHIC SYMBOL OF THE CITY

SOURCE: CASTAGNOLIS, FERDINANDO, "ORTHOGONAL TOWN PLANNING IN ANTIQUITY,"  
P. 70.

devine law<sup>14</sup>. The form '#' in this matrix, sites the 'forbidden city' within the overall arrangement and then locates the seat of Brahama within the 'forbidden city'.

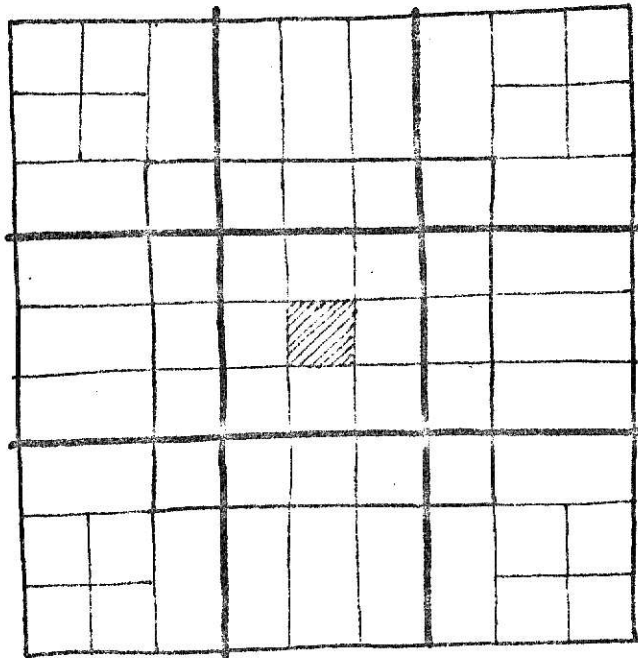
The Form was profusely employed as a tool and matrix of urban design during Medieval and Renaissance periods as is evident in the plans of many forts and musoleums built during those periods. The Form also provided the basis for design of various 'Mughal' and 'Persian' style gardens laid during those periods. The characterstic example of such gardens is the one laid around the world known musoleum Taj Mahal built about the 15th century. The garden laid with the Form as matrix, provides optimum balance and spatial integration between the main structure and it's surroundings. The application of the Form facilitates the laying of water channels and fountains. These, apart from providing the cooling effect in the hot tropical weather also form interesting vistas with the principal structure thus enhancing it's beauty. The central panel of the Form contains a reflecting pool and a raised platform which provides the desired transiction between the entrance and the musoleum. Thus the application of the Form in landscaping lead to the evolution of the optimum environments for the principal structure.

China:

In China, Mumfucious, the scholar and philospher of the 4th centruy B.C., conceived the Form as a basic system of land development. In this system, which is known as 'Yin' or 'Well' system on the basis of the shape of the Form, Mumfucious professed that the form '#' be adopted as a basic module for the purpose of land sub-division and taxation. He suggested that the land, for the purpose of accricultural subdivision, should be devided into squares of side 1 Li( Li=300 steps), and each of these squares should be divided

Roga	Ahi	Mukhya	Bhullata	Soma	Bhujaga	Aditi	Diti	Agni
Papa- yasa- man	Rudra						Apa	Pary- anya
Sasha	Rudra Jaya		Prithvidhara			Apa- Jaya	Jayanta	
Asura							Indra	
Varuna	Mitra		Brahma			Aryaman	Surya	
Kusuma- danta						Arya	Satya	
Sugriva	Indra		Vivasvan			Savitr	Bhrsha	
Dauva Vika	Indra Jaya						Savi tra	Anta- riksha
Pita- rah	Nrga	Bhargava	Gandharva	Yama	Bhatisata	Vishtha	Pisun	Amila

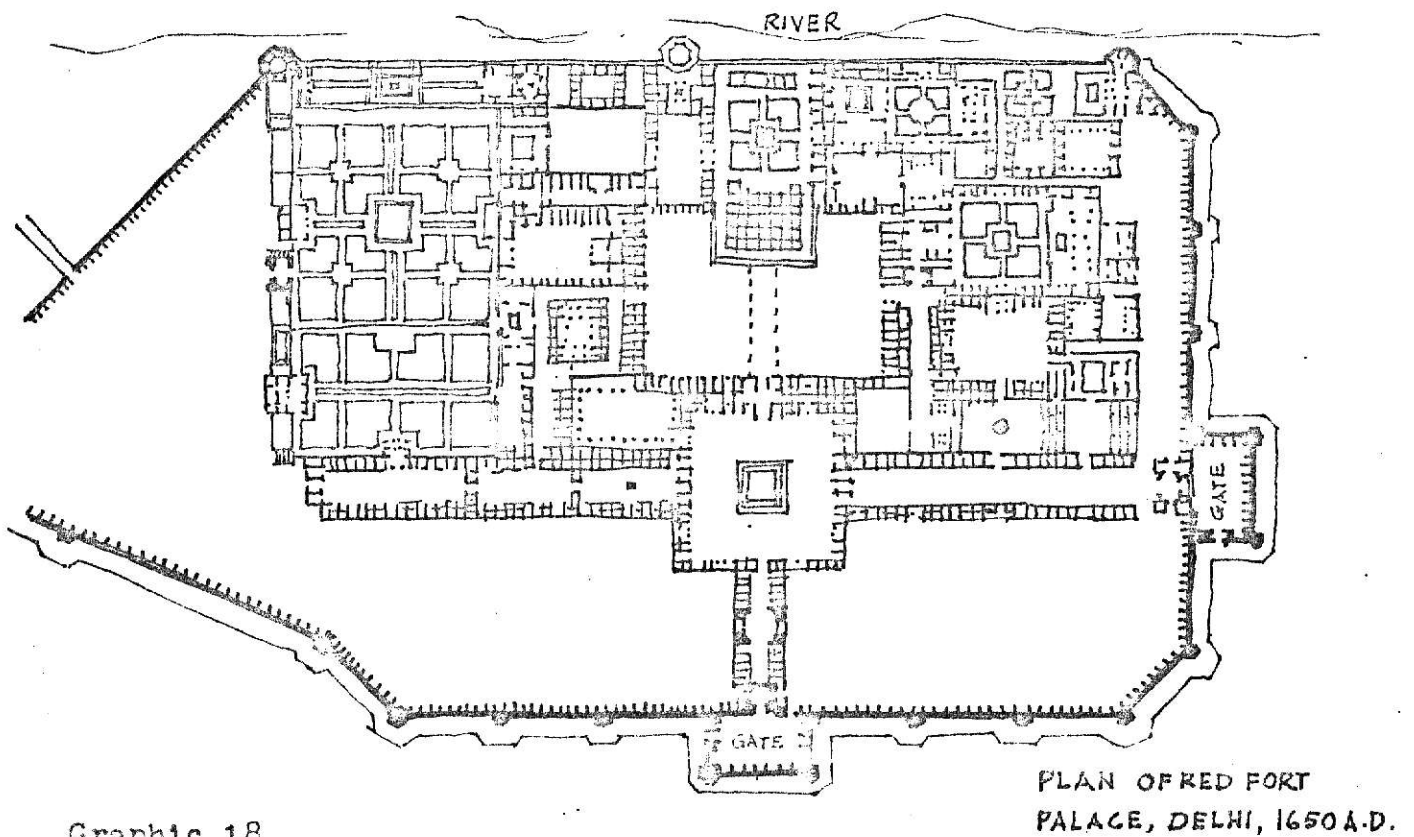
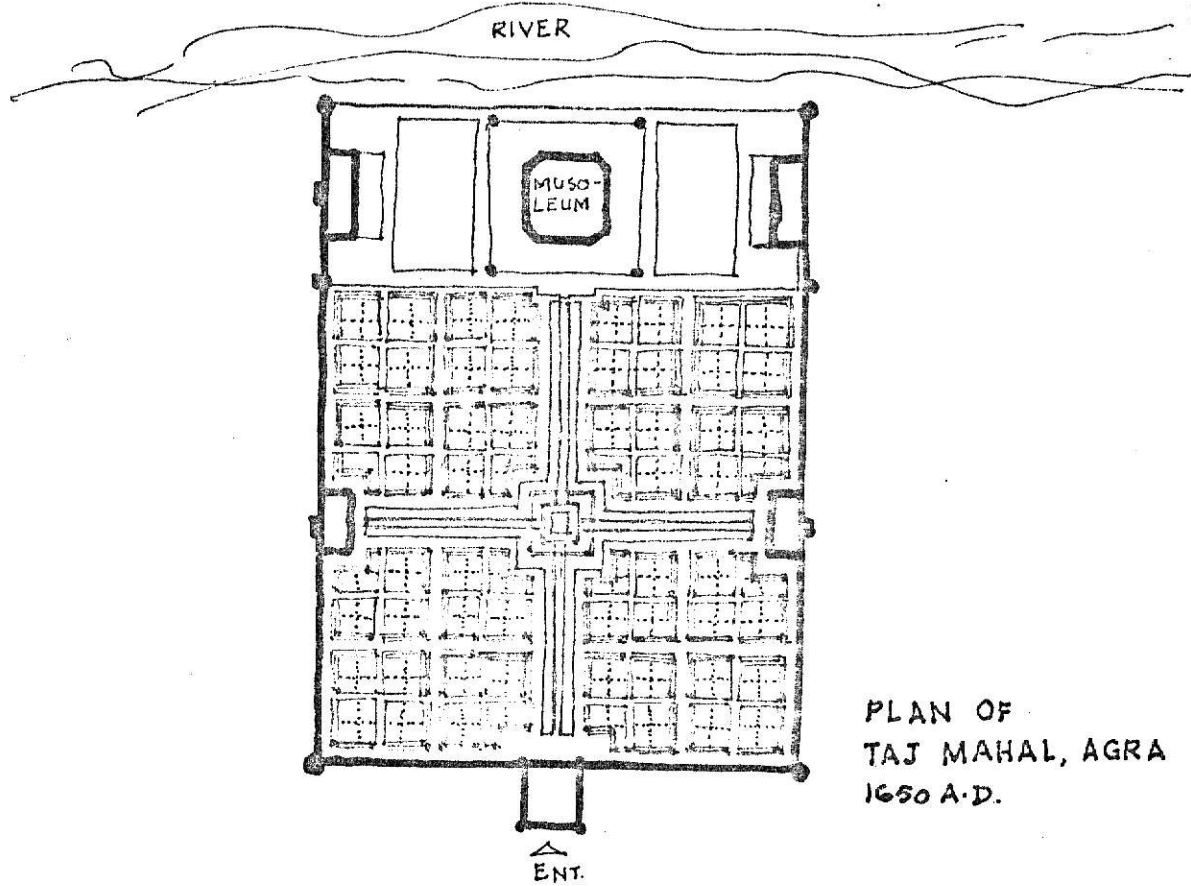
THE BASIC MODULAR GRID OF  
HIND CITY AS LAID DOWN IN  
"MANSARA". THE COERCIVE  
MODULE HAS BEEN MADE ACCEPT-  
ABLE AS A DEVINE LAW



THE GRID FORMULATES A PERFECT  
COMPROMISE BETWEEN PRE-  
ESTABLISHED, INFLEXIBLE UNITS  
IMPOSED BY EXTERNAL AUTHORITY,  
AND HIERARCHICAL SYSTEM OF  
INTERSQUARED UNITS. IT PLACES  
BRAHMA IN THE "FORBIDDEN CITY"  
OF NINE SQUARES, SURROUNDED  
BY EIGHT CHIEF DEITIES, WHICH  
FORM A LINK TO THIRTY-SIX SQUARED  
MINOR CELESTIALS.

Graphic: 17

THE FORM "#" AS APPLIED IN ANCIENT  
HINDU CITY PLANNING



Graphic 18

THE FORM "H" AS A MATRIX OF DESIGN IN MOHAMEDAN  
PLANNING IN INDIA

into 9 equal divisions by applying the form '#'. Each of the land division thus obtained would be of area 100 Mu (1 sq. Li = 900 Mu). He proposed that the eight peripheral divisions in each square be allotted as owned farms to eight families and the central division in each of the square be retained as public land. Each family, apart from cultivating its own farm, would also cultivate 10 Mu of the public land as a form of taxation. This would result in 80 Mu of public land as cultivated land and would leave the rest 20 Mu for public buildings and residential buildings for housing the families working on the public land. Mumfucious also developed the following socio-physical hierarchy of administrative units on the basis of the 'Yin' system<sup>15</sup>:

4 Yin = 1 'E' = 32 families      where as 1 Yin = 1 sq. Li = 900 Mu.

16 Yin = 1 Cho' = 128 families

64 Yin = 1 Den' = 512 families

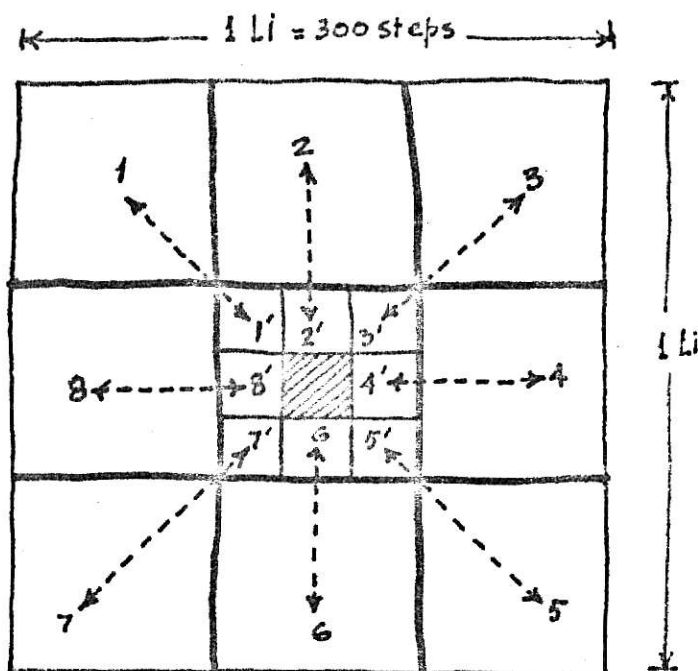
256 Yin = 1 Shin = 2048 families

1024 Yin = 1 Du' = 8192 families

Although the System could not be practised at that time with much success due to the socio-economic and technological reasons prevailing then, it definitely was an attempt towards the concept of unit-matrix system of urban development with the Form formulating the basic 'unit'.

Later during Chin dynasty (B.C. 16-A.D. 50), the Form formulated the basis of the 'Min Tang' system for planning politico-religious cum palace complex at a time when the priests acquired supreme powers and the complex formed nucleus around which the community developed. Under this system, the central panel of the Form formed the palace, while eastern, northern, and western wings contained the temple of production, temple of God, and the temple of ancestors





LAND AREA = 1 Li x 1 Li  
 = 300 steps x 300 steps.  
 = 900 Mu

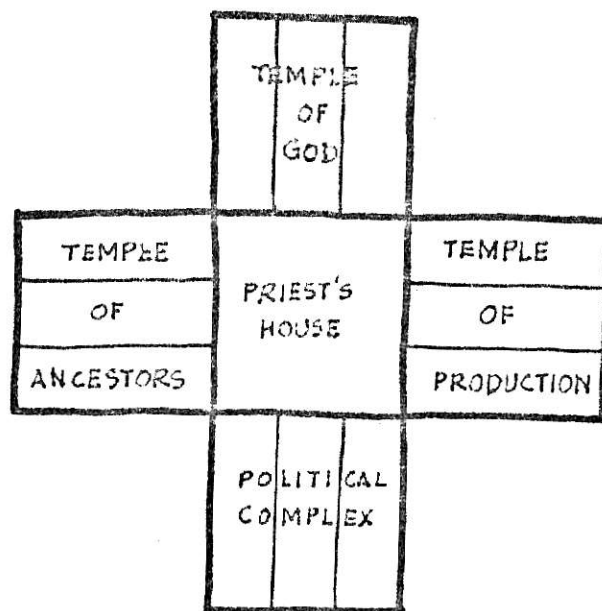
EACH FAMILY OWN = 100 MU OF LAND  
 PUBLIC LAND = 100 MU

EACH FAMILY CULTIVATE 20 MU OF PUBLIC LAND AS TAXATION  
 TOTAL PUBLIC LAND UNDER CULTIVATION =  $4 \times 20 = 80$  MU  
 THE REMAINING 20 MU OF PUBLIC LAND IS FOR BUILDING PURPOSES.  
 EACH FAMILY CULTIVATE A TOTAL OF  $= 100 + 10 = 110$  MU OF LAND

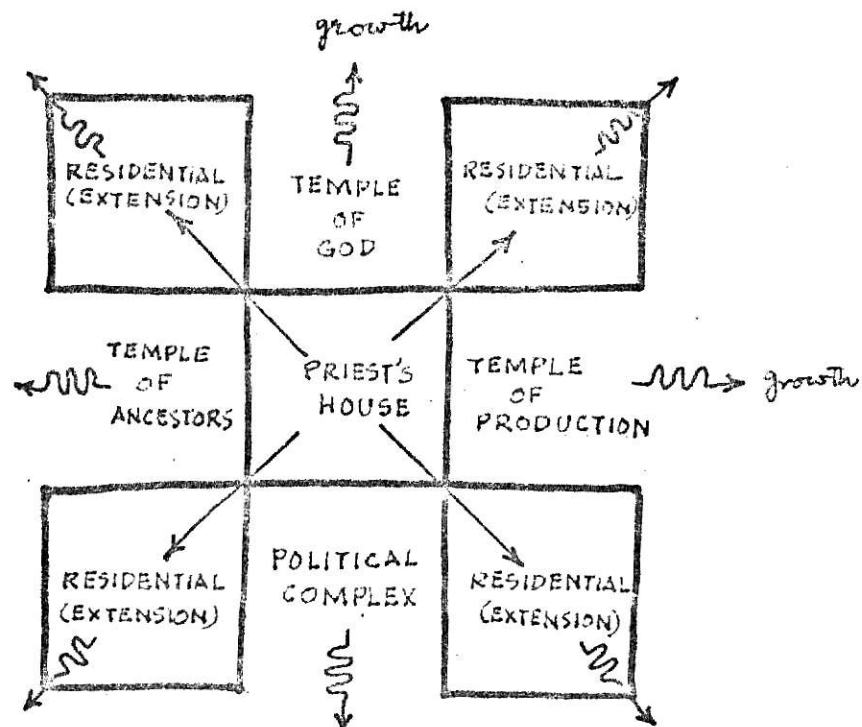
Graphic: 19

"CHIN TIAN TZE TOO" OR "WELL-FIELD SYSTEM"  
 FOR LAND SUB-DIVISION AND TAXATION IN  
 ANCIENT CHINA





MIN-TANG SYSTEM FOR THE DESIGNING OF RELIGO-POLITICAL COMPLEX



KAU - GUM - GI SYSTEM (LATER DEVELOPMENT)

Graphic: 20

THE FORM "H" AS BASIS OF URBAN DESIGN  
IN ANCIENT CHINA

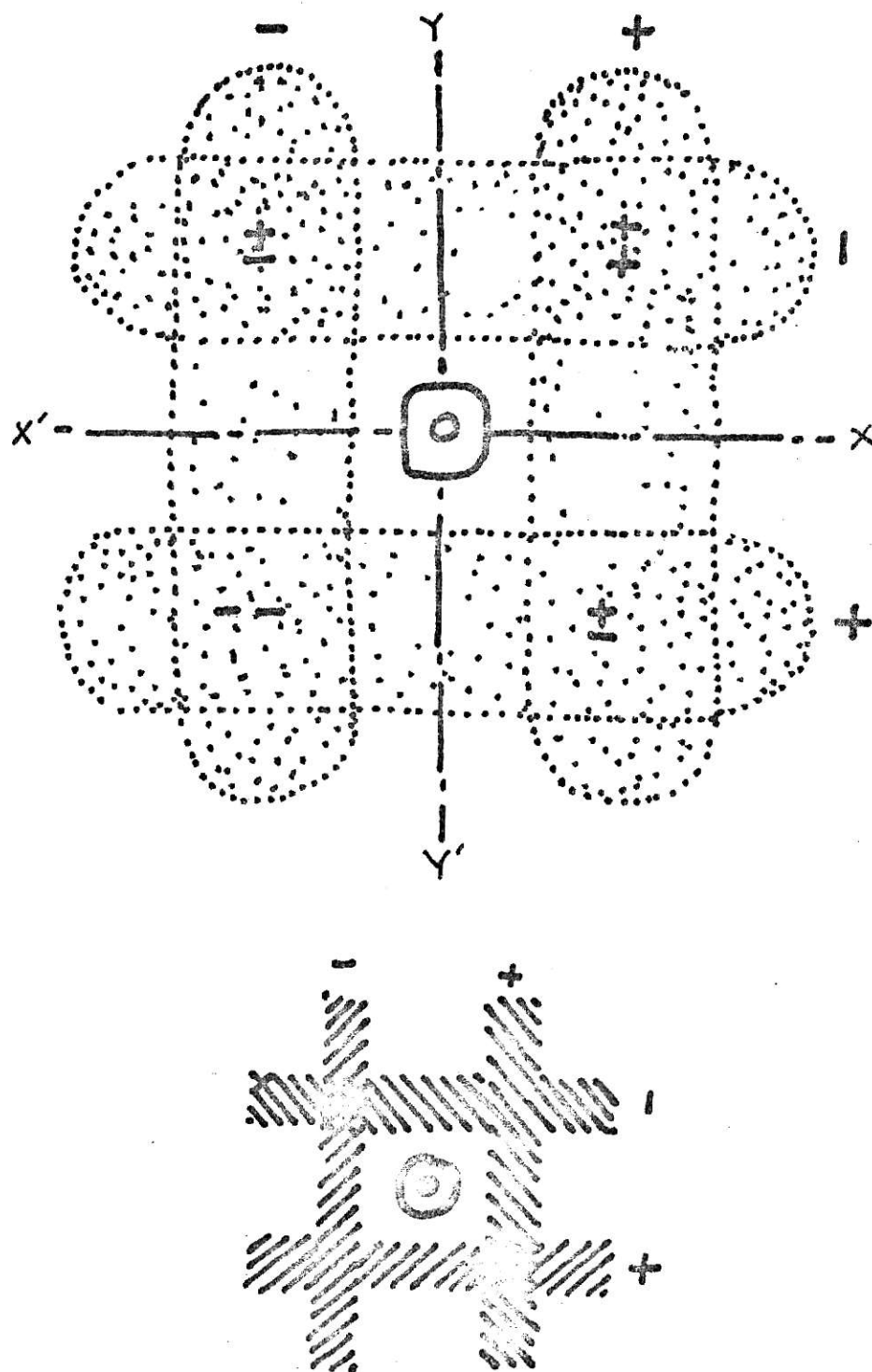
respectively. The fourth i.e. southern wing of the Form was assigned for the purpose of political assembly and administrative usage. Later, as the priest's power grew and his palacial cum residential needs increased, the corner panels were acquired and emerged in the residential complex<sup>16</sup>.

#### Egypt:

A study of the structural properties of ancient Egyptian concept of space, from temple to entire country, reveals that it's organization, function, and form rest on simple semantic "pairs of opposition". These opposing pairs are counterbalanced around the two axis- real or theoretical- which intersect at right angles to each other. The point of intersection is identified with the center of the world<sup>17</sup>. The space is conceived as a balanced organic entity about this point of intersection. The whole concept is conceivable in the form '#'. The lines formulating the Form, symbolise the 'opposing pairs'.

#### Libya:

In Libyan philosophy, the numbers 3 and 4 symbolize the world. These numbers formulate the basis of the organization of the oasis of Fezzan. A tripartite oasis corresponds to a "head" and a quadripartite one to a "belly". The Albarkat oasis corresponds to a belly and is therefore quadripartite. Its center is considered as the head of the oasis, as is rectangular, oriented north, east, south, and west. It is surrounded by 4 sectors, considered as the limbs, and the whole constitutes a square, walled inclosure. Tripartite oases consist of two sectors separated by a road running north-south or east-west and a fort. One level of the oasis of Fezzan represents the cosmic notions, and another the anthropomorphic notions<sup>18</sup>. This whole philosophical explanation of oases being quadrilateral and linked with cardinal directions,



Graphic: 21

THE FORM "#" AS CONCEPT OF "PAIRS OF OPPOSITION"  
IN EGYTIAN SPATIAL DESIGN

is transferable into the basic form '#' which may be conceived as basis of this philosophy of spatial organization.

#### Tunisia:

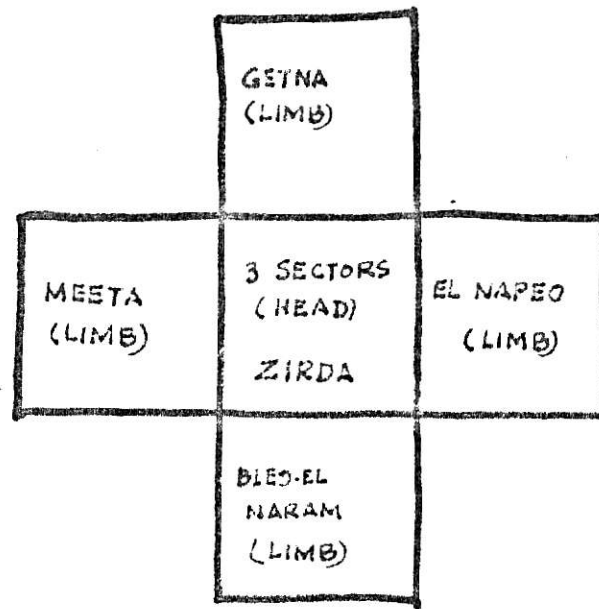
The settlement of Tozeur in Tunisia is believed to stand on a site which consisted of two sectors. The eastern one corresponding to the upper world, and the western one to the lower world. Today Tozeur has 7 sectors. The three central sectors are mytho-philosophically conceived as formulating the 'head' and the other four sectors which occupy outer position, as the 'limbs' oriented to the points of compass. As in the case of oasis of Fezzan, each sector is convertible into a pre-signifier leading to a signified connotation which is cosmic<sup>19</sup>. Thus the Form, as in the case of Egypt and Libya, also formulates the basis of mytho-philosophical concept of space in Tunisia.

#### North Somali:

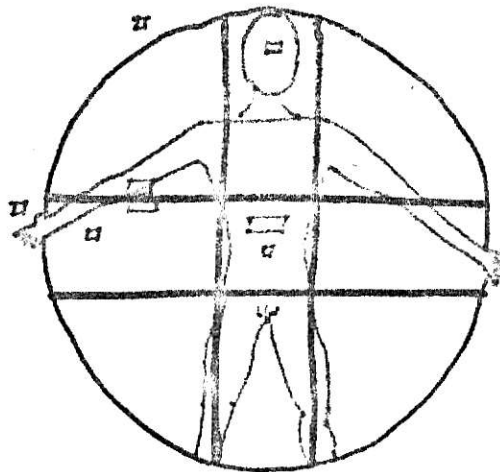
Earlier communities in North Somali were conceived on the basis of Tomuctu, which is the representation of primordial star from which the world was created. Tombuctu is conceived as comprised of a central sector and 4 outer sectors. These are arranged as the 4 arms of a cross oriented to the points of the compass, and correspond to the limbs of the human body<sup>20</sup>. This mytho-philosophical concept of space being similar to those which prevailed in Libya and Tunisia, can also be conceived as derived on the basis of the form '#'.

#### United States:

The earlier city planning in United States was typical of 'Colonial type' planning. The plans of early American cities and towns were conceived in Europe for the purpose of being implemented in United States. For the purpose of convenience, these plans were drawn on grid iron pattern in order to



TOZEUR (TUNISIA, AFRICA)



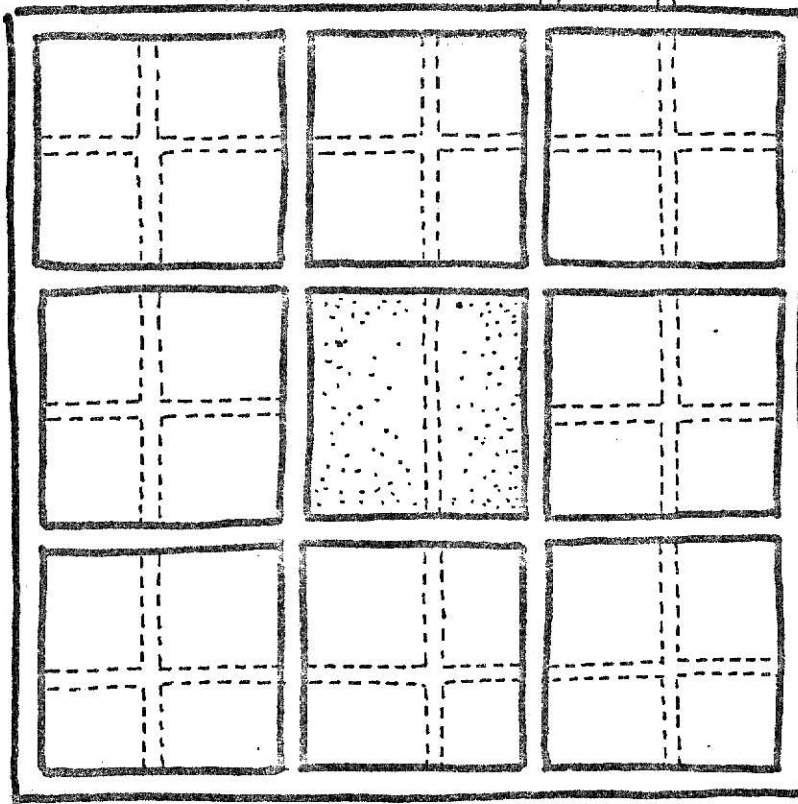
TOMBUCTU (NORTH MALI, AFRICA)

Graphic: 22

THE FORM "H" AS PHILOSOPHY OF CITY PLANNING  
IN AFRICAN COUNTRIES

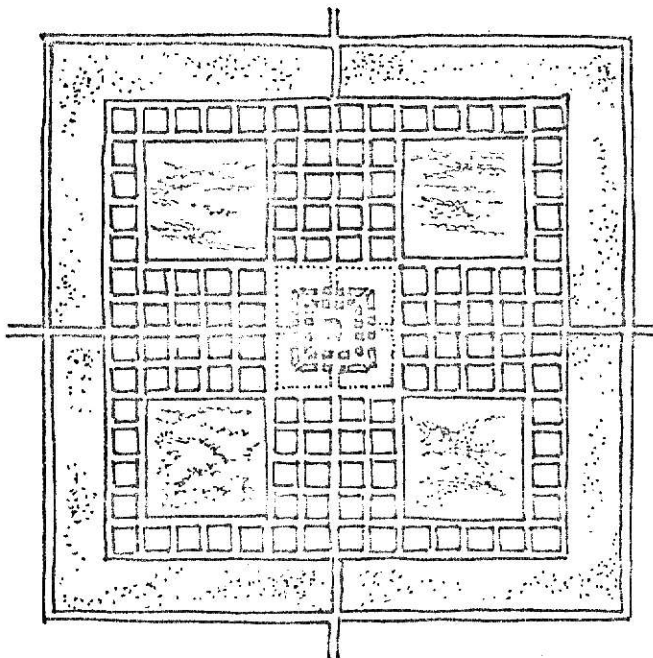
facilitate their implementation. The form '#' being a basic module of such a pattern, is traceable in many of these plans. The Form predominantly appears distinguishing the 'court square' or 'town square' from rest of the community in many of these towns and cities. The Form in its true value as a matrix of urban development is evident in the original plan of New Haven built in the year 1641. The Form divides the city plan in nine equal squares with the central square serving as the town center. Although the later growth of the city has been in somewhat radial pattern, the original plan has preserved itself through all these centuries. This is attributable to the rationality of the Form under varying technological conditions.

The popularity of the Form as a basic concept of design is also evident in the nation's first regional plan, the Margravate of Azilia which was never executed<sup>21</sup>. The plan was laid out by land grantee Sir Robert Montgomery in Georgia in 1717. The plan was conceived as a geomorphic-concentric spatial entity in which the land was subdivided into 25,000-acre regions with smaller and smaller quadratic subdivisions. The inhabitants were to live in three different types of habitats: (i) in a concentric capital city where Montgomery's castle was to be surrounded by large house blocks with interior garden courts, (ii) in an outer fortification belt, working two mile square "fee farms" and (iii) on farms- 116 in each district of 640 acres each. The plan also had four provincial forests in the corner directions and a greenbelt around the central city to segregate the city from the country side<sup>20</sup>. Interpreting this plan in terms of the form '#', the central panel formulates the capital city, cardinal directional panels were occupied by rural communities, and the corner panels contained the regional forests. Although the plan could not be executed,



== ORIGINAL LAYOUT  
 --- LATER DEVELOPMENTS

PLAN OF NEW HAVEN



MARGRAVATE OF AZILA, GEORGIA, 1711  
 (THE FIRST REGIONAL PLAN IN U.S.A.;  
 NEVER EXECUTED)

SOURCE: "MATRIX OF MAN" P.190

Graphic 23

THE FORM " #" AS APPLIED IN EARLY CITY AND REGIONAL  
 PLANNING IN UNITED STATES

the adoption of the form '#' as the basic matrix in this first known regional plan suggests the profundity of the Form among the planners.

#### Soviet Union:

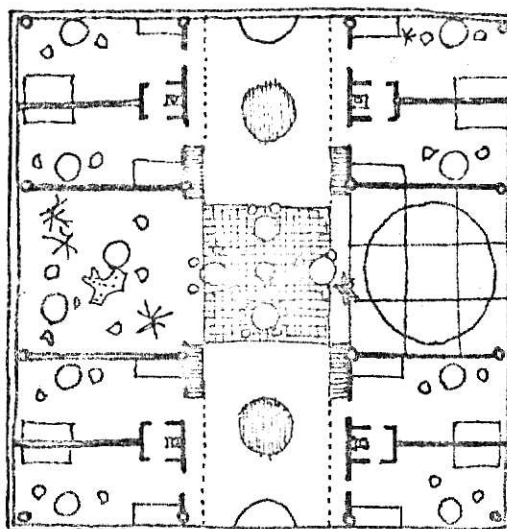
With the advent of communism in Russia, a new way of socio-economic life emerged which gave rise to the concept of 'Commune' living. Commune is large scale physical development comprised of clusters of residential units in which people live collectively as a large family sharing together the socio-economic benefits. The form '#' is traceable as the basic concept and matrix in the design of many of these communes. One such commune unit is that planned by architect-planner Leonidov for the commune town of Magnitogorsk. The unit comprised of a group of eight residential units, is applied repeatedly as a matrix to formulate the design of the whole community. Adopting the Form as his basis of design, Leonidov conceived its corner as individual living units, the central panel for collective living, north and south panels as circulation and service areas which govern internal and external relations of the unit, and the side panels as open spaces for recreation functions of various age group living in the unit.

The intensive application of the Form in mankind's thoughts and beliefs as well as his planned environments in different parts of the world and under different socio-economic conditions, infuse the characteristic of 'universality' to the Form as basic unit profoundly conceived by man for varied design functions.

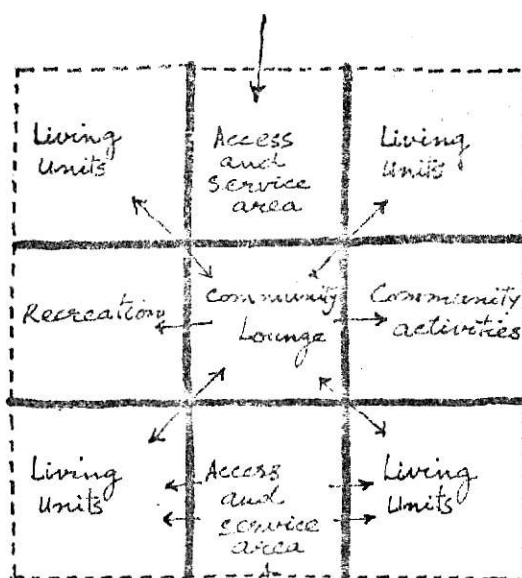
#### b. Evolution and Development of the Form '#' in Urban Design:

The origin and development of the Form as conceived in contemporary city planning, has been a slow but gradual process. It is moulded by the varied





ONE TYPICAL ELEMENT OF THE EIGHT-GROUP  
HOUSE CLUSTERS



SPATIAL ORGANIZATION

Graphic: 24

## THE FORM "H" AS SPATIAL DESIGN IN LEONIDOV'S PLAN OF A 'COMMUNE' UNIT FOR MAGNITOGORSK

(SOURCE: LEWIS, DAVID, "URBAN STRUCTURE" P. 249)

socio-economic and technological conditions that prevailed during various phases of history.

The origin of this basic form initiated with the evolution of gridiron way of planning which emerged as the outcome of mankind's urge for order and regularity in his environment in contrast to chaotic growth of nature. The earliest planned communities were predominantly laid on scientific principles and mythological beliefs, and as such lacked considerable spatial variance. These cities were laid in accordance with orientation, that is the placing of structures and streets in correspondence to the points of compass. Orientation first applied to the city as a 'whole', was later on extended to the street layout, which eventually lead to the gridiron pattern in planning<sup>22</sup>. The basic image or form of these earliest planned communities was '+' produced by the intersection of the major routes laid with respect to cardinal directions. The form '#' in these communities is primarily evident as a module in their layout pattern.

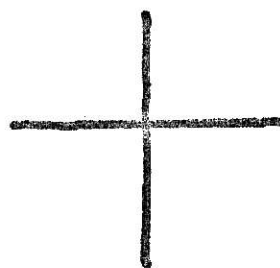
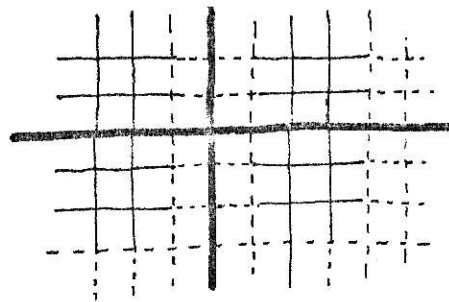
In due course of time, the vicinity of the intersection of two major routes acquired significance importance due to its strategic location and consequently various public buildings like temple, market place etc. emerged at this location. This in turn lead to concentration and subsequent congestion of traffic at and near the intersection of these major routes. For this as well as social, technological and aesthetical reasons, such structures appeared in later communities as planned complex in which the structures were arranged within or around an open space. This planned complex containing major structures developed as town center and became the nucleus of social, political, cultural, and economic activities in the city. The form '#' demarcating this

this town center became the general image and development pattern of planned communities of that age. The Form in many cases was supplemented by some additional minor streets terminating on the outskirts of the town center.

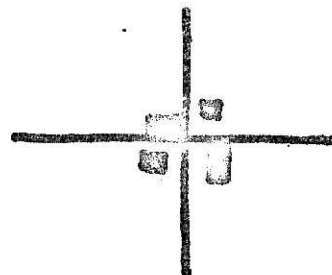
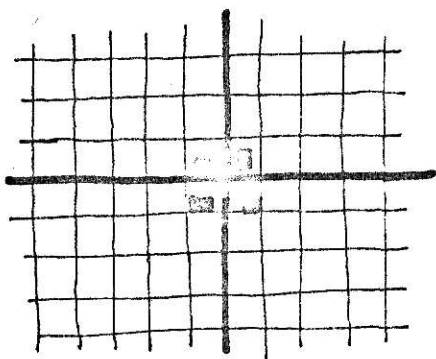
Later during Renaissance and Baroque periods, cities jumped out of their peripheral walls and grew considerable in size. Consequently, additional radial streets developed in communities originally laid on gridiron pattern, for reducing the traveling distances to major structures in the town center and also to create picturesque vistas with these existing structures. These additional radial streets did not eliminate the original form '#' but supplemented it with additional lines. The general image of the cities during this phase of history became hub of streets terminating at the town center. With little effort, the original form '#' could still be traced in these hubs.

In post-baroque period; with the advent of rail transportation as well as intensive urbanization resulted by industrialization, the converging streets resulted in traffic congestions and chaotic conditions in and around the town center. Also the evolution of automobile as primary means of transportation made it possible to travel long distances conveniently in comparatively short periods. This in turn super-blocks and fewer streets in the city. Consequently, the prime reasons for developing radial streets during Renaissance and Baroque periods got nullified and the form '#' reemerged in its original form as a basic image of gridiron planned cities.

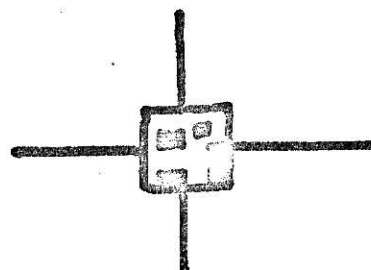
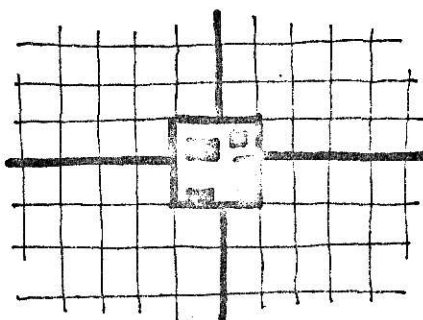
The steeply increasing car ownership and intensive urbanization during last few decades have adversely affected the environment and safety in the cores of the larger cities. This lead to the plea for reversal to the concept of



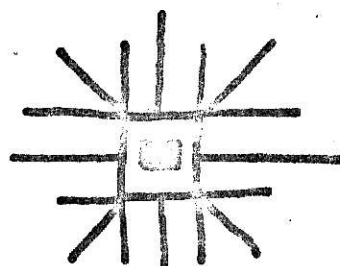
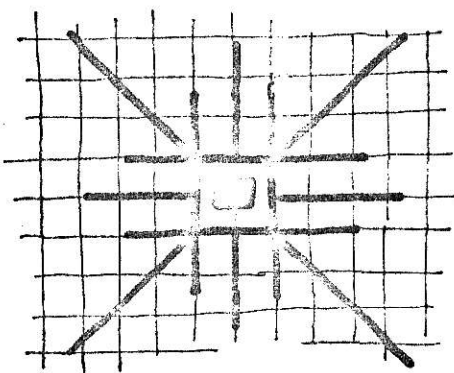
STAGE I



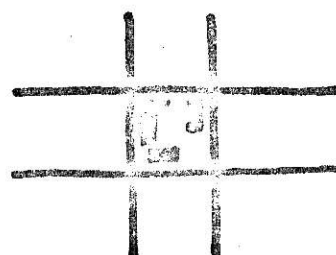
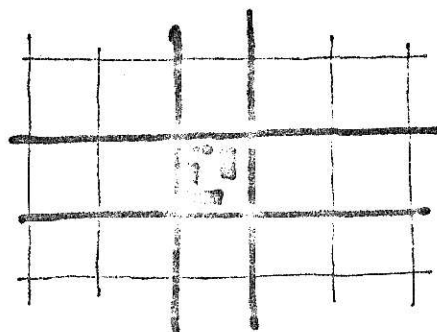
STAGE II



STAGE III



STAGE IV



STAGE V

URBAN FORM

URBAN IMAGE

Graphic:25

HISTORICAL EVOLUTION AND DEVELOPMENT OF '#' AS URBAN FORM

shopping malls and pedestrian oriented areas in the city core. The form '#' has been successfully conceived and in contemporary city planning, as a one-way traffic system for regulating vehicular traffic in and around the central business district.

Thus the form '#' has continuously influenced urban design and city development during all phases of the history of planned city development and in the process has retained itself as a basic image of cities during all these years.

### C. Analysis and Evaluation of the Practice of the Form '#':

An analysis and evaluation of the development and application of the form '#' reveals some significant qualitative values and virtues of the Form:

- \* The mere fact that the Form was conceived and adopted for different purposes, in different parts of the world, during different periods of history, by different civilizations who had little or no contact with one another, stresses the universality of the Form as a mean for emphatical expression of spatial arrangements and relationships.
- \* The universal characteristic of the Form suggests mankind's fancy for the form and its profoundness in his thoughts, beliefs and actions. This in turn testifies that the Form is easily conceivable, and adoptable by mankind to understand, study and analyse the spatial organizations and relationships. Hence the application and scope of the Form in various professional fields should be further promoted by exploring virtues and potentialities of the Form as regards to needs of the specific fields.

- \* The Form is generally conceived by mankind to study and analyse concentric systems and also to locate an element emphatically with respect to its related elements. These properties of the Form are also very much applicable to the urban design field. Urban design with an hierarchy of spatial entities, varying from dwelling the smallest unit of city development to the city itself. Each of these spatial entity is oriented towards a center or focal point which binds the entity into an organic 'whole'. For example, the dwelling is oriented towards the family area or internal court, housing cluster towards the common green, neighborhood unit towards the neighborhood center, community towards the community center, and the town or city towards the CBD area. Thus the Form can be usefully applied as a basic unit and tool in urban design, to concentrically organize spaces in an harmonic and organic relationship.
- \* The analysis of mankind's myths and practice of city planning reveals that the modular gridiron city has had two ancestors; a realistic one and a spiritual one. The former saw the collective habitat as a coercive container, while the later conceived it as a geometric allegory of cosmic predestination. Both shared the conviction that the anonymous masses were not entitled to a free environmental choice but were to be molded by a module that was determined by an intelligence higher than their own. The Form being deep rooted and intensively applied in both these ancestors, formulates the common denominator between the two. Thus the cities if designed with form '#' as the basic module, should satisfy mankind's spiritual as well as physical needs and desires.
- \* The urban form is usually shaped by the impact of the social and technological conditions. These conditions varies from society to society and

from period to period. The fact that the Form is generally retained as a basic element of gridiron city planning in almost all parts of the world and during all the phases of history, testifies the usefulness and adaptability of the Form under varied social and technological conditions. On the basis of this consideration, it may be conceived that the Form should also prove rational as a basic urban form under not much foreseeable social and technological conditions of distant future.

- \* The frequent application of the Form by mankind to express his concept of universe and heavenly arrangements, suggests that the Form is nearest to his concept of ideal place or utopia. Thus cities designed on the basis of the Form '#' would much tally with masses utopian beliefs and so would be readily acceptable to them.

The above qualitative values and virtues of the Form very much qualify it as the basic unit of urban development, which should be further analysed and improved upon to serve as optimum unit for the unit-matrix system approach in urban design.

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### III ESTABLISHMENT OF THE UNIT.

Future is conceivable as the projection of the past based on the present. The form '#', which has influenced mankind's thoughts, beliefs, and myths since time immemorial, and has been associated with his planned environment from the very beginning, should continue to do so in future also. For this reason the potentialities of the Form in terms of urban design should be exploited, by analysing and evaluating the Form on the basis of various criteria that govern the urban design. On the basis of such evaluation, the Form may be retained, modified, reformed, or rejected as an optimum unit for the proposed 'unit-matrix' system of urban design.

#### A. Evaluation of the Form '#':

All urban designs are generally evaluated on the basis of three primary design criteria. These criteria are:

- (a) Psychological perception, they stimulate
- (b) Spatial organization, they promote
- (c) Functional efficiency, they achieve

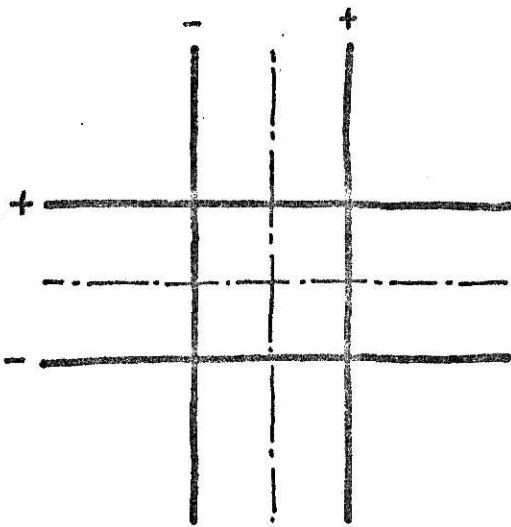
The degree of accomplishment as regards to these criteria, collectively formulates the performance standard of an urban design. The form '#' should therefore be interpreted, analysed and evaluated in terms of these three basic aspects of urban design, in order to determine its merits and demerits the spatial design unit.

#### (a) Psychological Perception:

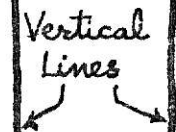
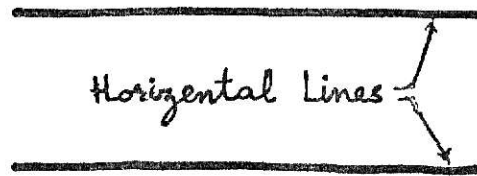
Psychological perception of the form "#" is the activity of thought which it stirs in human brain. Such activity of thought is in turn reflected in human behavior.

Interpretation:- The form '#' is comprised of 4 straight lines. These constituting lines are symbolic of resoluteness, rigidity, and strength<sup>1</sup>. They have within themselves a certain energy which appears to travel along their lengths and be intensified at their end. Of the 4 constituting lines, two are horizontal and the other two are vertical. The horizontal lines convey a meaning of passivity and relaxation<sup>2</sup>. Following these horizontal lines is instructive mimicry and man feels a sense of immanent, the rational and the intellectual<sup>3</sup>. These lines are parallel to the earth on which man walks and accordingly accompany his movement. These horizontal lines extend themselves at eye level and so create no illusion about their lengths. The vertical lines in the form '#', defying gravity, symbolize uprightness, determination and sublime. These lines are also representative of infinity, ecstasy, and emotion. To follow these lines, man must halt and raise his eyes to heaven, leaving for a time his normal visual direction. These vertical lines lose themselves in the sky and so are deceptive about their lengths<sup>4</sup>.

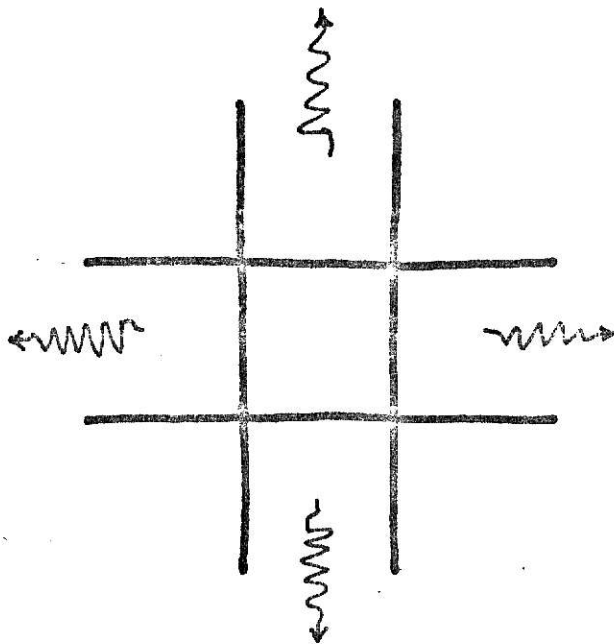
Analysis:- The various lines formulating the Form, imply speed and activate the space around them due to the energy which they carry in themselves. Also, the Form being comprised of two horizontal and two vertical lines, depicts both, the passivity of the leisure, and the uprightness of activity and progress in a perfect balance. The carrying out of these extreme interpretations by the Form, makes it a complete organic entity. Horizontals and verticals operating together in the Form, introduce the principle of balanced oppositions of tensions. The verticals express a force which is of primary significance -- gravitational pull, the horizontals again contribute a primary sensation -- a supporting flatness. These two types of straight lines together produce a deeply satisfying resolved feeling, because together they



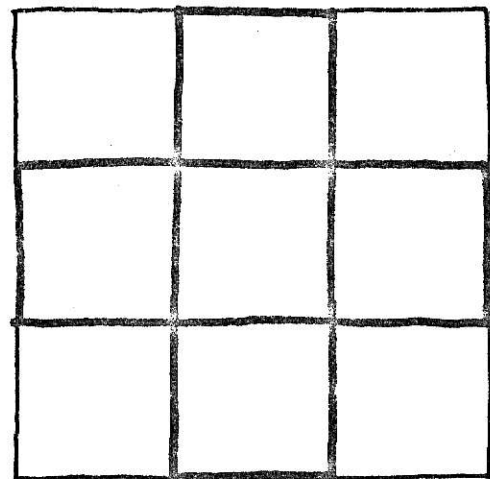
THE FORM AS A QUADILATERAL  
SYMMETRY REPRESENTS BALANCE



COMPOSING ELEMENTS  
OF THE FORM



THE FORM AS ITSELF  
REPRESENTS "CONTINUITY"



THE FORM ON APPLICATION  
RESULTS IN "FINALITY"

Graphic: 26

PSYCHOLOGICAL PERCEPTION  
OF THE FORM "#"

symbolize the human experience of absolute balance and standing erect on level ground. The Form being identical about both horizontal and vertical axis with origin at the centroid of the central panel, formulates a concentric quadrangular symmetry symbolizing equilibrium. The fact that the Form is formed by the cancelling out of a pair of vertical lines or active movements by a pair of horizontal lines or passive movements, induces the characteristic of balanced organism to the Form. The open ends of the lines in the Form, represent continuity. But, when the Form is applied to an area, the ends of the lines are sealed, thereby achieving finality. These properties of the Form illustrate its profundity power.

Evaluation:- The evaluation of the analysis of the psychological interpretation of the form '#' delineates its following merits and demerits as regards to urban design:

**Merits:**

- \* The spatial designs conceived as the form '#', would be balanced in all respect as a result of the equilibrium characteristic of the basic form.
- \* The designs obtained by the application of the Form would have the potentialities for growth and enhancement due to the continuity characteristic of the Form, and would be organically balanced as a complete entity at all stages of development due to the finality characteristic of the Form.
- \* The designs resulted by the Form would have the necessary centripetal pull needed to direct and attract to the heart of the spatial entity, as a result of the concentric symmetrical structure of the Form.

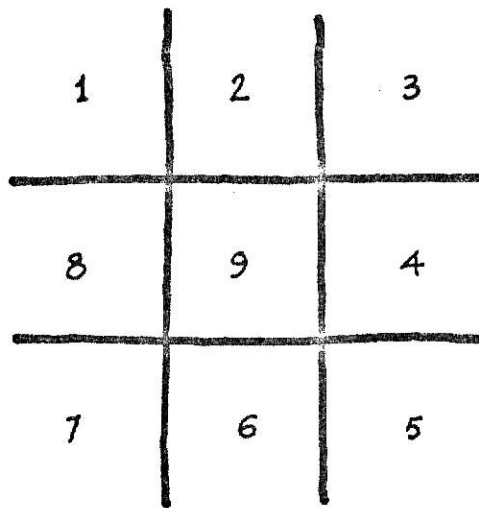
\* The designs produced by the application of the Form, would be rigid and would lack desired variance due to symmetrical arrangement of lines in the form '#'. These designs would be too static lacking in terms of dynamism.

(b) Spatial Organization:

Urban design deals with integration and organization of spaces to produce optimum environment while fulfilling the basic functions. Optimum environment are primarily the outcome of harmonic spatial integration evolving the development of intimate spaces. To achieve this, the spatial interflow should be rhythmic with sufficient variance to stir human perception and interest in the overall spatial composition. Thus the spatial perception is not a passive recording of stimulus material but an active concern of the mind.

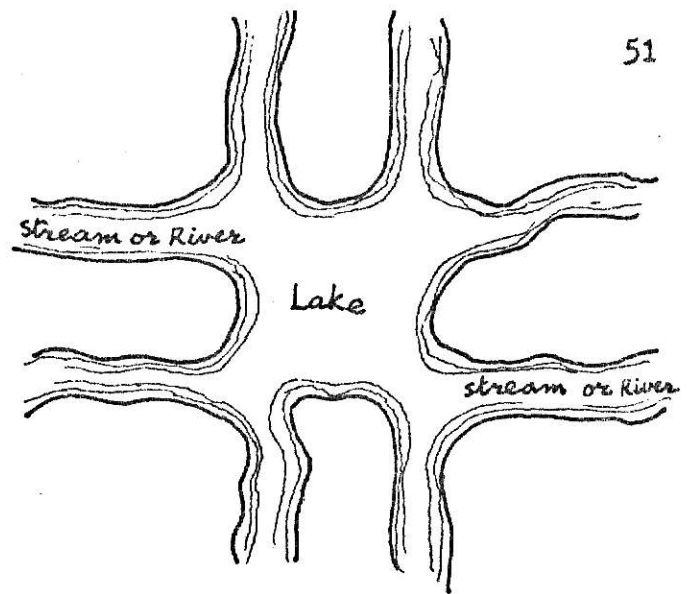
Interpretation:- The space as applied to urban design, is the three dimensional expansion of any kind. It is perceived by the visualization of its limits and by kinesthetic experience, i.e., by the sensation of observer's movements. In the state of "visual tension", kinesthetic sensation and visual perception fuse most intensely, and the conscious enjoyment of urban design as artistic experience produces this visual tension. People in their movements are influenced and directed by three dimensional confines and by the structural lines of such confines<sup>5</sup>.

The form "#" formulates a frame of human activities resulting in the evolution of 9 spaces arranged in a concentric organization. Eight of these spaces surrounds the ninth space. These spaces are distinguished by the lines in the form "#".

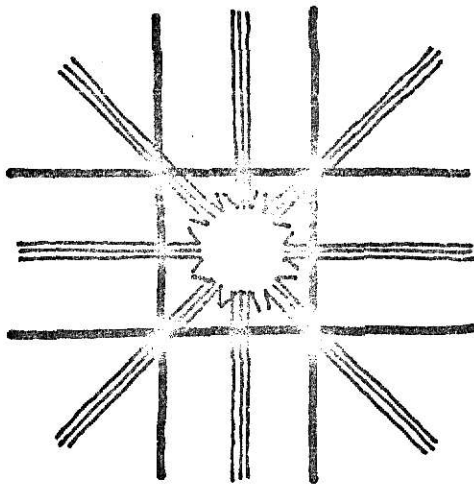


1 to 8 are irrational spaces  
9 is rational space

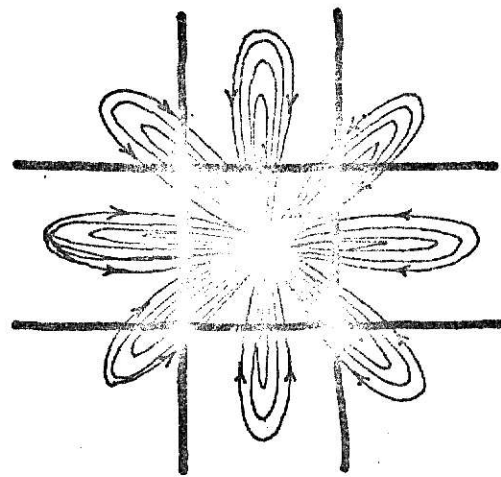
TYPE OF SPACES PRODUCED  
BY THE FORM



SPATIAL CONCEPT OF  
THE FORM



PSYCHOLOGICAL GRAVITATIONAL  
FORCES PROVIDED BY THE FORM



THE FORM AS BINDER OF SPACE  
INTO AN ORGANIC ENTITY

Graphic: 27

SPATIAL ORGANIZATION  
BY THE FORM "#"

**Analysis:-** Of the nine spaces produced by the form '#', the eight peripheral spaces are variable, irrational and indefinite arranged around a rational space of definite size and shape. The orientation of the peripheral spaces towards the nucleus space, makes the latter an intimate spatial entity holding together the whole space. The central spatial panel in the Form, formulates a common place for infusion and interaction of the surrounding individualistic spaces. Conceptually, the streets or linear spaces in the Form, formulates rivers channeling the stream of human communication, which means much more than mere technical "traffic", into the vast central space comparable to a natural or artificial lake<sup>6</sup>. In the overall spatial arrangement, the central space or 'square' occupies an enhanced and dominant situation and interlocks the whole design area. Thus this focal space or panel dictates the flux of life not only within its own confines but also through the adjacent streets for which it forms a quasi estuary.

**Evaluation:-** The critical appraisal of the analysis of the spatial interpretation of the Form, leads to following inferences regarding its merits and demerits:

**Merits:** The Form possesses the following spatial properties with respect to urban design.

- \* The central space due to its enhanced and strategic location, acts like a magnet attracting and bringing in people right to the nucleus of the design thereby activating the whole design area.
- \* The Form is flexible in terms of sizes of the spaces to be developed. It is adjustable to specific quantitative spatial needs by varying the distances between the parallel lines which make the Form.

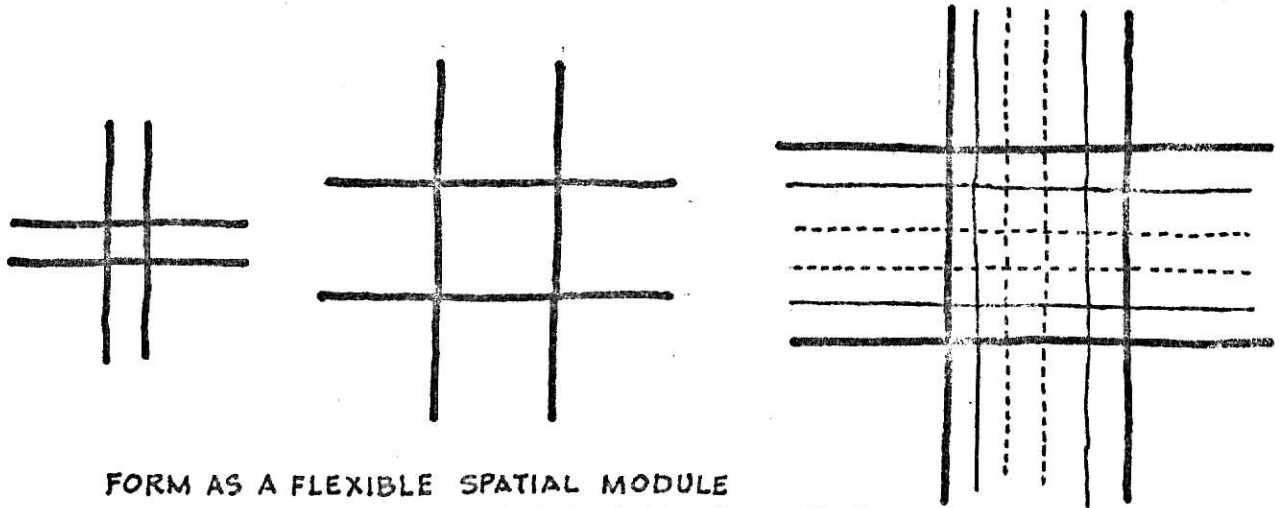
- \* The phenomenon of linear spaces emerging into a centralized vast space, results in the desired rhythmic flow of spaces in all four directions in the design, providing convenient accessibility and favorable environment.
- \* The central space which is also the focus area of the overall design, is entered at its corners by means of linear tunnel like spaces. This results in the central space being unfolding itself to the view of the commuters, thus providing a visual drama which generates and keeps intact their interest and curiosity in the spatial organization.
- \* The quantitative spatial variance between linear streets and the central void, provides the desired diversity needs to stir human perception.
- \* The act of entering the central open space through a tunnel or hole, generates and releases the desired perceptual and emotional tensions of the people. Thus intense kinesthetic sensation and visual perception ultimately fuses into an relaxed atmosphere.

#### Demerits:

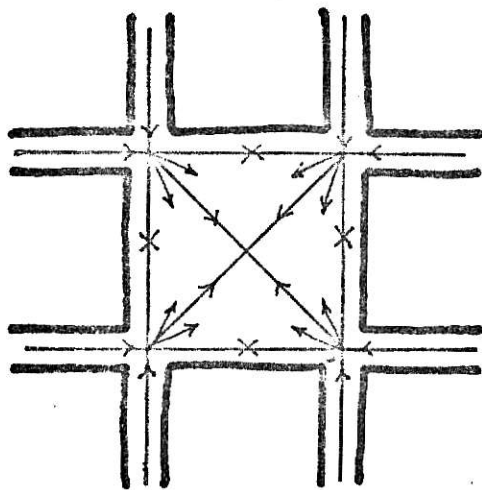
The evaluation of the spatial analysis of the form '#', also suggests its following demerits as regards to urban design.

- \* In the spatial organizational conception of the Form, the linear spaces or 'rivers' appear to pass by the central open space or 'lake' instead of terminating at it. Such an arrangement appears somewhat unnatural and also fails to distract the attention and commuters on streets, to the major portion of the nucleus space in the design.
- \* The through routes by-passing the central space, creates a feeling of emptiness for the commuters as there is nothing at the ends of these routes

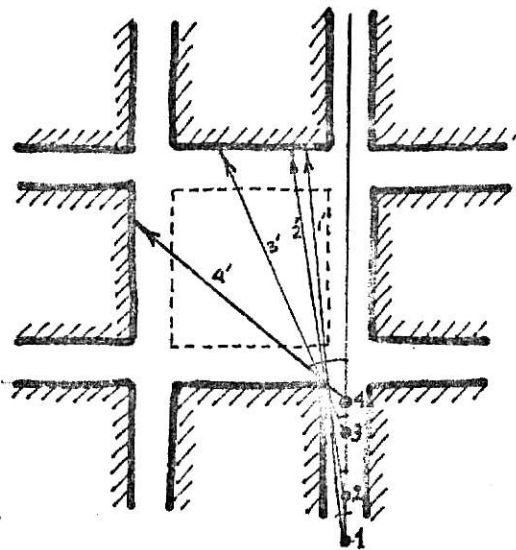




FORM AS A FLEXIBLE SPATIAL MODULE  
IS ADAPTABLE FOR PRODUCING VARIED SPACES



ENTERING THE VAST CENTRAL SPACE  
THROUGH TUNNEL LIKE LINEAR SPACES  
RELEASES HUMAN TENSION RESULTING  
IN RELAXED ATMOSPHERE



CENTRAL SPACE UNFOLDS ITSELF GRADUALLY  
TO COMMUTER'S VIEW, KEEPING INTACT HIS  
INTEREST AND CURIOSITY

Graphic: 28

KINESTHETIC PERCEPTION OF THE  
SPACES PRODUCED BY THE FORM

"#"

to arrest and divert their attention and vision.

- \* The spatial arrangement resulted, being a simple symmetry, is somewhat rigid and lacks in terms of dynamic character.

(c) Functional Efficiency:

All designs are intended to fulfill certain utilitarian functions, which formulates the 'goals' for the design. The extent of achievement of these goals amounts to be the efficiency of the design. The form "#" should be interpreted, analysed and evaluated in terms of various urban functions in order to establish its functional values and virtues.

Interpretation:- The Form should be interpreted and reviewed in the lime-light of three basic urban functions, namely:

Land use development(areas),

Traffic networks(lines),

Facilities distribution(points).

The lines of the Form divides any given rectangular space into '9' divisions. In terms of land use categories. The sizes of divisions are adjustable to specific needs by simply varying the proportions of the constituent elements of the Form. The lines in the Form are conceivable as traffic routes providing accessibility to various land use areas. The facilities or points would be distributed within the areas and with respect to the traffic routes.

Analysis:- The functional interpretation of the Form suggests that the Form is adoptable and has been profusely employed as a basis for developing models to facilitate the development of various urban functions.

In terms of "land use models", the central division of the Form being more or

less equidistant from the peripheral spatial divisions, is ideally suited to perform the functions of the services and activity center for the whole spatial entity. Thus, the central division becomes the central business district in the design for a city, community or village center in the design for a community, neighborhood center in the design for a neighborhood unit, common green in the design for a residential cluster, and the internal court or family room in the design of a dwelling. The Form on application to a city, conceptually distinguishes the high density city core from the low density suburban areas, forming a sort of ring street around the core. Such an arrangement facilitates the development of the core or CBD area as a traffic free zone in the form of a shopping mall, a contemporary reversal in urban planning trends.

In terms of "traffic network models", the Form facilitates the development of a functional hierarchy of streets. One set of the parallel streets bring in traffic from outside into the design area and transfer this traffic to the other set of parallel streets which in turn distribute this traffic within the design area.

The Form also formulates the "model for optimum location for urban motor freight terminal". Ideally, the terminal should be located where a balance can be achieved between high density central city locations near shoppers and increasing travel time and freight handling costs. Such a balance between centrality, density, and accessibility is achieved by the generalized location of the optimum distribution point adjacent to high density central core as well as near the interchange of freeways in the form "H"7.

The Form also provides basis for developing optimum "bus rapid transit system models". The schematic systems derived on the basis of the form "H" show how a relatively small mileage of special bus right of way can provide area-wide rapid transit by utilizing freeway systems as an integral part of their operation. Radial freeways could provide ample wide medians to permit extensions of bus lanes (or right of ways) as required by future growths. Off street busways penetrate the heart of the downtown. In some cases, metering of freeway traffic might serve as an alternative to exclusive lanes<sup>8</sup>.

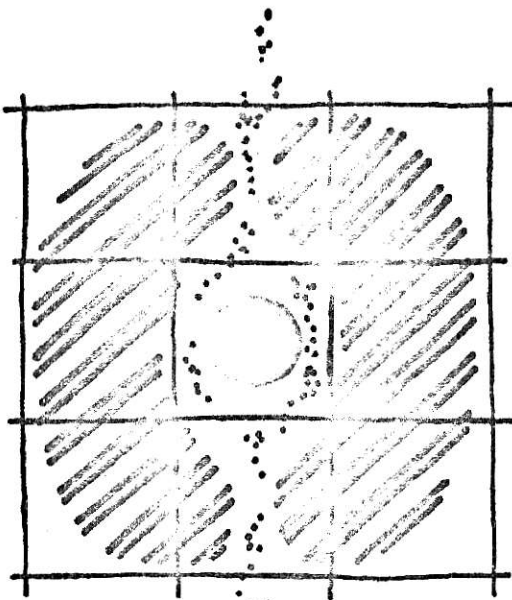
The Form also facilitates, and has been applied as a basis for analysing "possible inter-model substitutability of rail or bus rapid transit for freeways in large urban areas". The hypothetical system derived on the basis of 'inter-model substitutability'. Even with rapid transit, most freeways are retained for system continuity<sup>9</sup>.

Since the Form has no points, it is not interpretable in terms of models for facilities distribution, although the Form may guide in determining optimum location for specific facility within an urban space.

**Evaluation:-** The evaluation of the functional interpretation and analysis of the Form reveals its following merits and demerits:

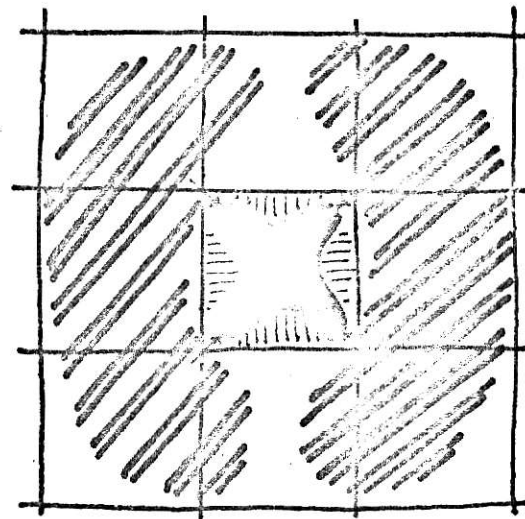
**Merits:**

- \* Each of the eight peripheral spaces in the Form are developable as a self sufficient spatial entity with minimum dependence on the central space. Thus the Form is transferable into an heirarchical order of urban spaces. This would prevent overlapping of functions, thus leading to attainment of high degree of efficiency in the resultant design.



FORM FORMULATES THE BASIS OF THE CONCEPTUAL DESIGN OF URBAN SPACES VARYING FROM DWELLING TO CITY ITSELF.

- = centralised activity area (Service Center)
- /// = individualised activity area (residential)
- ... = transition zone (open area)



FORM AS BASIS OF MODEL OF AN OPEN-HEART CITY WITH PEDESTRIAN ORIENTED CORE

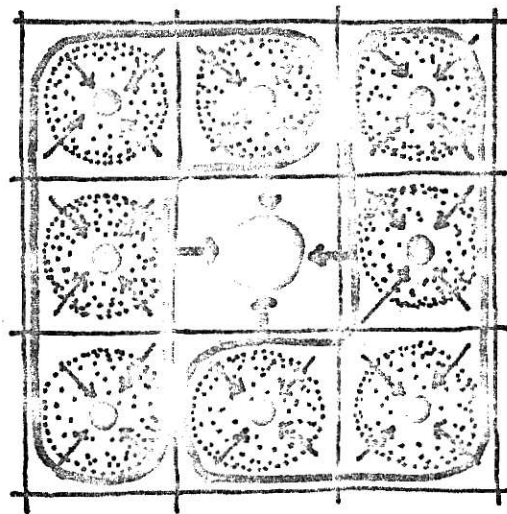
- ✕ = shopping mall
- ≡ = parking
- = pedestrian entrance

⊙ = micro-space

⊙ = mega-space

● = micro center

● = mega center



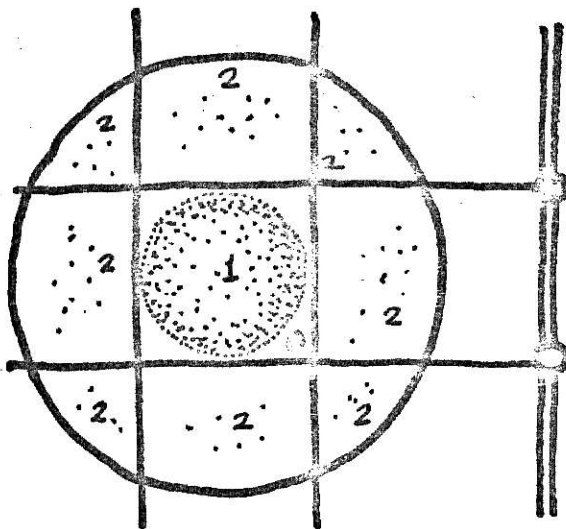
✕ = minor activity

→ ⊙ ← = major activity

FORM AS A COMPLEX STRUCTURE COMPRISED MICRO AND MEGA URBAN SPACES

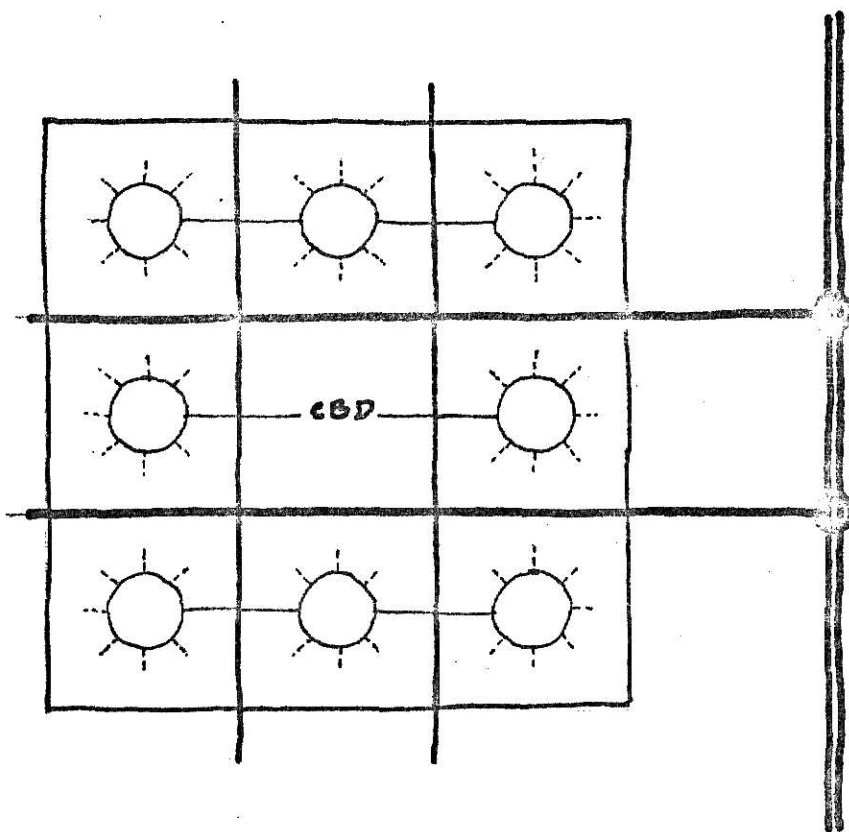
Graphic: 29

THE FORM "X" AS APPLIED IN THE DEVELOPMENT OF URBAN LAND-USE MODELS



- == Expressway
- Freeway
- 1 High density core
- 2 Low density suburb
- optimum distribution point

MODEL FOR GENERALIZED LOCATION OF  
OPTIMUM DISTRIBUTION POINT FOR URBAN  
MOTOR FREIGHT TERMINAL



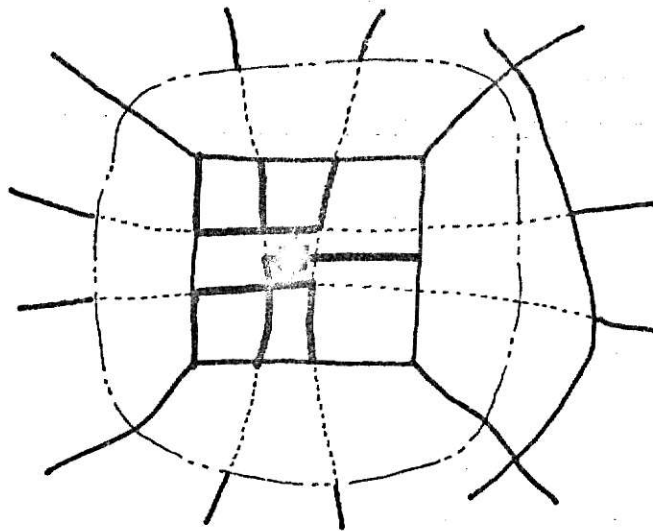
- == Expressway
- Freeway
- Arterial st.
- Collector st.
- Local st.

MODEL FOR FUNCTIONAL  
HIERARCHY OF STREETS  
IN A CITY

Graphic: 30

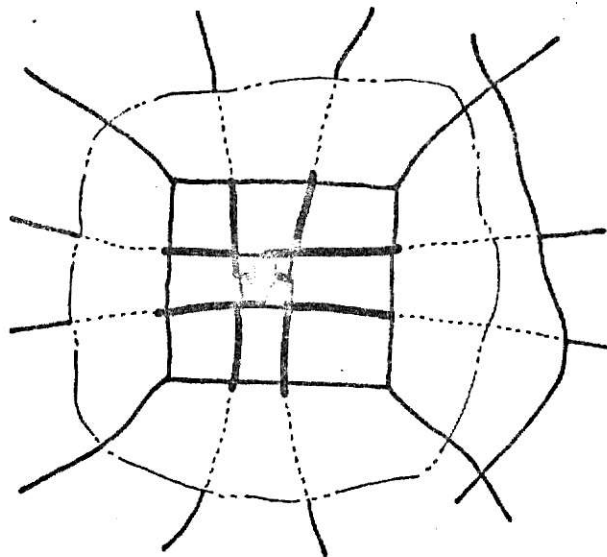
TRANSPORTATION MODELS DEVELOPED  
ON THE BASIS OF THE FORM "#"





BUS-WAYS THROUGH HIGH DENSITY AREA

- Exclusive bus-way
- - - Right of way
- Freeway
- - - Urban limit
- ▣ Central business district



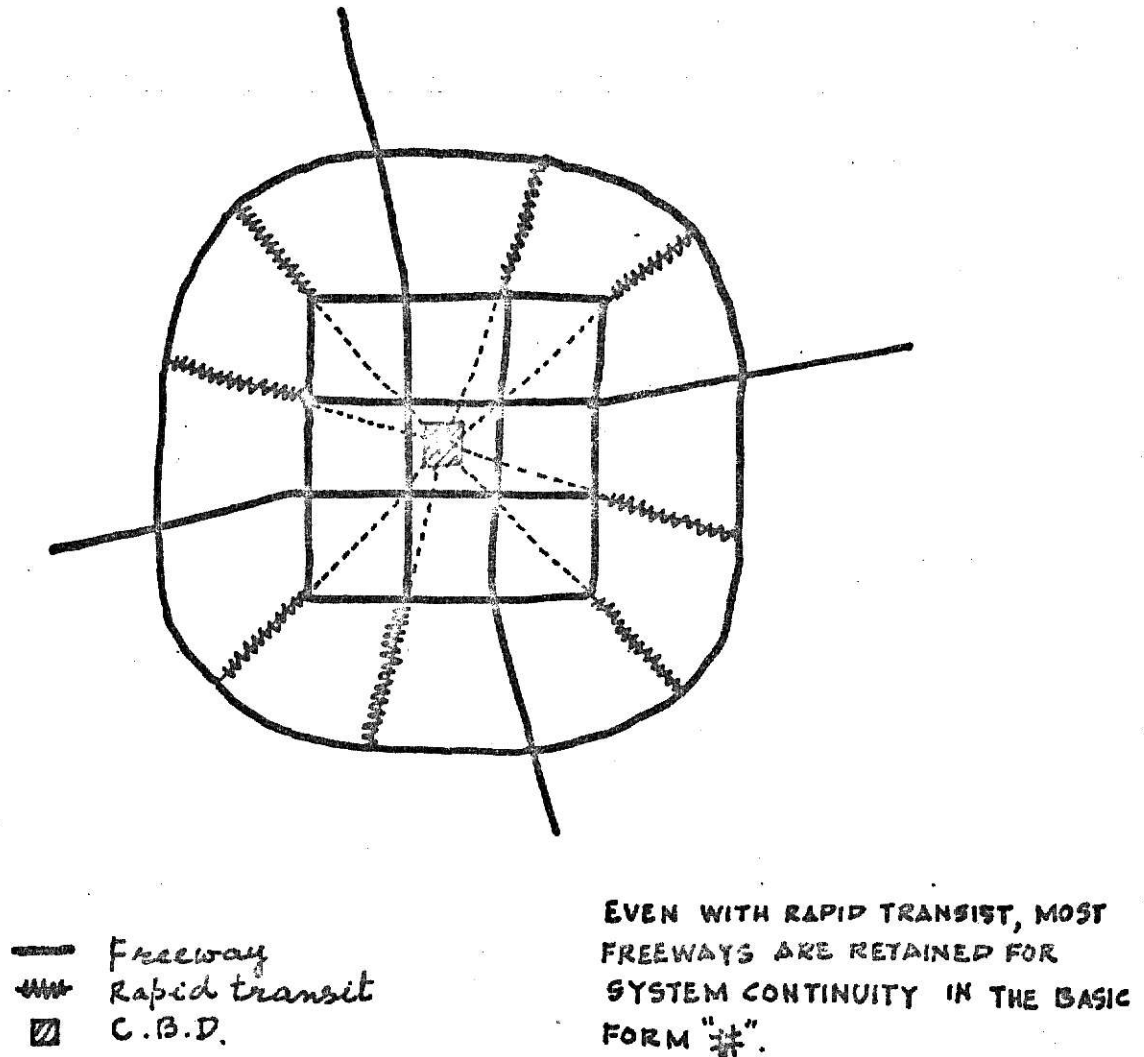
ALL BUS-WAYS ALONG FREEWAYS

Graphic: 32

## CONFIGURATION OF HYPOTHETICAL BUS RAPID TRANSIS SYSTEM

SOURCE: WILBUR SMITH AND ASSOCIATES, "TRANSPORTATION  
AND PARKING FOR TOMORROW'S CITIES" P. 218





Graphic: 33

POSSIBLE INTER-MODEL SUBSTITUTABILITY  
 OF RAIL OR BUS RAPID TRANSIST FOR  
 FREEWAYS IN LARGE URBAN AREAS

SOURCE: WILBUR SMITH AND ASSOCIATES "TRANSPORTATION  
 AND PARKING FOR TOMORROW'S CITIES", P. 226.

- \* The traffic framework formed by the Form, is adoptable as an optimum one-way traffic system for regulating traffic and relieving congestion in and around the urban core.
- \* The Form facilitates the development of mass transportation and rapid transit systems in city design. Both these aspects of urban transportation planning are steeply gaining significance and are projected to dominate urban as well as regional traffic planning in the future.
- \* The Form facilitates the development of an hierarchy of streets in city planning. The set of apralled streets bringing in the regional traffic from regional routes, formulates the major arterial routes while the other set of parallel streets receiving the regional traffic from major arterials, become minor arterials or collector streets. Local streets are linked to these collector streets.
- \* The street system resulted by the Form, also facilitates the designation of routes for mass public transportation, as such transportation may be along the minor arterials thus preventing conflict with fast through traffic on major arterial routes which run prependicular to the proposed public transportation routes.
- \* The concentric arrangement of spaces resulted by the application of the Form, promotes intense intimacy and social interaction among those using the design area.

Demerits:

- \* The street system produced by the Form, offers short-cut routes for the inter-city traffic, encouraging such traffic to pass through the community thus endangering safety and producing adverse environment in the community.

- \* In the spatial organization resulted by the application of the Form, the traffic routes rigidly isolate the central space from the peripheral spaces thus adversely affecting the intimacy and harmony in the overall design.

#### B. Derivation of the 'Unit':

An optimum unit for proposed Unit-Matrix System of urban design may be derived from the basic form "#", whose values and virtues in terms of urban design are established earlier. For this reason, the Form should be modified or reformed in such a way that its demerits as a basic unit of urban development, are nullified while its merits are retained and possible enhanced. This modified or reformed form would then serve as the optimum unit for the unit-matrix system approach in urban design. In order to achieve this, the basic form "#" should be put to minimum alterations required to eliminate its demerits, so that its merits are not considerably effected by it. Thus, to modify the basic Form for achieving the desired affects, it should be considered and conceived in the limelight of its each demerit and then be operated upon and remedied accordingly.

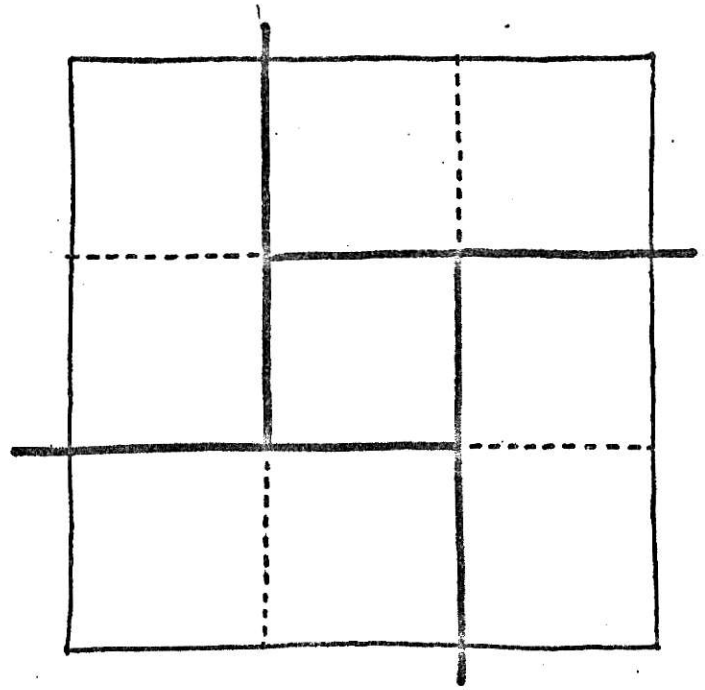
The various demerits or shortcomings of the Form, determined on the basis of its perceptual, spatial and functional aspects, may be summed up as follows:

- \* The basic form being identical about its both horizontal and vertical axis, formulates a rigid symmetry comprised of straight lines and so the spatial designs conceived on the basis of this form, are too static to considerably stimulate human perception.
- \* In the spatial organization resulted by the basic form, the linear spaces comparable to streams, appear to by-pass the central vast open space

comparable to lake. Such an arrangement appears to be unreal and unnatural, and fails to divert and direct the attention of the commuters on the linear paths, towards the central space which is also supposedly the focal space in the design.

- \* The through routes by-passing the central space, create a feeling of emptiness for commuters as there is nothing at the far ends of these routes to attract, arrest, and divert the vision and attention of these commuters.
- \* The traffic routes by-passing the central space, formulate rigid barriers which isolate the central common place from the peripheral spaces. This in turn adversely effects the intimacy and environment of the total design.
- \* The street system resulted by the basic form, offers short-cut routes for inter-community traffic encouraging such traffic to pass through the community thereby endangering the health, safety, and welfare in the design area.

In order to nullify the first of the above demerits of the basic form, the Form may be conceived as being made up of tangible and untangible alternating each other. The tangible lines would form the backbone of the design of the spatial entity, while untangible lines may either be totally eliminated or may be conceived as unsolid or invisible lines playing only secondary role. Thus the rigid axial symmetry of the basic Form would be nullified, and it would attain the desired dynamic character. The reformed unit thus resulted would be " ". The new unit thus produced should be analysed and tested in terms of other demerits of the basic Form. The remodelled unit also eliminates the second and third of the demerits. The linear open spaces formed by routes, no more by-pass the central open space but now terminate at this focal space, thus resulting in the development of optimum psychological,



- SPACE BINDING LINES
- TANGIBLE LINES
- NON-TANGIBLE LINES

Graphic: 34

DERIVATION OF THE 'UNIT' FOR URBAN  
DEVELOPMENT FROM THE FORM '#'

physical, and social environment. Also the major routes formed by the tangible lines in the new unit, may no more end in drab hollowness but can be made to terminate at major structures or areas in the design, forming picturesque vistas in the process. These structures formulating visual barriers, arrest the commuter's view, diverting it towards the centralised focal space in the design.

In the reformed unit, the fourth demerit of the basic Form is also nullified to a great extent. The termination of major routes on the periphery of the central open space greatly enhances its location and promotes its intensive utilization. Such an arrangement somewhat eliminates the isolation of the central space and makes it an harmonically integrated part of the overall spacial design. The further encasing of the central space by means of the blocked routes, enhances the intimacy and socialization of the central space.

The modified unit also eliminates the fifth and last of the demerits of the basic Form. The elimination of through routes prevents unnecessary passage of traffic through the design area. The design area would contain only that traffic that originate or terminate at it. Thus the reformation of the basic Form in the suggested manner eliminates all of its demerits in terms of urban design. In addition, the derived unit also possesses the following additional merits as compared to the original form:

- \* The cumulative length of the streets is reduced by about one third in the modified Form which makes the reformed unit more economical and also results in larger traffic-free spaces.
- \* The 'cross' traffic intersections of the original form are reduced to 'T'

## PSYCHOLOGICAL

THE UNIT ACQUIRES DYNAMIC BUT BALANCED CHARACTERSTIC INSTEAD OF RIGIDITY AND DRABNESS OF THE SYMMETRY OF THE ORIGINAL FORM.

## ECONOMICAL

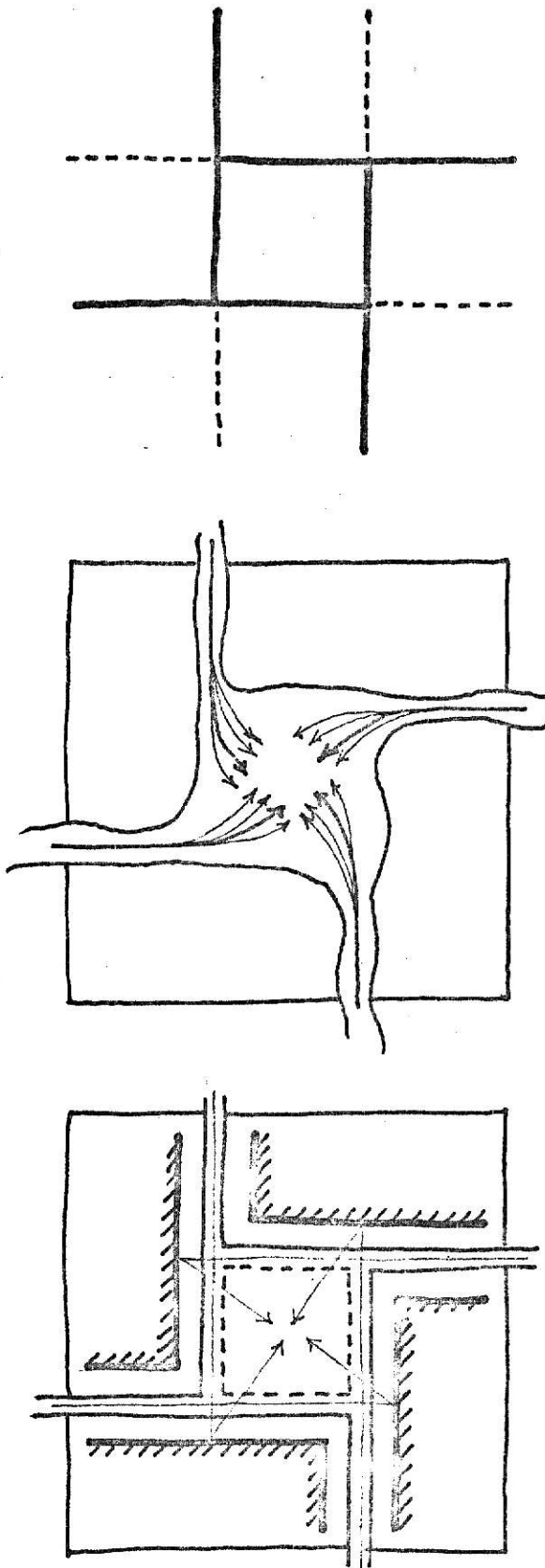
TOTAL LENGTH OF STREETS IS REDUCED BY  $\frac{1}{3}$ RD. WHICH MAKES THE UNIT COMPARATIVELY ECONOMICAL

## ENVIRONMENTAL

LINEAR SPACES FLOW INTO THE CENTRAL SPACE INSTEAD OF BYPASSING IT AS WAS IN THE CASE OF THE ORIGINAL FORM. THIS FURTHER ENHANCES THE INTIMACY OF THE CENTRAL SPACE

## KINESTHETICAL

THE DEAD ENDS OF THE STREETS, ARREST AND DIVERT VISION TO THE CENTRAL SPACE, THEREBY REMOVING THE FEELING OF EMPTINESS CREATED BY THROUGH STREETS IN THE ORIGINAL FORM



Graphic: 35

MERITS OF THE DERIVED UNIT OVER  
THE ORIGINAL FORM "H"

junctions in the reformed form, which are safer as these keep the traffic speed under check.

The reformed form, with all the merits of the original form "#", as well as with some additional merits but without the demerits of the original form, should formulate the optimum unit for the proposed unit-matrix system of urban design.



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4. Ibid. PP. 188-189.
5. Zucker, Paul, "Town and Square", P. 6.
6. Ibid, P. 2.
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8. Ibid, P. 218.
9. Ibid, P. 226.

#### IV. APPLICATION OF "UNIT" AS "MATRIX"

The modular form which is established as optimum 'unit', should be tested for its appropriateness and adoptability as a means and matrix of spatial development in urban design. In order to facilitate this, the unit may be applied and evaluated as a matrix of spatial organization for designing the following entities which formulate the heirarical order of urban spaces:

- (a) Dwelling
- (b) Cluster
- (c) Neighborhood
- (d) Community.

The above elements, although compete as spatial entities, are also integral components of the total urban environment. The evaluation of 'unit-matrix' system in the design of these urban entities should provide basis for establishing rationality or irrationality of the system as an optimum mean of urban design.

- (a) Dwelling:- Human dwelling is conceivable as the smallest element of city design. It is a complex composition in space, formulated by harmonic integration of enclosed and open spaces to produce optimum environment for family living.

Human dwellings are primarily of two types: (i)Single-family dwelling, and (ii) Multi-family dwelling. Spatial organizational concept varies considerably for each of these types and hence the unit should be tested as matrix of design separately for both these types of dwellings.

##### Single-family Dwelling:

The unit in case of Single-family dwelling, should be conceived as two separate but inter-related matrixes. One, as a matrix of site planning to facilitate optimum location for the built-up structure and organizing various functional

open spaces around the structure, and second as a matrix within the first matrix for organizing various functional spaces in the built-up structure, into an organic and efficient relationship.

As Matrix of Site Planning:- The lot or site for a single-family dwelling should be conceived as comprised of a number of functional spaces or zones, in order to promote maximum utilization of the land. The various such zones in which a single-family dwelling site may be divided are:

- \* **Reception Zone:** This is the zone which conceptually receives the households as well as guests coming to the dwelling lot from outside. This is primarily the area lying in between the principal structure and the public accessibility route. This space formulates the front yard, forming foreground for the main structure. The zone itself is comprised of two sub-areas: the paved areas in the form of driveway and paths, and the landscaped area. This zone provides the desired transition between the public street and the private dwelling. The space is intended to create favorable visual perception and impression by providing such elements as fountain, pool, sculpture, etc. This zone, as a secondary function, also supplements and enhances the aesthetics of the principal structure.
- \* This is the zone in which the outdoor group activities of the family members and their guests are concentrated. Such activities include family functions, outdoor dining, swimming pool etc. This zone is also divisible into two sub-areas, namely, the outdoor dining area and the swimming pool area. This zone corresponds and supplements the activities and environment of the living-dining area in the dwelling structure.

- \* Built-up Zone: This is the zone on which the dwelling structure housing the indoor activities of the family and its guests, is situated. This is the most significant of all the zones on the lot as it corresponds to the total activities of the family and its overall environment.
- \* Working Zone: This is the zone in which the working of the family members in general and housewife in particular is confined. Such activities include gardening, drying of washed clothes, and infants toddling. The zone corresponds and supplement the service areas in the dwelling structure. This zone is also comprised of two sub-areas: (i) drying-yard corresponding to the utility room, and (ii) kitchen garden corresponding to the kitchen.
- \* Private Living Zone: This is the zone intended for individual or private living of the family members. The zone corresponds and supplements the bed rooms in the dwelling structure. In many tropical countries of Asia and Africa, this zone formulates the outdoor sleeping area. The zone is also divisible into two sub-areas: (i) parents outdoor living area corresponding and supplementing the master bed room, and (ii) children outdoor living area corresponding to children bed room.

The Unit as matrix facilitates the organization of the above zones into a balanced, organic and functional relationship. The 'Built-up Zone' being the most significant one, should occupy the central panel of the Unit. The 'Reception Zone' and the 'Working Zone' should occupy the front and rear panels respectively, in correspondence with their functions. The 'Collective Living Zone' and the 'Individual Living Zone' should be in the side panels on opposite sides of the principal structure, due to their divergent characteristics.

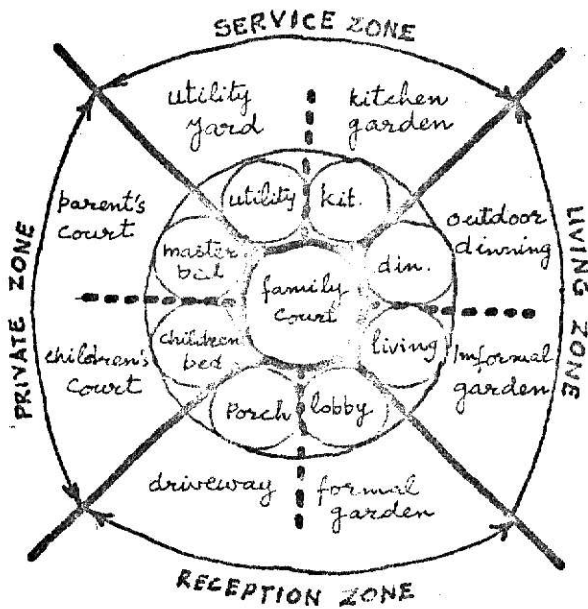
The sub-spaces created by the intangible lines in the peripheral panels of the Unit, corresponds with sub-functional areas of the zones occupying these panels. Thus the Unit formulates an excellent matrix for optimum organization of spaces on a single-family dwelling lot.

As Matrix of Spatial Organization within the Dwelling Structure:- The spatial concept of a single-family dwelling may be conceived as oriented around its basic function namely "family living", which may be either in the form of a family room as is generally the case in Western Countries, or may be in the form of an internal courtyard which is characteristic of the dwellings in the Oriental and Tropical Countries. Obviously, the "family living" space should formulate the nucleus of spatial organization within the dwelling structure. Two of the other functional spaces in the human dwelling are such that they are predominantly activated during only part of the 24 hours day-night period. Such spaces may be categorized as the 'day-time activated space' and the 'night-time activated space'. 'Day-time activated space' is primarily the living-dining area of the dwelling, in which the activities of the family members are concentrated during day-time only. 'Night-time activated space' is primarily the sleeping or private area of the dwelling to which the family activities shift at night. These profusely but divergently activated spaces should be on opposite sides of the nucleus space, namely 'family room' or 'interior court', in order to facilitate balanced distribution of spatial functions within the dwelling. The other two functional spatial entities within the framework of a dwelling are: the 'service area' comprised of utility room and kitchen, and the 'entrance area' comprised of porch and entrance lobby. These spaces are only passively activated but otherwise serve around the clock.

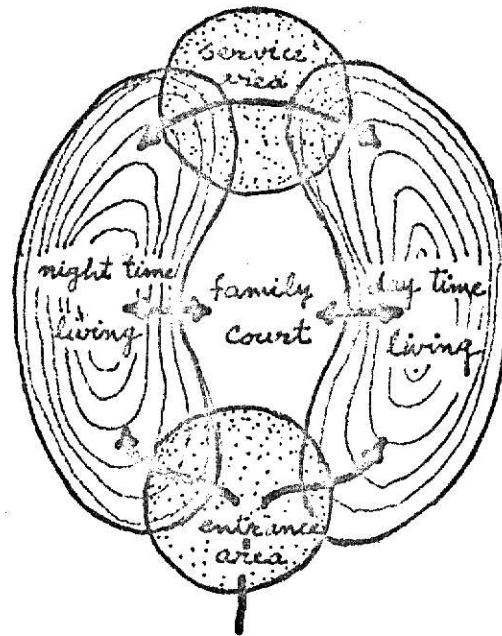
These passive spaces should lie inbetween the actively activated spaces, namely 'day-time activated space' and 'night-time activated space', in order to provide a kind of transiction between these functionally divergent spaces. Such spatial concept would harmonically activate the whole built-up area, interweaving the various spatial entities into an organically functioal 'whole'.

Interpreting the established 'Unit' in the limelight of the spatial organizational concept of a dwelling, the central panel of the Unit should formulate the nucleus space, that is 'family room' or 'internal courtyard'. The day-time activated space comprised of two sub-areas 'living' and 'dining', should be in one side panel and the night-time activated space comprised of two sub-areas, the 'parents sleeping area' and the 'children sleeping area', be in the other side panel. The peripheral panel nearest to the street providing accessibility to the dwelling lot, should contain the entrance area primarily comprised of two sub-areas: the 'car porch' and the 'entrance lobby'. The other passively activated space, the service area comprised of sub-areas: the 'utility room' and the 'kitchen', should be in the far-side peripheral panel of the Unit. Thus the Unit formulates an optimum matrix functionally harmonic organization of spaces within the dwelling structure.

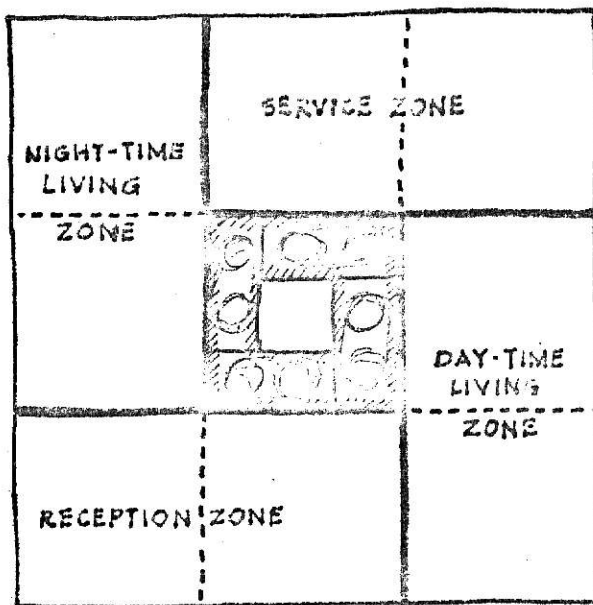
On the basis of interpretation and analysis of the application of the established unit in the design of a single-family dwelling, it may be concluded that the Unit as matrix of site planning as well as the matrix of spatial organization within the dwelling structure, facilitates the coresponding and inter-relating of open and enclosed spaces resulting in the evolution of the optimum environment.



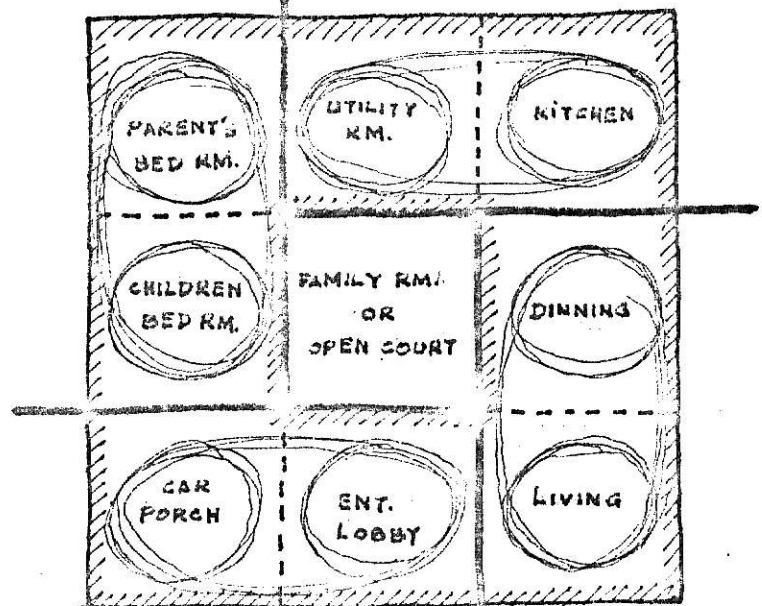
SPATIAL ORGANIZATION



DESIGN CONCEPT

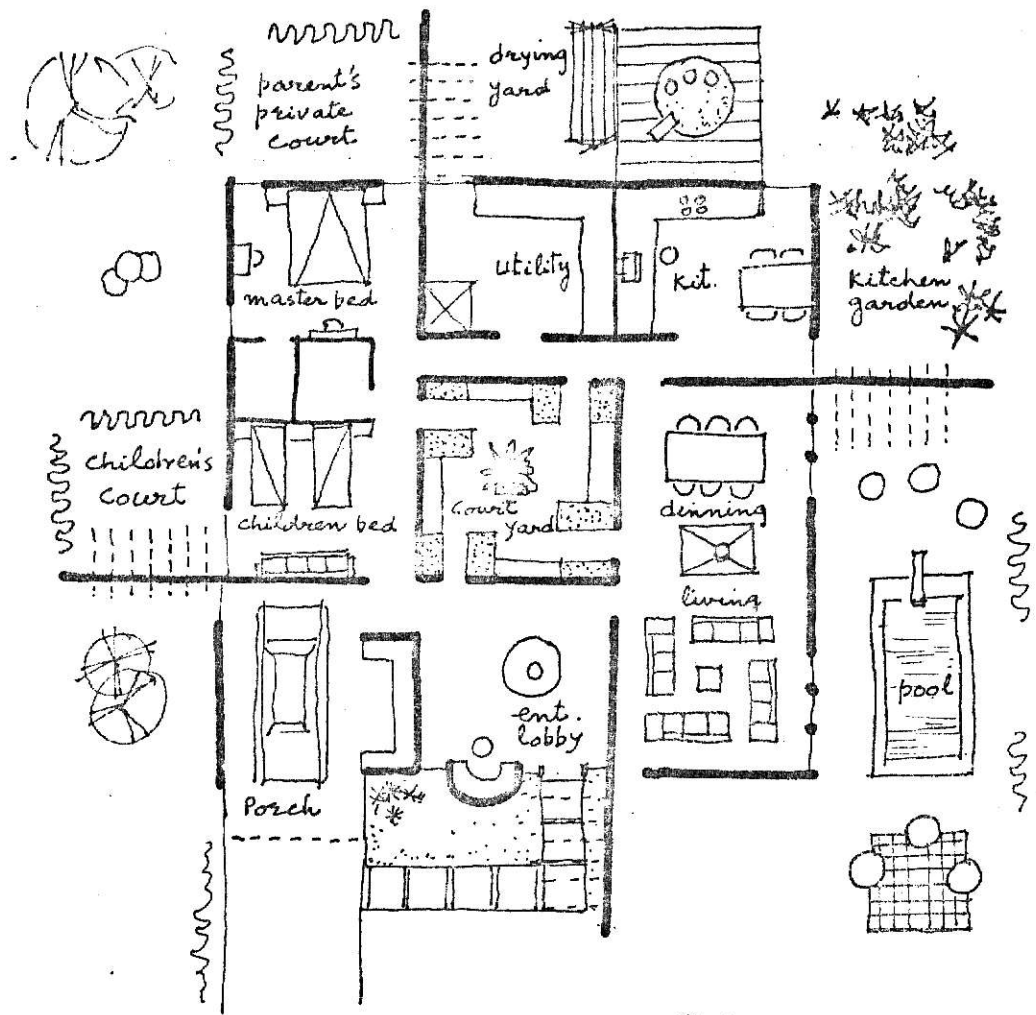


SITE PLANNING

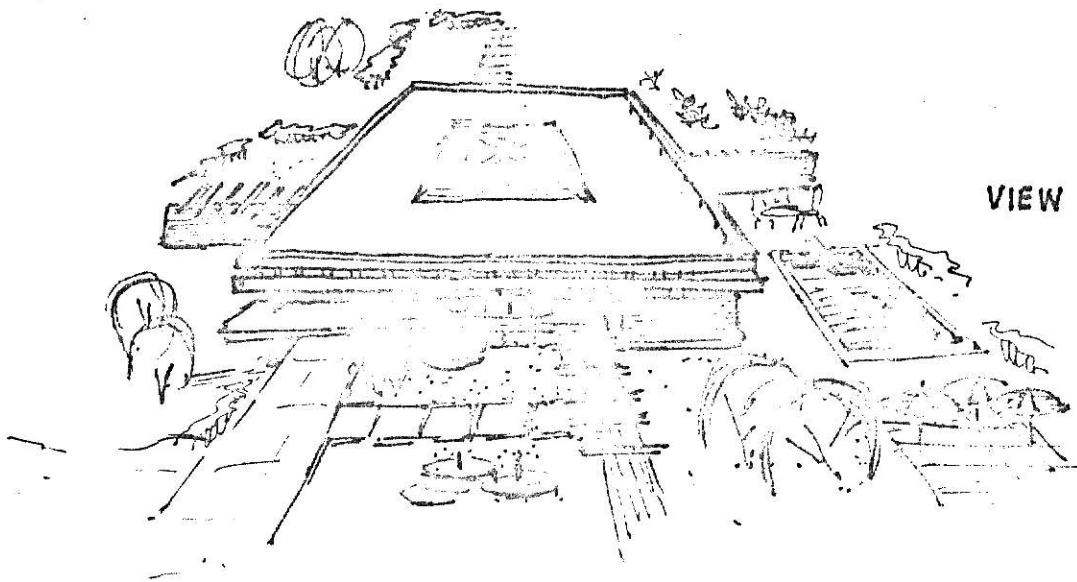
SPATIAL DEVELOPMENT WITHIN  
THE BUILT-UP AREA

Graphic: 36

# UNIT-MATRIX SYSTEM AS APPLIED IN PLANNING A SINGLE FAMILY DWELLING



PLAN



VIEW

Graphic: 37

## DESIGN OF A SINGLE FAMILY DWELLING



### Arithmetic of Design Matrix:-

The unit-matrix whose qualitative virtues in dwelling design are found to be optimum, should next be reviewed to determine its quantitative values. For this purpose, the uni-matrix should be formulated as of definite size and scale so that it could be readily applied with only minimum variance needed to suit individual design needs. In order to facilitate this, the unit-matrix may be conceived as comprised of an optimum module and the sizes of the resulting functional spaces be compared and analysed with respect to general area standards for such spaces.

The module for the unit-matrix should be such that it is adoptable economically and without structural design complexity. Such maximum structural spans which can be spanned as simple one-way slab without adhering to beam construction, are in the vicinity of 12 ft. x 12 ft. Conceiving the unit-matrix as being comprised on a 12 ft. module, the sizes of the resultant functional spaces are:

Living-dining Area = 12' x 24', of which 12' x 12' may be the 'chat area' and 12' x 12' be the 'dining and fireplace area'.

Service Area = 12' x 24', of which 12' x 12' may be the kitchen and 12' x 12' be the utility room.

Sleeping Area = 12' x 24', of which 12' x 9' may be parents bedroom and 12' x 9' be the children bedroom, with 6' x 12' area for two toilets.

Family area or Interior Courtyard = 12' x 12'.

Entrance Area = 12' x 24', of which 12' x 12' may be the lobby and 12' x 12' be the porch. The porch, if required as carport, may be extended in the front yard.

The above areas are in general agreement with average areas for such spaces in practice. These areas are adjustable to specific individual requirement, by making subsequent minor adjustments in the sub-areas resulted by the application of the matrix. For example, in the 'service area', the kitchen size can be increased by correspondingly decreasing the size of the utility room. Similarly in the 'sleeping area', the size of the master bedroom and vice versa. Accepting the above areas of functional spaces as optimum, the size of the unit as matrix of single-family dwelling structure is conceived as 36' x 36'.

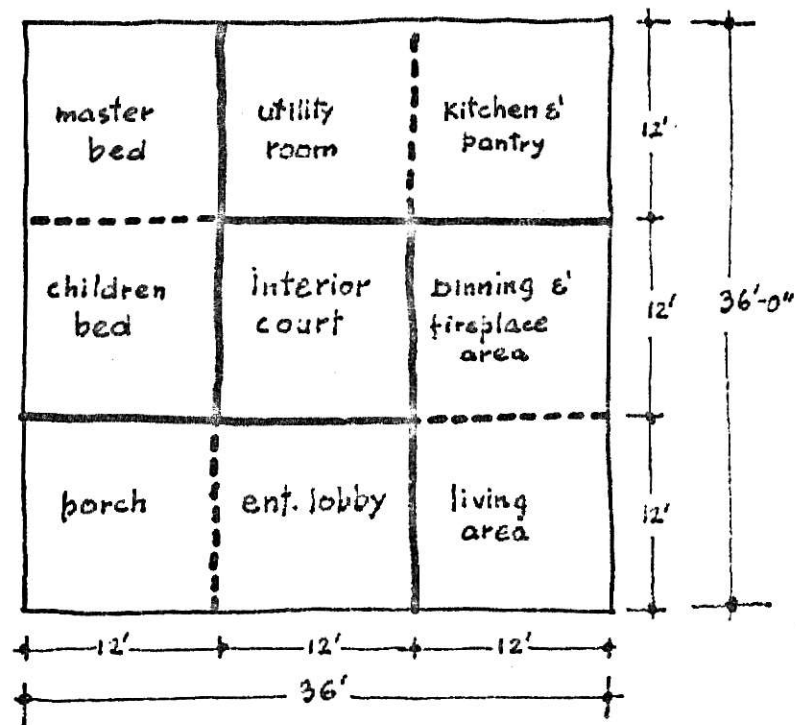
Assuming one module or 12' wide open space all around the principal structure, the lot size comes to be 60' x 60'. But for environmental and utilitarian reasons, more open space is generally desirable in front and rear of the dwelling structure than at its sides. In order to facilitate this, the open spaces in front and rear may each be increased by one module, making both front and rear yards as 24' wide each. These area sizes are conceivable as adequate for these spaces to fulfill their functions. On the basis of this increase in sizes of front and rear courts, the consequent lot size becomes 60' x 84' which may be considered as adequate for a single family of 3 to 5 persons.

On the basis of the above analysis, it may be concluded that the Unit formulates an optimum matrix for qualitative and quantitative organization of spaces in the design of a single-family dwelling. The matrix size for designing the built-up area or covered spaces is derived as 36' x 36' and for lot planning as 60' x 84'. Both these matrixes are based on a basic module of 12' x 12'.

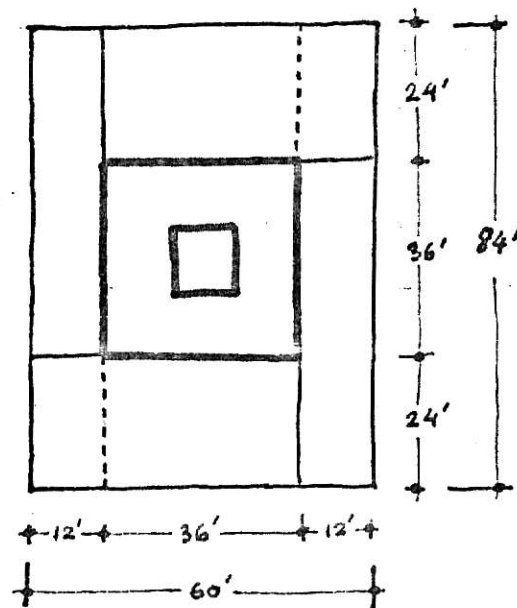
#### Multi-family Dwelling:-

Multi-family housing in the form of high rise point structures, generally

MATRIX OF DWELLING  
= 36' X 36'



MATRIX OF THE LOT  
= 60' X 84'



Graphic: 38

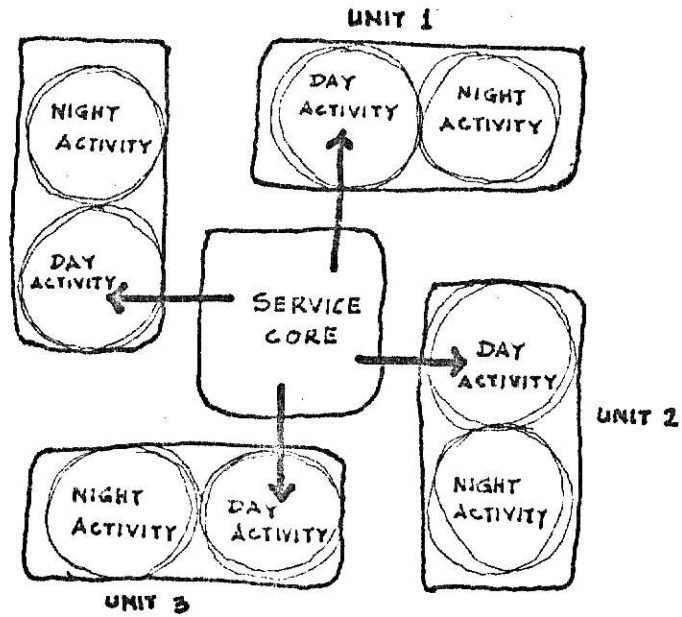
## ARITHMETIC OF UNIT-MATRIX FOR DESIGNING A SINGLE FAMILY DWELLING

derives maximum environmental values economically. Such residential structures are conceivable as optimum balance between economy and environment. Although there are only 4 to 8 dwelling units per floor in such structures, high degree of privacy is secured for these apartments and the dwellers enjoy a wide perspective of visual environment. In spatial concept of multi-family high rise point structures, the residential units are conceivable as organized around a service core consisting of staircase, elevators, pipe-shaft etc. This service area being in centralized location, is in position to economically serve and feed the residential units as service lines in such an arrangement are of minimum lengths. Conceiving and interpreting such an spatial arrangement in terms of the derived unit as the matrix of design, the central panel of the unit formulates the service core with one or two dwelling units in each of the four peripheral panels. Such an arrangement would result in independent physical and visual environment for each family living in the structure.

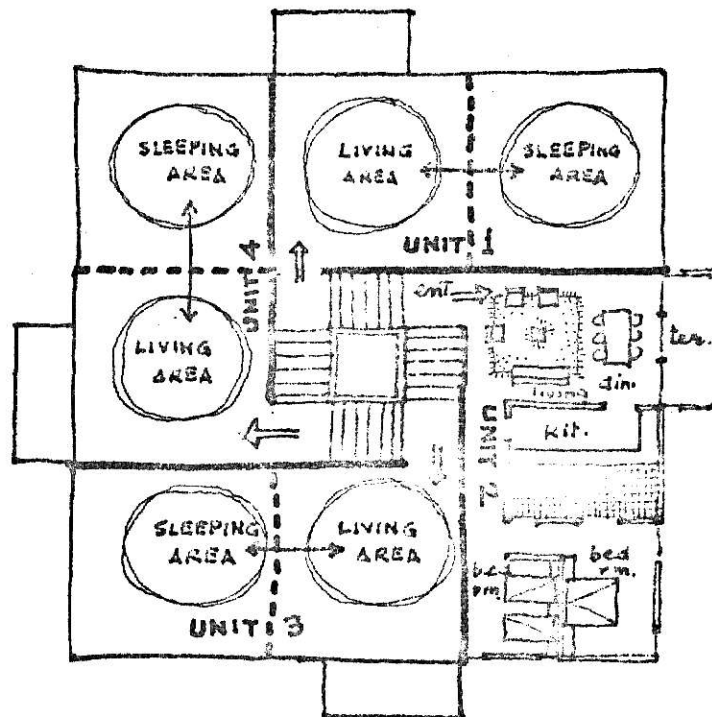
#### Arithmetic of Design:-

The adoption of the Unit as comprised of module 24' x 24', generally results in the evolution of functional spaces of sizes conceived as optimum earlier in the case of single-family dwelling. Also the service core of size 24' x 24' may be considered as adequate to carry out its functions efficiently.

The adoption of 24' x 24' grid for the Unit, results in a net area of 24' x 48' for each family. Of this about 24' x 24' is designated for day-time functions in the form of living cum dining room and kitchen, and the remaining 24' x 24' is allotted for night-time functions primarily comprised of bedrooms and toilets. Following is the further breakdown of resultant functional spaces:



SPATIAL ORGANIZATION



TYPICAL FLOOR PLAN

Graphic: 39

UNIT-MATRIX SYSTEM AS APPLIED IN THE DESIGN OF  
MULTI-FAMILY HOUSING

Living cum dining room = 12' x 24'

Kitchen = 12' x 12'

Storage and lobby = 12' x 12'

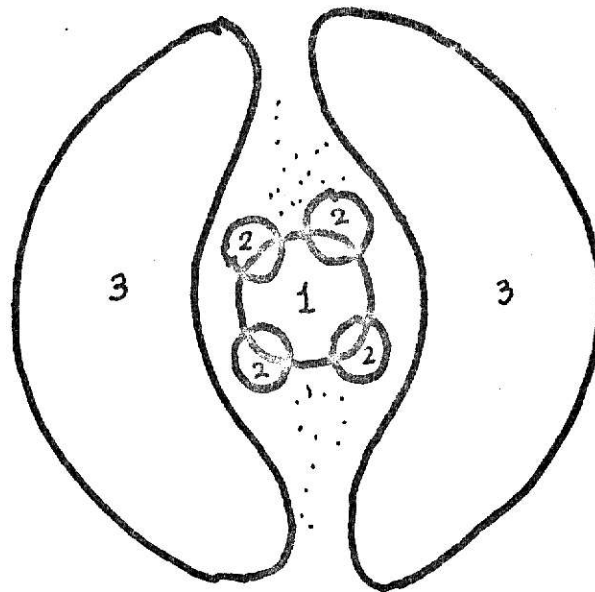
Toilets and dressing area = 10' x 20'

2 Bedrooms = 14' x 24' (each of about 12' x 14')

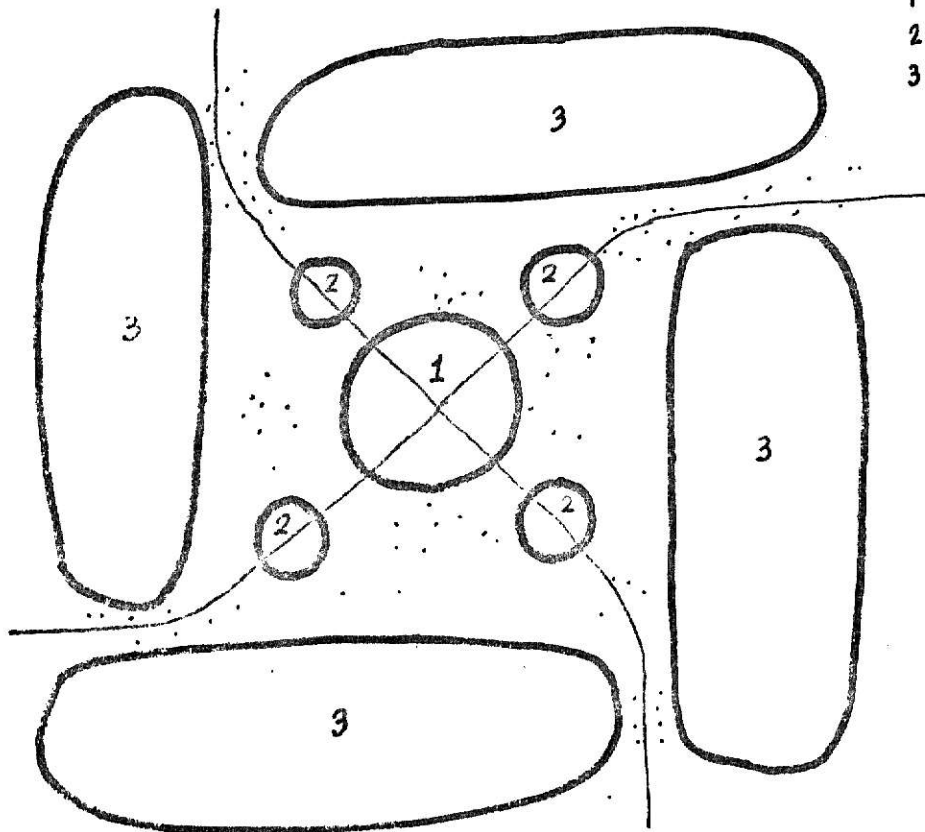
Reviewing the above sizes in the limelight of the general prevailing residential space standards, the above sizes are adjudged as adequate. Hence the unit-matrix for designing multi-family housing in the form of high rise point structures, is 72' x 72' comprised on a basic module of 24' x 24'.

- (b) Cluster:- Cluster is a group of dwellings oriented towards a common 'green'. The common green, apart from serving as tot-lot for children of the cluster and providing optimum visual environment, also promotes desirable social intimacy among the dwellers. Thus the common green should be conceived as not a mere void but as an active space which integrates the residents through a kind of socio-physical relationship, into a larger family. Thus the cluster is conceivable as the dwelling for a larger social family comprised on many families.

Applying the Unit as matrix for designing a cluster, the common green, which by means of its common service functions binds the whole cluster into a spatial entity, should formulate the central panel of the Unit with residential lots being contained in the four peripheral panels. The cluster may be encased by a local street, which should provide vehicular accessibility to the residential lots. Such an arrangement would release the common green as a traffic free zone. The accessibility and movement to and within the common green would be only by means of pedestrian paths.



SPATIAL CONCEPT

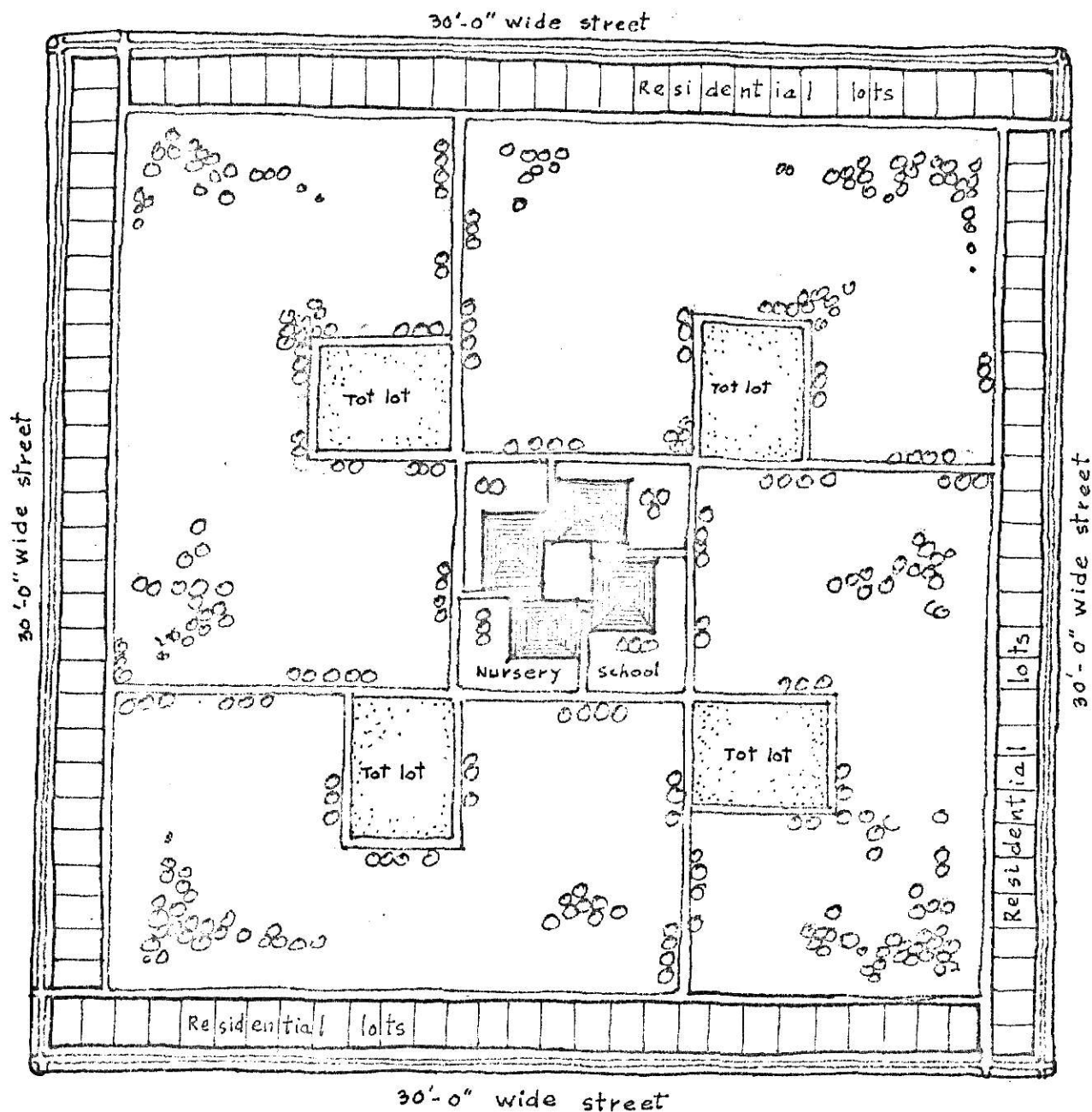


1 = NURSERY SCHOOL  
 2 = TOT LOT  
 3 = RESIDENTIAL LOTS

SPATIAL ORGANIZATION

Graphic: 40

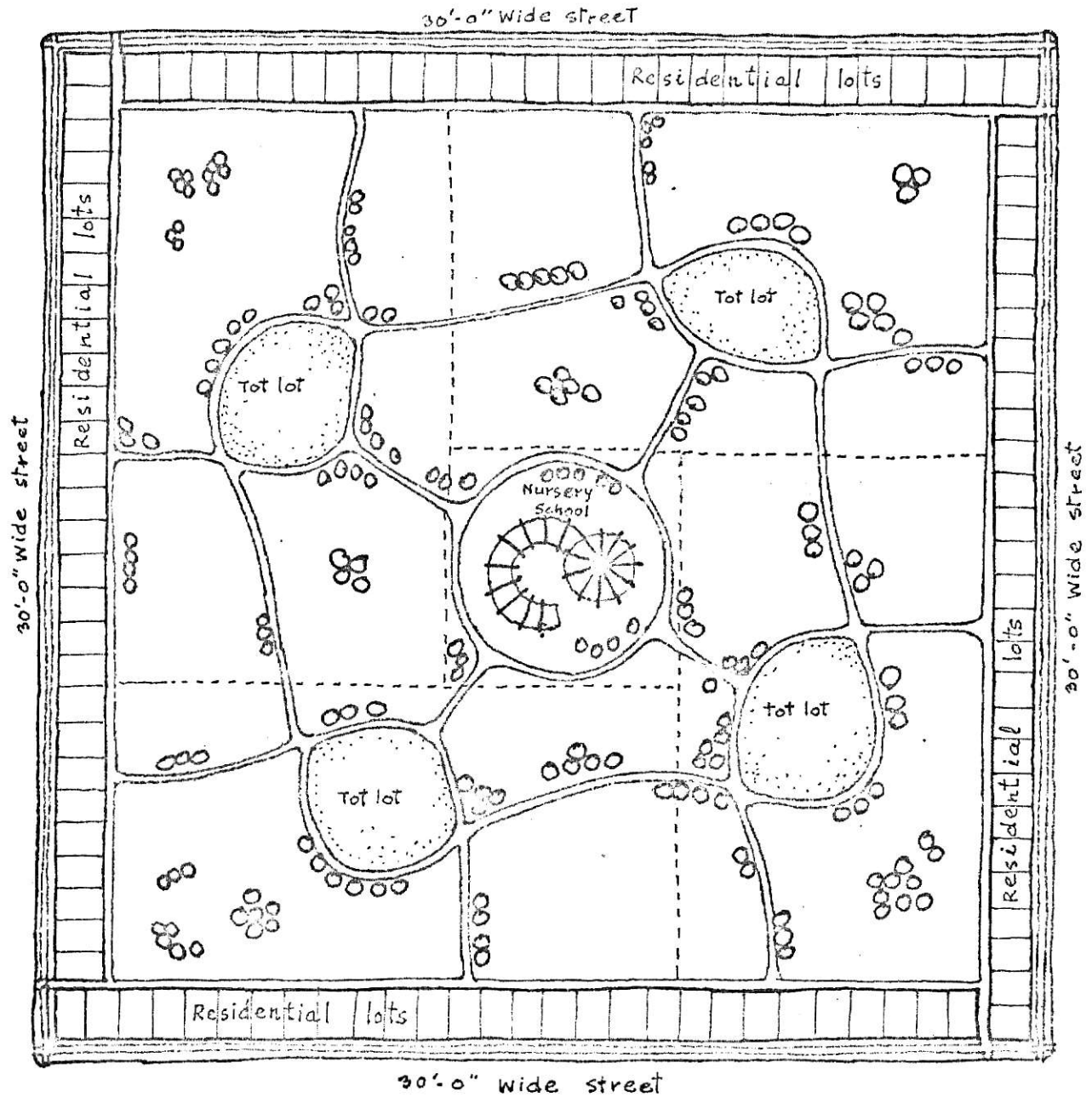
DERIVED 'UNIT' AS MATRIX OF CLUSTER DESIGN



Graphic: 41

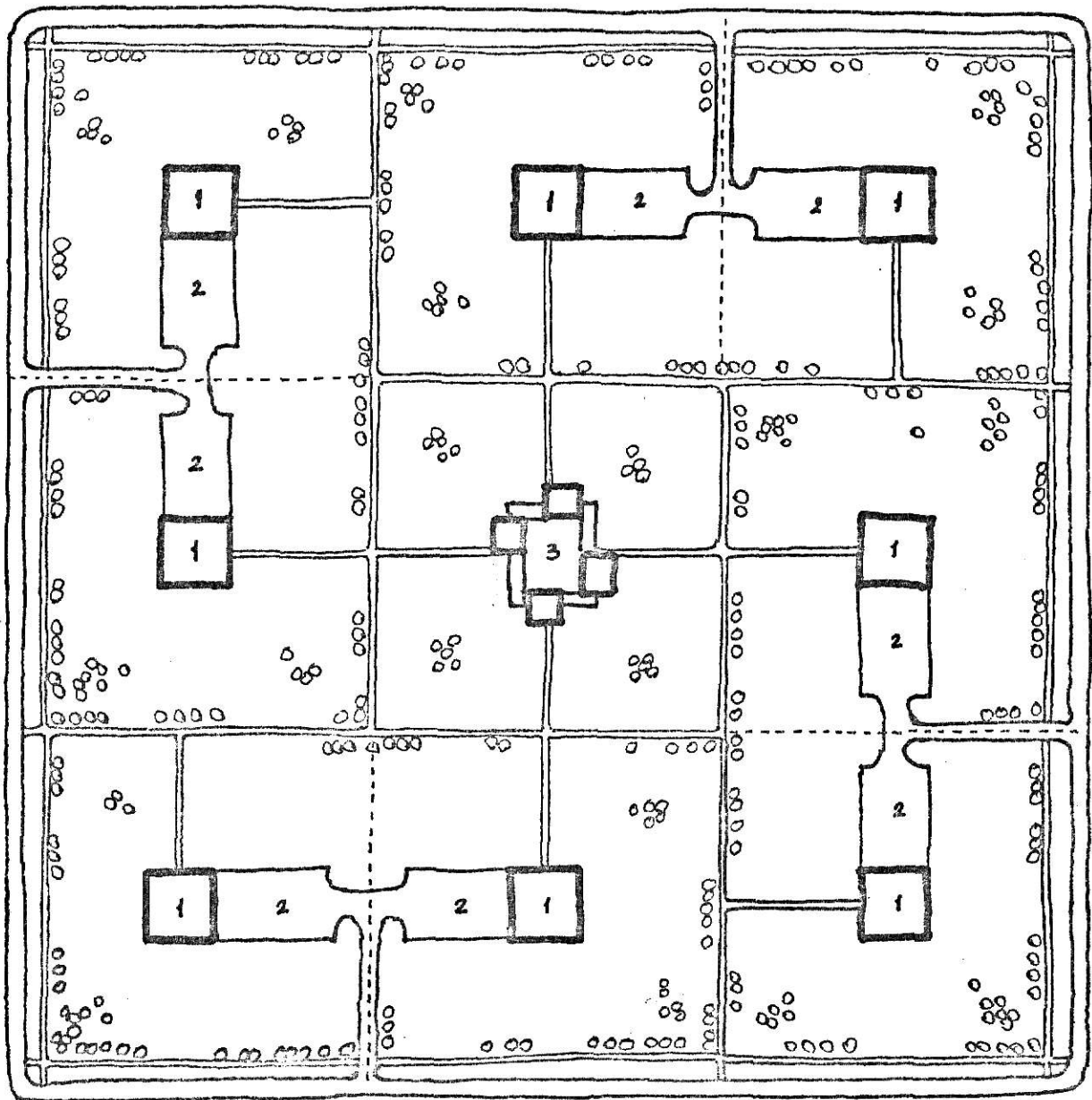
UNIT-MATRIX SYSTEM AS APPLIED IN THE DEVELOPMENT  
OF A FORMAL LAYOUT FOR A RESIDENTIAL CLUSTER





Graphic: 42

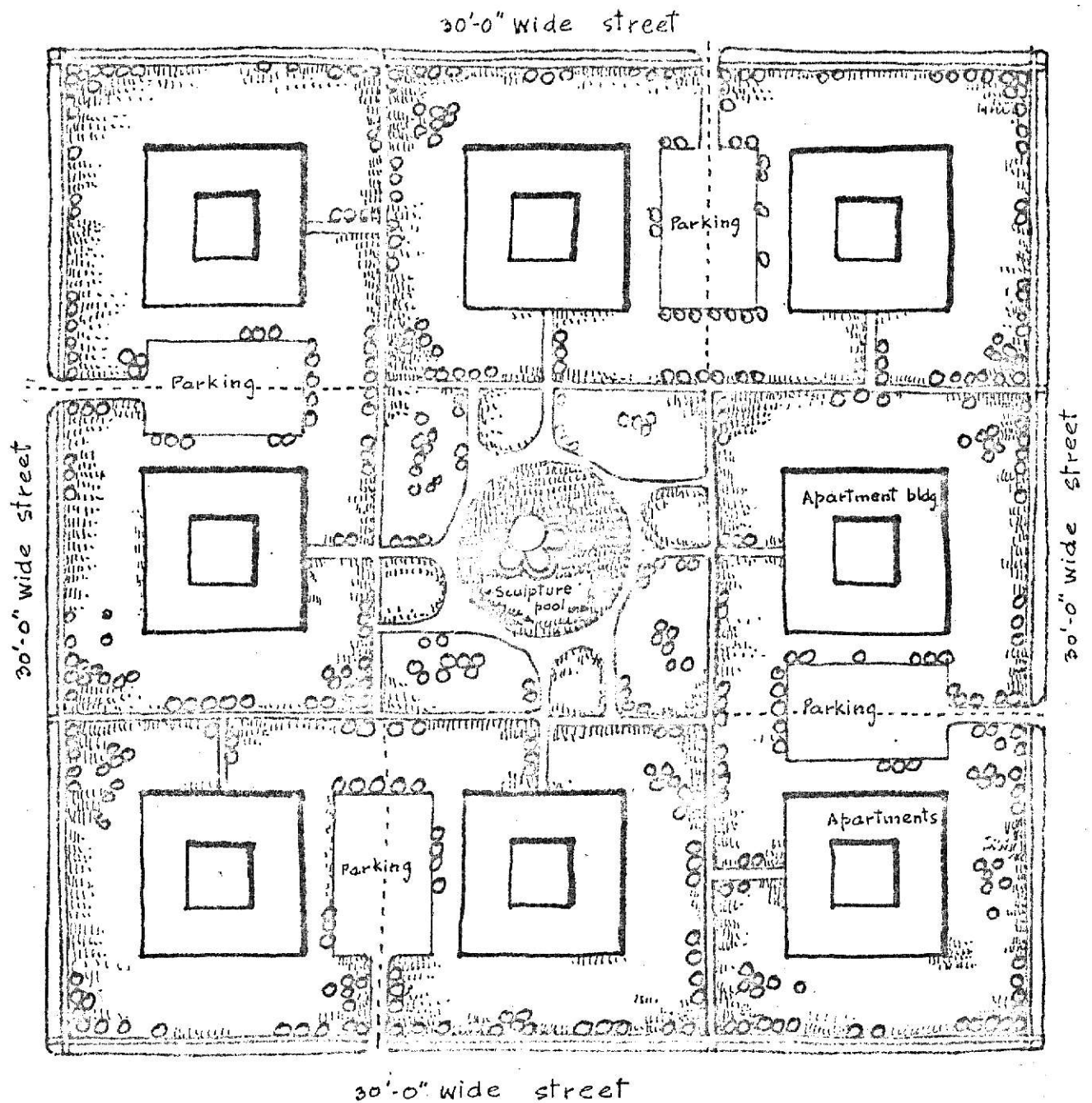
UNIT-MATRIX SYSTEM AS APPLIED IN THE DEVELOPMENT  
OF AN INFORMAL LAYOUT FOR A RESIDENTIAL CLUSTER



- 1. APARTMENT BUILDING
- 2. PARKING
- 3. NURSERY SCHOOL
- = PATHS
- == LOCAL STREET

Graphic: 43

## UNIT-MATRIX SYSTEM AS APPLIED IN THE DESIGN OF LAYOUT FOR AN APARTMENT CLUSTER



Graphic: 44

UNIT-MATRIX SYSTEM AS APPLIED IN THE DESIGN OF  
LAYOUT FOR AN APARTMENT CLUSTER

The Unit is also applicable as an optimum matrix for designing the common green. In case of a smaller cluster, the focal element of common green would be the tot-lot which maybe conceived as the central panel of the Unit, with peripheral panels designed for passive recreation. In case of a larger cluster, the focal element of the common green may be the nursery school or day-care center, which should be conceived as the central panel of the Unit. Also a cluster of such magnitude may have about 4 tot-lots which should be uniformly distributed in the 'green' to harmonically serve the residents. In order to facilitate this, the four tot-lots should be located in four peripheral panels in such a way that each of these panels has one tot-lot. The tot-lot should formulate the focal element in the design of each peripheral panel and should predominantly serve the respective wing of residential lots. Thus the Unit as matrix of cluster design, results in the evolution of an organic and functionally harmonic spatial organization.

Same design concept is also adoptable for achieving optimum designs for multi-family housing clusters. In such a case, the apartments would be in the peripheral panels with central panel of the Unit conceived as nursery school or tot-lot depending upon the size of the cluster.

#### Arithmetic of Design Matrix for Cluster:-

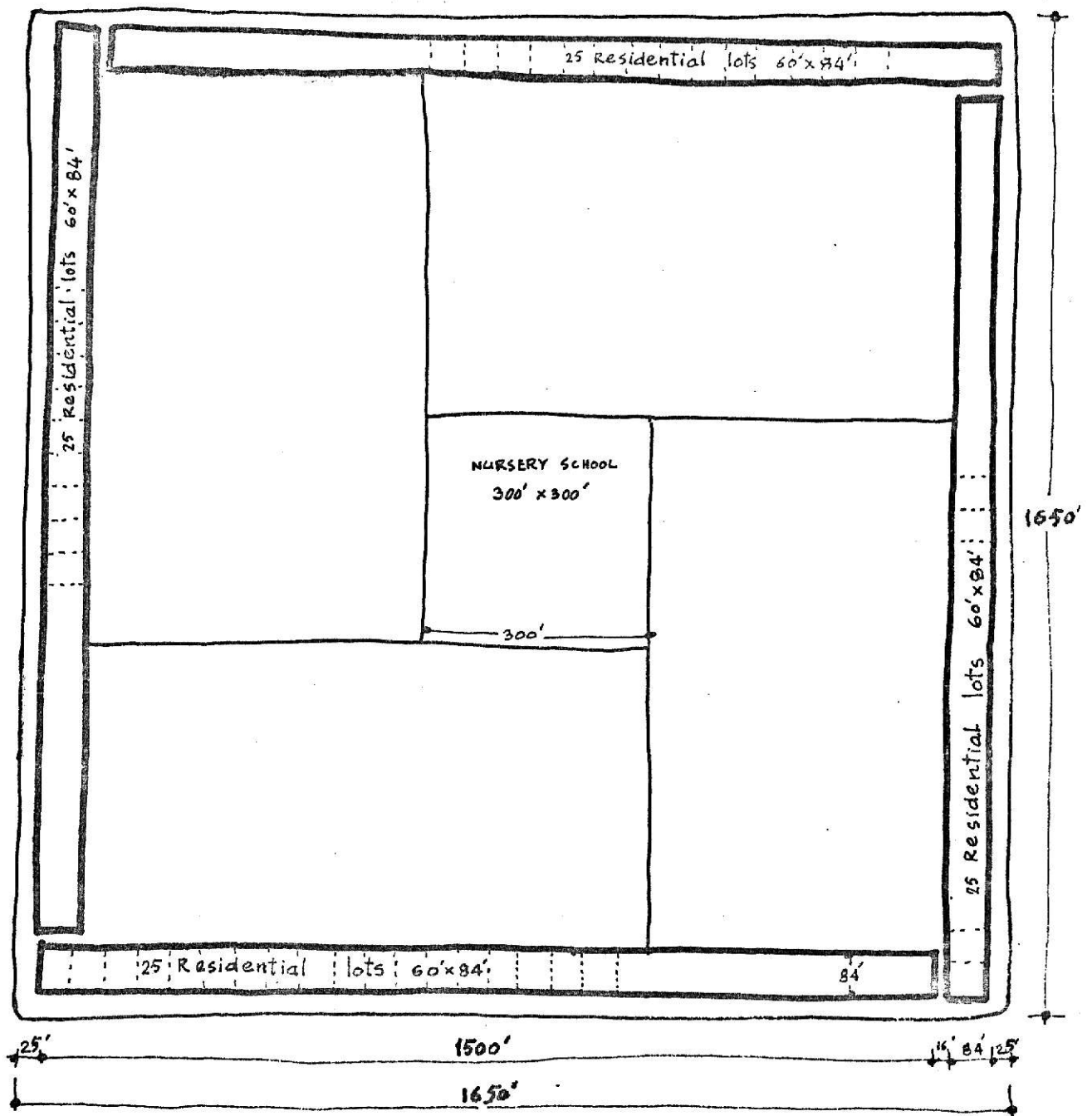
An optimum population size for a residential cluster may be conceived as that which should provide ample enrollment for a nursery school or day-care center. Conceiving that about 35 children are sufficient to support such a facility and one child out of every three families would be going to the facility, the optimum size of the cluster should be about 100 families or dwellings. Distributing these dwellings equally in the four peripheral panels of the unit-matrix, each of the panel would have about 25 dwellings. On the basis of the

previously established single-family dwelling lot size of about 60'x90', and making provisions for sidewalks, landscaping, streets, etc., the optimum cluster size for 100 families or about 450 to 500 people is determined as approximately 1650' x 1650'. This leads to a total area of the cluster as 6.25 acres and the residential density in the cluster as 16 dwelling units per acre. Such a density for single-family residential development, is generally professed as optimum by various planners and is in general accord with established planning standards.

Thus the optimum design matrix for a cluster of 100 families is derived as 1650' x 1650'.

- (c) Neighborhood:- Next significant element in urban hierarchy is the neighborhood unit, which is conceived as a socio-physical entity of a population size sufficient to provide enough enrollment for an elementary school. The basic daily services in a neighborhood unit are provided by its service center which is commonly known as the 'neighborhood center'. The basic elements of a neighborhood center are: elementary school, shopping facility, recreational area, and religious building or community hall. The location of the neighborhood center should be such that it harmonically serve the whole neighborhood on pedestrian scale.

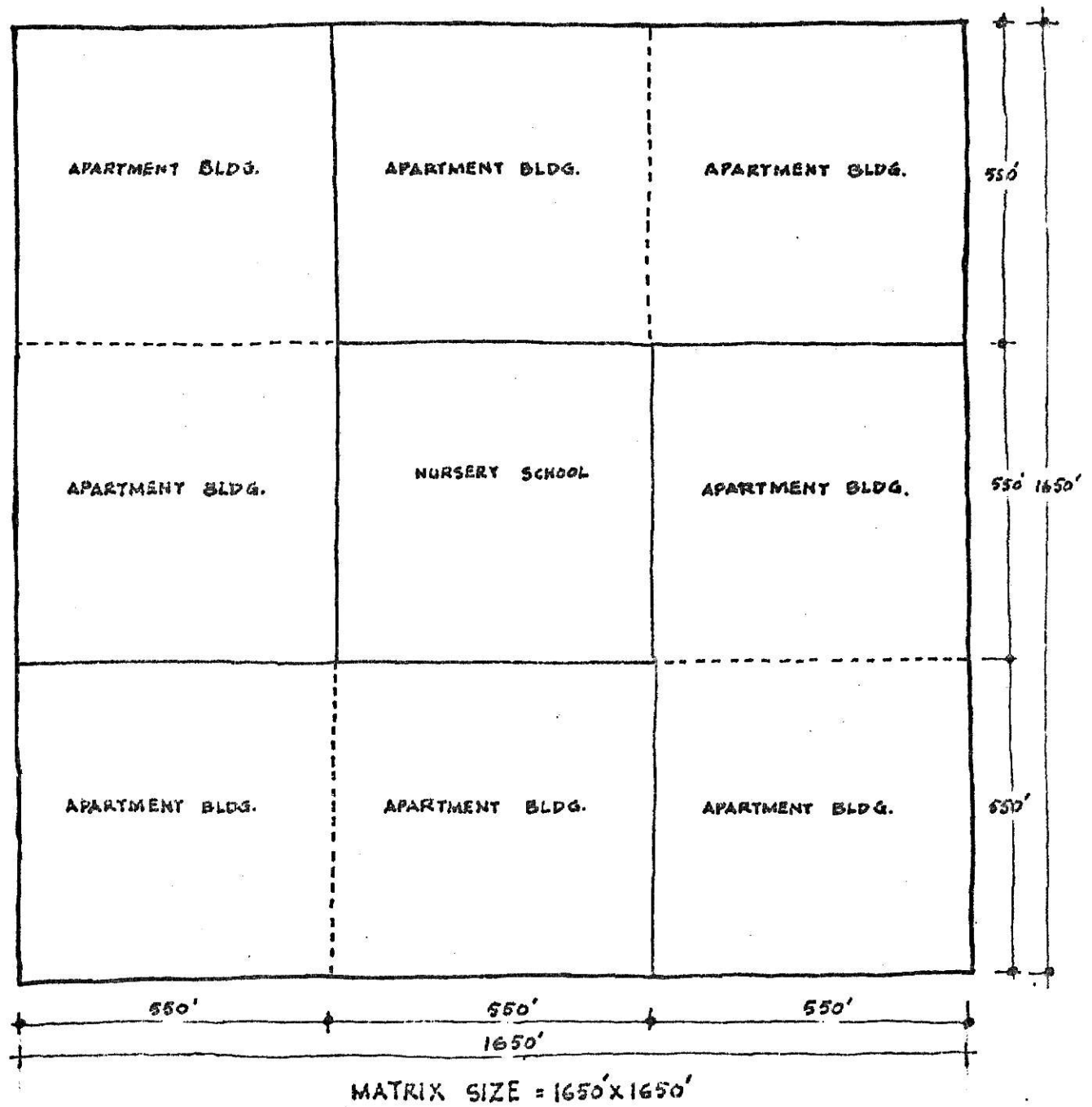
The population in a neighborhood unit is conceivable as being contained in clusters organised around the neighborhood center which spatially and functionally integrate the various comprising elements of the socio-physical entity into an organic relationship. Interpreting and conceiving the derived unit as matrix of neighborhood design, the central panel of the Unit should formulate the neighborhood center, with resident population distributed in



MATRIX SIZE = 1650' X 1650'

Graphic: 45

## ARITHMETIC OF UNIT-MATRIX FOR DESIGNING SINGLE FAMILY DWELLING CLUSTER



Graphic: 46

## ARITHMETIC OF UNIT-MATRIX FOR DESIGNING AN APARTMENT CLUSTER



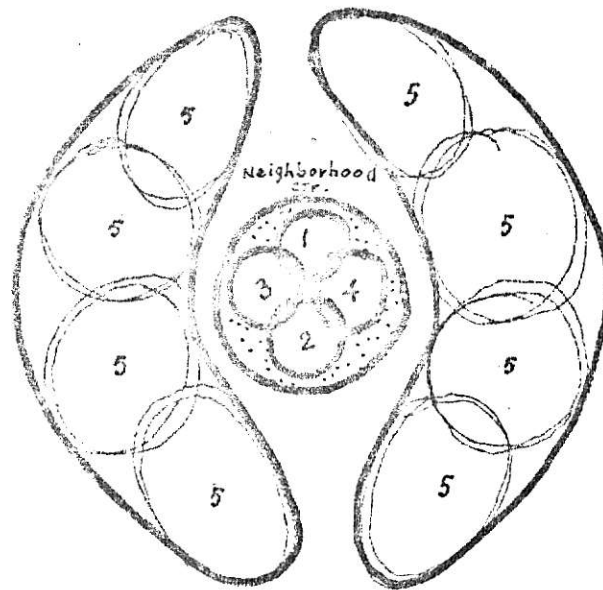
four peripheral panels. Thus each peripheral panel would contain about 1,000 persons in about 200 dwellings grouped as one or two clusters. Each peripheral panel should have one or two nursery schools depending upon the general age structure of households living in the neighborhood. These nursery schools should formulate the focal element in the design of the respective peripheral panels. Arterial streets should circumscribe the neighborhood with only Collector and Local streets serving within the spatial entity. Collector streets should provide accessibility to the clusters and the neighborhood center, with Local streets linking the dwellings with the Collector streets. The development of streets in such functional hierarchy would keep the through traffic off the neighborhood and should result in the attainment of high degree of functional efficiency, thus assuring general safety and welfare for the residents in the neighborhood.

The derived unit also formulates an optimum matrix for designing the neighborhood center. The four basic elements of the Center, namely; elementary school, shopping center, religious building, and recreation center or club are conceivable as being contained in the four peripheral panels of the Unit. The central panel should be in the form of a planned open space which should formulate the focal element in the design of the neighborhood center. This central open space should formulate the desired transition zone between functionally varied facilities, and should visually and perceptually bind these facilities together.

#### Arithmetic of Design Matrix for Neighborhood Unit:-

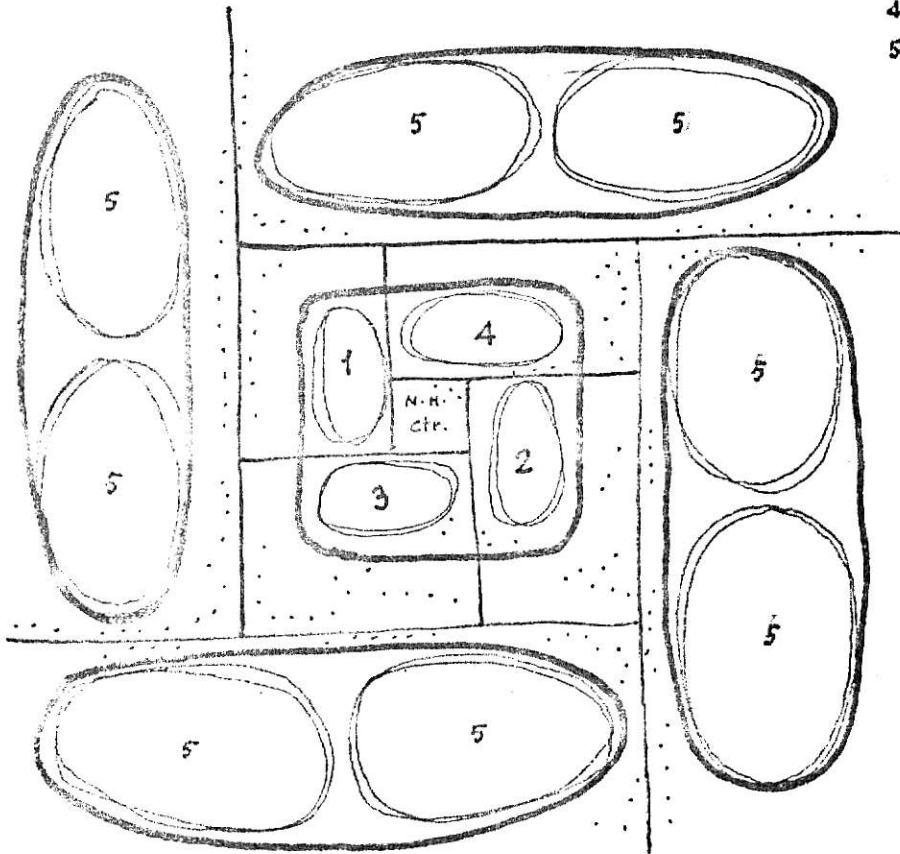
Conceiving the neighborhood unit as being comprised of eight clusters contained in the four peripheral panels of the Unit, and adopting the previously derived optimum size for each cluster of 100 dwellings and area 1650' x 1650'





SPATIAL CONCEPT

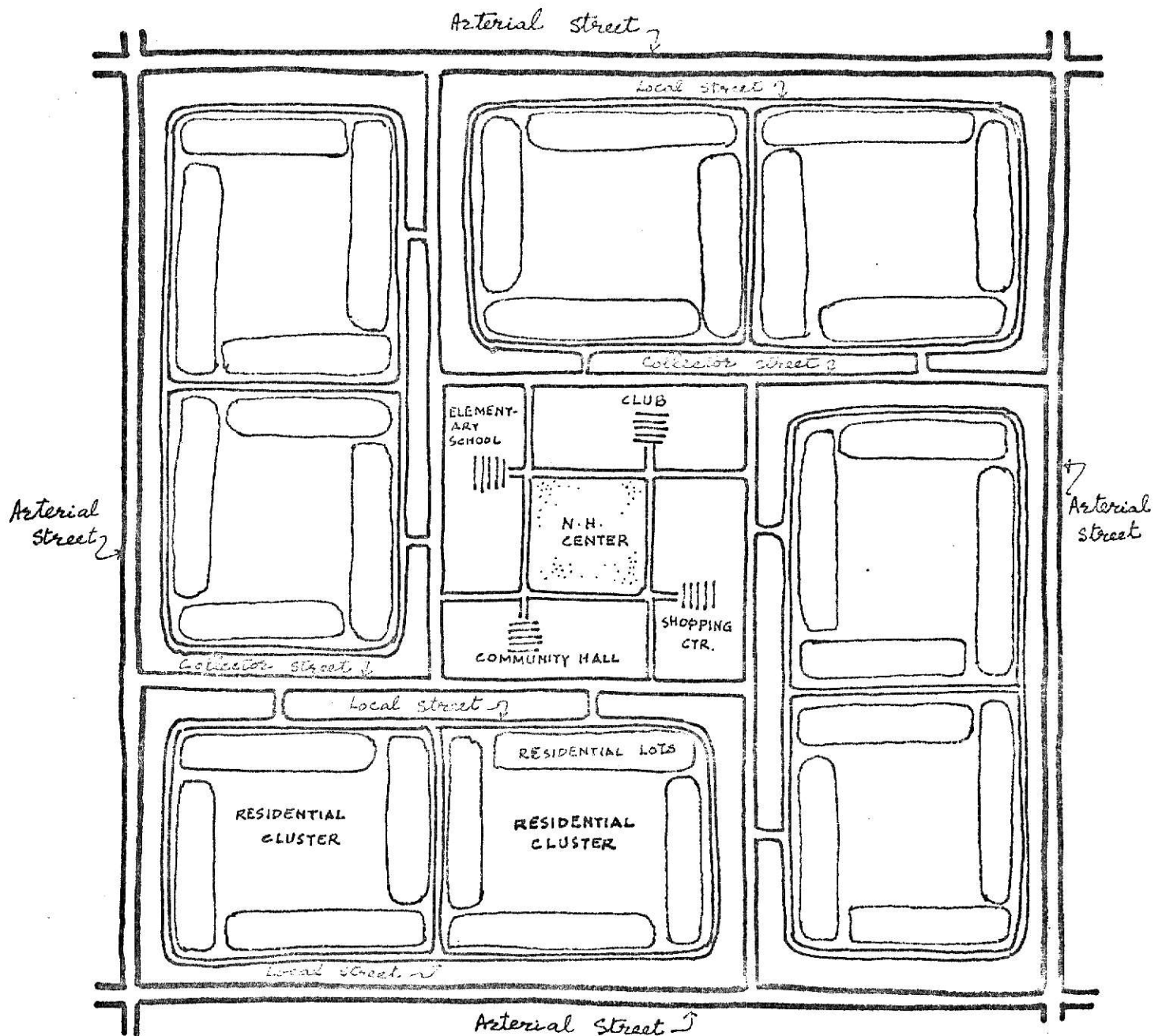
- 1 = ELEMENTARY SCHOOL
- 2 = N.H. SHOPPING
- 3 = COMMUNITY CTR.
- 4 = N.H. RECREATION AREA
- 5 = RESIDENTIAL CLUSTERS



SPATIAL ORGANIZATION

Graphic: 47

DERIVED 'UNIT' AS MATRIX OF  
NEIGHBORHOOD DESIGN



Graphic: 48

# NEIGHBORHOOD UNIT DEVELOPMENT ON THE BASIS OF THE UNIT-MATRIX SYSTEM

as basis, the size of the neighborhood unit is arrived as,  $(1650 \times 3)' \times (1650 \times 3)'$  or 1650 yds.  $\times$  1650 yds. Providing provision for streets, landscaping, etc., the size of the neighborhood is derived as 1700 yds.  $\times$  1700 yds. This being less than a mile square, the walking distance between the farthest point and the neighborhood center would be less than half mile and so is commutable on foot.

Number of dwellings in the neighborhood =  $4 \times (100 \times 2) = 800$ .

Neighborhood area = 639 acres.

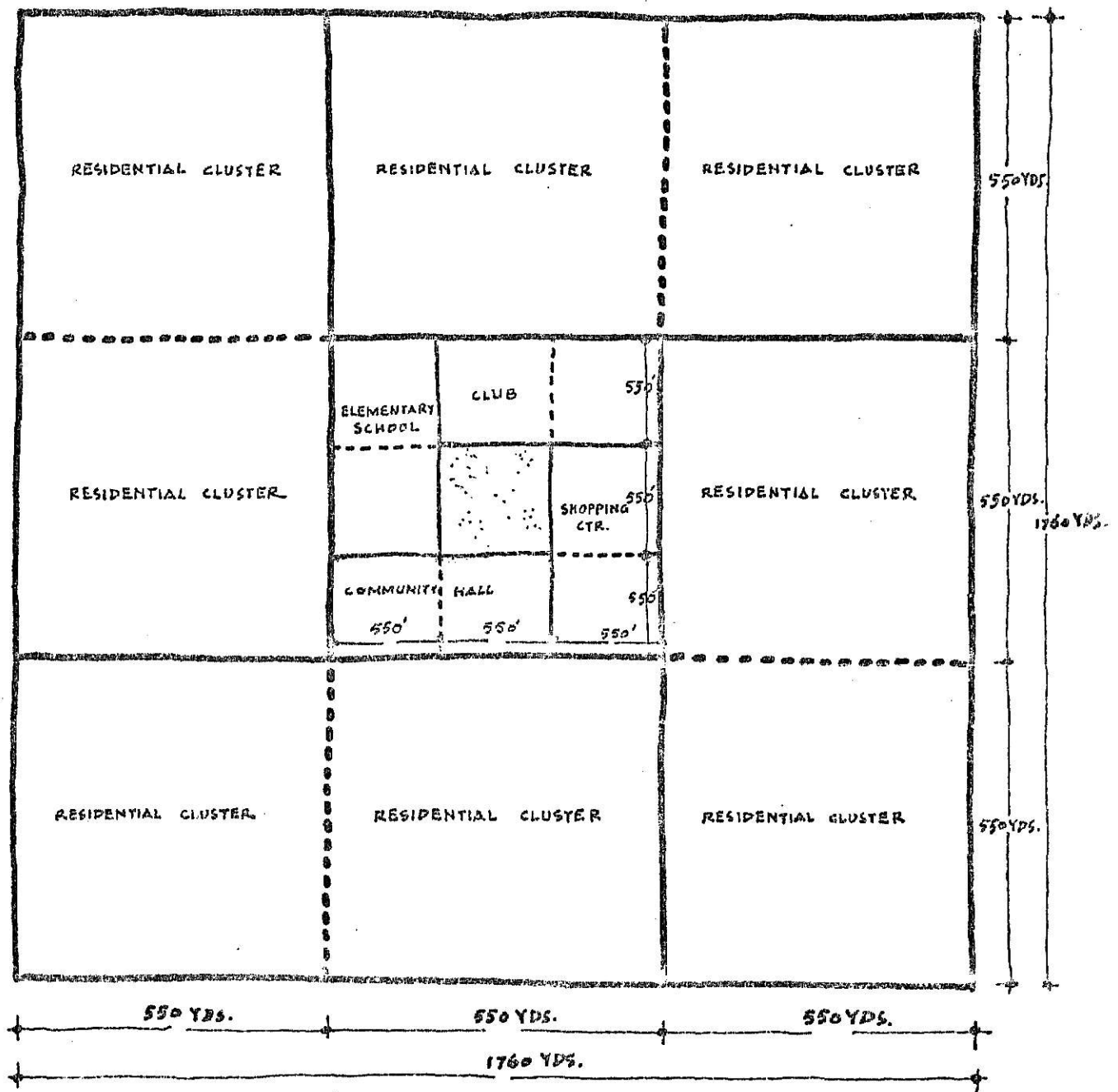
Gross density = 1.25 dwellings per acre or about 6 persons per acre.

Area of Neighborhood Center =  $639/9 = 71$  acres.

The above statistics are in general accord with design standards for neighborhood development.

Hence the optimum unit-matrix size for neighborhood development is 1650 yds.  $\times$  1650 yds., formulated on a basic module of 550 yds.

- (d) Community:- Next higher spatial entity in urban hierarchy is the 'Community'. The population size of a Community should be such that it provides sufficient enrollment for one Senior high school and two Junior high schools. Also the Community is conceived by many as the lowest limit of population scale for new towns. Thus as a political entity, a Community should have sufficient population base for supporting various public facilities independently. The service areas of a Community are conceivable to be grouped its core so that it may harmonically serve the whole Community. The service core of a Community is generally termed as Community Center, primarily comprised of commercial center and civic center. The other basic facilities namely, the Senior and Junior high schools and the recreation center should be located in the vicinity of the Community Center, to enable these facilities to harmonically serve all parts of the community.



MATRIX SIZE = 1760 YDS. X 1760 YDS.

Graphic: 49

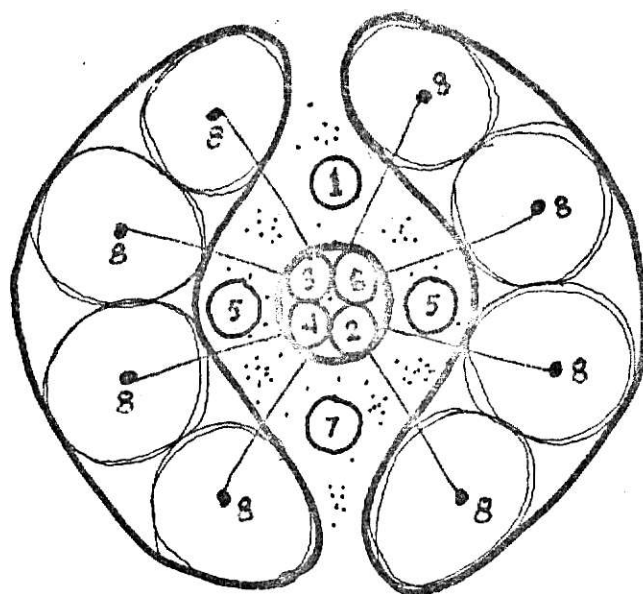
ARITHMETIC OF UNIT-MATRIX FOR DESIGNING  
A NEIGHBORHOOD UNIT

Conceiving the derived unit as a matrix of Community design, the central panel of the Unit should formulate the service center containing the major facilities needed to serve the whole Community. The residential areas grouped in neighborhood units, should be distributed in the four peripheral panels or eight sub-panels of the Unit. The population size usually conceived as optimum for a community to exist as independent political entity, varies between 30,000 and 50,000. This population is distributable in eight neighborhood units, each of population size 4,000 to 6,000. Thus each peripheral panel would have two neighborhood units, that is one in each peripheral sub-panel. Such spatial organization should interweave the various elements of the Community into a functionally organic entity, leading to the development of high degree of environment and performance efficiency in the Community. The derived unit also formulates an optimum matrix for spatial organization in the design of the service center for the whole Community contained in the central panel of the unit-matrix derived for the design of the Community. In this matrix, the central panel of the Unit should contain the most significant element of the service facilities. In this matrix, the four secondary elements; senior high school, two junior high schools, and the recreation center, should be housed in the four peripheral panels.

Thus the derived unit as three integrated matrixes, formulates a basic tool for optimum spacial development in the designing of a Community.

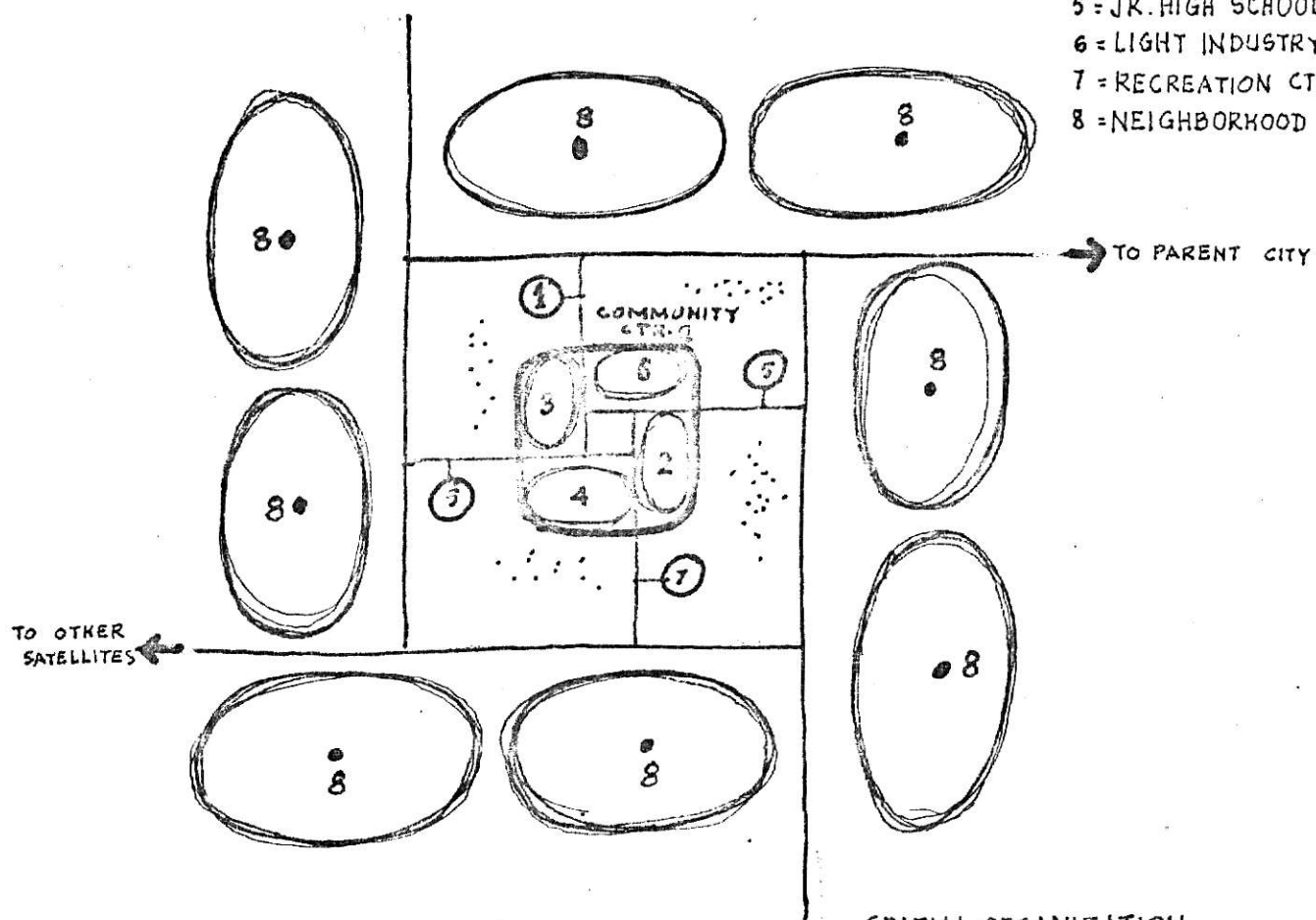
#### Arithmetic of Design Matrix for Community:-

Adopting the previously established optimum neighborhood size of 1,700 yds. x 1,700 yds. as basis and making provision for streets, landscaping etc., the size of a Community comprised of 8 neighborhood units should be about 3 miles x 3 miles. Assuming this as the size of the derived design matrix for Community:



SPATIAL CONCEPT

- 1 = SR. HIGH SCHOOL
- 2 = CIVIC CENTER
- 3 = OFFICE COMPLEX
- 4 = COMMERCIAL CTR.
- 5 = JR. HIGH SCHOOL
- 6 = LIGHT INDUSTRY
- 7 = RECREATION CTR.
- 8 = NEIGHBORHOOD UNIT

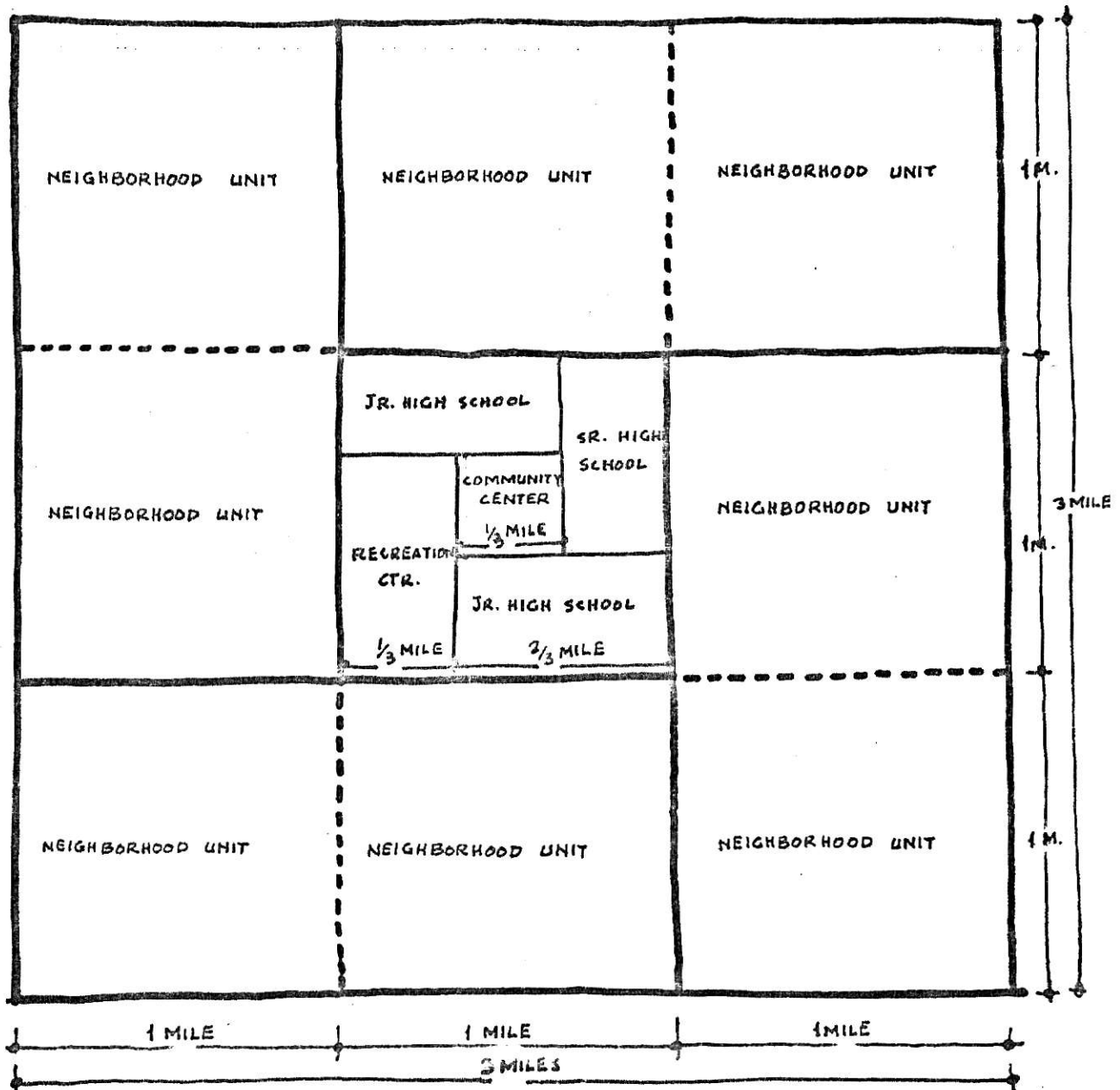


SPATIAL ORGANIZATION

Graphic: 50

DERIVED 'UNIT' AS MATRIX OF  
COMMUNITY DEVELOPMENT





MATRIX SIZE = 3 MILES X 3 MILES

Graphic: 52

ARITHMETIC OF UNIT-MATRIX FOR DESIGNING  
A COMMUNITY



Total area of the Community = 9 sq. miles or 5,760 acres.

Area under 'service core' = 11.1%

Area under Community Center (Central Business District ) = 1.25%

The above area proportions are in general accord with landuse standards for community development.

Thus the derived unit of size 3 miles x 3 miles, framed on a grid of 1 mile, should formulate optimum matrix for designing a community of population 30,000 to 50,000 contained in eight neighborhood units.

The successful testing of the application of the derived unit as matrix for designing various spatial entities in urban hierarchy, suggests that the Unit as matrix formulates a system which is adoptable as a basic tool and methodological approach for conceiving organic spatial organization in urban design. It is conceivable that the application of the 'unit-matrix' system should generally facilitate the entanglement and simplification of complex urban design problems. Also the fact that the Unit formulates an optimum design matrix for as small a spatial entity as 'dwelling' and as large an entity as 'community', suggests that the unit-matrix system can be employed with identical success for guiding the designs of all magnitudes.

Thus the derived 'unit-matrix system' possesses the necessary values and virtues to serve as a generalised methodological approach of urban design.

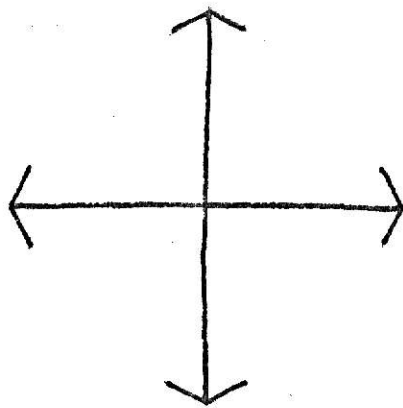
## V. APPLICATION OF UNIT-MATRIX SYSTEM IN NEW TOWNS

Town or city is the largest conceivable urban entity. The design and development of such large spatial entity is a complex process involving many professionals, requiring intensive monetary investment, and extending over long periods. The complexity and magnitude of scale involved in new towns development, in the absence of an established design methodology, frequently results in these towns falling short of their desired objectives. Consequently, doubt is initiated in many minds, about the strategy of building new towns as a tool for achieving optimum socio-economic and physical development. Thus new towns development needs to be put on a firmer footing, in order to enable these towns to achieve their prime objectives. For this purpose a scientific design methodology should be derived on the basis of the established unit-matrix system. In order to facilitate this, sound logical design principles for new town development should be formulated. On the basis of these principles, the spatial organisation concepts for new towns should be framed. The derived unit should then be conceived and employed as a matrix of conceptual city design for accomplishing the conceived spatial organisation. The arithmetic of this matrix should then be worked out for varied population sizes. These matrixes would formulate readily available tools for designing new towns.

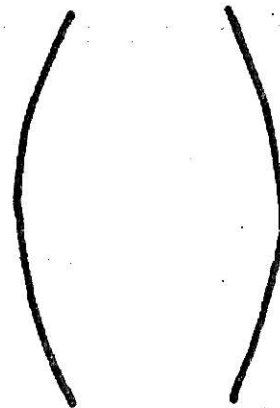
### A. Design Principles for New Towns:

The designs for new towns and cities should be conceived on the basis of the principle of 'organic-dualism', which is synthesis of two separate philosophies: (a) Organism, and (b) Dualism.

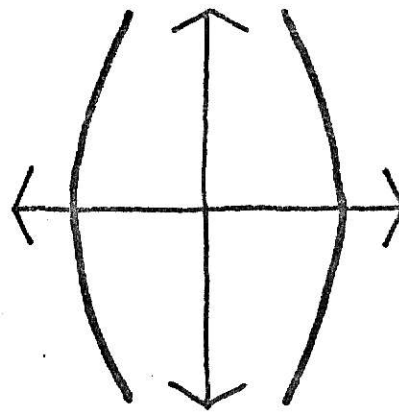
- (a) Organism:- Under 'organism', city should be considered as fundamentally organic in nature. This concept conceives a living entity as composed of mutually dependent parts that maintain vital processes initiated by the interaction



ORGANISM



DUALISM



ORGANIC-DUALISM

Graphic: 53

DESIGN PRINCIPLES FOR NEW TOWNS

between the organic entity and its environment. Also all living organisms are continuously undergoing through organic change and development while retaining their vital processes. Thus growth directions should be designated, along which the living city should grow and also could be continuously changed through time and needs.

- (b) Dualism:- Under 'dualism', the city should formulate a balanced entity, which should be retained during all subsequent growths and changes. City's man-made elements should balance it's static natural features. It's built-up areas should be complemented by it's open spaces, and it's physical environment should be in harmonic relationship with it's social structure. Thus a proper balance divergent poles should be achieved and maintained in a planned city, in order to enable it to become a healthy environment for living, working and recreating.

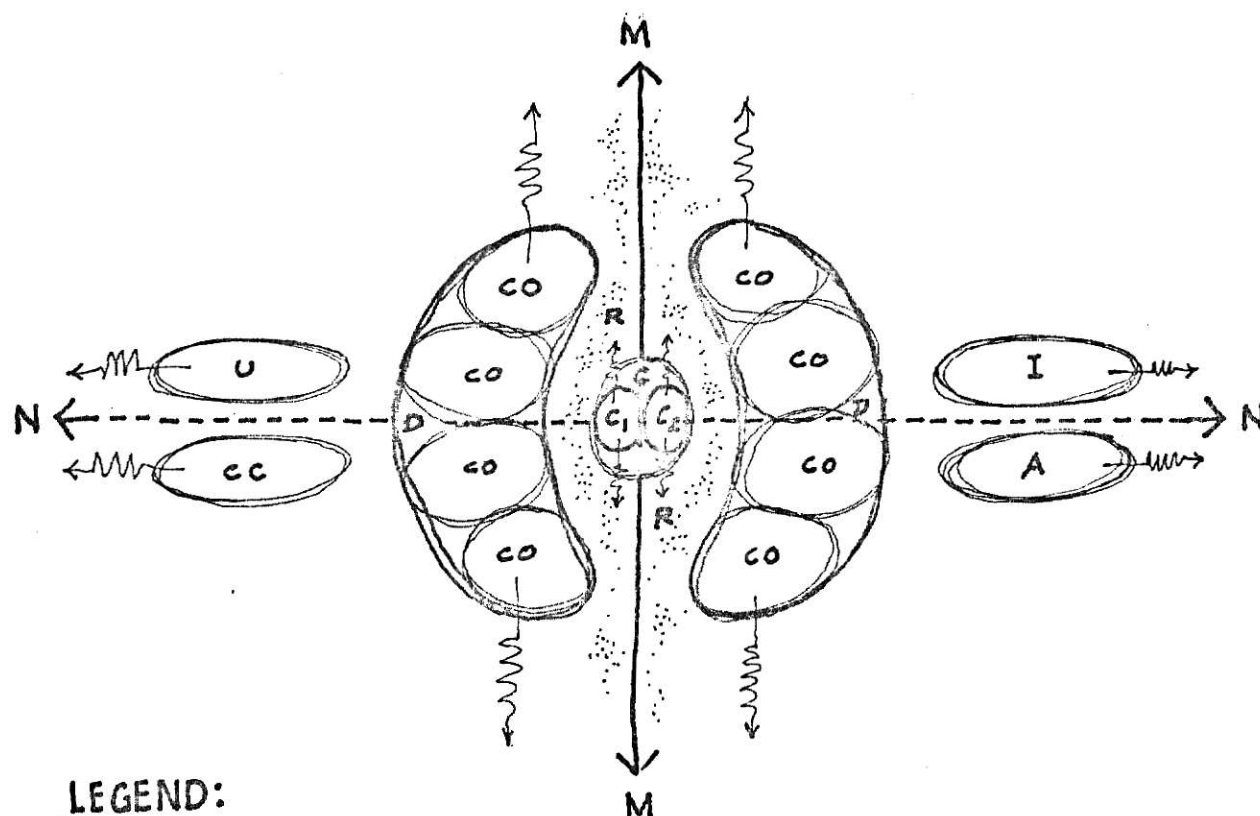
#### B. Spatial Organizational Concepts:

The above two philosophical concepts can be integrated into a single concept which could be termed as 'organic dualism'. This synthesis as applied to city design, conceives that the city is an organic entity comprised of various components. The design for the city should be aimed at attaining a functional equilibrium between these components. This equilibrium should be maintained while designating growth and change directions for the city. This concept should be transformed into optimum spatial organizational concept for designing new towns.

The most significant element of a city is the city core around which the spatial organization of the city should be conceived. The core of the city; usually called town center, or city center, or central city, or simply downtown, is comparable with the heart of a living entity. This heart is conceivable

as comprised of dual elements; a commercial center or central business district, and a civic center or government-cultural complex. Both these elements lying close to each other, should balance and supplement each other. Such a development should assure a healthy 'heart' which in turn would lead to healthy social, economic, cultural and civic life in the city.

Spatial organization should be conceived with respect to the horizontal and vertical axis of the city. The city core being the nerve center and most significant component, should be conceptually located at the origin of the two axis. Surrounding the city core should be the residential area, divided into two districts along the vertical axis. These districts are comparable with the two lungs in living organism, one on either side of the heart. Each district may be sub-divided into 2 or 4 communities, villages, or neighborhoods, depending upon the desired population size for which the city or town is to be designed. In such a spatial arrangement, each community or neighborhood would be somewhat equidistant from the city core, which as service center, provides vitality to the city. Open or recreational areas should primarily lie inbetween the city core or heart and residential districts or lungs. Thus the city's development would be basically extended along its vertical or primary axis. This primary axis could also be termed as 'central open axis', since the open areas dividing the city in two parts, are along this axis. The major economic and employment resources like industry, wholesale business, university, airport, etc., should be conceived as located along the horizontal axis and on the outer sides of the residential districts. These 'work areas' are comparable with two hands or wings of the living entity. Thus residential areas along the vertical axis and work areas along the horizontal axis, would be in a balanced and harmonic relationship with minimum interference to each other.



### LEGEND:

MM = MAJOR AXIS	D = RESIDENTIAL DISTRICT
NN = MINOR AXIS	CO = COMMUNITY
C = CITY CORE	I = INDUSTRY
C <sub>1</sub> = COMMERCIAL CENTER	A = AIRPORT
C <sub>2</sub> = CIVIC CENTER	U = UNIVERSITY
CC = CONVENTION CENTER	R = OUTDOOR RECREATION

—wavy arrow— = PRIMARY GROWTH DIRECTION

Graphic: 54

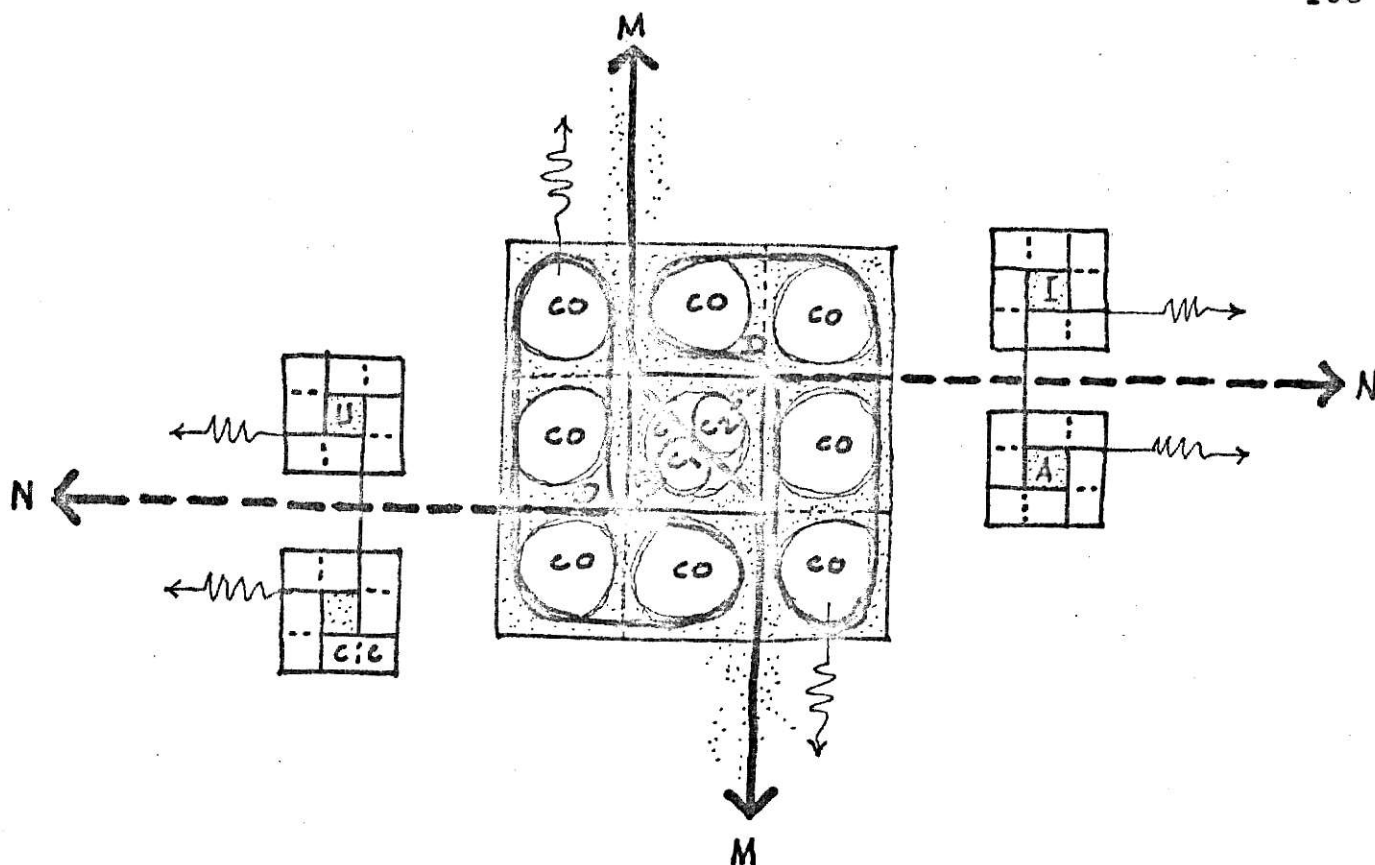
## SPATIAL ORGANIZATIONAL CONCEPT FOR DESIGN OF A NEW CITY

The city in accordance with its organic characteristic, has to grow and change from time to time. The spatial arrangement in the conceived organic-dualistic city, provides great flexibility for future development and expansion. The city core's growth would primarily be towards the two ends of the open axis, and only secondarily along the minor axis. Thus the core would grow simultaneously with city's growth, thereby always retaining a balanced development.

C. Development of Design Matrix:

The Unit-Matrix system which is earlier successfully interpreted and tested as a basic tool for designing various entities in urban spatial hierarchy, including the community (lower limit of the scale for new towns), should next be translated and tested for hypothetically designing a new city of population size 250,000 (higher limit of new town scale). For this purpose, the derived unit should be applied and reviewed as a basic form for achieving the conceived optimum spatial organization of cities.

Interpreting the derived unit in terms of spatial organization, MM and NN are conceivable as major and minor axis respectively in the city design. The city core comprised of dual elements, commercial center ( $C_1$ ) and civic center ( $C_2$ ), should be located at the 'origin' of these axis and contained in the central panel of the derived unit. Thus the city core as 'heart' and 'nerve center', would be strategically located to harmonically serve the whole city population, should be arranged around the city core, and divided into two equal districts ( $D_1$ ) and ( $D_2$ ) by the major axis. Each of these districts would be comprised of 4 peripheral panels. Thus each district can be conceived as composed of 4 communities, with each peripheral panel containing two communities of population size about 20,000 each. In other words, the



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-wavy arrow = PRIMARY GROWTH DIRECTION	

Graphic: 55

## DERIVED UNIT AS MATRIX FOR DESIGNING A NEW CITY



whole population of the city would reside in eight communities or villages, and each peripheral sub-panel of the derived unit would contain one such community. Each of these communities may be designed as comprised of eight neighborhoods, each resultant neighborhood as composed of eight residential clusters, and each cluster as composed of about one hundred dwellings, each time employing the respective unit-matrix. The major recreation or open areas should be along the lines formulating the unit. These open areas lying in between the communities as well as between the city core and the residential areas, should provide the desirable buffer.

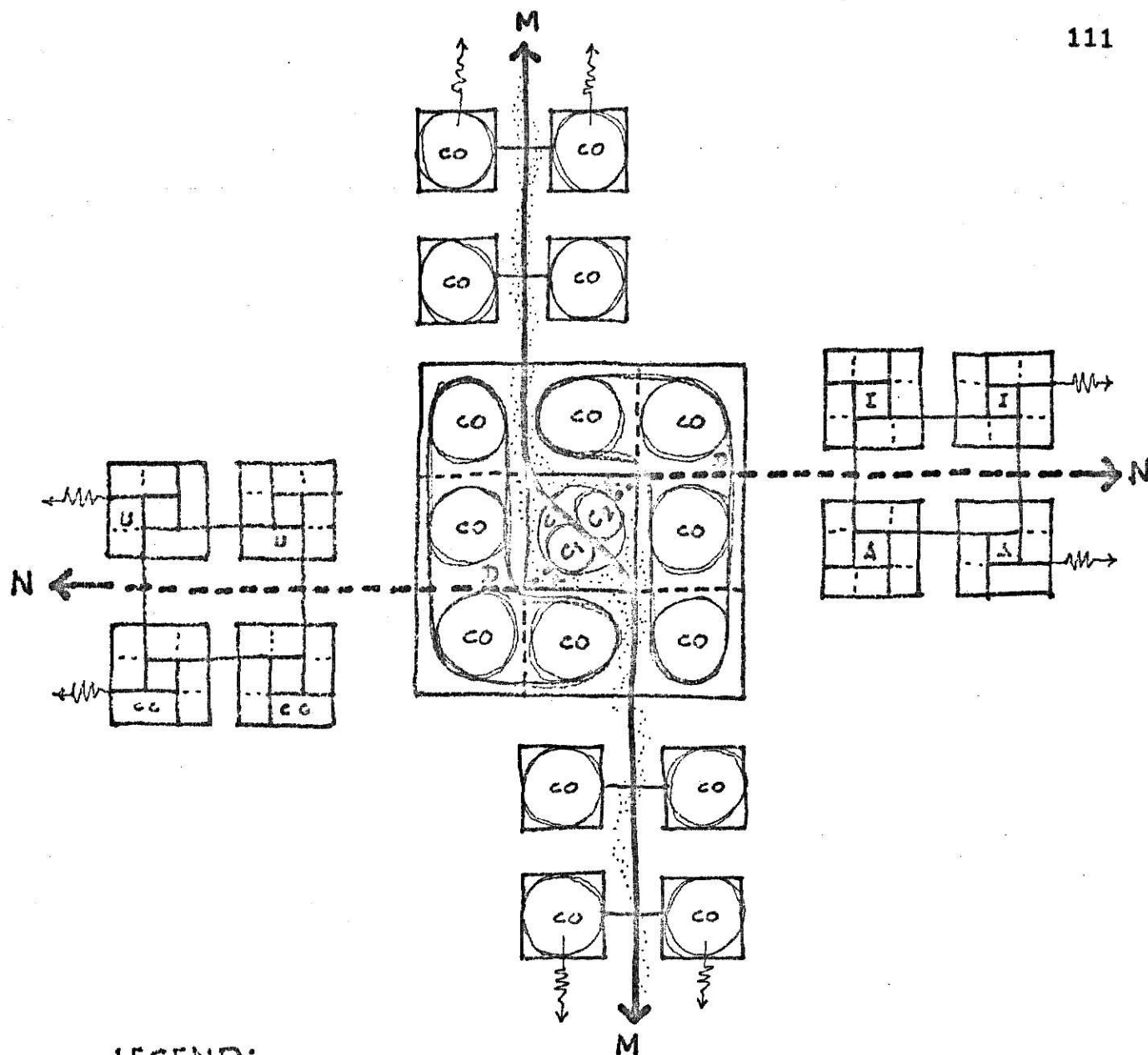
The major work areas and regional facilities like industrial parks, wholesale business, highway business, airport, regional convention center, university center, etc., should be located along the minor axis and flanking outwards from the residential districts.

In terms of transportation, the regional accessibility and linkage would be provided by the route along the minor axis. This route should be developed as parkway or expressway, with minimum number of traffic intersections. The accessibility and linkage to various communities in the city, would be by means of another major route which would run along the major axis. A rapid transit public transportation system may be developed along this axial route. Such transportation system which could be on, or under, or above, or parallel to the route along the major axis, would harmonically and economically serve all the communities, linking to one another as well as to the city center. The terminal for this rapid transit system would be located in the vicinity of the intersection of the two major axial routes, and close to the city center. The comprising lines encasing the central panel of the unit, and encasing the

whole unit, would formulate ring arterials around the city core and residential districts respectively. The ring arterial around the city core would facilitate the regulation of traffic in around the 'heart' and would prevent unnecessary passage of traffic through the core. Thus the pressure on the 'heart' would be confined to minimum thereby enabling it to render it's functions efficiently. The downtown or city core may primarily be developed underground or over-head in order to provide grade separation from intensive traffic around it and also to facilitate the release of ground-level space for transportation and park development. Such development should result in optimum environment and safety in the core area. The outer ring arterial encasing the city, would facilitate the regulation of inter-city and trans-city traffic, preventing unnecessary passage of such traffic through the city. This should result in safety and welfare in the city.

#### Future development and Growth:

It is generally experienced that cities function efficiently and economically upto certain maximum population size, beyond which they become somewhat unmanageable. Also per capita cost of living in larger metropolitan cities rise steeply with increase in population. For these reasons, a city of population size over about 250,000 is not advisable to be planned as a single entity, but should be conceived as a 'regional city' comprised of many political units. In the limelight of this concept, the future residential growth of the new city should be designed in the form of satellite communities along the major axis, extending outwards on both sides of the city. These communities would be linked to the parent city as well as to one another by extending the route and rapid transit system earlier developed along the major axis. The industrial commercial growth of the city would be along the minor axis. The growth of the city center would be as harmonic extension in the surrounding open areas.



### LEGEND:

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CC = CONVENTION CENTER	R = OUTDOOR RECREATION

—W—> = PRIMARY GROWTH DIRECTION

Graphic: 56

FUTURE DEVELOPMENT AND GROWTH OF THE  
CITY DESIGNED BY UNIT-MATRIX SYSTEM

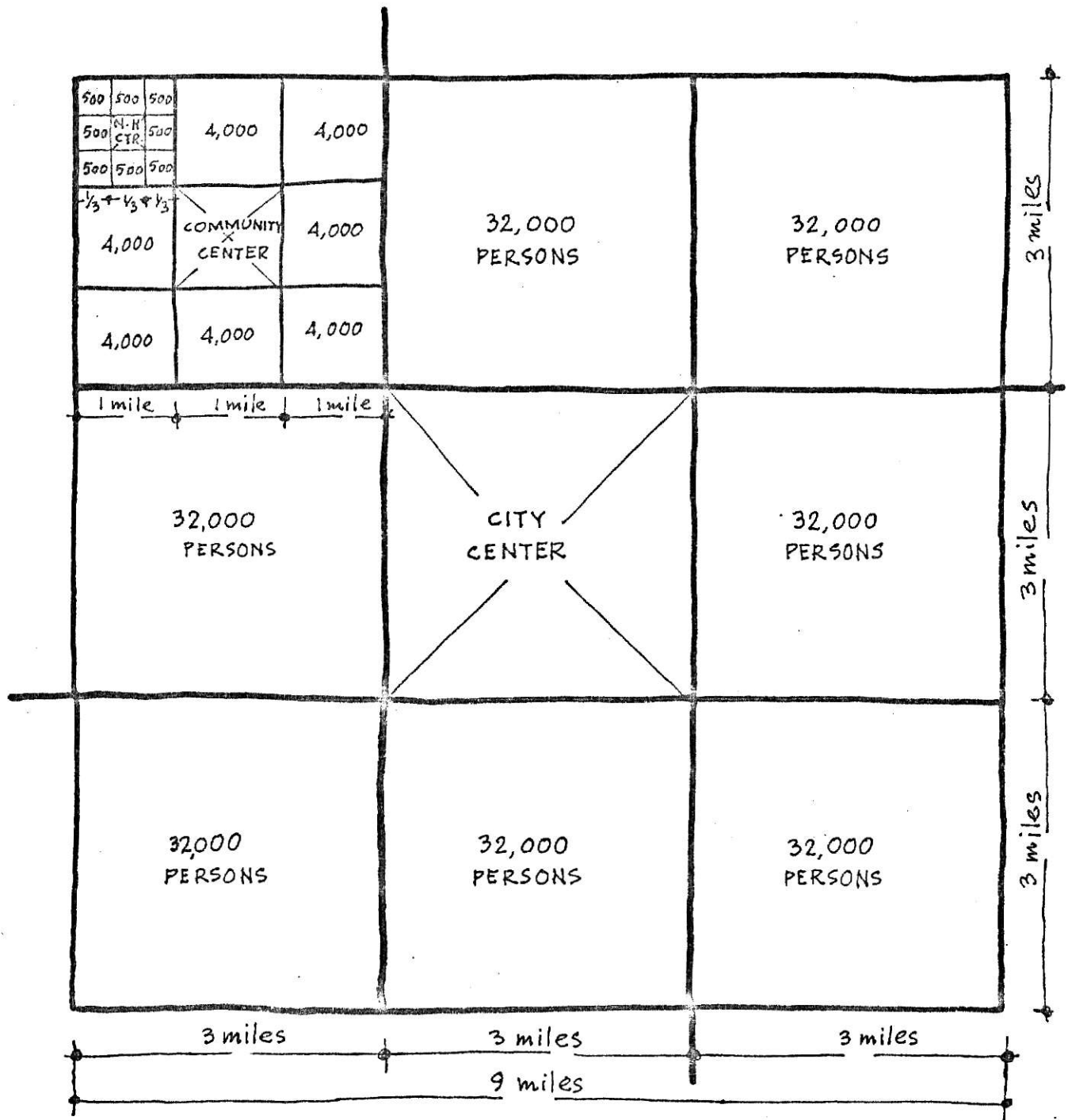
In the above conceived growth pattern, the physical growth along the two axis should balance each other. Also the social growth along the major axis would be balanced by the economic growth along the minor axis. Thus all the components of the city would have potential for independent development and growth, enabling the city to retain it's equilibrium at all stages of it's developmental growth.

D. Arithmetic of Design Matrix:

A city of 250,000 population is conceivable as comprised of eight communities of about 30,000 population each, one in each of the eight peripheral panels of the derived unit which is established as the design matrix. As established earlier, the optimum physical size of the design matrix for such community is 3 miles x 3 miles. Since one community is equivalent to one side panel of the unit, the size of each such panel would be 3 miles x 3 miles. Applying this as basis, the optimum size of the unit-matrix for designing a city of about 250,00 population is 9 miles x 9 miles.

For the purpose of design, a square of 9 miles side, should be divided into 9 equal squares. The size of the each resultant panel would be 3 miles x 3 miles. Of these, each peripheral panel would formulate a community of about 30,000 population, while the central panel would formulate the city core comprised of city center surrounded by open recreational area.

Each resultant community may be conceived as comprised of 8 neighborhoods of about 4,000 persons or 800 dwellings each, designed around a community center. For this purpose, each community of 3 miles x 3 miles would be divided into 9 equal panels of size 1 mile x 1 mile each. Out of these, the 8 peripheral panels would formulate the residential clusters and the central panel would



Graphic: 57

ARITHMETIC OF DESIGN-MATRIX  
FOR A CITY OF 250,000 POPULATION

form the neighborhood center.

Each resultant cluster may be conceived as being comprised of 8 residential groupings of about 12-15 dwellings each, designed around tot-lot, or nursery school, or any other common facility like wash house etc. For this purpose, each cluster of  $1/3$  mile  $\times$   $1/3$  mile should be divided into 9 equal divisions of size  $1/9$  mile  $\times$   $1/9$  mile each. Of these, the 8 peripheral divisions would contain the single-family or multi-family dwellings, while the central division would formulate the common facility.

Single-family or multi-family dwellings in the above clusters, may be designed by applying the unit-matrix system as described in the previous chapter.

Thus the derived unit-matrix system facilitates the designing of new towns and cities, by aiding the development and design of various spatial entities which collectively in an hierarchical order, formulate the town or city.

On the basis of these spatial analysis and arithmetical derivations, it can be safely concluded that the derived unit-matrix system formulates a sound methodology based on logical and sound principles, for designing new towns and cities.

## VI. CONCLUDING REMARKS.

The Unit-matrix System of urban design is not intended as an offer of 'escapism', but as a definite systematic approach for attacking and entangling the complexity of urban design projects of varied magnitudes.

The derivation of the Unit-matrix System is based on equal consideration of the two independent kinds of knowledge, symbolic or mystical and intimate or scientific, which exist side by side in man's consciousness. For this purpose, a basic form of intense symbolic and mystical values is critically evaluated and transformed into an optimum design unit by applying aesthetic criteria. The unit thus obtained is then successfully conceived as matrixes of various spatial entities in urban hierarchy, complying with the various scientific design principles involved. Either of the two kinds of knowledge existing in man's consciousness, appeals to only part of the whole man. Scientific knowledge appeals to the detached, analytical, disciplined and objective mind that is not swayed by emotional reactions. Mystic knowledge on the other hand, appeals to a desire for emotional involvement to a sense of empathy negating the critical self. Both these kinds of knowledge are therefore incomplete in themselves. Any theory or philosophy based on the consideration only either one of them, would lack in universal appeal and acceptance. The Unit-matrix System being derived by giving equal consideration and emphasize to both these kinds of knowledge, formulates a complete knowledge which should appeal to the whole man. The contemporary man is not satisfied with the division and is attempting to transcend the dualism of knowledge into a single synthesis. The Unit-matrix System is a step in this direction in the field of urban design.

The dualistic concept of two independent kinds of knowledge existing in man's consciousness, shapes his attitude towards reality. The word 'reality' carries varied definitions in terms of science, mysticism, and art. For science, 'reality' consists of facts; for mysticism, 'reality' dissolves in sensations; for art, 'reality' produces a chain of events. Reviewing the Unit-matrix in the limelight of the above definitions, the unit as matrix is proven by facts, evolves sensational spaces due to it's dynamic characteristic, and produces avisual drama in the form of chained events for the space users. Thus the Unit-matrix System having complied with man's attitudes towards reality in terms of science, mysticism, and art, is not a mere concept, but a definite design theory whose practicability is established on facts.

Man does not live only in the present moment and has a sense of historic continuity. He knows himself to be a link in the chain of tradition. As he evolves a new form, it is natural for him to look into history and see how other generations coped with a similar problem. In order to meet this psychological aspect, the form for the unit-matrix is derived by modifying a basic form which has dominantly influenced planned community development, either directly or indirectly, during all phases of history of mankind.

The world has been undergoing for last hundred years or so, through transition from a basically agricultural and agrarian society into an highly industrialized and scientifically suffocated civilization. Such period of transition is also generally the period of uncertainty. In order to overcome this uncertainty and also to prepare himself for the foreseeable complexity of future, man is striving to achieve perfection by establishing standardized theories and methodologies as values for guiding himself. The Unit-matrix System of design is intended as one such standardized approach and yardstick



which should guide and aid urban designers in their professional work.

The optimum characteristics of the unit-matrix system suggests that the potentialities of the System in other physical design professions, namely, interior design, architecture, landscape architecture, environmental planning, etc., should be explored, thus widening the scope of application of the System and establishing it as a universal tool of physical design.

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THE DERIVATION OF A UNIT-MATRIX SYSTEM OF URBAN DESIGN  
AND IT'S APPLICATION IN NEW TOWN DEVELOPMENT

by

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B. Arch., Delhi University, 1963  
M. Arch., University of Nebraska, 1971

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AN ABSTRACT OF MASTER'S THESES

submitted in partial fulfillment of the

requirement for the degree

MASTER OF REGIONAL AND COMMUNITY PLANNING

Department of Regional and Community Planning

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1973

This study is intended to establish a unit-matrix system of urban design and test the system for designing a hypothetical new city. For this purpose, a basic unit of design with optimum qualities is established. Also an urban spatial hierarchy is developed on the basis of educational facilities as the guiding criteria. The established unit is then conceived and evaluated as design matrixes of various entities in this hierarchy. Optimum sizes and dimensions of these matrixes are calculated. These matrixes of same shape but varied sizes are inter-related into a mathematical relationship formulate the desired unit-matrix system.

A basic form "F" is selected as the basic modular form from which to derive the unit of urban development. A study is made regarding the application of this form in various fields. It is found that this form being intensively employed in philosophy, mythology, science and art, as well as city planning, is nearest to man's thoughts, beliefs and concepts. Hence the form is generally acceptable to masses.

This modular form is next reviewed and its merits and demerits in term of urban design are delineated. The form is then reformed such as its merits are generally retained and enhanced while its demerits are eliminated. This reformed form formulates the optimum unit for the unit-matrix system.

An urban spatial hierarchy comprised of dwelling, cluster, neighborhood, community and city is next established. The derived unit is then successfully applied and tested as the basic form of design of each of the above entities. Thus the unit formulates an optimum design form which is adoptable for all these entities. Ideal size and dimensions are calculated for each entity which formulates

the matrix of design for that entity. An optimum functional and mathematical relationship between these matrixes is worked out. It is found that 8 multi-family dwelling structures form an ideal cluster, 8 of these clusters form an ideal neighborhood, 8 of these neighborhoods form an ideal community, and 8 such communities form an ideal city. The derived matrixes in this binding relationship, formulates the unit-matrix system.

The derived system is next tested for designing an hypothetical city of about 250,000 population. This city is conceived as being comprised of 8 communities of 30,000 population each arranged around a city center; each community as comprised of 8 neighborhoods arranged around the community center; each neighborhood as comprised of 8 clusters arranged around a neighborhood center; and each cluster as comprised of about 125 dwellings arranged around a common green. It is found that the overall matrix for the city would be 9 miles X 9 miles, matrix of each community would be 3 miles X 3 miles, matrix of each neighborhood would be 1 mile X 1 mile, matrix of cluster would be  $\frac{1}{3}$  mile X  $\frac{1}{3}$  mile. Similarly the system can be successfully employed for designing cities and towns of any size as well as their constituent elements.

On the basis of this study, it is concluded that the derived unit-matrix system formulates an effective tool and methodology of urban design which should facilitate city planning and designing in future.