PROGRAMMING
ARCHITECTURAL PROGRAMMING

ARCH 4394

Division of Architecture
Texas Tech University

Professor W. Lawrence Garvin
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GOALS, OBJECTIVES AND PROBLEM STATEMENT

Goals and Objectives:

Essentially, from the BACKGROUND, ACTIVITY ANALYSIS and SITE ANALYSIS can be derived most of the project goals and objectives. These statements must be salient of single purpose and void of preconceptions. Most clients don't need building, they need the resolution of emerging functional problems. Discovery of the whole problem is an iterative process, the initial phase of which is a Background statement from which can be derived the principles issues. The final phase of this reiteration can be approached with confidence only after the final draft is otherwise complete.

Issues are problem structuring devices. They may emerge from study of any of the following subject areas: principles, policies, priorities, processes, functions (activity networks/behavioral settings), systems: information, communication, product, transportation, planning: physical, operational, financial, organizations: public, private, formal, informal, personnel, individuals, groups, demography, time, growth/change (current flexibility/future convertability) environments: physical, ecological, conflicts, future needs and preferences.

Both goals and objectives should be "action verb" centered, outcome or product-related. They should be equally significant imperative statements listed in a logical progression. Goals and Objectives need not be equally divided in number nor symmetrical in subject matter.

Goals describe what the project will accomplish and why in intrinsic mission-oriented qualitative sentences (to do or to be). It is intended to be the articulation of the project concepts which guide the designer toward project meaningfulness.

Objectives describe the quantifying or measurable performance-oriented factors which can be used to evaluate the design solution. Each should describe a single key result to be accomplished.

Project Summary
In the same spirit, each author may choose to summarize the principal concepts, problems and solution alternatives highlighted throughout the program document. The statement should be limited to two pages double-spaced, but certainly not more than three double spaced or one an one-half pages single-spaced. If it appears that the "Project Summary" and the "Goals & Objectives" are redundant the lessor should be omitted.

An alternative method of formulating a Project Summary is suggested by Penå in Problem Seeking. It uses the following matrix to identify the principle statement of an acceptable solution.
Goals, Objectives and Problem Statement

The following sequence is suggested:

1) Establish Goals; What does the client want to achieve and why?
2) Collect Facts; What is it all about?
3) Uncover Concepts; How does the client want to achieve these goals?
4) Determine Needs; How much money, space, quality?

Having completed that exercise, you are then prepared to; State the Problem. The following questions in Penà's format provide another checklist which may be useful in developing your own Goals and Objectives or Project Summary or Problem Statement.

Function:

1) State the unique, performance requirements to satisfy the personal or popular needs of the client/user.
2) State the unique performance requirements to accommodate the major activities in the project.
3) State the unique performance requirements created by the relationship among activities in the project.

Others:

1) Other adjacent developments
2) Street hierarchy
3) Ultimate scope considered
4) Insulation perimeter areas

Form:

1) Identify and abstract the major form giving influences of the site on the building design.
2) Identify the salient environmental influences on the building design.
3) Identify the quality of the project and its implications on the building design.
Goals, Objectives and Problem Statement
Page 3

Others:

1) Directional signage
2) Preserve natural forms
3) Utilize open space systems as positive design enhancement
4) Sense of community
5) Identify future development influence
6) Respond to future building areas

Economy:

1) Establish an attitude toward the initial budget and its influence on the fabric and geometry of the building
2) Determine if operating costs are critical issues and establish a design directive
3) Reconcile the possible differences between the initial budget and life cycle costs

Other:

1) Consider short-term and long-term effects
2) Long-term saleability

Time:

1) Consider the possible influences of historic surroundings.
2) Consider which major activities will most likely remain static and fixed and which might be dynamic and flexible.
3) Consider the implications of change and growth on long range performance

Other:

1) Phasing response in design and alternative strategies
2) Planning frame note for future development

See examples in Penâ, pp. 118-133.

Penâ also suggests the relationship between project complexity and the scope of the programming task. At level one might be an elementary school building. At the fourth level might be a regional shopping center, major airport or downtown subway station. Understanding the differences among levels of complexity may be helpful in determining the effort necessary to complete each segment of your own program.
FIRST LEVEL
- Two phase processes
  - Traditional services
    - Simple, single building
    - Familiar building type
    - Background research to help communication
  - Simple client structure
  - Centralized decision-making
  - Client/Owner/User involvement

SECOND LEVEL
- Two or three phase process
  - Consulting services
  - Building type specialists
  - Interdisciplinary team
  - Complex client organizations
  - Multi-head client decisions
  - Conflicting user groups

THIRD LEVEL
- Three phase process
  - Pre-programming surveys
  - Extensive project management
  - Wide variety of consultants
  - Multi-company specialists
  - Joint venture organization
  - Extremely large, mixed use projects
  - Research to provide documented justification for recommendations
  - Complex administrative organization processes client approvals
  - Autocratic high level decisions
  - Non-participating user group

FOURTH LEVEL
- Considerations expended to include political considerations
  - Bureaucratic process
  - Small, large firms with sense of public service
  - Urban development problems
  - Research to withstand public scrutiny
  - Complex client structure
  - Political decision-making
  - Advocacy groups
DATA COLLECTION

Unstructured data collecting can become an infinite consumer of time and intellectual energy. In contrast, a well composed data collection plan may facilitate an efficient and productive information gathering process. The nature of the information may favor a particular methodology. Therefore, the collection plan must be as diverse as the characteristics of the information needed to delineate the social, economic and environmental conditions and trends. The nature of the information is sufficiently obvious and codified that it may be extracted from an existing information base. In such cases, the programming process may progress in a linear manner for information to analysis and the specific application known general concepts. The necessary examination of related human behavior, trends in building form and function or the implications of evolving technologies will not be facilitated by similarly well structured informational sources. In such cases it may be necessary for their verification and finally to identify the information necessary to complete the analysis.

INFORMATION <-> ANALYSIS <-> CONCEPT

In both cases, the refinement of the program will require successive reiterations of the process.

Acquisition of information or development of concept in every instance must be meaningfully pertinent to the project under consideration. The researcher must continually ask, "How does this affect my project?" "Does the designer need to know this?" Priorities of effort can be determined upon the relative intensity of positive responses to this question.

These notes compiled principally from the following sources:

2. Todd, Finding Facts Fast

The nature of the investigation may depend upon the nature of the project, the type of information needed or the characteristics of the sources.

A. Circumstances

1) type of definition of relevant issues
2) availability of appropriate or related information
3) originality of the project

B. Information type

1) historical, philosophical, social, economic or political
2) project goals and objectives
3) resources and constraints
4) applicable technologies  
5) design issues and concepts  
6) user needs and preferences  
7) applicable codes, standards and regulations  
8) financial, functional and operational requirements  
9) existing conditions and implications  
10) growth and transformations, trends and projections

C. Information sources:

1) observation  
2) interview and survey  
3) literature and record searches

(By example, the text of Palmer (Chapter 2) illustrates ten ways to organize outlines.)

Observation

Observation methods are useful for examining existing conditions or current behavior. Both natural and built environments are undergoing a continuous process of change and transformation - evolution. (To describe only the static condition is inadequate.) Of course, rates of change vary; earthquake activity in the last 11,000 years is of interest, a light bulb burns for 500 hours, hot coffee cools in minutes, lightning flashes in micro seconds. Rates of change are an element of each impact analysis.

Human behavior is consciously or unconsciously responsive to the environmental setting in which it takes place. Therefore, each record of human behavior must include: time, place, participants, their predispositions and an analysis of place.

Environmental Setting Triad

In order for observation records to be useful they must be reliable, consistent and representative. They may be acquired by unobserved observations, participation, behavioral mapping, statistical records or instrumentation.

Record

1) Activity, frequency, duration, sequence, repetition, group differences, uses and responses to particular settings.
2) Characteristics of spatial settings
3) Personal interaction characteristics
Interviews and surveys are better adapted to discover or examine user needs, preferences, and attitudes. Interviews are more likely to be subjective, biased and time consuming. The statistics thus compiled are used to measure, differentiate and correlate the identified characteristics.

Both interviews and surveys must be carefully constructed in order to be useful. Both require pretesting to verify efficacy of structure and content.

A. **Interviews** are useful in exploration of:

1) client goals, objectives and philosophies
2) project background and history
3) preferences, values, attitudes and opinions
4) identification of conflicts and contradictions
5) operations, procedures and existing spatial impacts on both
6) space, preferences, needs and projections
7) equipment use and characteristics

Questionnaires provide an expedient and effective means for collecting quantifiable and comparable information, particularly on population characteristics, attitudes, perceived needs and preferences. Structured questionnaires provide the respondent with a limited set of responses. Open ended questionnaires (such as student evaluation of faculty questionnaires) provide for spontaneous responses rather than the more frequent and limiting multiple choices.

A. **Questionnaire (or interview) sequence**

1) introduction
2) warm-up
3) body of study
4) respondent demography

B. **Question content must be carefully composed**

1) exact in meaning
2) use vocabulary familiar to respondents
3) Worded to allow only a single meaning
4) devoid of bias
5) unemotional phraseology
6) of limited length

Standardized forms have the advantages of; a) identification of the unit about which information is being collected, b) identification of variables to be measured, and c) orderly method for recording data.

Data interpretation is influenced by the nature of the sample.

a) cross-section surveys are addressed to the entire respondent pool
b) longitudinal surveys canvas pools at periodic intervals
c) contrasting sample surveys canvass pools with known characteristic differences

d) random samples do not seek to encompass isolatable respondent pools

e) stratified random samples may be peculiar to one or a limited number of respondent characteristics

f) cluster samples address subgroups of one or more distinguishable respondent pools

Questionnaires are particularly useful in attitude measurements; that is, the identification and categorization of patterns of group values, feelings, perceptions, priorities, preferences and goals and operational priorities. Some examples include:

1) Semantic differences; friendly-hostile, inviting-uninviting

2) Behavioral evaluation; good-bad

3) Relationships; strong-weak

4) Rates of change; fast-slow

Literature Search

The exponential growth of the information base of use to the programmer requires careful organization of the research effort if it is to be effective. Any research plan should carefully analyze who would know or who would care enough to record it. The relative importance of information, the energy required to acquire it and the conclusiveness of such information must be evaluated. The investigator must continuously distinguish between process and product in making these evaluations. It is essential to be realistic about purpose, time and cost.

See the attachment for a matrix (Sanoff, figure 46) related to information (product) with organizational criteria (process). If not utilized with circumspection, such patterns are more likely to be confusing than helpful. Similarly the programmer must be careful not to mix function data or diagrams with those relating to access or with those of adjacency requirements.

Classes of written material:

1) books

2) magazines and journals including learned society periodicals

3) newspapers, particularly the local paper and the New York Times

4) duplicated unpublished documents; posters, reports, schedules.

5) manuscripts; unpublished, unduplicated.

Standard References include:

Enoch Pratt Reference Books: A Brief Guide

Readers Guide to Periodic Literature: Standard Periodicals

(Subj) (Directing)

Encyclopedia of Association

Art Index
### Applied Science & Technology Index

Guide to Reference Books Eugene P. Sheehy

### Social Sciences Index

Subject Guide to Books in Print

Technical Book Review Index Specification Libraries Association

World Almanac/Texas Atlas

U.S. Govt. Printing Office (TTU Depository)

Monthly catalog selected lists of U.S. Govt. Pubs.

Subj Biography Index

Encyclopedia Britannica (Americana, Chambers, Colliers', Comptons')

Lucid, coherent, exposition

A Study of Resources & Major Subject Headings Available in U.S. Federal Library, 1970

### Maintaining Extensive or Unique Collections or Resource Materials

Types and Sources of Information

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<th>TYPES</th>
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<td>Client objectives</td>
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<td>Existing facility</td>
<td>Client philosophy/history</td>
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<td>Existing facility plans/drawings</td>
<td>Client organization</td>
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<td>Other facility plans/drawings</td>
<td>Facility type</td>
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<td>Facility programs</td>
<td>Design issues</td>
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<td>Owner records/archives</td>
<td>User needs issues</td>
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<td>Owner literature (promotional documents, employee handbooks, organizational charts, etc.)</td>
<td>Codes, standards, etc.</td>
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<td>Related programming/planning studies</td>
<td>Functions/operations</td>
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<td>Research findings-user needs</td>
<td>Existing problems</td>
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<td>Research findings-facility performance</td>
<td>Growth projections</td>
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<td>Community leaders</td>
<td>Demographic data</td>
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<td>Local authorities</td>
<td>Project constraints</td>
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<td>-Planning, -Zoning, -Building, -Utilities.</td>
<td>Site conditions</td>
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<td>Data Banks</td>
<td>Programming techniques</td>
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<td>-Programmer's</td>
<td>Client objectives</td>
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<td>-Project files</td>
<td>Client philosophy/history</td>
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<td>-Abstracting services</td>
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<td>User needs issues</td>
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<td>Codes, standards, etc.</td>
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<td>Existing problems</td>
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<td>Growth projections</td>
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SOURCES (cont'd)

Technical experts
Other programmers/designers
Publications (books, reports, etc.)
Journals/periodicals
Local newspapers
Design graphs
Visits to other sites
Census records
Public records
Telephone Books yellow pages
Community directories/profiles
Local associations

A working bibliography is the single most important tool of a literature search. To compile such a bibliography:

a) don't abbreviate
b) take complete notes including the complete bibliographic reference with page numbers
c) carefully record quotes - scrupulously use quotation marks
d) text references should refer to the appropriate chapter and page when book or document names or other general headings do not adequately identify location of the source.

A standard format is offered as a starting point for the preparation of an outline. Any other format more appropriate to the thesis topic and which satisfies the common-sense test of thoroughness may be equally useful.

The purpose of an information gathering plan is to:

a) disclose critical information items
b) discover information items, the acquisition of which has peculiar circumstances or long lead times
c) develop a conceptual framework into which information can be integrated
d) be a useful planning tool for its author (as such, it must be sufficiently extensive as to serve also as a work scheduling device)

To develop a plan:

1) Determine principal headings
2) List important issues associated with each heading
3) List essential information elements associated with each issue
4) List best sources for each informative element
5) In developing the headings and lists:
a) Define a logical sequence
b) Associate information with critical dates
c) Avoid generalized descriptions
d) Use bibliographic notations
e) distinguish among information, analysis and concepts

TYPES (cont'd)

Demographic data
Project constraints
Site conditions
Programming techniques
f) anticipate use of information sources which serve more than one heading and relate items in ways which will aid management of the collection process sequences

g) describe product rather than process

6) Listed among the information elements should be evolution, state-of-the-art, and future trends of each building type incorporated in the project. Generalizations extracted from such investigations are appropriate to "background." Specific concepts or principals are more appropriate in "case studies" or "activity analysis." Similarly, with regard to the following categories of information, the resulting analysis belongs either in the "background" or "site analysis" depending upon whether or not its impact is site specific. Every project must include and the bibliography refer to the pertinent analyses related to:

a) regional and local planning issues
b) existing or proposed land use, master plans, existing conditions, condition of buildings, age, and future projections.
c) demography/sociology/economic climate
d) transportation systems, and traffic conditions
e) environmental impact/ecology/topography/climate
f) market studies for speculative projects, including housing, offices, and retail stores

Attachments: 1) Programmer's Kit
2) Matrix (amended) from Pená Problem Seeking.
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<th>Determine Needs</th>
<th>State Implications and Criteria</th>
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BACKGROUND

References: Péna, Problem Seeking, pp. 49-64 and 77-124.
Kemper, Architectural Handbook (see page references below)

A. How do the users comprehend their problems? How was the need for this project first identified? Are there viable non-building alternatives to meeting user needs? How was the need for the project evolved? Who considers it important? Are there other supporters for a "building" situation? What are the project's problems, needs and opportunities?

B. What are the significant issues which are neither form generating nor site specific? Issues are problem structuring devices. They may emerge from study of any of the following:

- principles, policies or priorities
- processes: people, products, paper, information
- functions, activity networks or behavioral settings
- systems: information, communication, transportation, structural, ecological planning, physical, social, financial, operational
- organizations: public, private, formal, informal, personnel
- demography: density, race, age, sex, ethnicity, income, education, employment, physical health, social health
- culture; ethics and values
- environments: physical, social, financial, institutional, ecological
- conflicts among any of the above
- time/sequence
- growth/change; future trends (current flexibility/future controvertibility)
- past, present and future needs and/or preferences

The "Background" statement must describe the user needs in relation to all scales of issues commensurate with the intended project scope. The physical planning issues should be examined in general terms in "Background". Site specific issues should be examined in the "Site Analysis" section. Between the two sections, every relevant scale of physical planning concerns should be addressed. Among the physical planning issues to be considered, in terms of both existing conditions and future trends, are:
BACKGROUND

Regional and local planning activities

Comprehensive plans/Master Plans/land use plans

Existing condition and projections: demography, sociology, economic climate, transportation system, traffic, land use, ecology/topography/climate/environmental context and impacts, age and condition of buildings, market studies for speculative projects.

For those needing a more systematic set of suggestions, it is suggested that you review Penål Problem Seeking. Note that it is particularly difficult to effectively use only part of Penål's approach and that it does not match the suggested program format. His approach does provide a usefully consistent and comprehensive explanation of information gathering.

Penål's "Five Steps"

1) Establish Goals
   What does the client want to achieve and why?

2) Collect Facts
   What is it all about?

3) Uncover Concepts
   How does the client want to achieve his goals?

4) Determine Needs
   How much money, space, quality? What are the users?

5) State the Problem
   What are significant conditions and general directions the design should take?

This is typically part of a "Squatter" exercise and is unlikely to develop as thorough a statement as is necessary to this course.

"Programming is a hauristic process not an algorithm. Steps may be taken in a different order or simultaneously."

...A Spanish proverb, "He who grasps too much squeezes little." Grasp what is manageable -- and what is useful to the designer.

Four areas of Consideration from Penål

1) Function: people, activities, relationships

2) Form: site, environment, quality

3) Economy: Initial budget, operating costs, life cycle costs

4) Time: past, present, future

For more detailed suggestions, see Penål information index, pp. 36-37.
"There must be a filtering process which emphasizes the major aspects of information: 'ABSTRACT TO THE ESSENCE'."

Programming is an iterative process continuously involving client/user...

Continuous communication avoids future misunderstandings and the consequent costs of design redevelopment or construction alteration.

The program descriptions progress from the most general (master plan/total complex) to the more specific (total building, its functions, interrelationships and environmental requirements) and ultimately to each activity center.

Planning Issues. The Environmental Context

Answer the questions and/or develop questions/answers relevant to your project:

What are the characteristics of the following conditions, events, circumstances and nature of existences and how do they influence, independently and collectively, your project elements (people, place(s), site(s), activities, facilities)?

Demographic Social/Psychological Issues

a. Population (large scale, intermediate scale, intimate scale)

1. Consistencies or changes in the number, composition and distribution of people.
2. Catchment population (number, composition and distribution-locations)
3. Population density patterns and socio-economic patterns/groups
4. Expressions/nature of population: perceptions, beliefs-feelings, attitudes, values, appreceptions, cognitions, preferences, behaviors (under what conditions), ideas, concepts, purposes
6. Actions taken to satisfy needs and results of those actions: Physical and mental satisfaction, acquisitions (positive and negative actions): acquisitions and conserving of inanimate objects; actions of power, ambition or accomplishment; actions of defense of status; actions of human power exerted, resisted or yielded to; of affection; actions of asking, telling communication with results (examples); competition for space, location, bets fit; concentration of nodes, events, uses, similarities, necessities; centralization or gathering together at concentrated points or a pivotal point connecting nodes; de-centralization or separate away from nodes or centralized places; segregation or intimate associational preferences and selections excluding others and expressed spatially; invasion/succession: people moving from one location to another (invading another
b. Environment The Natural and Modified Natural Environment (see: MeHarg, Simonds, Oglayay, Rubenstein, Lynch, Rapoport, Hilberseimer)

1. Ecological systems - Questions to answer: Why did humans settle here? Why did they stay? How did they alter the natural ecology? Why were areas of human concentration? What are the major human activities associated with the ecology? What are the present ecological changes taking place and why? What are the critical ecological-environmental issues that impinge upon the project and the environmental context of your project?

2. Climate - the facts and meanings of temperature, humidity, air movement, sun and shade at both micro and macro scales. See Kemper, Architectural Handbook for examples of solar analysis, wind analysis, humidity analysis, precipitation analysis, and thermal analysis. Relate climate to human comfort and functions.

3. Topography - vegetation - wild life - the shape/form of land, observe and record land use patterns/transportation/kinds of construction, desirable or undesirable building areas, predicated upon topography - drainage systems, beauty, etc. Describe the kinds, location and characteristics of vegetation, discover the usefulness of vegetation.

4. Geology and soils - geology should be analyzed in terms of: a material resource, a support for structural systems, shaping
BACKGROUND

the topography and/or, and as a vital element in the water cycle of the earth. Check for possible geological hazards, soils—analyze soils in terms: their permeability, shear strength, and volume change. Required data of the geology and soil of the site include: depth to bedrock, drainage patterns, underground water conditions and depth to water table, susceptibility to erosion, sliding, subsidence, or inundation from floods.

5. Hydrology - the location, occurrence, circulation and distribution of the earth's water and atmosphere including; streams, bodies of water, inundations, tides-flooding, groundwater - tables, aquifers- recharge basins, surface drainage, erosion, siltation, and their relationships to topography, geology, and soils.

6. Biology - the biologic community - plants, birds, animals, fish, insects and integrated back into the ecological system.

c. The Built Environment - an examination, analysis, and graphically recorded study of:

1. The urbanized pattern, structure and form in which your project will be developed (land use/activity patterns and dominant nodes - districts - landmarks - edges - paths (see Kevin Lynch, Images of the City). Relate to population composition/distribution and natural environmental conditions and examine changes occurring.

2. Transportation - circulation systems - functional movement patterns for vehicles and pedestrians. Examine and record the hierarchy of movement systems, the terminal or points of generation and receptions of volumes of movement, the kinds of movement vehicles, and the goods and services and/or purposes of movement - not significant connections and separations. Relate to urbanized patterns, structures and form.

3. Market or catchment area(s) for your project - their characterization, location, size, distances - time characteristics relative to the urban environment and transportation systems and relative to your project.

4. The building condition/age or other significant characteristic (height, bulk, architectural character, agglomerations, etc.)

d. The Imaged Environment - Human Environmental interactive imates. Analyze and describe the character of the natural and built environment. Define Problems, opportunities which impinge upon your project. Good sources of image analysis include:
BACKGROUND


- An examination of the following systems:
  
  1. Economic systems/marketing systems
  2. Technological systems
  3. Management/Organizational systems
  4. Political/Governmental Systems
  5. Regulation, codes, laws, rules systems
  6. Activity Systems
  7. Planning Systems

An excellent summary of example is provided by Kemper in the discussion of "MANITOU STATION: A PROPOSED RESIDENTIAL COMMUNITY" pp. 15-33. Note particularly the progression to larger scale maps. Read the discussion of "Catchment" beginning on p.50 and continue through "Environmental Planning", top of page 120.

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非常重要
Any background statement must summarize current knowledge and future trends relating to regions, localities and neighborhoods in general as well as the specific region, locality and neighborhood. Information sources and format models abound.

Boston Transportation Planning Review - Regional Framework: the report provides the framework to be used by a society in conflict and transition for decisions about:

The Environment
- availability of water resources
- availability of air resources
- quality of the physical environment
- use of vacant land
- quality of life

The Economy
- journey to work
- goods movement
- roles of CBD & airport
- impact of (proposed) construction expenditures

Equity
- consumer cost of transportation
- access to jobs
- equity (quality of transportation services)

Traditional analysis of public works was based on a community cost/benefit review stated in terms of economic growth and engineering efficiency. The inclusion of concern for the consumer evidences a change in public agency orientation. The study sought to articulate, rather than hide the basic conflicts over goals and means (and competing special interests) in solving transportation problems. The different approach produced some surprisingly different conclusions. The study's geographical boundary (circumferential Route 128) proved to be too limiting due to the significant growth patterns and changes outside that perimeter. Also, new institutions and management organizations appear to be as promising in resolving conflict and orchestrating change as might be the alternative facilities changes.

Studies trends included:
- Population decentralization
- Unique and preserving qualities of urban core areas
- Shifts from a manufacturing to a service base has produced an economic crises
- Historic buildings, places and the environmental quality are threatened
- Many do not share in economic growth; low paying service jobs, obsolete and poor housing
- Rubber-tired transportation technologies of auto and truck have shaped the transportation network although Steel rail transit and commuter rail remain viable. The movements of goods and people have contradictory needs.
Conclusions reflect the conflict in the use of public funds to service public transit systems or private automobiles. Construction of new public facilities will create new jobs. Short term solutions and long term solutions appear to be contradictory.

The new conclusions are:

Goals:
1) reduce auto travel (hours of access, controlled roadways, access tolls, parking fees)
2) encourage multi-person vehicular movement (car pool, bus, jitney, rail)
3) facilitate (rubber-tired) goods movements (controlled hours of access, controlled arteries)
4) improved management of existing systems-regional parking policy
5) development of a balanced transportation system including: attractive public transit, arterial street alternatives to major expressways serving finer grained truck and bus movements.

Simonds Landscape Architecture presents a much simpler comprehension of the problem in the rules he offers in relating land use and transportation (p. 210).

1) No traffic study is complete without examination of affected areas
2) Plan expressways past an area rather than to it
3) Other beltways are circumferential "classifiers" of traffic movements
4) Inner rings are "interceptors" to receive traffic or divert it

LAND USE:

Planning considerations of the Alabama Development Office. The report provides an overview of the spatial distribution of existing land use patterns to facilitate future planning. It describes early settlements. A classification system is included (attached) based upon the principal headings of: a) urban & built-up, b) agricultural, c) forestland, d) water, e) non-forested wetlands, and f) bareland.
### Coastal
- Gulf
- Bay
- Estuary
- Other

### NON-FORESTED WETLAND

#### Vegetated
- Other Wetland
- Tidal Flats
- Marshes

#### Bare Wetlands
- Bare Wetlands

### BARELAND

#### Beaches
- Beaches

#### Exposed Rock
- Exposed Rock

### Extractive
- Strip Mines
- Quarries
- Tailings
- Other Extractive Use

### Other Bareland
- Other Bareland
ALABAMA STANDARD LAND USE CLASSIFICATION

URBAN AND BUILT-UP

Residential
- Single Family
- Duplex (2 dwelling units in one structure)
- Multi-family (more than 2 dwelling units in one structure)
- Mobile Home Park
- Mobile Home (single)
- Other Residential
  - Home occupation
  - Lodging House
  - Garage, stable, kennel

Commercial
- Retail Trade
- Wholesale Trade
- Business Services: offices, stores
- Consumer Services
- Other Commercial
  - Theater
  - Hotel
  - Lumber Yard
  - Junk Yard

Industrial
- Light Industry
- Heavy Industry

Transportation
- Motor Vehicle (roads & highways)
- Rail
- Air
- Water
- Communications
- Utilities

Public and Institutional
- Public: police, fire, postal service, municipal, recreation
- Semi-public
- Institutional
  - Church
  - Private School
  - Private Club
  - Nursing Home
  - Hospital

Open Land
- Open Land
- Cemetery

Mixed Urban
- Mixed Urban

AGRICULTURAL

Cropland and Pasture
- Active Cropland
- Idle Cropland
- Rotated Crop & Pasture

Horticultural Areas
- Orchards
- Vineyards
- Groves
- Bush Fruit
- Other Horticulture

Feeding Operations
- Poultry Feeding
- Cattle Feeding
- Swine Feeding
- Other Feeding Operations

Other Agricultural Land
- Other Agricultural Land

FORESTLAND

Forestland
- Deciduous Forest
- Coniferous Forest (evergreen)
- Mixed Forest

Bushland
- Bushland
- Developing Bushland

Tree Plantations
- Tree Plantations
- Other Forestland

WATER

Streams
- Rivers
- Creeks
- Canals

Reservoirs & Lakes (man-made)
- Reservoirs and Lakes
- Ponds
ACTIVITY ANALYSIS

Bibliography:
Alexander, Ishikaw, Silverstein; A Pattern Language; Oxford University Press, 1977.
Chermayeff, Alexander; Community & Privacy; Doubleday & Co., 1963.
Lang, Burnett, Moleski, Vachon; Designing For Human Behavior; Douden, Hutchinson & Ross, 1974.

The statements of goals and objectives provide a basis for developing project concepts once constraints are interposed. However, in order to optimize creative responses to the project problems and issues, an activity analysis must be completed which focuses upon user needs and preferences without imposing conventional space parameters. The characteristics of Activity Analysis include:

A. A discussion of user needs in terms of human behavior and environmental psychology contexts: Behavioral cycles: Pattern language; Functional analysis; circulation. Adjacency; Survey results; preferences, rankings, Environmental limits or consequences.

B. Action oriented descriptions which avoid conventional references (and images) to spaces.

FROM NOTES ON THE SYNTHESIS OF FORM

To solve a problem:

1) It must be possible to generate a wide enough range of possible alternative solutions symbolically
2) It must be able to express all criteria for solution in terms of the same symbolism

Then compare alternative solutions to select "best" via non-arbitraryness, simplicity and clear organization.

See Alexander Diagrams Pp. 81 and 82.
Formally, a decomposition of a set $M$ into its subsidiary subsystem sets is a hierarchical nesting of sets within sets, shown in the first of the two diagrams.

"THE PROGRAM"

Decomposition of a set of misfits.

Each element of the decomposition is a subset of those sets above it in the hierarchy.

Form is derived from the program in the synthesis phrase or the "Realization of the program."

Starting point of analysis is the requirement (functional prop. and constraints). The end product of the program (description of formal characteristics) i.e., Goudi "diagram of compression forces"

User satisfaction and Performance Standards

Translation (a) a requirement diagram is useful only if it contains physical implications—elements of form

(b) a form diagram is useful only if its functional consequences are foreable—if it contains the elements of the requirement diagram

example: traffic count diagrams

"Corbu's 1920's house forms were efforts to understand 20th century living."

Designs are hypothesis: each constructive diagram is a tentative assumption about the nature of the contract.

The intention of a problem can be captured by a diagram

Each variable need be defined only specifically enough to allow the design to be unambiguously defined as a "fit" or "misfit" commonplace communicable limits scales.

Tests 1) How can we be sure we haven't left out an important issue?
2) How do we know all considered variables are relevant?
3) For a specific variable, how do we know when a misfit occurs? Any interaction between form and context which causes stress is a misfit. Design a process of error reduction in organized systems.

Criterion for (problem) decomposition

1) easily grasped implication (form) of (two) variables--which pair can be expressed diagramatically strong

2) it must be possible to combine diagrams

- as a requirement diagram
  1) identify only those features of a problem which are relevant to this set of requirements
  2) contain no information not explicitly called for by the requirements.

- as a form diagram
  1) must be specific about being all physical requirements
  2) so general as to contain no arbitrary characteristics

Every diagram is both pattern (of its own components) and a component. The designer invents a conceptual framework.

PROGRAM

There is a simple statement in "Preface" to the paperback edition of C. Alexander's Notes on the Synthesis of Form which succinctly describes the intent of programming. He disparages study of design process in the abstract which some have initiated as a consequence of accepting that portion of the book's content. Alexander explains that, to him, the importance of the book is the evolution of "the idea of diagrams" or "patterns."

"The diagrams have immense power." Abstract patterns of physical relationships which resolve/optimize small system of interacting and/or conflicting forces, and which are independent of all other forces and all other possible diagrams. It is the idea that is is possible to create abstract relationships, one at a time, and to create designs both of which are whole, by fusing these relationships. Because the diagrams are independent of one another they can be studied and improved one at a time so that their evolution can be gradual.
cumulative. More important, because they are abstract and independent, they can be used to create, not just one, but an infinite variety of designs; all of them free combinations of the same pattern.

The book's central idea is that independent patterns that resolve systems of interacting human forces can be identified in a natural way by considering the implication of limited systems of forces and their conflicts. Understand the idea that patterns are created by studying limited systems of forces which are internally strong and whose interactions with other forces are weak.

Rapaport has suggested that the concepts of the collective unconscious must be understood before discovering the meaning of shelter. (1) The collective unconscious is discussed in terms of "self" and "symbol"--the archtype behavioral setting. Charles Burnette offers five space concepts of Jean Praget as described by Christian Nober-Schulz which range from conscious to unconscious. (2)

1. **pragmatic** space of physical action (man/nature integration).
2. **perceptual** space of immediate orientation (identity necessary to function).
3. **existential** space which forms man's stable image of his environment (social and cultural linkages).
4. **cognitive** space of the physical world (logical conceptualization).
5. **abstract** space of pure logical relations (symbolic conceptualization).

The Activity Analysis should evidence the search through each of these conceptual ranges of meaning. The statements of goals and objectives may provide a basis for developing project concepts once constraints are interposed. However, to optimize creative responses to the project problems, an Activity Analysis should focus upon user needs and preferences without imposing conventional space parameters. Of course, some building types such as athletic facilities offer limited potential for this approach.

Activities can be described morphologically as: a) list of characteristics or b) methods of achievement. Observers are conditioned to understand activities in terms of conventional places of performance (bar, dining room, etc.) without open-minded consideration. It is important for the programmer to conceptualize activities in terms of enveloping environments. In his description of surrounding environments, Ittelson provides a useful list of characteristics. (3) Environments surround; no fixed boundaries in time or space.

a. surrounding quality forces observer to become a participant.
b. multi-model prospectus (perception, motivation, cognition)
c. peripheral (outside the focus of attention) and central information from visible stimuli
The Activity Analysis should employ performance language. Using the Performance Concept: State desired attributes, either in terms of 
a) user satisfaction or b) performance characteristics, without 
specifying the means to be employed in obtaining them. It allows 
the fundamental question to be raised as to the optimum way a 
basic need can be met by describing the needed solution through 
identification of its problem-solving characteristics.

In performance concept language describing enacted behavior, the 
programmer just consider the hierarchical relationships of activities.

1. Identify activity (avoid references to spaces)
2. List secondary or derived activities.
3. List boundary requirements for each activity and identify 
   whether or not the environmental boundary (stated indirectly 
as a statement about behavior) is based upon fact, or 
assumption.
4. Determine dimensional and area limits -- anthropometrics.
5. Select tentative operational arrangements.
6. Rank activity relationships.
7. Synthesize activity patterns.

Having described each activity, examine their compatibilities 
or fit. (4).

8. Select activities which can take place in a common cell or 
   physical environment (as defined by boundaries) whether 
   primary or secondary in nature.
9. Examine alternative arrangements for relating cells on 
   the basis of essential boundary conditions and optimized 
   functional patterns.
10. Select the most meaningful arrangements from among the 
    alternatives.

Perin explains: "The best way of expressing data for a designer or 
physical things is in terms of enacted behavior which use space, place, 
frequency, duration, extent, objects and other people to accomplish 
its purpose. (5)"

A. Which activities need physical support?
B. Which activities need acknowledgement of environment?
C. Concepts that unify conditions under which we do some 
things and not others.
"The Design program is a scaffolding to connect the human sciences with environmental design." (6)

In Environmental Psychology (7) the four aspects of 1) privacy, 2) personal space, 3) territoriality and 4) crowding are explored. The study of these aspects is overlayed with consideration of stress and satisfaction. By definition, this discipline is the study of individual's use of and adaption to the physical environment, particularly urban settings as described in terms of these phenomena. "Freedom of choice" is offered as a unifying concept in the examination of an individual's aroused and active efforts to search the physical environment for relevant ways of achieving personal goals.

No established theoretical structure or organizing concepts exist. A general understanding of human behavior as an experience in relation to physical settings has been examined under more or less controlled conditions. Therefore, the principles holding implications for the design of spaces have only begun to be examined. Basic data gathering techniques include: survey, observation, experimentation. (8)

"Stress Inducing & Reducing Qualities of Environments," as explored by Susan Seagert. It is asserted that stress is a systemic concept--both a physical and a psychological syndrome. (9) As a behavioral system, personal space territoriality concepts provide essential social objectives to minimize physical conflict and limit aggression through spatial and/or social order. (10) Recognition of territoriality provides a means for establishing and maintaining a sense of personal identity. (11)

Personal space is a subset of the general concern of territoriality. Robert Sommer describes personal space first as a physical state "...the emotionally charged zone around each person...which helps to regulate the spacing of individuals," and secondly as the "...process by which people mark out and personalize the spaces they inhabit." (12)

Altman considers privacy as the central theme in relating privacy, territory and crowding. The concept of territory (and personal space) provides a mechanism for achieving a necessary balance between privacy and social interaction. The psychological condition of crowding evidences the functional failure of that mechanism. (13)

Weston offers an analysis which identifies four basic states of privacy 1) Solitude - free of observation by others, 2) Intimacy - minimized sensory intrusion from outside this boundary of a maximized interpersonal relationship, 3) Anonymity - freedom from surveillance in a public setting and 4) Reserve - secrecy in aspects of self regardless of social circumstances. (14)

Privacy is an interaction concept, a learned sensitivity of the need to escape the demands of the presence of others. It is an expression of self and ego which is developed as a conscious intentional separation from social and physical environments.
Attitudes toward privacy reflect changes in socio-cultural patterns and the individual's state of progress through the cycles of life. Age, socio-economic status, needs, desires, abilities, experiences, and feelings all impact privacy requirements. Personal roles, societal demands and values all continuously evolve. The calculus of behavior which anticipates future consequences of contemplated actions employs the concept of privacy. The importance of one's ability to exercise control over privacy is responsive to both persons life cycle state and the socio-environmental circumstance. (15)

Altman relates population density to the social pathologies of crime, mental health and physical disease; the social processes associated with the crowding are examined in terms of stress. (16) Not all crowding is stress inducing. Indeed, R. G. Baker (cited elsewhere) concludes that the "under manning" of spaces may induce stress.

D. Stokols offers a definition of crowding as a personal, subjective consequence of goal-directed behavior and distinct from the physical quality of density which is, in contrast, devoid of psychological meaning. "The experience of crowding, thus, can be characterized as a motivational state directed toward the alleviation of perceived restriction an infringement, through the augmentation of one's space supply, or the adjustment of social and personal variables so as to minimize the inconveniences imposed by spatial limitation." (17)

The consequence of an individual's sense of disequilibrium in managing the mechanism of territoriality is stress. Coping with stress inducing crowding situations often involves stress reducing socio-cultural mechanisms implicitly shared. (All facing the same direction in elevators, queuing at bus stops.) Aggression and withdrawal are responses to crowding induced excessive stress. (18)

Case studies of buildings in use provide one of the most effective means for examining the fit of activities with their environments. In the Fourth Dimension, E. and M. Hall compared the pre-building intentions with the post-occupancy evaluation in ways which illuminated the impact of corporate policy upon the daily behavior of employees. Their report offers poignant insights for programmers and designers. The lack of; personal privacy, opportunity to personalize work places, and spatial opportunity for social informalities are inhibiting. Hall concludes that work of some employees would be improved by the introduction of some screening. Fatigue, complaints about cafeteria food and parking space remoteness appear to be among the consequences of the open, uncluttered design of office spaces. Sarinen's unrealized expectation was that the building's absence of color would be fully compensated for by its occupants. While the buildings fame did produce a responsive improvement in employee dress, the art works color added over the initial five year period was considered a significant improvement. It's worth repeating here that the emphasis upon performanc language throughout the program text is intended, in part, to facilitate the post-occupancy evaluation of each programmed project.
The elements of the language are entities called patterns. Each pattern describes a recurring problem and the core of a solution to that problem. The description is phrased (or abstracted) to permit its repeated use without design (or form) duplication. Each language is a culturally based network with similarities, and notwithstanding the different languages resulting from individual preferences.

Pattern Format: The two essential purposes of the pattern format are 1) to present each pattern in connection with the related larger and smaller patterns— and thus to grasp the essence of all patterns in the language and 2) to present the problem and solution of each pattern in such a way that it may be judged or modified without loss of meaning or purpose.

1) Pattern title in Bold type (with astrisk evaluation)
2) An illustration of archtype example of pattern
3) An introductory paragraph describing the context of the pattern by explaining how it helps to complete certain larger patterns
4) The problem description is captioned in a bold type heading—the essence of the problem in one or two sentences
5) The body of the problem description follows
   a) empirical background of pattern
   b) evidence for its validity
   c) range of different ways pattern can be recognized or manifested
6) The problem solution, capitalized in bold type
7) The description of the solution pattern which describes the field of physical and social relationships which are required to solve the stated problem in its stated context. It is always stated in the form of an instruction—what to do.
8) A diagram with labels to indicate solution components
9) A paragraph which relates this pattern to all small patterns of the language which are needed for embellishment.

No pattern is an isolated entity. Each exists to the extent that it is supported by other patterns; the larger patterns in which it is embedded, the similarly scaled patterns which surround it and the smaller patterns which are embedded in it. This is a fundamental view of the world.

Each solution is stated in such a way as to describe the essential field of relationships needed to solve the problem; but stated in sufficiently general terms as to allow adaptation to personal preferences and local conditions. The solution is stated to capture the variant properties common to all places.
FOOTNOTES


8. ibid., p. 10.


PLANNING AND DESIGN GUIDELINES

CHILD CARE CENTERS AND OUTDOOR PLAY ENVIRONMENTS

Gary T. Moore and Uriel Cohen
Environment-Behavior Research Institute
University of Wisconsin-Milwaukee

&

Tim McGinty
Community Design Center, Inc.
Milwaukee

with

Ann Blocher Hill, Research Assistant
Carol Gee Lane, Research Assistant
Lisa A. Lindberg, Administrative Secretary
Heidi Marie Hollenbeck, Editorial Assistant
Donald Gatzke, Graphics Assistant
Thomas Mudrovich, Graphics Assistant
Mary Keeler, Photographic Assistant
Mark Beaudry, Photographic Assistant

Frederick A. Jules, Design Consultant

Project Officer

William E. Johnson, Special Projects Section
Office of the Chief of Engineers
U.S. Department of the Army

with Murray Geyer and Shirley Brown
SYNOPSIS

TITLE

PLANNING AND DESIGN GUIDELINES:
CHILD CARE CENTERS AND
OUTDOOR PLAY ENVIRONMENTS

PURPOSE

The purpose of this project was to research and develop two design guides on environments important to child development—child care centers and outdoor play areas—and to specify new, research-based criteria for the design of these facilities for military bases around the world.

CONTEXT

The project responds to two problems affecting the children of military families (about 1,200,000 children). First, the Army maintains the largest number of employee-sponsored child care centers in the country (close to 200). As is the case everywhere in the country, demand for child care far exceeds supply. Furthermore, existing centers are totally inadequate, often shoe-horned into old barracks. Second, outdoor playgrounds and informal play areas are seriously lacking in most family housing areas.

These problems must be seen against the background that the early preschool years are the time of the child's most rapid and formative development. While many children spend 8 to 10 hours a day in child care facilities, they are also the greatest users of public outdoor space. It is now recognized that early childhood development can be stimulated through the better design of child care centers and outdoor play areas.

The military has recognized the need for more and better facilities and for better design guidance, and anticipates spending several hundred million dollars over the next decade for new construction, renovation, and adaptive reuse to provide better children's environments.

However, as the research behind this project has been broadly based, it is not restricted to military settings but is applicable to the country as a whole (over 75 million children).

OBJECTIVES

The project focuses on developmentally-appropriate environments for children, that is, optimal settings for stimulating physical, intellectual, and social development. We asked the questions: What architectural factors contribute to developmentally-oriented child care? And what factors contribute to outdoor play environments which will enhance all areas of the child's growth and development? Old models of traditional "playgrounds" and institutional "baby sitting renters" were rejected as we searched for new ways to think about—and to design—environments for the developing child.

Specific objectives were the following:

- to identify key design features and physical patterns which facilitate child development
- to assess a sample of military and civilian children's settings
- to interpret the latest research on children's environments from around the world
- to develop behaviorally-based criteria and design patterns for child care centers and outdoor play environments
- to produce two planning and design guides for use by architects, landscape architects, child care directors, recreation personnel, and housing and neighborhood planners in the contexts of master planning, programming, design, and evaluation
RESEARCH PROCEDURE

1. Literature Review
2. Field Research and Post-Occupancy Evaluation
3. Criteria and Pattern Development

A three-step research procedure generated the design guidelines:

LITERATURE REVIEW

A systematic search was made of all research and design literature pertaining to the planning and design of children's environments. Emphasis was placed on empirical research on children's needs relative to the physical environment, effects of the environment on children's behavior and development, and post-occupancy evaluations of child care centers, playgrounds, and related settings. Supporting information was also sought from programming studies, building type studies, and expert opinion. Finally, manufacturers' brochures, and military, national, and state codes and licensing regulations were consulted.

The standard indexes and print bibliographies in child development, early childhood education, environment-behavior studies, architecture, and planning were consulted, and a computer search was conducted through the ERIC System and other computer-based indexes.

The project staff collected and catalogued over 1500 sources, including books, research papers, building type studies, conference presentations, and brochures. Over 5000 slides and hundreds of black-and-white photographs were collected of significant architectural examples around the world. Collected and catalogued, the research team now has an excellent library--open to the public--of the world literature and other source materials on children's environments.

Two interim reports were prepared from this phase of the research--abstracts of the 40 most important works and a master bibliography.

- Bibliography on Children's Environments: Child Care Centers, Outdoor Play Environments, and Other Children's Settings, 1979.

POST-OCCUPANCY EVALUATION

At an early phase of the project, field research and informal post-occupancy evaluations were conducted at 50 children's environments around the U.S. and Canada. The sample was comprised of 15 civilian and 8 military child care centers, and 20 civilian and 7 military play areas, and included playgrounds for handicapped children, Montessori child development centers, infant care centers, adventure playgrounds, and a children's museum. The settings varied in geography, climate, rural-urban context, program philosophy, type and size of building or play area, budget, and degree of community involvement, and included disasters as well as award-winning projects.
Research instruments used at each of the 50 sites included:

- Architectural inventory of the site, building or play area, subsystems, and construction details, including sketches and photographs.
- Observation and recording the spatial behavior of children, staff, parents, and other participants in the setting.
- Focused interviews with staff, program directors, administrators, base planners and architects, and some parents and children.

In addition, interviews were conducted with nationally-known experts.

All data was analyzed and summarized into a case study on each facility. Emphasis was given to the results from the user observations and interviews. Assessments were made of special strengths and weaknesses of different building types and design features relative to educational philosophies and child development goals.

The results were reported in an earlier case study and appendix.


The criteria development process had six basic steps:

- Identification of behaviorally-based design issues. Sources included the research literature, field research, previous research experience of the principals, and consultants. Example issues are reducing anxiety children feel when being dropped off at a child care center, or providing safe yet challenging neighborhood play areas.
- Assembly of relevant information. Data was assembled for each issue by the project staff into packets tacked to a large working wall. Emphasis was given to empirical research, but building type studies, the 5000 slide collection, and the case studies were culled for examples of particular designs solving the identified problem.
- Generation of patterns. The team used the collected information as the starting point in proposing solutions to the various issues. Some patterns could be deduced directly from existing empirical research (e.g., from the effects of crowding on children's behavior in day care) while other patterns had to be arrived at inductively (working hypotheses) in order to resolve conflicts between environment and behavior (e.g., children's need for creative challenge versus the paucity of stimulation provided by most playgrounds). Sample solutions and their issues include HOME BASES for P to 16 children in response to group size and CONTINUITY AND BRANCHING in response to attention span.
- Development of technical criteria. Elaboration to each pattern to aid in its implementation, including square footage, adjacencies, materials, fire safety regulations, etc.
- Refinement and illustration of each pattern.
- Organization of the patterns into a logical sequence for policy making, planning, and design.

The output from this process is a set of 115 patterns for child care facilities and 75 patterns for outdoor play environments, together with supporting evidence, illustrations, and introductory material. The two accompanying design guide documents have been submitted and accepted by the client, and will be published in an edited form in 1980.

- Recommendations for Child Care Centres, 1979.
Each design guide is organized in three major parts.

INTRODUCTION
- nature of child development
- role of the architectural environment
- the nature of and different types of play and child care programs
- a conceptual typology of different types of child care facilities and play environments
- emerging national and international trends

This section represents the minimum necessary introduction to child development theory and types of program options. The assumption is made that most designers will not go beyond these guides, and thus all the background information is furnished together in one place.

PLANNING
- policy decisions
- site surveys and location decision-making
- regional master planning criteria and processes
- techniques for developing facility programs including user participation and for estimating site development and building costs

The goals of this section are to enable base master planners or facility engineers to prepare overall master plans for child care facilities and outdoor play areas for the base or region as a whole, and to program and cost particular facilities in active collaboration with child care directors and recreation personnel.

DESIGN
- general design criteria
- site design principles
- architectural design criteria, from general to specific, from overall organizing principles to patterns and criteria for specific activity spaces
- building subsystem recommendations
- furnishings (child care centers) and site details (play areas)

The patterns in this section parallel the design process, that is, they evolve from siting and broad concepts of design to individual space criteria, building subsystem recommendations, and technical details. This is the section which would be most intensively used by design architects.

Each pattern presents all the necessary information for design with the child in mind, but only presents that information derived from considerations of child development—no attempt has been made to include standard operating procedures, as other technical references are available. Thus, information on duct sizing is not given, while suggestions on child-scaled building materials are given.
A detailed Executive Summary is provided at the front of each design guide. The following is offered to give a sample of a few of the most crucial findings and resultant patterns and recommendations from the 190 patterns in the accompanying documents.

**POLICY RECOMMENDATIONS**

- The total number of children served in one child care facility is directly related to the quality of child care services provided.

  New policies should be established to limit the size of child care centers to 60 to 75 children. Where larger numbers cannot be avoided, policies should dictate the construction of a campus plan of semi-autonomous modules of 60-75 children each.

  (Child Care, Patterns 410 & 504)

**PLANNING RECOMMENDATIONS**

- Most parents and children want to have child care within walking distance of home, and children's anxiety about some centers is heightened when the facility is in an unfamiliar locale.

  Child care centers should be provided for a mile diameter catchment areas, and should be located on the seams between neighborhoods.

  (Child Care, Patterns 508-511)

**DESIGN RECOMMENDATIONS**

- Children are more likely to be content and feel less separation anxiety from parents if they are in a familiar setting.

  The entry sequence to any child care center should be residential scaled, friendly, home-like in character, provide a sense of protection and enclosure, and provide views through to a friendly face and to activities inside.

  (Child Care, Patterns 803, 914-913)

- Small groups work best. The size of the group in which the child spends most hours of the day makes the most difference to the quality of child care services offered. Left on their own, the vast majority of children play in groups of 2 to 5.

  Child care centers should be organized in terms of home bases for 8-10 infants-toddlers and for no more than 16 older preschoolers. Resource rich activity pockets should be provided for 2-5 children around the home bases.

  (Child Care, Patterns 906-908)

- The needs and demands of children of different ages often compete and conflict. Yet children learn from contacts both with children their own age and from younger and older children.

  Partial separation should be provided for different age groups in a modified open space layout, but all indoor and outdoor activity spaces should include an infant-toddler-pre-schooler connection with strong visual and circulation connections and with some overlapping spaces.

  (Child Care, Patterns 905, 909-910)
OUTDOOR PLAY ENVIRONMENTS

POLICY RECOMMENDATIONS

- Play is essential to healthy social, physical, and intellectual development. Children are the greatest users of public outdoor space, and the majority of children's play occurs in informal neighborhood settings.

  Policies should be adopted which stress the importance of play and of informal neighborhood-based play spaces, and which encourage the better design of all public outdoor spaces (e.g., throughout family housing areas) with the developmental needs of the child in mind.

  (Child Play, Patterns 101-103, 108)

- The success of comprehensive play programs depends on advocates for play and on qualified play leaders, both a long recognized need in Europe.

  Policies should be promulgated which provide a children's play advocate and qualified play leaders on every military base.

  (Child Play, Patterns 102, 106)

PLANNING RECOMMENDATIONS

- Children will play anywhere and everywhere; they need a wide variety of play and recreation opportunities.

  Every military base and similar regional area should work toward implementation of a tiered park system, hierarchically organized to include a regional park, smaller neighborhood parks, comprehensive playgrounds, and links and networks of play.

  (Child Play, Patterns 200-209)

DESIGN RECOMMENDATIONS

- The overall success of a play area is inversely related to the degree of haphazard juxtaposition of different pieces of play equipment. Children's attention span is less on traditional, manufactured play equipment than in other types of play environments like creative and adventure playgrounds. The predominant activity on conventional play equipment is motor and physical play.

  Provision should be made for the organization of overall play spaces in accordance with sound, behaviorally-based site organization principles like continuity and branching, controlled access, looped circulation, and separated but linked zones. Within this matrix, provision should be made for a variety of play opportunities and types of play spaces.

  (Child Play, Patterns 505-511, 600-614)

- The quality of all play spaces can be enhanced by good design that responds to children's developmental needs and the role of the physical environment.

  Provision should be made for the organization of overall play spaces in accordance with sound, behaviorally-based site organization principles like continuity and branching, controlled access, looped circulation, and separated but linked zones. Within this matrix, provision should be made for a variety of play opportunities and types of play spaces.

  (Child Play, Patterns 700-722)
Crowding: Meaning, Theory, and Methods

Irwin Altman
The University of Utah

1. A certain set of precipitating conditions.
   a. **Situational factors**, which include high density of people per unit of space, for long periods of time, and in physical environments where resources are limited and where few behavioral options are provided.
   b. **Personal factors**, such as inexperience and/or inability to deal with others in dense situations and low expectations and desire to interact with others, based on personal history, mood, and the like.
   c. **Interpersonal conditions**, such as social interference, inability to obtain resources, and intrusion.

2. A set of **organismic, psychological factors**, such as feelings of stress, disruption, and malaise.

3. **Coping responses**, including verbal, paraverbal nonverbal, and environmentally oriented behaviors that are ineffective in reducing stress or in achieving desired levels of interaction over lengthy periods of time.

4. Extreme **costs** in terms of physical, physiological, and psychological outcomes.

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**Figure 4** A model of crowding
Mildred and Edward Hall wished to compare attitudes toward the work place before and after occupancy. The intent of the exercise was "to reveal a paradigm."(*) They entertained three assumptions: 1) settings elicit standard behaviors, 2) behavioral studies must reference the context of environment, and 3) buildings may be examined independent of the rest of the physical setting. Consequently, this study examined three variables: a) the structure, b) the occupants, and c) the corporate organization. Their conclusion is that the building's communication had important consequences for the occupants.

Chairman of the Board, Wm. A. Newett, provided both a strong personal and corporate imprint upon the building. In hiring Architect Saarinen, he expressed an intention to create a building which was outstanding aesthetically, to raise local architectural standards of modern architecture, and to project an appropriate corporate image.

Saarinen's initial design was an inverted pyramid sited on the top of a hill. It was rejected. In making that initial presentation, he described three major intentions: 1) to provide functionally efficient space, 2) to create a pleasant (working) environment, and 3) to express in architecture the special character of the company. The second design was accepted and constructed.

The authors attribute the building's success, in part, to the careful pre-planning. Departmental growth projections and adjacency requirements were carefully considered. The basic 3' x 6' module was thoroughly examined in model and mockup as were many or most other aspects of the design solution.

The outcome is praised by the authors as an invaluable asset. It conveys quality and congruence, extreme sense of order, efficiency, neatness, precision, a design for work. The segregation of departmental units encourages autonomy of function. The partition system is used and contributes the intended space flexibility. The absence of a gradation of quality in furnishings enhances the sense of each worker's self-worth. The open planning and employee access to the building's perimeter provides most with a conscious opportunity to appreciate the beauty and vitality of the pastoral exterior environment. Employees consistently expressed appreciation of that consideration.

The lack of personal privacy, opportunity to personalize work places, and spatial opportunity for informalities are inhibitions. (**) Fatigue, complaints about cafeteria food and parking space remoteness appear to be among the consequences of the open, uncluttered design of office

(*) Mildred & Edward Hall, The Fourth Dimension In Architecture; The Impact of Building on Man's Behavior; the Sunstone Press, Santa Fe, N.M., 1975, p. 7.
(***)Ibid, p. 18 (Hall concludes that work of some employees would be improved by the introduction of some screening.)
POST OCCUPANCY EVALUATION

spaces. Saarinen's unrealized expectation was that the building's absence of color would be fully compensated for by its occupants. While the building's fame did produce a responsive improvement in employee dress, the art works color added over the initial five year period was considered a significant improvement.

The HVAC system controls received the usual range of complaints. Additionally the low humidity maintained in winter for the purpose of avoiding window (single pane) condensation and the consequent chill adjacent to windows were acknowledged design shortcomings. So was the loss of acoustic privacy due to the sound transmission through executive office floor ductwork.

On the executive floor, where the module and open planning concepts were not imposed, the secretaries were more critical of their loss of privacy. Occupants of the windowless ground floor were also more vocal of their feelings of oppression. The authors suggest that the programmers and planners did not adequately explore their needs during the initial phases. The provision of a first aid station -- and consequent access to a nurse -- produced a demand for medical attention not contemplated by the plan and not easily accommodated after occupancy.

In the final analysis, most employees are enthusiastic about their work environment. The corporate image was enhanced internationally. The standards for local architecture did improve. Job applicant qualifications improved. Work efficiency did improve. The authors draw more general conclusions in a "IV Summary for Architects" beginning on page 32 of their monograph.
SITE ANALYSIS

Having studied the project activities while avoiding form generating preconceptions, the programmer is then prepared to analyze the selected site or site alternatives. The intent is to examine existing conditions and development potentials. This is done first, by describing each of the factors which influence site usage and then by suggesting zoned uses of the site which optimize the behavior setting requirements, of programmed activities, both interior and exterior. The intent is to be described in terms by which the designed site development can be judged as to its response to these existing conditions and functional needs.

Suggested references:

- Gordon Cullen, Townscape

Analysis Methodology

1) List activities/functional requirements
2) Order concepts randomly accumulated
3) Consider separately each of the factors listed below
4) Examine maps, ordinances and related public documents related to land use and comprehensive planning
5) Examine background for site implications
6) Develop site aspects of case studies
7) List timing and economic constraints such as project phasing and budget comparisons
8) With regard to each factor, describe and/or diagram the necessary design response in evaluative terms.


Note Simonds "Site Analysis Diagram", p. 51, and "Site Structure Diagram", p. 52, of Landscape Architecture and examine the profuse analytic and conceptual diagrams through the text. The factors considered by each of the earlier referenced authors are diagrammatically examined in this text.

In Earthscape, Simonds examines McHarg's principles in more simplified diagrams and terminology. In doing so he extends use of the principles to more simple and smaller scaled circumstances.

Principle Factors of Analysis

Historically, architectural forms have largely resulted from man's struggle with adverse climate conditions. Controlling interior climate mechanically has contributed to insensitivity to general and local climatic variations
and to the creation of unresponsive styles of architecture. Because climate is a necessary stimulus to human life, the totally insulated environment that does not relate to the natural cycles of the local climate is not desirable. The end of the cheap-energy era may encourage taking advantage of favorable climatic aspects while minimizing the impact of the adverse aspects.

McHarg's enormous contribution to regional planning processes is to compose information relating to the many, often conflicting ecological considerations. His analytic methods are thorough, costly, and comprehensive. His conceptual method superimposes color overlays to reach a composite understanding of optimum multiple land uses. His "intercompatibility of Land Uses" matrix includes the following elements: urban, suburban, industrial, institutional, vacation settlements, forestry, recreation, and water management.

His studies also include the natural determinants of climate: temperature extremes, fog, flood and drought control; stream sedimentation, water pollution, air pollution, and consequent soil erosion.

Natural features considered include: surface water, flood plains, aquifer outcrop, steep slopes, unconsolidated sediments, crystalline bedrock.

Urban suitability is classified as to: prime—no restrictions; secondary—forested; qualified (as in aquifer outcrop), restricted—steep slopes; unsuited—flood plain; unavailable—institutional or public open spaces.

Urban Human Factors include: social disease, physical and mental disease, ethnicity, race, pollution, density, unions, poverty, unemployment, housing quality, overcrowding and illiteracy.

Lynch points out that in locating structures and activities in space, the differences which arise from the spatial arrangements generate significance in terms of: proportion, density, shape, grain, pattern and linkages. Planning begins with two considerations: 1) human purposes, and 2) pre-existing conditions. He points out that while a development disturbs a site it should enhance and not violate it. Typical goals include:

a) functional adequacy
b) optimum communication
c) choice/variety
d) cost-optionalizing criteria
e) health and comfort
f) adaptability—future uses
g) image quality—livability, enjoyment, meaning

Having examined each factor's impact on future design solutions, it is important to conceptualize the consequences. This can be accomplished in terms of related factors groups. Doing so leaves the synthesis of these factors to the designer. A useful form of this conceptualizing is illustrated by Simonds in Landscape Architecture on p. 52 and thereafter. Quality graphics are desired.
SITE ANALYSIS

PHYSICAL FACTORS

SCOPE OF ENVIRONMENTAL ANALYSIS:

Environmental analysis encompasses the interrelationship of land use with the environment, involving physical, functional, legal-political, economic and social relationships and leads to the determination of environmental criteria for (a) programming and (b) designing. (p. 91, Lynch, Site Planning.)

Data on the site and its immediate context (with annotations);

A. Physical Data
   1. Geology and soil:
      a. Underlying geology, rock character and depth
      b. Soil type and depth, value as an engineering material
         and as a plant medium
      c. Fill, ledge, slides, subsidence

   Soil structure: Thermal conductivity of natural materials generally decreases as these materials are drier, less dense and more porous. For example, conductivity decreases in the following order: solid granite, wet sand, humus, wet marshy soil, dry sand, peat. Ground surfaces affect on the temperature because it either reflects or absorbs the solar heat.

   2. Water:
      a. Existing water bodies - variation and purity
      b. Natural and man-made drainage channels - flow, capacity, purity
      c. Surface drainage pattern, amount, blockages, undrained depressions
      d. Water table - elevation and fluctuation, springs
      e. Water supply - quantity and quality

   3. Topography:
      a. Pattern of landforms
      b. Contours
      c. Slope analysis
      d. Visibility analysis
      e. Circulation analysis
      f. Unique features

   The topography that is, the shape of the land, is a prime determinant of land use and circulation patterns. Topography determines shape of cities as well as individual site and building developments. Topographical maps indicate the character of the site; they indicate slopes, hills, valleys, streams, wooded areas, all man-made features such as roads and structures and also easements, property lines and utilities.

   The U.S. Department of Geological Survey provides contour maps of all areas in the scale of 1 inch to 2000 feet and contour intervals of 10 to 20 feet. For more detailed maps, the services of surveyors and civil engineers are usually needed.
SITE ANALYSIS

The slopes of a site determine to a large extent its development potential. Slopes under 4% are considered level. From 4% to 10%, they are called easy grades and can be used for almost all types of construction. Over 10% they are considered steep and construction becomes more expensive. If there is no slope, a site may have drainage problems, and slopes of 50% or more are subject to erosion. Maximum slopes for some other types of land use are as follows: grassy recreation areas--3%, walkways-4%, parking areas-5%, driveways-8%.

Natural and man-made drainage networks need to be identified. Also must be identified the views available from different points of the site. Contour maps are to be used to make notes regarding the exposure to sun and wind on different slopes.

Topography affects air movement as well as orientation to the sun. Wind speeds on the crest of a ridge may be 20% higher than those on the flat ground, and wind is generally quieter on the lee side than on the weather side of a hill. But the later condition may be reversed if the lee slope is gentle and the weather side is steep.

Cold air floods are a nocturnal phenomenon on open slopes. A layer of cold air near the ground is cooled by the ground beneath it and flows downhill. Positions at the foot of long open slopes are notoriously cold and damp, and hollows become frost pockets. Such air flow can be diverted by barriers uphill or prevented from pooling by breaching the downhill topographic dam. When air is coldest near the ground and warmer higher up, the situation is called an "inversion", because it is the reverse of normal daytime conditions. If the day is also windless, then fog and smoke will not be dissipated, and thus smog will collect over urban areas.

Topography may be analyzed in a methodical way as a mosaic of slope areas, a potential network of circulation, a set of fields of view, or a collection of probably micro-climates. It must also be judged as a total system, a unique landscape, a place of particular character.

4. Climate:
   a. Regional data on variation of temperature, precipitation, humidity, solar angle, cloudiness, wind direction and force
   b. Local microclimates: warm and cool slopes, air drainage, wind deflection and local breeze, shade, heat reflection and storage, plant indicators.
   c. Sound levels, smell, atmosphere quality

The general climate of any area is mainly a function of latitude, altitude above sea level, distance from the ocean and conditions of the ocean. It is expressed in data on the range and distribution of temperatures, the hours of sunshine, solar orientation, the direction and velocity of winds, precipitation, and humidity.

The general climatic condition within the United States can be summarized in four major climatic zones: 1) cool, 2) temperate, 3) hot arid and 4) hot humid. The main source of information on general climate is the U.S. National Weather Service.
Local changes in the general climate can occur at any site owning to small-scale variations in the topographical features of the site. This local climate, or micro-climate, is largely a function of elevation above sea level, exposure to sun and prevailing winds, size, shape and proximity of water bodies, soil structure, vegetation (trees, shrubs, meadows, crops) and man-made structures (buildings, streets, parking lots, etc.)

Although the spatial extent of any of these factors may be quite limited (e.g., the two sides of a shadow line, two sides of the same building, two slopes of the same hill,) their impact on people may be very large. From an experimental point of view, hundreds of miles and not dozens of feet might separate two adjacent micro-environments.

Elevation above sea level: Since thin air in higher altitudes is less capable of conducting and storing heat, the temperature drops 1 degree F. with each 200 - 400 feet rise. In some marginal areas, like northern Florida, elevation becomes so important that weather forecasts and frost warnings are issued in terms of altitude.

Exposure to sun and prevailing winds: The directions of slopes may greatly modify micro-climate. South sloping sites may be much warmer than north facing slopes and may have several more weeks of growing season because of later arrival of cold weather. There is usually more rain falling on the leeward (opposite of windward) side of a mountain, and wind turbulence is the lowest at the bottom of the hill, while the highest wind speed occurs at the top.

Size, shape, and proximity of water bodies: Since water has much the higher specific heat, temperature accumulation and decay is much slower in water than on land. Water bodies store the solar heat during the day and release it at night. Since large water bodies have much less heat loss during the winter than does land, they create mild winters in coastal areas whereas in summer the water temperature is lower than that of the land (land absorbs the heat faster), and the cool breeze towards the land prevents excessive heat.

Information on micro-climate can be obtained only through personal observations or those of long-time local residents.

Human comfort:
A healthy human body maintains a constant inner temperature of about 90°F. If this temperature varies, the person will be uncomfortable; if it rises 10°F, he/she will die or suffer serious damage. Although the body can release or store heat to maintain its optimum temperature even in extreme climatic conditions, most people feel comfortable within a relatively narrow range of temperature and humidity. This range varies from one individual to another, one culture to another, and one activity to another.

Comfort range is generally between 70 and 80 degrees F., as long as relative humidity is between 20% and 50%. People feel definite discomfort in temperatures above 85°F and below 60°F. At high temperatures air movement or mechanical cooling is required. High humidity adds to the discomfort.
in hot weather as well as in the cold. Air movement adds comfort in hot and high humidity conditions; flows of 50 to 200 feet per minute are pleasant and flows of higher speed are annoyingly drafty.

The architect can help create comfort conditions through proper orientation, proper use of fenestration and materials, ground cover and planting, shading or exposure to sun and mechanical equipment for heating and/or cooling.

5. Ecology:

a. Dominant plant/animal communities — location and relative stability
b. Their dependence on existing factors, self-regulation, and sensitivity to change
c. Mapping of general plant cover, including wooded areas.
d. Specimen trees to be retained: their location, spread, species and elevation at base

Vegetation:

The natural vegetation of a site can give valuable information regarding the soil and local micro-climate. If the site is poorly drained, its trees and shrubs will differ from those on a site that is dry and rocky. The amount of vegetation on hillsides of different orientation also indicates the different amounts of precipitation to which those areas are exposed. Existing plants indicate also the types of new planting likely to grow well on the site. Existing large trees should be preserved wherever possible. Not only are they beautiful to look at and complementary to a building, they also control the micro-climate with respect to wind, temperature, noise and glare.

Plants alter the form of the surface, increasing the area for radiation and transpiration, shading the ground, braking air movement and trapping air within the stand. The net result is a cooler, more humid more stable micro-climate. Plants will also trap a certain amount of smoke and dust. Thick (50 to 150 feet) belts of shrubs and trees are effective windbreaks and reduce wind velocities by as much as 30 to 50 percent! Deciduous trees, while providing shade in summer, allow sun to come through in winter. On a day when the standard temperature is 77°F, concrete surface and grass surface temperatures can be 95°F and 52°F, respectively!

Ecology:

Ecology is the study of the dynamic relations between a community or organisms and its habitat. Since man is part of nature, urban areas are also ecological systems. Self reproducing, evolving, competitive, and cooperating organisms interact with their changing spatial environment to form a community that persists but gradually changes. Ecological communities are not moral and to man they may appear ugly or wasteful. While "improvement" of an ecological community for the scientist refers to the maturity and stability of the system, the diversity of its species, "improvement" for the site designer refers to overlapping but not identical ends: stability and predictability, human comfort and usefulness, interesting diversity, sensuous beauty,
self-maintenance. Scientific and design criteria will often partially coincide, but not always. With future understanding and after a revolution in our values, we may find a more consistent ethic that embraces all living organisms. Meanwhile, we are at least concerned with preserving the preconditions for life on earth.

There is a typical conflict between human actions, directed toward human purposes, and the tendency for undisturbed habitats to reach stable mature states. Nevertheless, even man-free ecosystems are not completely stable. With good management, men can maintain stable intermediate states that are appropriate to their purposes. Species diversity and a mix of habitats as well as basic resources, such as soil, air, water, can be preserved. The recycling of scarce nutrients and the efficiency of energy utilization may even be improved. All this can be done while ensuring environments that fit human biological and cultural preferences. But it will require far more careful management of the environment and of the human population than has been exhibited thus far.

Land use patterns:

Although economic factors determined to a great extent the land use patterns of the past, the economics of ecosystems were not readily understood. Today, it is apparent that the supply of open space is limited, and new guidelines for future land use are being developed. Such guidelines include preservation of the natural ecosystems in all undeveloped spaces.

6. Man-made structures:
   a. Existing buildings: outline, location, floor elevations, type, condition, use
   b. Circulation facilities (roads, paths, rails, transit, etc.): location, capacity, and condition
   c. Utilities (storm and sanitary sewers, water, gas, electricity, telephone, steam, etc.): location, elevation, capacity

Man-made structures: The man-made environment, in particular the urban environment, usually makes undesirable modifications to the microclimate. The cities are usually warmer (heat island effect) and noisier than the surrounding countryside. They also experience more rain, cloud, fog, and smog. They are burdened with the problem of air pollution, and they are more tiring to the eye because of the glare produced by the paved surfaces and by buildings. Also, the highrise buildings in downtown areas tend to create their own wind patterns because of temperature differences between the sunny sides and the surfaces in shade. The resulting air currents are often increased by the funnel effect created between two buildings. Extensive paved surfaces cause rapid runoff, with a loss of local humidity and cooling, and more frequent and more disastrous floods downstream. Happily, some ill effects are reversible. For example, in London, where open heating fires have been banned, winter sunshine has increased 70% in one decade (the sixties) and ground visibility has improved three times.
SITE ANALYSIS

7. Sensuous qualities:
   a. Character and relation of visual spaces
   b. Viewpoints, vistas, visual focal points
   c. Character and rhythm of visual sequences
   d. Quality and variation of light, sound, smell, feel

B. Cultural data
   1. Resident and using population:
      a. Number and composition
      b. Social structure and institutions
      c. Economic structure
      d. Political structure
      e. Current changes and problems

   2. On-site and adjacent behavior settings: nature, location, rhythm, stability, participants, conflicts

   3. Site values, rights, and restraints:
      a. Ownerships, easements, and other rights
      b. Legal controls: zoning and other regulations
      c. Economic values
      d. Accepted "territories"
      e. Political jurisdictions

The control of noise outdoors is a special subject in itself. Although too little noise can occasionally be a problem, the usual problem is to reduce either the noise level, or the information content of the noise. Sound sources are increasingly powerful and ubiquitous.

In most areas, noise levels should be kept down to 50 or 60 decibels and down to 30 decibels just outside rooms devoted to study or sleep, if they are allowed the luxury of open windows. Various sources scale in decibels are as follows: quite rustle of leaves - 10 decibels; soft whisper - 20 to 30; hum of a small electric clock - 40; ambient noise, house kitchen - 50; normal conversation - 60; busy street - 70 to 80; subway close at hand (or a piano) - 90 to 100; auto horn or pneumatic hammer - 110 to 120; jet plane - 160.

The most useful means available to control noise is "thinning out" of sound as it travels from the source. Noise from a point source decreases by 6 decibels with each doubling of distance and noise from a linear source such as a highway decreases by 3 decibels with each doubling of distance. To prevent the transmission of speech between two open and face to face windows, the distances should be at least 20 feet and between two side by side windows, the distance should be at least 6 feet.

Sound is dispersed by turbulence and gusty winds. Barriers of planting or structure will also reduce sound transmission. Belts of trees are only partly useful. Solid barriers are more effective in cutting down noise - particularly if the barrier is high, close to the source of noise and the
sound is high frequency. Nonreflective textures will also reduce sound levels. If noise levels cannot be brought down to an acceptable point, it is often possible to mask it by desirable or random sound: the play of water, music, the rustle of leaves, even "static" or "white noise".

4. Past and future:
   a. Site history and its traces
   b. Public and private intentions for future use of site, conflicts

5. Images:
   a. Group and individual identification and organization of the site
   b. Meanings attached to site, symbolic expression
   c. Hopes, fears, wishes, preferences

C. Data Conclusion

1. Classification of site by areas of similar structure, quality, and problems

2. Identification of key points, lines, and areas

3. Analysis of current and likely future changes - the dynamic aspect of the site

4. Identification of significant problems and possibilities.
Suggested References (no order of priority intended):


SITE ANALYSIS


In the previous segments of the programming process, the programmer is expected to avoid preconceptions about the specific spaces to be enclosed by the building project. While images of surfaces enclosing activities cannot be avoided, the effort is to avoid deciding upon a particular way in which individual or groups of activities are to be bounded. Of special concern is the avoidance of activity stereotypes which are certain to impede creative thought processes.

In both the Activity Analysis and Site Analysis, information is aggregated, analyzed and synthesized in ways which offer conceptual views of the project needs and aspirations. From those analyses the program development can be extrapolated into the numerical form of the Space Summary.

At this stage of development the usual preoccupation with room lists is avoided by structuring a Space Summary from the analyses of activities and boundary conditions. The Space Summary is an initial room list from which the actual scope and cost of the building project can be first determined.

A. Segregated areas the size of which are based upon occupancy limits as established by activity, statute or convention.

B. Subtotals which group like spaces together by function or cost.

C. Cumulative totals, segregated by cost relatable criteria, allow future differentiation of unit costs.

Activities occupy spaces. People perform activities. The number of people collectively performing the activity determine the area or volume necessary to accommodate each activity. Where more than one activity is accomplished in a single space, its area or volume is determined by the maximum occupancy and the corresponding vigor of their activity.

\[
\text{area/person} \times \text{no. of participants/activity} = \text{total area/activity}
\]

The unit of measure (area per person) may be determined by building code, conventional standards or personal preference. The FHA minimum property standards determine minimum room sizes for public housing. Of particular value are FHA's standards for minimum closet and storage spaces. Conventional auditorium seating varies in width from 19 inches to 24 inches and in spaces between rows from 12 inches to 22 inches clear (O.B.C.). A client may complain, "My bedroom is too small."
In every case there is an objective basis for establishing the unit of measure and total occupancy of the space enclosing each activity. The total area or volume of the project can be approximated from compiling the arithmetic sums for each listed activity. In moving from abstract to concrete there is a danger of omission; particularly with regard to transition spaces. Case studies and existing building references will provide check lists which can be compared to this programmer's initial summary summary lists. There are conventional rules of thumb to generate total areas useful for cost estimating.

**Process of Compiling a Space Summary**

1. Determine the maximum number of persons to be accommodated for each exclusive activity and then for related groups of activities.

2. Determine and document the appropriate square footage per occupant (code, statutes, rules of thumb, common practice or experiemntal evidence) to arrive at the assignable square footage per activity.

3. Examine environmental requirements of the activity(s) to discern whether or not a single enclosure (space) is appropriate.

4. Aggregate similar enclosures or related activity groups.

5. Summarize total assignable square footage: a) Similar space type subtotals; b) Total of all spaces.

6. On the basis of previous knowledge or conventional practice compare the project's net assignable square footage.

7. Other appropriate considerations include: a) Utilization rates; b) Access requirements (public, private); c) Adjacency factors.

Frequent omissions, which may prove to be an embarrassment when the detail costs are developed, are the transition spaces such as lobbies, covered passages, pedestrian bridges or utility tunnels. Every space related cost center must be included.

Other kinds of cost related requirements can be identified in the **Systems Performance Criteria.**

By completing the exercise described above, the programmer would arrive at a figure representing the net square foot area. To determine the building area or volume, the programmer must convert those figures to gross square foot area by means of "net to gross ratios." The following ratios are examples of popular expectations:

- **a)** Apartment block or small building.......85%
- **b)** High rise office building...............75%
- **c)** Dry research laboratory (physics).......65%
- **d)** Wet research laboratory (biology).......55%
Space Summary

While such ratios are not governed by building codes, experienced clients may have specific expectations based upon previous construction experience or comparable case studies. Of course, the higher the net to gross ratio the more cost effective a building might be—assuming no impairment of maintenance or operations. The programmer must provide an appropriate justification for the selection of each net-to-gross-ratio.

Therefore, each space summary should have the following characteristics:

a) Each space listed with assigned square footage and notation as to how unit area was determined.

b) Related groups of spaces arranged with area subtotals.

c) Total net or assigned area shown.

d) Appropriate net to gross ratio, justified.

e) Total building area.

Spaces may be grouped functionally in the manner described above. They may also be grouped according to similarities of construction complexity; i.e., six operating rooms, 12 intensive care units, or 200 single bedrooms. Since the unit costs for constructing each of those space types is substantially different, there will be a cost estimating convenience in the latter type of listings. For simple buildings such as an elementary school building there may be no advantage in doing so.

Where site development constitutes an appreciable proportion of the project costs, these should be identified separately with the appropriate subtotals and totals. Facilities for the summer olympics would be an example of a project where site developments such as fields, bleachers, paving, parking and landscaping must be considered independently of projected building types.

The Space Summary has several uses:

1) Initial verification as to whether or not the activity analysis was sufficiently thorough; via case studies, etc.

2) Initial indication of project scope.

3) Initial indication of project cost feasibility; the cost analysis is an iterative process. Feasibility is
Space Summary

usually examined at each iteration. In the interest of avoiding unfortunate surprises, it is imperative that this early determination of scope be thorough and realistic. A detailed space list will provide more accurate totals, but to wait to determine feasibility at that stage may be fatal to a project in terms of trust or timing.

We will discuss the space lists in relation to the cost analysis in a later assignment.
SYSTEMS PERFORMANCE CRITERIA AND CODE CONSIDERATIONS

User Satisfaction

Systems Performance Criteria and code requirements are also important to the cost analysis. Systems Performance Criteria is to the building construction documentation what the Activity Analysis is to the Space Summary. Material specifications, if appropriate at all, belong in the Detailed Space Description to be discussed hereafter.

A. The structural, mechanical, electrical, lighting, acoustic, communication, transportation and enclosure elements of the project are to be examined in terms of performance outcomes and user satisfaction. Only those specific concerns which relate to user satisfaction and design effectiveness are to be considered.

B. Extrapolations from the applicable codes which apply to the program specific are appropriate. Uncommon or expected code requirements may be reviewed but standard code references are to be rigorously avoided.

The language of this description should employ the performance concept; which is, the intended outcome is stated in terms of a) user satisfaction, and/or, b) physical accomplishment. The stated intent specifically avoids specifying the means to be employed in obtaining these ends. This descriptive method is expected to provide an indication of the limits of acceptability and the essential evaluation criteria.

In a general way, the criteria should provide the physical or performance characteristics which point toward a systematic solution for meeting the needs of individual activities (or spaces). If there is doubt, the applicable codes and regulations may be listed (note that an omission and a later related construction omission will place restitution responsibility on the owner.) Where it is in the owner's interest to interpret code provisions, such interpretations or extrapolations are appropriate. The inclusion of code and statute references should be evidently justified by the unique circumstances to which they refer.

The most important characteristic of this intent is to identify the specific structural and environmental needs which have been discovered during the information gathering and analysis phases of the architectural program development. The programmer's purpose is to alert the designer and cost estimator to these otherwise unexpected concerns. A client preference for a retractable dome for a swimming pool, or stadium, is one example. There is no reason to record the obvious, such as the minimum width of corridors or stairs required by the applicable codes. Systematic inclusion of code texts into the body of the program document is to be scrupulously avoided. To do so is both pointless and legally hazardous.

Building Systems. In a general way the criteria should provide the physical or performance characteristics which point toward a systematic solution for
meeting the needs of individual activities (or spaces). It is not necessary that the examination of building systems follow the construction categories listed below. Other conceptual frameworks are equally appropriate. In determining the comprehensiveness of the criteria provided, each programmer will find it useful to develop a comparable checklist against which his/her criteria can be evaluated. The systems identified in one form or another should include the following:

- **a)** structural; spans, volumetric implications, either internal or external, resistance to unusual forces or responses to circumstances.

- **b)** enclosure; quality, environmental responsiveness

- **c)** mechanical; operating cycles, noise, vibration, odors

- **d)** electrical; subsystems, operations

- **e)** mechanical transportation; elevator, escalator, dumbwaiter, people movers

- **f)** health hazards; volatile solvents, radiation, biological or carcinogenic containments

- **g)** life safety; occupational hazards or protection from impinging natural hazards

- **h)** security

Each system may be studied in terms of:

- **a)** durability

- **b)** expandability

- **c)** functional flexibility—activities simultaneously accommodated in a space

- **d)** convertibility—incompatible activities sequentially served in the same space

- **e)** utility consumption

- **f)** efficiency; functional, maintenance or energy conservation

- **g)** life cycle cost analysis

An example of a different, but potentially equally comprehensive format; use to discuss successive items is:

- **a)** Program (context)
- **b)** Concept
- **c)** Criteria
- **d)** Principles
- **e)** Conclusions
Programming

Once the actual process of design begins, the programming stage is obviously critical. Rather than producing a list of footnotes levels to be ascribed in the various types of rooms, the design team should list in the program the activities and biological needs, as well as their implications for the luminous environment. For each space or class of spaces weighted by importance, frequency, sequence, locality, etc., this type of listing can be used to generate performance criteria for each luminous environment, detailing its required characteristics and degree of flexibility. A suitable hardware system can then be selected on the basis of these criteria. Such a process can be extremely tedious and time consuming. However, the exercise of having gone through such a systematic detailed process of conceptualization once is invaluable. An experienced designer goes through the process almost unconsciously in the design of every space, and is able to sum up the activities, the biological needs, and their respective environmental implications in simple summary statements of objectives and design concepts. A verbal summarization of a detailed activities program and its corresponding design objectives is much more valuable and productive than any amount of simplistic numerical criteria. There is a great difference between summarizing a complex program in words and the unfortunate general practice of singling out one aspect or one "most difficult" task as the basis for lighting criteria. The verbal program statement for the Washington subway system presented here is an excellent example of this kind of summary.

VERBAL PROGRAM STATEMENT FOR THE LUMINOUS ENVIRONMENT OF THE WASHINGTON SUBWAY SYSTEM

DESIGN OBJECTIVES

The lighting design of the Washington Metropolitan Area Rapid Transit System has been the result of an intricate part of the total architectural concept with the purpose of creating an image consistant with the concepts of optimum comfort and productivity. Comfort implies freedom from visual noise such as disorderly, irrelevant patterns of lights, bright lighting fixtures. The presence of a visual background maximizes the impact of positive experiences such as focusing on objects of interest, signs or light patterns which are associated with facts which we want to know, consciously or unconsciously. A low-background free from visual noise also contributes to the pure pleasure of just looking around.

Orientation

Patterns of lights and illuminated signs should be designed to reveal the clarity of circulation, make structural elements, and sequence of architectural spaces. If the design is carried out with the passenger should consciously receive all the visual information needed to tell him where he is and how to reach his destination.

It is important to realize that passenger safety may be endangered by excessively low lighting levels than by confusing circulation, patterns, especially under crowded conditions. Special types of lighting will serve the dual purpose of enhancing the appearance of the spaces and improving safety and traffic flow.

Entrance Areas

The important functional elements marking the entrance to the system should, if possible, be standardized and be given a strong lighting expression. The combination of a distinctive station name, station kind, and station should be instantly recognizable, not only in the setting of an isolated park, but also against a brightly illuminated commercial background. The image would be strengthened if all lighting in the immediate area were to come directly from the station, without the daytime or nighttime clutter of other lighting standards and fixtures.

The system symbol should be distinctive whenever seen and should be the strongest design element in the immediate vicinity, thereby attracting traffic to the terminals. An illuminated station name, name, and symbol will strengthen the image as well as a pattern of lights which make the ticket office a chandelier setting the office apart from the signs and windows. The entry of the terminal should read as a bright plane of distinctive shape (e.g., round).

The stair-escalator enclosure if properly highlighted can also contribute to identifying the system.

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Example:
COST ANALYSIS

The Cost Analysis can be derived from the Space Summary. Having the groupings of like spaces, a unit cost per square foot for each occupancy type (offices, clinics, hospitals, laboratories, auditoria, swimming pools, etc.) can be ascertained from local experience or standard reference. Standard references also offer an additional breakdown of costs (including both labor and material) for each group of building materials expected to be consumed by the construction. Such additional breakdowns may be useful in comparing schematic cost estimates with the first contractor material take-off estimate generated from construction documents. However, the labor and material cost summaries have no particular value in an academic exercise. To be of value under any circumstances, the local experience of material/labor costs must be substituted for those in standard references.

A. The intent is to provide an all inclusive summary, future oriented and client focused.

B. The preferred method is on a per square foot unit cost basis.

C. Unit costs, derived on a particular date, must be escalated to the projected bid date or construction mid-point, as appropriate. Think of the notation $\text{t}$.

D. A project development and construction schedule are an essential part of this analysis.

E. The cost analysis should include: 1) Floor area unit costs by building type; 2) Total initial cost; 3) Feasibility, based upon the rate of return of investments, as appropriate; 4) Life cycle costs, including conversion costs; and 5) Case study cost comparisons.

Different building types have different cost implications. The Cost Analysis of each architectural program must be specific to the building type or other circumstance. Sloping sites and unusual subsoil conditions are two examples of the latter.

Escalation is most currently estimated by projecting the historic cost increases as recorded by the "Engineering News Record Index" or the reports of the S.W. Dodge Corporation. The indices are provided for twenty different metropolitan areas so that a building unit cost (as derived from a case study) constructed in a specific location can be adjusted both for: a) geographic area differences and b) time difference.

Additionally, the method of financing must be fully examined. A public use facility to be funded by grants or bond issue present the simplest task inasmuch as the escalated total cost of the project will be the only consideration. Presumably, life-cycle costs and energy conservation are included. For revenue financed projects, the available revenue for debt service over the useful life of the building must be examined. For speculative project, marketability and return on investment must also be considered.
COSTING METHODS

1) Unit Costs
2) Materials Take-off Cost Estimate
3) Life Cycle Cost
4) Rate of Return Analysis

Unit Costs: based upon historic costs of comparable units
- Cost per bed; dormitories (see handout)
- Hospitals
- Cost per square foot; net assignable, s.f. or gross, s.f.
- Cost per parking space; at grade, superstructure, underground

The essential requirement is to determine the comparability of units of measure.

a) Suite accommodations of endowed private schools may not be comparable to 2-4 bedroom, double-loaded corridor public university dormitories, nor are high-rise apartments comparable to walk-ups.

b) The assignable square feet in an office building must carry the costs of building vertical circulation, entrance, corridor, service and mechanical spaces.

c) The cost of on-grade parking may not have comparable grading or landscaping costs (300-600/space). Parking structures without sprinklers or ventilation may cost $3000-$6000/space. Underground structures with both may cost $6000-$10,000/space.

Material Take-off Cost Estimate

Usually completed by professional cost estimators as material/labor cost estimate may be based upon: a) Building description (program); b) schematic design drawings; or c) completed construction documents. The procedure associates labor costs for placing each unit with the material quantities to be incorporated into the construction, then adds overhead and profit to arrive at an in-place cost of each unit of material. The magnitude of "boiler plate" specification may prompt an additional estimate for "special conditions" (insurance liabilities, which would also be included in the unit cost of completed buildings.)

Site preparation, excavation, and site development may be estimated separately as would be furnishings and equipment.

Escalation

A decade ago the annual inflationary rate was 3-5%/year. More recently the rate in the construction industry is, approximately, 1%/month. It is currently, substantially less. Therefore, a building which requires 2 or 3 years to construct is subject to considerable speculation about escalation costs.
A construction bid issued today will be based upon the cost of labor and materials at the mid-point of construction. A cost estimate using today’s costs for labor and materials must be construed as if today were the construction mid-point.

<table>
<thead>
<tr>
<th>Bid/Start</th>
<th>Const.</th>
<th>C</th>
<th>Mid-point</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 yr.</td>
<td></td>
<td>2 yrs.</td>
<td>3 yrs.</td>
</tr>
</tbody>
</table>

Building costs estimated as of this date.

Using the cost of a similar project bid a year ago and requiring three years to complete to estimate the cost of a similar building to be bid one year hence, will require an escalation calculation based on the following diagram:

<table>
<thead>
<tr>
<th>Last Year</th>
<th>To Date</th>
<th>C</th>
<th>One Year</th>
<th>Second Year</th>
<th>C</th>
<th>Third Year</th>
<th>Fourth Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Comparable Project</td>
<td>Escalation Estimates</td>
<td>Our Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Therefore; the estimate of our project must include the period from six months to 30 months hence. If the escalation over the six-year period is uniform, then the difference between bid dates might be an adequate base. However, if a) the escalation rates vary, or b) the buildings have different lengths of construction, additional escalation estimation adjustments are necessary.

Note that today’s labor and material cost represent the mid-point of a construction period. If a building is to be bid one-year hence and requires two years to complete, then two years of escalation must be calculated into the costs.

**Life Cycle Costs**

Allocation of resources and choices from among feasible alternatives, requires strategy using recognizable and easily understood units of measure. A broad definition of life cycle costs could include two basic cost components:
LIFE CYCLE COST ANALYSIS: A GRAPHIC EXAMPLE

a) Initial costs, including land, site development, building fees and furnishings

b) Annual operating and maintenance costs including
   - Building administration*
   - Maintenance and operation
   - Custodial Services
   - Utilities
   - Groundskeeping*
   - Safety and security*
   - Renovations, alterations and major repairs
   *sometimes excluded

Alteration costs may exceed initial construction costs in relatively short periods of time; similarly, operating costs may exceed the initial construction
costs by \((x\ 50-100)\). Alternatives of operating costs and lateration costs will figure importantly into life-cycle costing.

A building program which results in a low space utilization may also result in a high life-cycle cost; i.e., classrooms which are assigned 80% of available hours (acceptable) which have an average of 40% of the chairs occupied (unacceptable).

Different building elements have different useful lives: roofs, walls, floors, mechanical equipment.

The useful life of a building is of considerable importance. Fifty years is a frequently used average life for permanent buildings—others might be:

- Mobile homes: 5–10
- "Temporaries": 10–20
- Permanent: 40–60 (housing-vs.-monumental construction)

Conversion of Current Equivalent Costs

Capital and operating costs are not measured in comparable terms because of the time differences. The question is: How much should be spent in additional capital cost in order to reduce future operating costs? Where mortgages or bonding are involved, the cost question includes the construction costs plus the compounded interest on that additional capital. The additional cost is justified only if the future operating costs are greater.

The compound interest of earlier expenditures reflects the fact that funds allocated to construction may have alternative uses. If the dollar expenditures initially postponed can be free for other (social or investment) purposes, then the comparative usefulness of those expenditures can be evaluated.

Expressed in terms of the interest rate, the future cost-avoiding current expenditure should be undertaken only if the later costs is greater than \((1+r)^n\) times the current expenditure, where \((r)\) is the real rate of interest. However, the value of a \$ expenditure, (for \$ resource) to be delivered is discounted when compared to that expenditure (or resource) available today. Therefore, assumptions must consistently utilize: escalation, inflation, discount rates.

MARKET JUSTIFIED COST-BENEFIT ANALYSIS

(James Canestaro, Real Estate Feasibility Analysis Handbook, University of Wisconsin, Madison, 9/78)

The Market Justified Cost Approach (using the gross income multiplier) is the first cost-benefit analysis technique to illustrate the iterative nature of the preliminary project feasibility analysis process. The initial step in this analysis is to identify the market rent for the real estate sub-market, in which the proposed project will be competing. Next, a review of rental space production in the sub-market will establish the maximum amount of gross leasable area that the project can safely offer in the market place. The
estimates of rent per space unit and proposed number of rental units is a variable item which will ultimately affect the amount of potential gross income generated by the project. Capitalization of the potential gross income results in the estimate of total project value. The resulting building budget is subsequently divided by the total gross square footage of the building to establish the justified cost per square foot. This cost is qualified on the basis of the specified rent being charged. It should be noted that the gross square footage is a direct function of the estimate of building efficiency.
To emphasize the iterative nature of the process, the rent per space unit is established at $11.50 per square foot, the midpoint of the market rent range. The result of the calculations, shown in the following diagram, is a justified building cost of $43.24 per square foot. This equates to a building design which would rank as economical on a scale of building quality and complexity.
The Market Justified Benefit Approach (using the net income multiplier) is the companion to the previous cost-benefit analysis technique. Again, as in the first set of calculations, the process is reversed. The building cost dictates the required rent per space unit. The variables used in this calculation remain the same as in the previous example. For the purpose of simplicity, only the rents and building costs have been modified and adjusted after each calculation. In actuality, however, it will be necessary to also adapt and modify the project operating expense data and initial capital cost items.

In this fourth cost benefit analysis example, results from previous calculations have been analyzed and a building cost of $49.00 per square foot has been selected. The indicated rent per space unit necessary to support the modified building budget is now $12.70 per square foot per year.
## MARKET JUSTIFIED COST ANALYSIS

### Using the Gross Income Multiplier:

<table>
<thead>
<tr>
<th></th>
<th>Rent per Space Unit</th>
<th>Proposed Number of Rental Units</th>
<th>Potential Gross Income</th>
<th>Gross Income Multiplier</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent per Space Unit</td>
<td>$12.75/sq.ft./yr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed Number of Rental Units</td>
<td></td>
<td>85,000 sq.ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Gross Income</td>
<td></td>
<td></td>
<td>$1,081,750</td>
<td></td>
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<tr>
<td>Gross Income Multiplier</td>
<td></td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Project Value</td>
<td></td>
<td>7,586,250</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Using the Net Income Multiplier:

<table>
<thead>
<tr>
<th></th>
<th>Rent per Space Unit</th>
<th>Proposed Number of Rental Units</th>
<th>Potential Gross Income</th>
<th>Net Income Multiplier</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent per Space Unit</td>
<td>$12.75/sq.ft./yr.</td>
<td></td>
<td></td>
<td>10.5</td>
<td>7,463,536</td>
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<tr>
<td>Proposed Number of Rental Units</td>
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<td>85,000 sq.ft.</td>
<td></td>
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</tr>
<tr>
<td>Potential Gross Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Income Multiplier</td>
<td></td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Project Value</td>
<td></td>
<td>7,463,536</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Building Cost per Space Unit:

<table>
<thead>
<tr>
<th></th>
<th>Building Cost per Space Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Number of Space Units</td>
<td>$100,000 sq.ft.</td>
</tr>
<tr>
<td>Building Cost per Space Unit</td>
<td>$50.68/sq.ft.</td>
</tr>
</tbody>
</table>

### Other Costs:

- **Carrying Charges**: $604,951
- **Builder's Profit**: $208,122
- **Fees & Permits**: $340,389
- **Land Value**: $1,000,000
- **Site Work**: $364,700
- **Building Budget**: $4,945,374

### Revenue:

- **Rent per Space Unit**: $12.75/sq.ft./yr.
- **Total Project Value**: $7,586,250
### Market Justified Benefit Analysis

**Using the Gross Income Multiplier:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Cost per Space Unit</td>
<td>$40.63/sq. ft.</td>
</tr>
<tr>
<td>* Proposed Number of Space Units</td>
<td>$100,000 sq.ft.</td>
</tr>
<tr>
<td>Building Budget</td>
<td>$4,863,000</td>
</tr>
<tr>
<td>+ Carrying Charges</td>
<td>$104,951</td>
</tr>
<tr>
<td>+ Builder's Profit</td>
<td>$208,122</td>
</tr>
<tr>
<td>+ Fees &amp; Permits</td>
<td>$340,389</td>
</tr>
<tr>
<td>+ Site Value</td>
<td>$1,054,700</td>
</tr>
<tr>
<td>+ Total Project Budget</td>
<td>$7,381,162</td>
</tr>
<tr>
<td>Total Project Budget</td>
<td>$7,381,162</td>
</tr>
<tr>
<td>Gross Income Multiplier</td>
<td>7.0</td>
</tr>
<tr>
<td>Potential Gross Income</td>
<td>1,054,451</td>
</tr>
<tr>
<td>Rent per Space Unit</td>
<td>$12.41/sq. ft./yr.</td>
</tr>
</tbody>
</table>

**Using the Net Income Multiplier:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Building Cost per Space Unit</td>
<td>$40.63/sq. ft.</td>
</tr>
<tr>
<td>* Proposed Number of Space Units</td>
<td>$100,000 sq.ft.</td>
</tr>
<tr>
<td>Building Budget</td>
<td>$4,863,000</td>
</tr>
<tr>
<td>+ Carrying Charges</td>
<td>$104,951</td>
</tr>
<tr>
<td>+ Builder's Profit</td>
<td>$208,122</td>
</tr>
<tr>
<td>+ Fees &amp; Permits</td>
<td>$340,389</td>
</tr>
<tr>
<td>+ Site Value</td>
<td>$1,054,700</td>
</tr>
<tr>
<td>+ Total Project Budget</td>
<td>$7,381,162</td>
</tr>
<tr>
<td>Total Project Budget</td>
<td>$7,381,162</td>
</tr>
<tr>
<td>Net Income Multiplier</td>
<td>10.5</td>
</tr>
<tr>
<td>+ Net Operating Income</td>
<td>702,967</td>
</tr>
<tr>
<td>+ Capital Replacement Reserve</td>
<td>0</td>
</tr>
<tr>
<td>+ Real Estate Taxes</td>
<td>167,500</td>
</tr>
<tr>
<td>+ Operating Expenses</td>
<td>151,250</td>
</tr>
<tr>
<td>+ Vacancy &amp; Bad Debt Allowance</td>
<td>51,774</td>
</tr>
<tr>
<td>Potential Gross Income</td>
<td>1,075,491</td>
</tr>
<tr>
<td>* Proposed Number of Rental Units</td>
<td>$85,000 sq.ft.</td>
</tr>
<tr>
<td>Rent per Space Unit</td>
<td>$12.65/sq. ft./yr.</td>
</tr>
</tbody>
</table>
AUA (BPS) Index Type: **FINE ARTS (ART, DRAMA, MUSIC)**

Name (College or University): **California State University, Dominguez Hills**

Location (City and State): **Carson, California**

Name of Project: **Theatre Arts Building**

Status of Development: [ ] Concept [ ] Preliminary [ ] Under Construction [x] Complete

Bid Date: **29 May 1975**

Completion Date: **14 June 1977**

Statistics:

<table>
<thead>
<tr>
<th>Gross Square Feet:</th>
<th>25,200 USF</th>
<th>Net Square Feet:</th>
<th>--</th>
<th>NASF/GSF:</th>
<th>68.93%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignable Square Feet:</td>
<td>17,370 NASF</td>
<td>NASF/GSF:</td>
<td>68.93%</td>
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<td></td>
</tr>
<tr>
<td>Cubic Feet:</td>
<td>--</td>
<td>CF</td>
<td>--</td>
<td></td>
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</table>

Cost:

<table>
<thead>
<tr>
<th>Construction:</th>
<th>General: $1,403,136</th>
<th>$55.68/GSF</th>
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</thead>
<tbody>
<tr>
<td>Plumbing:</td>
<td>97,573</td>
<td>3.86</td>
</tr>
<tr>
<td>H-V and A-C:</td>
<td>215,950</td>
<td>8.57</td>
</tr>
<tr>
<td>Electrical:</td>
<td>279,300</td>
<td>11.08</td>
</tr>
<tr>
<td>Fixed Equipment:</td>
<td>132,245</td>
<td>5.25</td>
</tr>
<tr>
<td>Elevator(s):</td>
<td>15,811</td>
<td>.63</td>
</tr>
<tr>
<td>Site Work:</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Include Lands:</td>
<td>110,962</td>
<td>4.40</td>
</tr>
<tr>
<td>Total Construction:</td>
<td>$2,254,784</td>
<td>$89.48/GSF</td>
</tr>
</tbody>
</table>

Design Fees:

| $157,073 |
| Movable Equipment: | -- |
| Utility Extensions: | (In Site Work, above) |
| Land: | -- |
| Contingencies: | -- |
| Soils and Survey: | -- |
| Contract Mgmt. & Test: 93,752 |

Total Project Cost: $2,505,609 39.43/GSF 2164

Cost Index: ENR/SCI: 1287  ENR/CCI: 2164

Date: 15 April 1979

Member: James E. Westphall

AUA Building Project Survey

(8 February 1979)

Description:

Reinforced concrete structure with built-up roof. 500-seat Little Theatre with continental seating and full rigged stage. Auxiliary spaces include control room, orchestra pit, scene shop, dressing rooms, and combination green room and drama classroom. Entire building is to be air conditioned.
Construction cost increases ease: up 6.8 per cent

The bad news: Construction costs are still rising. The good news: The rate appears to be slowing.

From September 1977 to September 1978, surveys by Dodge Building Cost Indexes, a unit of McGraw-Hill Information Systems Company, show building material costs have climbed by only 5.9 per cent. This contrasts with a 12 per cent increase in the period from September 1976 to September 1977.

The rate of increase in construction labor rates was 8.2 per cent for the latest 12-month period ending in September; a year earlier, the increase was at an 8 per cent rate. Construction cost changes for individual regions and specific cities continue to show wide variations. Some markets, local conditions—such as the impact on costs California and Florida—are areas where local market conditions are resulting in mark-ups, which are relatively lower than the national average. In California, the once-ravenous pace of home building has slowed, stabilizing lumber and wood product prices.

<table>
<thead>
<tr>
<th>Number of metro areas</th>
<th>3/78 9/77</th>
<th>9/78 9/77</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern U.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New England States</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Northeastern and North</td>
<td>26</td>
<td>27.5</td>
</tr>
<tr>
<td>Central States</td>
<td>46</td>
<td>52</td>
</tr>
<tr>
<td>Southeastern and South</td>
<td>31</td>
<td>35.5</td>
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<tr>
<td>Average Eastern U.S.</td>
<td>122</td>
<td>131</td>
</tr>
<tr>
<td>Western U.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mississippi River</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>West Central States</td>
<td>26</td>
<td>27.5</td>
</tr>
<tr>
<td>Mountain States</td>
<td>61</td>
<td>71</td>
</tr>
<tr>
<td>Average Western U.S.</td>
<td>183</td>
<td>258.5</td>
</tr>
<tr>
<td>United States. Average</td>
<td>183</td>
<td>258.5</td>
</tr>
</tbody>
</table>

HISTORICAL COST INDEXES—AVERAGE OF ALL NON-RESIDENTIAL BUILDING TYPES, 21 CITIES

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<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>101.4</td>
<td>102.4</td>
<td>103.4</td>
<td>104.4</td>
<td>105.4</td>
<td>106.4</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>New York</td>
<td>107.4</td>
<td>108.4</td>
<td>109.4</td>
<td>110.4</td>
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<tr>
<td>Los Angeles</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>123.4</td>
<td>124.4</td>
<td>125.4</td>
<td>126.4</td>
<td>127.4</td>
<td>128.4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Note: The cost index is a base of 100 in 1965. The index for each period is calculated by dividing the cost in the period by the cost in the previous period. The index is then multiplied by 100 to obtain the percentage change. The index for the first period (1965Q1) is 100. The index for the second period (1965Q2) is 100. The index for the third period (1965Q3) is 100. The index for the fourth period (1965Q4) is 100.*
most developers make money by keeping the cash flow on their projects.

Remembering that a developer wants to be competitive, we start determining the income, naturally enough, by multiplying the net rentable space (which is the maximum allowed by the zoning ordinance) by the market rental for comparable space. Subtract from this the standard vacancy, trash, and other charges. The net income becomes 53.50% of $277,500.

With this net income, the developer must do two things. He will pay off his debt, currently consolidated at 9% per annum, or 25 years, and keep the remainder of the income (the cash flow) as payment on his equity. What are the proportions of this division of income? The most common used ratio is 1.25:1, meaning that for each $1.25 of gross income, it is allotted to debt service, and 25¢ is the cash flow to the developer. In this example, therefore, the developer would divide the net income of $277,500 by 1.25 to determine the debt service on this project ($222,000 per year).

The next step is to determine the mortgage and equity amounts, remembering that the developer would probably want a minimum of 15% per annum return on his equity. Why would a developer undertake the risks of development for less? He could get a safe 9% per annum on a bond.

The mortgage amount is determined by the amount available for debt service. In this case, the $222,000 will finance a mortgage amount of $2,117,500 at 9% per annum for 25 years. As to the equity, if the developer's anticipated cash flow (his return on investment) is $55,500, he would receive only 10% per annum on an investment of $555,000, but he wants a 15% per annum return, $55,500 is 15% of $370,000. Therefore, he will invest that amount and the total project budget (equity and mortgage) is $2,487,500. Notice that the project budget was the building cost, which is not yet known. The project budget was determined by the income stream only. A developer will work back from the income to get the building budget.

As the second set of figures in the illustration show, there are many fixed costs of developers, which must be balanced against each other. Computed in the total project budget are legal fees, real estate commissions (up to 4% per annum for a 10-year lease), advertising, construction financing, developer overhead, architectural fees and operating deficit (it may take a year to fully lease a building). Added to this is a contingency, typically, actual costs and actual amounts for up to 50% of the total project, a portion that can be manipulated especially by the architect, and make the difference between a plausible project and a failure.

The process just outlined takes only a few hours, but it is the same way to test the project. potential for success. As Jonathan Moore says, you have wasted very little effort if the bottom line of the “cost” column exceeds the income, you can go back to the calculator for adjustments. Perhaps the building budget can be shaved, without diminishing the quality or marketability. Perhaps the entire figure is unrealistic. Perhaps a better mortgage rate or longer term could be arranged. Maybe the land costs are too high. Working together, the architect and developer have a variety of options for making the project a success. But discovering the discrepancies in the package at its inception—through a good financial analysis—costs little at the start. As Jonathan Moore says, running through the financial analysis for the building budget need not be the “kill switch” in the project.

<table>
<thead>
<tr>
<th>Financial Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>50,000 sq ft office building</td>
</tr>
<tr>
<td>Parking (6 cars; 1 car: 1,000 sq ft)</td>
</tr>
<tr>
<td>Total building cost</td>
</tr>
<tr>
<td>Total project cost</td>
</tr>
</tbody>
</table>

| Item               | Amount      |
|---------------------|
| Building: 50,000 sq ft @ $10/sq ft | $500,000 |
| Land: 4 acres @ $162,000/acre | $500,000 |
| Site work | $200,000 |
| Architectural and engineering fees @ 7% | $42,900 |
| Legal fees | $10,000 |
| Advertising | $5,000 |
| Operating deficit | $150,000 |
| Leasing commission (4% @ 10-year lease) | $40,000 |
| Construction permit | $100,000 |
| Developer's overhead (2%) | $50,000 |
| Contingency | $15,000 |

Total project cost: $2,487,500.
TWO SIDES OF THE COIN

CASH FLOW FEASIBILITY ANALYSIS
FOR THE FIRST YEAR OF THE SAMPLE PROJECT
The detailed space list is intended to be the central instrument in a project's design development. There is no detail too specific to be included within the format of this section of an architectural program; consequently, each space with unique characteristics must be separately identified. Usually, each space type is assigned a separate numerical identification. Repetition is necessary in this section. However, those requirements (almost) universally applied are more appropriately addressed in the Systems Performance Section of the program. At a minimum, information about each space should include:

- Facility number
- Descriptive title
- Expected number of occupants
- Assignable floor area
  (if appropriate) total number of rooms, this type:
  total floor area, this type:
- Functional description
- Environmental requirements
  Required dimensions
  Structural, lighting or acoustic requirements
- Other considerations (such as special ventilation requirements)
- Furnishings and/or equipment and related utility requirements
- Storage requirements

Where requirements for spaces not included in the assignable square footage of the project are known, these must also be included in the Detailed Space List, but not in the net assignable square foot total. Such considerations include:

- Elevator cab size
- Mechanical equipment on roofs or roof exhausts
- Service equipment in custodial spaces
- Transformer vault sumps and ventilation requirements
A frequently employed device which reduces redundancy in the Detailed Space list Section is the imposition of space standards. A standard laboratory module or a series of office sizes which is responsive to activity needs or administrative structure will allow the space unit to be thoroughly described once with simple notation added as to (a) the number of standard units required and (b) the total square foot area for that type unit.

The following Program Checklist is specifically useful in preparing the Detailed Space List. Not every project or every space type requires every item to be specifically referred to. For example, is open or closed shelving to be available for every standard office type? In other words, the detailed space list format should define the limits of choice. The format should also provide the opportunity to include any unique requirement. When using space standards, individual space requirements may be indicated by notations on the "standard" sheet. If that device becomes too complex then separate sheets for each space must be provided. In this case, it may be useful to suggest the special circumstances or conditions.

EXAMPLE

PROGRAM CHECKLIST

I. ARCHITECTURE

1. Floors
   Unusual floor loads
   Provision for special equipment
   Resistance (Chemical, grease, oil and others)
   Insulation (acoustical, thermal, shielding, vibration and others)
   Waterproofing or curbs
   Drain and pitch
   Grounding
   Finished surface; if any, preference
   Finished base; if any, preference
   Other requirements

2. Walls & Partitions
   Full Height
   Semi-private
   None required
   Fixed, movable, folding, screen or others
   Inserts for special equipment and adjustability
   Insulation (acoustical, thermal, shielding, vibration and others)
   Visibility to other spaces
   Finished surface, if any, preference
3. **Ceilings**
- Clear operational height
- Insulation (acoustical, thermal, shielding, vibration and others)
- Inserts or hangars for special equipment or adjustability
- Finished surface; if any, preference
- Other requirements

4. **Doors & Windows**
- **Doors:**
  - Special Size or Type
  - Special hardware or operations
  - Visibility thru door
  - Insulation (acoustical, thermal, shielding and others)
  - Raised threshold; if any
  - Other requirements

- **Windows:** If any required
  - Darkening provisions

---

**II. MECHANICAL**

1. **Heating & Ventilating**
- Air conditioning
- Special exhaust requirement (toxic or non-toxic)
- Re-circulation is not permitted
- Special temperature requirements
- Special relative humidity requirements
- Separate system - containment requirements
- Positive or negative pressure
- Individual or special control
- Special duct material
- Lab equipment load; installed in B.T.U./hr. or K.W. and use factor
- Other requirements

2. **Electrical**
   a. **Lighting:**
      - General illumination intensities at desk or bench height in footcandles
      - Special intensities at equipment
      - Variable intensities
      - Explosion proof devices
      - Emergency lighting
      - Other requirements
b. Power:

- Characteristics: 120 V. AC 60 cycles, 277/480 V. AC 60 cycles - 3 phase, 204/240 V AC 60 cycle single phase, 3 phase or others
- Lab equipment power requirement; amperage, voltage & use factor
- Emergency power, use factor
- Duplex receptacles, plug-in strips & special outlets
- Underfloor duct distribution
- Overhead bus duct distributions
- Other requirements
- Faraday isolation - grounding

Communication System:

- Telephone - private PBX or Bell Telephone to operator, direct line, intercom, others
- Public address system (one-way, two-way)
- Alarm and call systems (manual or automatic, coded or not coded)
- Clocks - type
- Closed circuit TV, master antenna TV, radio

Utility Service

(State type of service, class of pipe, if special, pressure, temperature, velocity, volume or others)

- Cold water
- Hot Water
- Ice Water
- Distilled/deionized water
- Waste (re-usable, decontamination or other special)
- Acid resisting waste
- Vents
- Steam (vents, if required)
- Compressed air
- Gas
- Oxygen
- Other gases
- Suction or vacuum
- Refrigerant
- Floor drains
- Sink and other plumbing fixtures
- Other requirements

Life Safety

- Sprinkler system (wet, dry, others)
- Fire detection devices
- CO₂
- Radiation detection device
- First aid equipment
- Blow out wall or panels
- Other requirements
- Eye wash fountain
III. EQUIPMENT

1. Laboratory equipment
   Benches
   Work tables
   Wall cabinets
   Shelving
   Refrigerators
   Countertop surface; if any, preference

2. Fume Hoods
   Single system of exhaust
   Special filter
   Face velocity
   Shielding or protection
   Special hood material
   Size
   Utility services (see Items II.3)
   Other requirements

3. Special Equipments
   Description (size and make)
   Operating load in B.T.U./hr. or KW and use factor
   Utility connections (See Items II.3)
   Special floor load
   Special mounting
   Other requirements

4. Furniture & Files
   Size and quantity
   Desks, tables
   Chairs, stools
   Files, closets, lockers
   Other requirements

Where space standards have been established the data collection can be systematized by relating the recorded information to each standard format. The attached sheets entitled "Laboratory Design Criteria" illustrate this methodology.

Fixed & movable equipment

For other than desks and chairs, data about movable or fixed equipment types, locations and physical requirements, are among the most difficult to record and manage. The attached checklist "Data Sheet" is a suggested device for collecting, recording and managing information about fixed and movable equipment. Note that the identification symbol allows numerical sequencing and location identification in the least redundant manner (and, therefore, least error prone.)
LABORATORY DESIGN CRITERIA
HARVARD MEDICAL SCHOOL

Building and room number: ___________________________________________

Department: _______________________________________________________

Research Group: ___________________________________________________

Number of Occupants: _______________________________________________

Area (net square feet): _______________________________________________

TYPICAL DOUBLE MODULE LABORATORY

FIXED EQUIPMENT LIST:

A
Stations

B
Stations

C
Stations

D
Stations

E'
Stations

D'
Stations

WALL ELEVATION S
**SPECIAL CONSTRUCTION REQUIREMENTS**

**OPEN SHELVING**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DEPTH</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
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</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
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<tr>
<td>D</td>
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</tr>
</tbody>
</table>

**CLOSED SHELVING**

| A    |       |        |
| B    |       |        |
| C    |       |        |
| D    |       |        |

**OTHER STORAGE REQUIREMENTS**
<table>
<thead>
<tr>
<th>Utility Requirements:</th>
<th>Equipment Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Manufacturer:</td>
</tr>
<tr>
<td>Amps</td>
<td>Size: Width: Height: Depth:</td>
</tr>
<tr>
<td>Independent Ground: Yes/No</td>
<td>Clearance: Left: Right: Front: Rear: Above:</td>
</tr>
<tr>
<td>Water: (Pipe Size) Hot</td>
<td>Servicing: Front/ Rear/ Top/ Left/Right</td>
</tr>
<tr>
<td>Cold</td>
<td>Mounting: Floor/ Table/ High-Low Bench/</td>
</tr>
<tr>
<td>Distilled</td>
<td>Shelf/ Stand/ Wall</td>
</tr>
<tr>
<td>De-Ionized</td>
<td>Weight:</td>
</tr>
<tr>
<td>Steam</td>
<td>Remarks:</td>
</tr>
<tr>
<td>Vacuum</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td></td>
</tr>
<tr>
<td>Compressed Air</td>
<td></td>
</tr>
<tr>
<td>Drain: Closed/Open</td>
<td></td>
</tr>
<tr>
<td>Special Exhaust</td>
<td></td>
</tr>
<tr>
<td>Operating Loads</td>
<td></td>
</tr>
<tr>
<td>B.T.U./HR.</td>
<td></td>
</tr>
<tr>
<td>Watts/HR.</td>
<td></td>
</tr>
<tr>
<td>WATER (G.P.M.)</td>
<td></td>
</tr>
<tr>
<td>Use (HRS/DAY)</td>
<td></td>
</tr>
<tr>
<td>New Location</td>
<td></td>
</tr>
<tr>
<td>Exisiting Location</td>
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<tr>
<td>Furniture</td>
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<tr>
<td>Equipment</td>
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</tr>
<tr>
<td>Fixed</td>
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<tr>
<td>Movable</td>
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<tr>
<td>Date</td>
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<tr>
<td>New:</td>
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<tr>
<td>Existing:</td>
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<tr>
<td>New Location</td>
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<tr>
<td>Existing Location</td>
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</tr>
<tr>
<td>Department</td>
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<tr>
<td>Investigator</td>
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</tr>
<tr>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>Title</td>
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</table>
PROGRAMMING