

# Design Procedure Applying Theory of Temporal and Spatial Environment

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Cerebral hemisphere specialization in the human brain may play an important role for the independent effects of temporal and spatial factors on subjective preference of the sound field. The scale values of subjective preference of the sound field and the visual field have been described by the temporal and spatial factors [Ando, Auditory and Visual Sensations, Springer-Verlag, New York, in print]. Accordingly, the theory of environmental planning incorporating the temporal and spatial values for the left and right cerebral hemispheres, respectively, has been proposed by blending the built environment and nature [Ando, theory of temporal and spatial environmental design in McGraw-Hill Yearbook of Science & Technology 2009, McGraw-Hill New York, 2009]. In this theory, three stages of human life (body, mind and creation based on individual personality) in the temporal design are treated. In the present paper, we shall discuss design procedure in application of the theory of environment, in which distinct temporal periods of the brain activities as well as the environment including those of cosmos, and distinct spatial ranks are taken into consideration. In design process, we exemplify acoustic environment. For the third stage of human life, which has not discussed previously, each element of the matrix consisting of the distinct temporal period and the spatial ranks is demonstrated.

Key words: Cerebral hemisphere specialization, distinct periods, distinct space, and design procedure

## 1. INTRODUCTION

Subjective preference is regarded as a primitive response entailing judgments that steer an organism in the direction of maintaining life to enhance its prospects for survival. Thus, subjective preference is related to aesthetic issue. The scale values of subjective preference of the sound field and the visual field have been described by both temporal and spatial factors extracted from correlation functions [Ando, 2009, Auditory and Visual Sensations, Springer NY, in print]. Cerebral hemisphere specialization in the human brain may play an important role for the independent effects of temporal and spatial factors on subjective preference.

Accordingly, a theory of environmental planning incorporating the temporal and spatial values for the left and right cerebral hemispheres, respectively, has been well described by blending the built environment and nature. The scale value of subjective preference for three physical environments, for example, is given by

$$S = [gl(x) + gr(x)]_{\text{Sound field}} + [gl(x) + gr(x)]_{\text{Visual field}} + [gl(x) + gr(x)]_{\text{Thermal field}} \quad (1)$$

The significant temporal and spatial factors in this equation are listed in Table 1.

In the present paper, in design procedures of environmental design for each element of matrix consisting of distinct periods of nature as well as brain, and distinct spatial spans of environment are taken into consideration.

## 2. TEMPORAL DESIGN OF ENVIRONMENT

### 2.1. Three Stages of Human Life (Time)

The rapid pace of change of our environment is making people wonder how long this environment will remain suitable for living. Up to the present, knowledge has been limited and has not been able to resolve this anxiety. Also, for attaining more delightful and excellent environment in term of time, an attempt is made here addressing temporal perspective, in addition to spatial design in architecture and in the environment. The temporal design may be realized by satisfaction of three stages of individual life, defined by

- (1) life of the body,
- (2) life of the mind, and
- (3) life of creations and/or discoveries based on a unique personality.

The third life is the most unique to man, which has been introduced recently. All healthy creations that may contribute to human society for a long time even after end of the first and second life have been based on the unique personality of the

individual. In addition to the first and second life, an attempt is made here that the environment is designed for the third stages of life, which are deeply related to individual preference.

## 2.2. Distinct Periods of Environment

In architectural planning and design, we often forget the temporal factors. The crucial factor in the temporal dimension of the environment is the periodic cycle. For example, the shortest period (about 0.5 to 5 s) is related to brain waves, which are associated with perception of, for example, music and the twinkling stars as well as the glitter of leaves and ripples on water surfaces. Rapid eye movement (REM) of about 70–150 minutes, related to a basic rest-activity cycle, is associated with one session of a concert, lecture, or work. The circadian rhythm deeply connected by sunlight with the Earth’s rotation period is associated with daily human activity. The week, created by social custom for work and leisure, is associated with the planning period of a concert, drama, or social activity without additional costs in publicity. Another period is concerned with the movement of the Moon. The revolution of the Earth around the Sun is associated with the color changes of leaves and annual festivals. The alternating generations of about 30 years and the life span of, say, about 90 years, may be considered in the planning of houses, in accordance with the individual schedule of life. The present theory suggests that these discrete periods are explicitly recognized during the design process for any human environment.

## 3. DESIGN PROCEDURES

It has been well known that distinct spatial ranks in design of space such as furniture, room, house or building, region, district, country and globe. Together with above-mentioned distinct periods in the environment, each of the matrix elements is taken into account in the design process. Followings demonstrate acoustic design procedure for the first and second lives, and in addition physical environmental design for the third stage of human life.

### 3.1. Acoustic Environment

Among the physical environments, the acoustic environment including sound and noise is most deeply related to development of human brain as well as body and

mind, so that acoustical environment is carefully planned. It is known that sound environment affect most effectively on, for example, mental development, annoyance, duration experience whether time is passing faster or slowly.

(1) About 1s signifies every moment that is related the “psychological present”. It is considered that it can be given by the effective duration of autocorrelation function (ACF) of source signals,  $\tau_e$ , because the auditory temporal window is approximately given by 30 times of  $(\tau_e)_{\min}$ . A sound reproduction system, which is a kind of furniture, designed

Table 1. Spatial and temporal factors of physical environments to be designed.

Physical Environments	Spatial Factors	Temporal Factors
<b>Acoustic (determined)</b>	(1) Listening level, LL  (4) Interaural cross-correlation, IACC	(2) Initial lime delay gap between the direct sound and the first reflection, $\Delta t_1$  (3) Subsequent reverberation time, $T_{\text{sub}}$
<b>Visual (proposed)</b>	(1) Lighting level including color  (3) Properties of the reflecting surface (4) Spatial perception including distance factor	(2) Properties of movement function of reflective surface, T
<b>Thermal (assumed)</b>	(1) Sensors distributed on body	(2) Air movement (breeze)  (3) Relative humidity (4) Temperature

Note: In addition to these variables, characteristics of sources, location change of sources, and observer’s activity should be taken into consideration.

by use of the temporal and spatial factors of the sound field, which has been developed for the sound field in a concert

hall. The spatial shape of the concert hall much influence to the form of whole building. A well-designed concert hall can act as a second musical instrument expressing both temporal and spatial sensations.

(2) Since brain concentration is limited for about 90 minutes corresponding to the rapid eye movement (REM), an intermission in concert program and a refreshment corner serving wine and soft drinks in a lobby, for example, are much effective as well as meeting other audiences and performers exchanging opinion.

(3) Flow planning of whole building including a rehearsal room and the storage of instruments is considered in a daily schedule.

(4) Weekly and/or monthly running program of concert may help to distribute notice without payment of additional cost needed for a single concert.

(5) Annual maintenance planning keeping the concert hall and building should be included at the design stage.

(6) Four seasons' planning of soundscape with bird singing, murmuring from leaves and little streams. Urban noise is planned to minimize effects on unborn babies and children.

(7) Urban planning minimizing environmental noise from jet-planes and motorcars and trains, which affect on development in specialization of human cerebral hemispheres, and development of height of children. Also, people living in an environmental noise feel time passes faster, so that they feel always busy without performing particular job. These effects are accumulated by daily environmental noise over several months or years, even if such environment has a period of 24 hours. Such effects on development of children are remained over next generations.

### **3.2. Environmental Design for the Third Stage of Life**

A typical human creative activity is the third stage of life. This kind of activity play an important role finding individual's personality and thus worth living, so that resulted creations could contribute to the society and the human life for a long time even after passing the first and second life. A lasting peace on earth may be achieved by release of individual personality given by Nature. Design of environment for the third stage for babies and children should be made much attention as well as the first and the

second life. The brain is almost developed by environment, i.e., home before entering elemental school. Figure 1 demonstrates each element of to be designed for the third stage.

(1-2) Since during sleep we sometimes happen to have a sudden inspiration, so that, for example, we need a small desk beside a bed to write it down in a dark. Drawings placed on the walls and flame from a well-designed stove can well stimulate the brain.

(3) Music in a listening room, and leaves of trees outside of a window moving in gentle wind, for example, may stimulate our brain also. Such a breeze can play important role in refreshing brain, which is introduced by a well-designed window facing with a green courtyard obtaining down current of air. Perspective can play important role for a long term planning of individual as well as of environment. A creative work space (CWS) and a creative kitchen space (CKS) with specialized work spaces for the left and right hemisphere tasks may well help for any kind of creation, i.e., the third stage of life.

(4) View window and/or view place of clouds moving, scattering and vanishing over the house that stimulates the left hemisphere by the temporal movement as well as the right hemisphere by its form. Arts and books corners in a house or a building stimulate the right and/or left hemispheres.

(5) A garden changing with sun light in a day and change of shape and color everyday, for example, may play important role to activate both of hemispheres.

(6) A well-designed walkway and riverside in a region to refresh body and mind getting an idea.

(7-8) Weekly program of an art museum, a concert hall, a church, a zoo, an aquarium and botanical gardens for peoples living in the local area. For example, if programs are planned such that, for example, Jazz concert is performed every Saturday evening and classic music is performed on Sunday evening, then people can participate concert according to their weekly schedule without extra cost for notice of performances.

(9-10) Place enjoying moon watching and its light inside rooms and buildings.

(11-12) Color change of leaves of trees. Festivals of concert and art according to seasons, and landscape including

soundscape design, for example, watching birds and flowers, hearing water-flow sound. Agriculture is deeply related to landscape, which changes in four seasons.

(13) Seasonal program of school, temple and church together with weekly program.

(14 – 17) For example, accepted artistic by people and scientific works might be succeeded by coming generations, in turn, to be classic. Education should be paid special attention to development of human brain, because there are certain time windows in young ages below around 18 years old accepting languages, music and mathematics. Closest environment to human such like furniture and drawings also are very effective for encouragement and development of brain and/or mind.

(17 - 20) Conservation with nature on earth and/or universe should be made in term of time, blending human life with natural cycles.

#### 4. REMARKS

The dimension of the head of newborn babies is relatively large, because this part is initially developed in fetal life. If we consider analogy for environmental design, it is highly recommended to develop the facilities related to the brain should be first designed in a house and an urban planning.

Such as museum, concert hall, library, church and institution, which may act as an important role for the third life of each individual. Then, arms and legs corresponding to the highways and communication systems can be developed later on. Otherwise, there were evidences that new towns were almost dead after about 30 years corresponding to a generation period, because young people did not interested in such town to move in.

Forthcoming change of global climate, much more attention should be paid for dynamical and temporal design of environment.

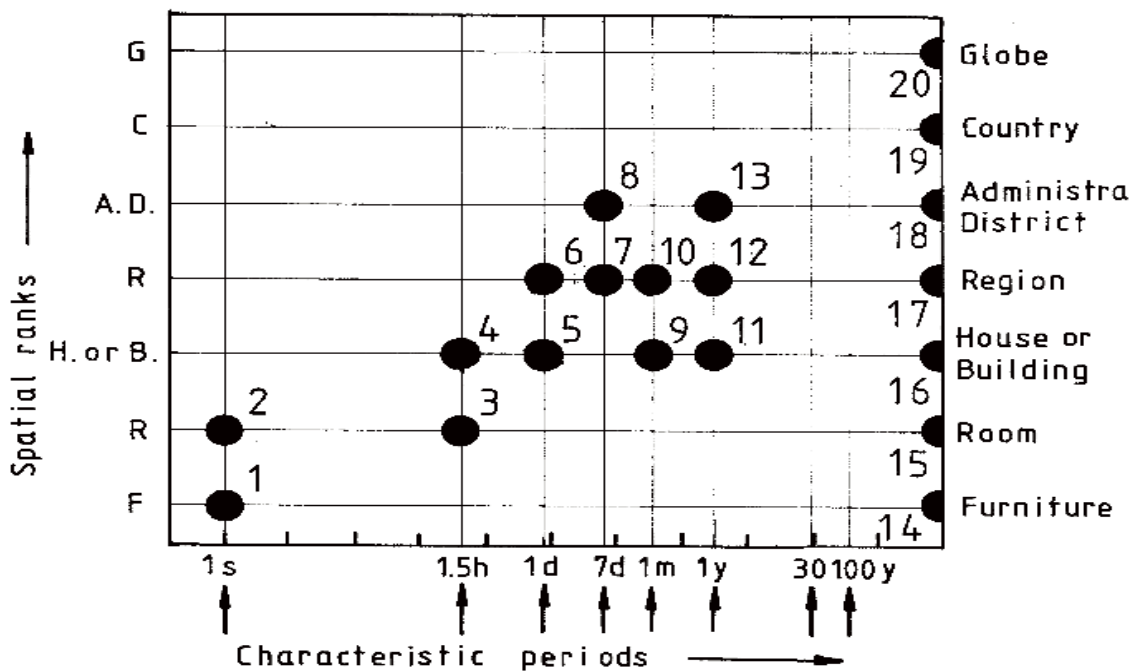


FIGURE 1 Each element for the third stage of like to be designed with distinct periods in the environment and distinct ranks of space.