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DESIGNING
AFFORDABLE
HOUSES

DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT

SEP 23 1991

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D E S I G N I N G
A F F O R D A B L E
H O U S E S

Prepared by
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Building Systems Consultants
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Prepared for
U.S. Department of Housing
and Urban Development
Office of Policy Development
and Research
Building Technology Division

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Foreword

Few challenges are more important in America today than the need to provide more affordable housing for more people. The work of HUD's Joint Venture for Affordable Housing is already proving that affordable housing can be provided through the cooperative actions of the public and private sectors--builders, local communities, Federal and State Governments--working together. The Joint Venture program is demonstrating across the country that reduced permit processing time, more efficient site plans, regulations that are more appropriate to today's housing needs, and reduced construction costs can increase housing affordability.

Earlier this year, HUD published "Design for Affordable Housing: Cost Effective/Energy Conserving Homes." That publication provides house plans which resulted from some of our earlier research and demonstration efforts. This new publication takes a more direct approach to designing affordable homes by showing how major components can be manipulated to provide many compact plan configurations.



Samuel R. Pierce, Jr.
Secretary

Introduction

The purpose of "Designing Affordable Houses" is to demonstrate that there are a wide variety of plan options available to the designer of compact houses. This analysis will review the functional elements that form the major components of small houses, the effects of varying proportions on these components and finally the options by which the relationships of these components can be manipulated to provide alternate plan configurations. Although this analysis is directed primarily at builders, and their design staffs, it should also be useful to any individual who is interested in design of moderate cost housing.

The origin of "Designing Affordable Houses" lies in the work this office has completed for government agencies and builders in analyzing and evaluating cost-effective house plans. During the course of this work it became apparent that designers, home builders and potential house purchasers are confronted with a particularly difficult task in attempting to understand the conceptual differences among the thousands of house plans that are available through industry sources and house plan services.

Our review of numerous plans for houses of all sizes indicated that the majority of plans were basically variations on a few simple plan relationships, and we felt that by trying to document these relationships, we might develop some insights that could prove useful in the development of potential design strategies.

Our analysis concentrates on single-family, single-story detached houses with an area, not including garage, of under 1,200 sq. feet. However, these plans are readily adaptable to split-entry or split-level plans by the addition of a stair at the entry or at the corridor juncture of the living and bedroom areas. Additionally, many of the organizational concepts explored here are also appropriate to zero-lotline, attached and multi-family housing.

The plans resulting from our analysis are intentionally diagrammatic, as further development would require additional investigations into the appropriate site, programmatic, formalistic and detailing refinements that distinguish successful houses from unsuccessful ones.

We do not suggest that these diagrammatic plans represent the only way to organize functions and spaces, but they represent many of the possible relationships for small compact houses. The diagramming of a house is a useful tool, moreover, for if the diagram does not work, chances are that the house will not either, no matter how much attention is lavished on the details.

The usefulness of this study is really twofold: it documents certain economical plan components so that the housing designer need not "reinvent the wheel" in every instance, and it attempts to provoke a more critical and incisive understanding of some of the processes and factors that shape the siting and design of small homes.

Alexander Grinnell
Principal-in-Charge

T.J. Cardenas Jeff Thompson
Don Carr Dana Tuluca
Peter Keyes Steven Winter

Steven Winter Associates
June, 1983

Graphic Design: H.L. Chu & Company

Generic Floor Plans

The "ranch" style house as it is known today is a somewhat distant derivative of the Spanish Colonial adobe houses that were common in New Mexico and California in the 19th century. The impressive courtyards and horse corrals have disappeared and the "ranch" style house has come to mean almost any single story house.

The compact "ranch" house proliferated after World War II and during the early '50's as a popular, inexpensive house for returning veterans. With the prosperity of the late '50's and '60's, the "ranch" grew in size and amenities and in turn spun off a variety of larger split-level variations.

The economic realities of the '80's however, have brought a renewed interest in smaller affordable houses.

The typical compact, single story "ranch" type plan is divided into two different components: a bedroom component and a "living area" component that includes the living, dining and kitchen/family rooms. A third component, the garage/carport, is usually linked to the living area component.

It is the manipulation of these three components, their size, proportion and relationship to each other, that can produce a wide variety of plan variations. An investigation of these variations will indicate that they can, for the most part, be reduced to the four generic diagrams illustrated.

The four generic plan diagrams include the following arrangements oriented as if to face a street:

- A. Adjacent bedroom and living areas.
- B. Adjacent bedroom, living area and garage.
- C. Adjacent bedroom and living area with garage in front of living or bedroom areas.
- D. Adjacent living and garage areas with bedroom behind garage (a patio house arrangement).

Further manipulation of the elements by rotating, offsetting and varying the components' proportions, will produce seemingly very different plans that are appropriate for different site conditions, but which retain essentially similar functional relationships.

Generic Floor Plan

Rotated Axis Variation

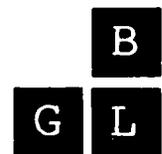
A



B



C



D



Proportional
Variation

Offset
Variation

Offset/Proportional
Variation

Rotated Axis/
Offset/Proportional
Variation

B L

B L

B L

B
L

B L G

B L G

B L G

B
L
G

B L
G

B L
G

B L
G

B
G L

B
L G

L B
G

L B
G

L
G B

Bedroom Components

16 feet

The bedroom component in a compact house is usually rectangular in shape with proportions that vary from house to house. This analysis illustrates the effect of proportion on space utilization within the bedroom component. It does not attempt to explore possible exterior detailing refinements that could alter the plan configurations. The designer is encouraged to make whatever modifications are appropriate to reflect specific design criteria.

The basic elements within the bedroom component are:

- o bedrooms
- o bathrooms
- o clothing, linen and general storage
- o access corridors

Additional elements that may or may not be included in the bedroom component include:

- o air conditioning and heating equipment
- o domestic hot water heater
- o laundry equipment
- o basement stair

Of these elements, the most critical key plan determinants are the location of the access corridor and bathrooms.

An analysis of bedroom components from 16 to 32 feet in depth will reveal a number of interesting plan characteristics. Some of these include the following:

16 foot depth: access corridor along exterior wall causes high percentage of circulation space (figure in parenthesis) and exterior exposure, but this depth is a useful proportion for patio and cluster housing.

18 foot depth: similar attributes to 16 foot depth, but corridor moves inside of storage wall, allowing for additional and more convenient storage.

20 foot depth: corridor moves inside of bathrooms, allowing for walk-in closets, storage rooms and more efficient circulation.

22 foot depth: corridor moves to allow for increased bathroom depth and efficient "wrap around" 3 bedroom unit with master bedroom suite.

24 foot depth: corridor moves to allow turned bath plus storage, well proportioned rooms and a great variety of bedroom, bath and storage configurations.

18 feet

20 feet

22 feet

24 feet

Note:

Numbers in parentheses refer to percentage of circulation.

0 12 24

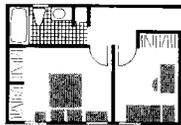


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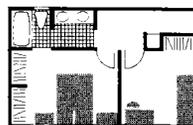


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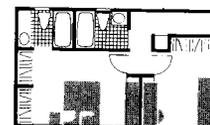
12 feet 14 feet 16 feet



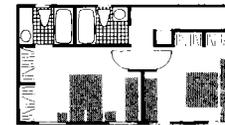
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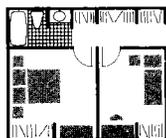
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448 ㎡ (12%)



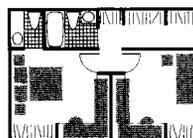
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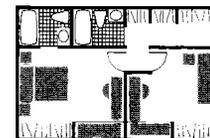
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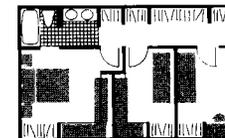
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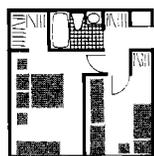
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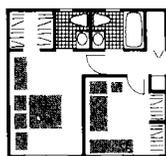
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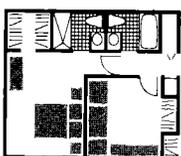
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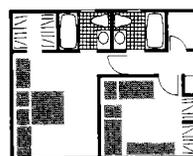
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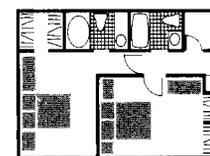
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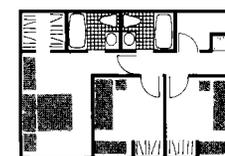
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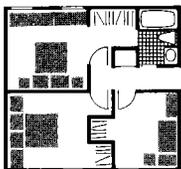
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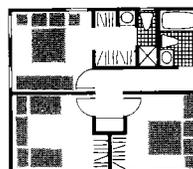
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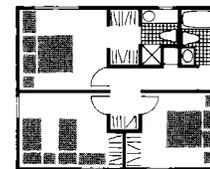
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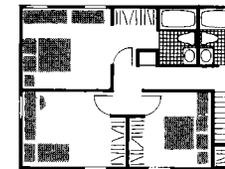
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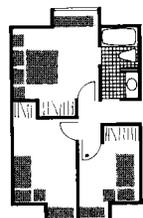
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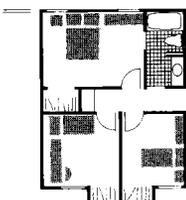
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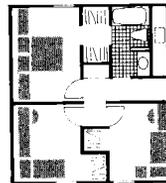
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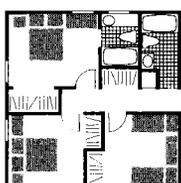
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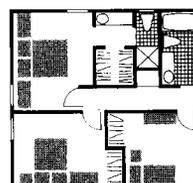
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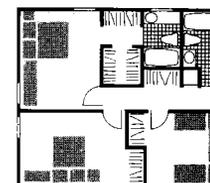
528 ㎡ (7%)



576 ㎡ (9%)



624 ㎡ (8%)



672 ㎡ (7%)

18 feet

20 feet

22 feet

24 feet

26 feet

28 feet

30 feet

Bedroom Components

26 foot depth: corridor moves to allow back-to-back bathrooms. Bath moves from upper right corner to end of corridor in most narrow (14') unit.

28 foot depth: A popular depth for many builders, 28 feet allows for a wide variety of layouts.

30 foot depth: A useful depth to combine with shorter living room to develop front or back porches and terraces. A different bath location (upper left) is possible at 30 feet.

32 foot depth: 32 feet allows for 3 bedrooms to be placed vertically or in an "L" shaped bedroom wing which in turn can be combined with an "L" shaped living area to develop a variety of pinwheel and interlocking geometries.

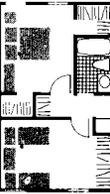
The bedroom components are dimensioned in increments of 2 feet in order to take advantage of "OVE" 24" o.c. framing techniques.*

* Reducing Home Building Costs with OVE Design and Construction.
 HUD Office of Policy Development and Research - available from HUD USER.

26 feet



364 ⌀ (5%)

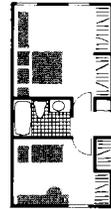


416 ⌀ (7%)

28 feet



336 ⌀ (5%)



392 ⌀ (5%)



448 ⌀ (3%)

30 feet



360 ⌀ (6%)

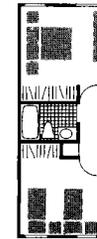


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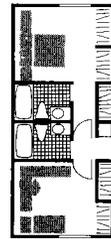


480 ⌀ (4%)

32 feet

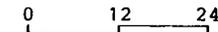


384 ⌀ (6%)

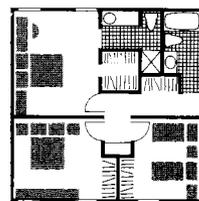
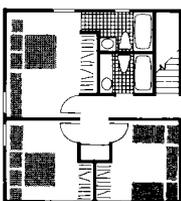
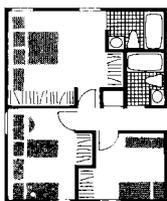
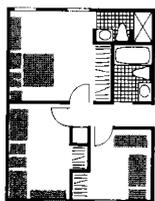
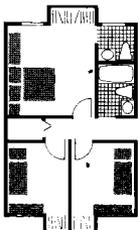


448 ⌀ (4%)

Note:
 Numbers in parentheses refer to percentage of circulation.



12 feet 14 feet 16 feet



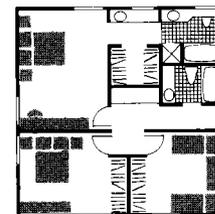
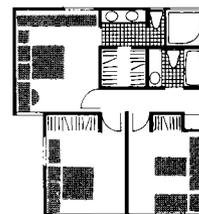
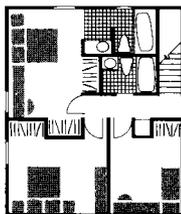
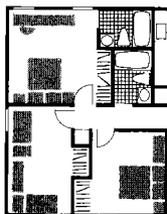
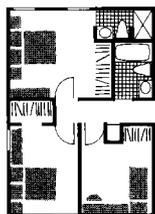
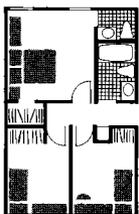
496 ㎡ (8%)

520 ㎡ (7%)

572 ㎡ (6%)

624 ㎡ (8%)

676 ㎡ (7%)



504 ㎡ (7%)

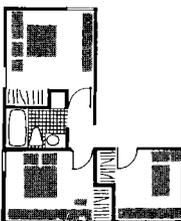
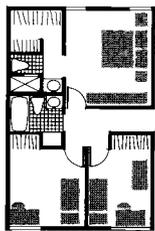
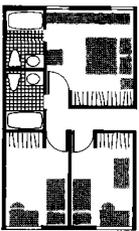
560 ㎡ (8%)

616 ㎡ (6%)

672 ㎡ (6%)

672 ㎡ (6%)

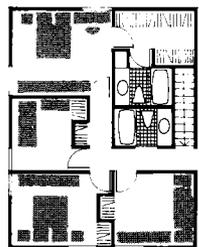
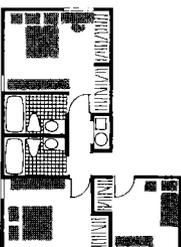
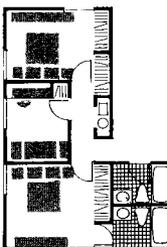
728 ㎡ (7%)



540 ㎡ (7%)

600 ㎡ (8%)

480 ㎡ (4%)



544 ㎡ (6%)

570 ㎡ (5%)

832 ㎡ (9%)

18 feet

20 feet

22 feet

24 feet

26 feet

28 feet

30 feet

Living Area Components

The living area component in a compact house contains the living, dining, kitchen and family room functions, as well as, in some instances, the entry closets, basement stairs, general storage and laundry areas.

In the past, the living, dining, kitchen and family room functions were frequently separate and compartmentalized. However, the trend to more informal living, the increase in the number of households without children, and the need to have individual activity space appear larger by "borrowing" space from other activity spaces, has lead to more open planning.

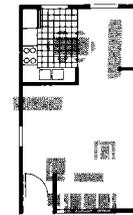
The living room in larger houses frequently served as a parlor, with the dominant number of activities taking place in the family room. This redundancy is no longer possible in small houses, and the functions of the living room and family room have largely merged together. Separate dining rooms have also become obsolete, and this function now takes place as an area in the living room, or is combined with the kitchen

in what has become a "country kitchen", a new type of family room where cooking and conversation co-exist. The kitchen, additionally, is frequently visually linked to the living area by means of a counter pass-through.

As a plan determinant, the kitchen is the most significant element in the living area component. Its specific location within the living area component will dramatically change the character and quality of the space, in particular, whether it orients to the entrance yard or to the back of the house.

The matrix at the right of this page illustrates the effect of alternate proportions on the quality of space and furniture arrangements, as well as the effect of different kitchen locations within the living area components. The area of the alternate components is indicated below the plan diagrams. The adjacent number in parentheses is the depth of the unit. The numbers at the bottom of the page refer to the unit lengths.

A

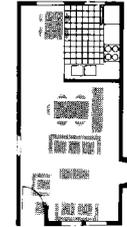


448 Φ (28')

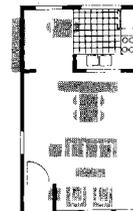


468 Φ (26')

B



420 Φ (30')



448 Φ (28')



468 Φ (26')

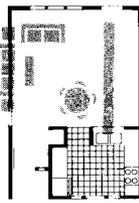
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420 Φ (30')

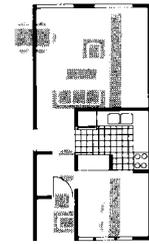


448 Φ (28')



468 Φ (26')

D



512 Φ (32')



540 Φ (30')

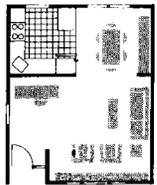
Note:
Numbers in parentheses indicate depth of unit in feet.

0 12 24

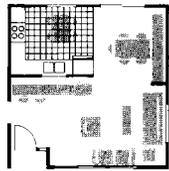
14 feet

16 feet

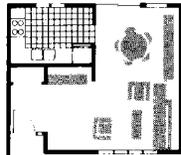
18 feet



480 ㎡ (24')



484 ㎡ (22')



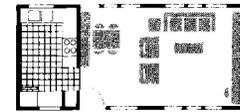
480 ㎡ (20')



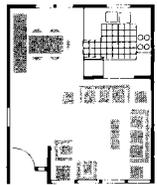
468 ㎡ (18')



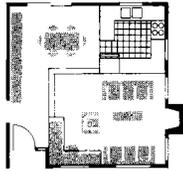
448 ㎡ (16')



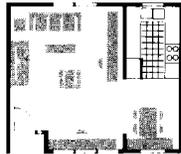
448 ㎡ (14')



480 ㎡ (24')



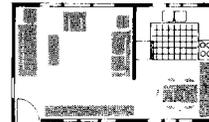
484 ㎡ (22')



480 ㎡ (20')



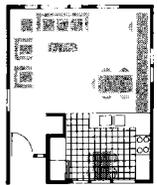
468 ㎡ (18')



448 ㎡ (16')



448 ㎡ (14')



480 ㎡ (24')



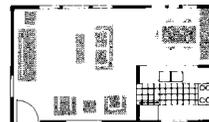
484 ㎡ (22')



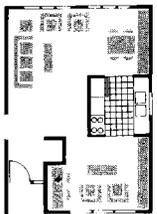
480 ㎡ (20')



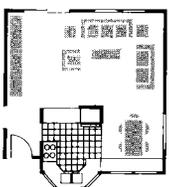
468 ㎡ (18')



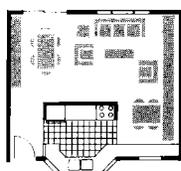
448 ㎡ (16')



560 ㎡ (28')



484 ㎡ (22')



480 ㎡ (20')



512 ㎡ (16')



504 ㎡ (14')

20 feet

22 feet

24 feet

26 feet

28 feet

32 feet

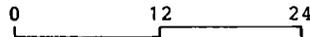
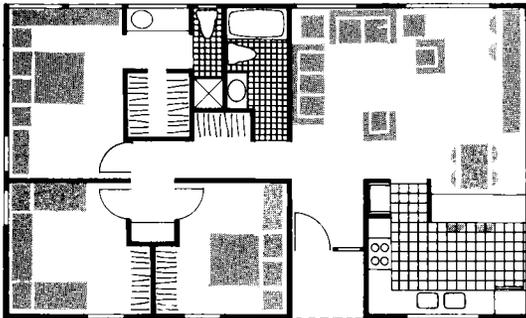
36 feet

Type A Floor Plan and Variations

A typical "ranch" type plan with adjacent living area and bedroom components. This plan is also adaptable to a two-story house with a garage by means of a mid-level, split-foyer entry.

As in all plans, the bedroom component can be "flipped" along the horizontal axis in order to locate the master bedroom at the front of the house.

In this design the kitchen is located in the front of the living area for visual control of the entry area. The location of the living room at the rear of the house allows for protected views into a landscaped yard and keeps circulation at the periphery of the room.



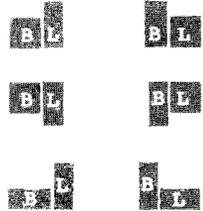
Bedroom and living area components can be square or elongated.



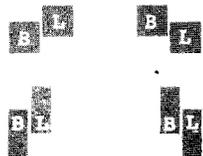
Adjacent components' proportions can be varied to define front or rear porches or terraces.



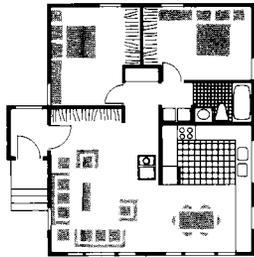
Adjacent components' proportions can be varied to create front or rear yards and "L" shaped patio house plans.



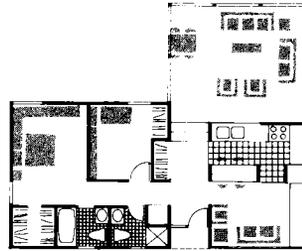
Components can be offset with respect to each other to create both front and rear yards.



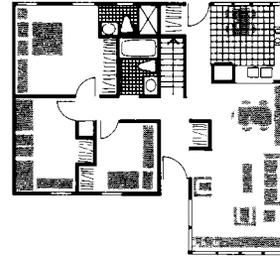
This compact plan, which appears quite different from the typical "ranch" type plan below, is, in fact, a very similar plan rotated 90°.



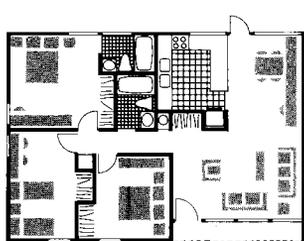
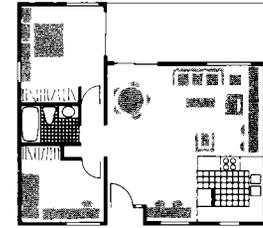
A combination of an almost square bedroom component with an elongated living area component defines a protected rear court and provides effective interior zoning.



A plan similar to that at the left, but with the setback oriented to the entry side.

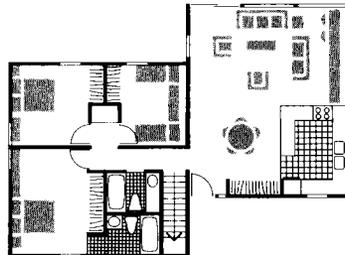


The combination of an elongated bedroom component and a square living area creates a terrace setback in front of living area.

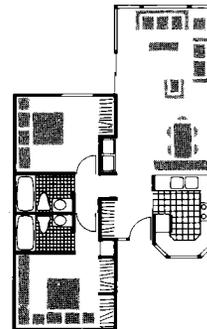


LEFT: A popular "ranch" plan with the kitchen and dining area to the rear.

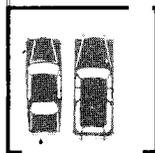
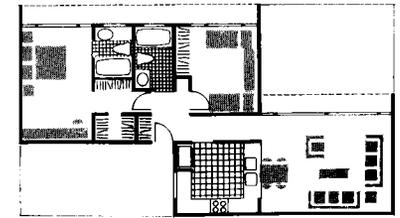
BELOW: Offsets allow for interesting elevations, efficient circulation.



Offset, elongated components help define private front and rear courts in narrow site configurations.



Offset, elongated and rotated components create potential protected deck areas and solar access for sloping sites.

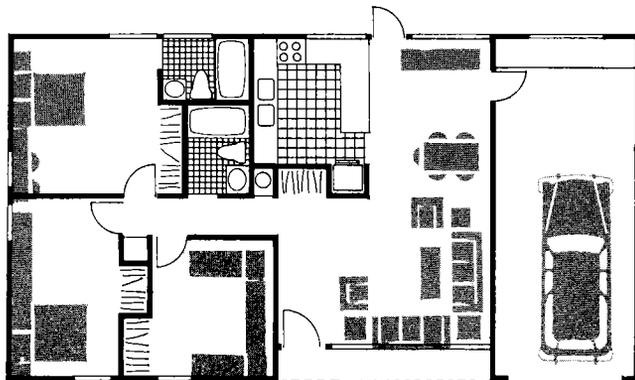


0 12 24

Type B Floor Plan and Variations

An efficient plan with bedroom, living area and garage components aligned. This arrangement is particularly economical, as the roof configuration is very simple. In some instances, however, narrow site widths preclude this in-line component arrangement, particularly when a two car garage is required.

As in all plans, the key organizational decisions involve the orientation of the living area. This decision should reflect careful consideration of many factors, including significant site features, special functional requirements, the importance of solar access, the need for privacy, and other subjective user requirements.



B L G

0 12 24

Bedroom and living room components' proportions can be square or elongated.

B L G

B L G

Adjacent components' proportions can be varied to define front or rear porches.

B L G **B L G**

B L G **B L G**

Adjacent components' proportions can be varied to create front or rear yards and terraces.

B L G **B L G**

B L G **B L G**

B L G **B L G**

Components can be offset with respect to each other to create both front and rear yards and terraces.

B L G **B L G**

B L G **B L G**

This plan utilizes the area behind the garage as a breakfast/family room. Another optional use for this space would be a porch.

B L G

A plan that provides for separation of bedrooms and the opportunity for a dramatic center building section.

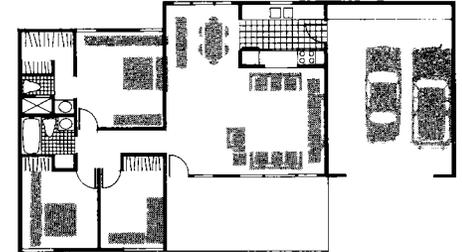
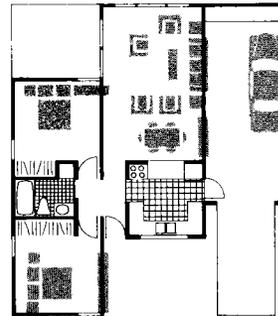
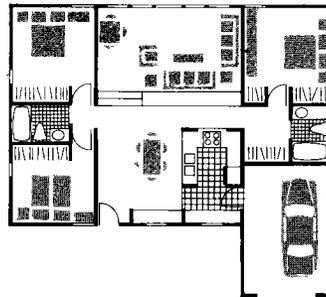
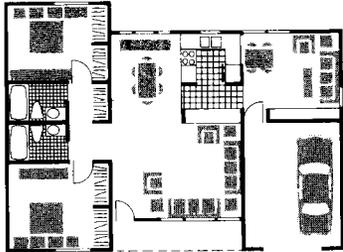
B L G

Elongated components allow for an in-line component relationship on a narrow site.

B L G

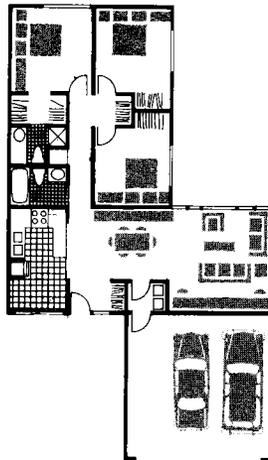
Square shaped in-line components may require too great a length for many of the newer subdivisions.

B L G



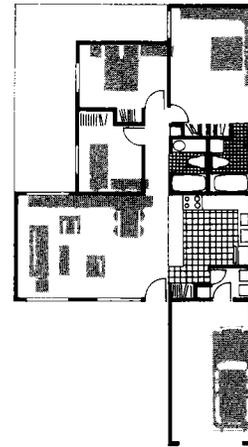
By rotating and offsetting components a plan is developed that would work well for attached, zero-lot-line and narrow sites. Ample light and ventilation are provided to all interior areas, something which is not true with many narrow-lot houses.

B L G



Another plan derived from a diagram that would work well with narrow lots. In this instance the living room orients to both front and rear yards.

B L G

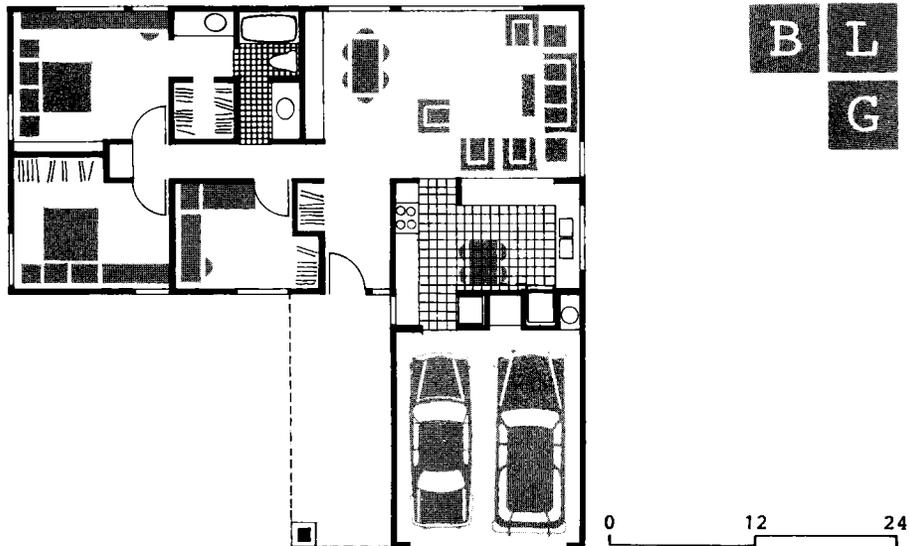


0 . 12 24

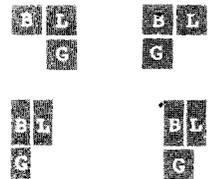
Type C Floor Plan and Variations

In this plan configuration, the garage is located in front of either the bedroom or the living area component. The location of the garage in front of the bedrooms allows the living area to orient to the entrance side, while the alternate location of the garage, in front of the living area, necessitates that the living area orient to the rear or side yard.

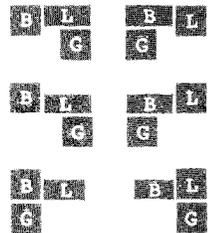
This particular configuration allows for the use of narrower lots than the type B component relationship described on the preceding page. Because of its "L" shaped plan, it creates an entry court, which is frequently a desirable feature.



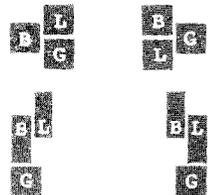
Bedroom and living area components can have square or elongated proportions.



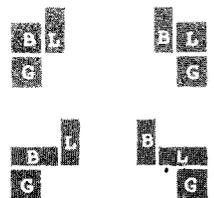
The proportions of adjacent components can be varied to create front or rear courtyards.



Adjacent components can be offset with respect to each other to create front and rear courtyards.

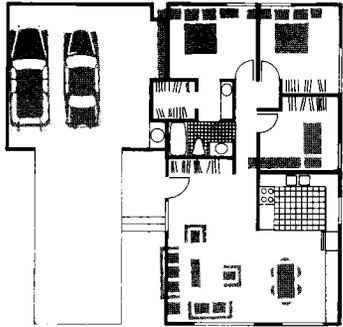


Combinations of differently proportioned components can provide a variety of differently proportioned exterior spaces.



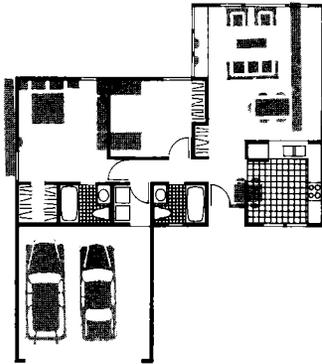
Typical "ranch" layout rotated 90° with living area component forward.

G B
L



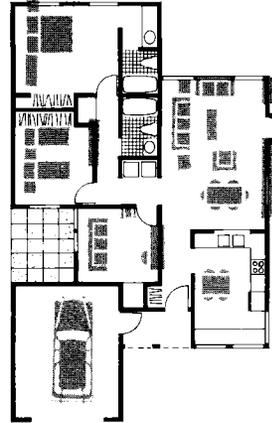
Elongating the living area component allows for an additional living room exposure.

B L
G



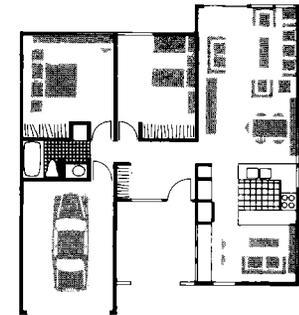
A narrow lot plan with internal patio/court.

B L
G



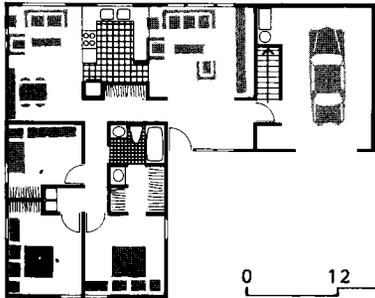
Elongated living room component creates an entry court, and also provides efficient circulation.

B L
G



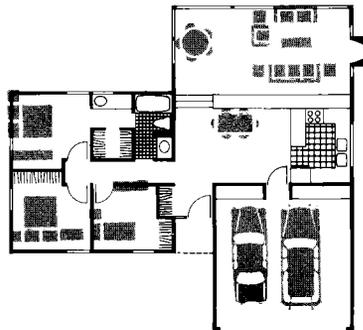
A rotated "ranch" plan with bedrooms forward and living area oriented to the rear.

L G
B



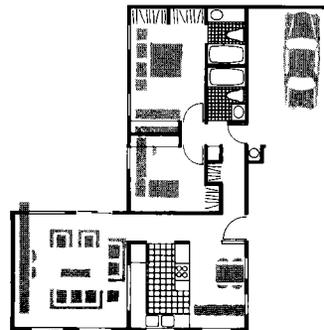
Offsetting components provides efficient circulation. Level changes generate interesting building sections.

B L
G



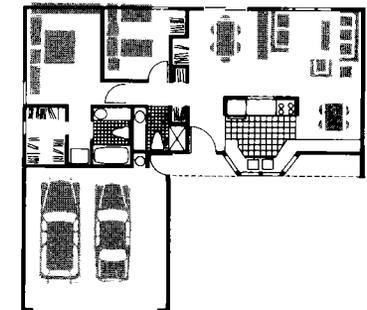
A "patio" type plan generated by rotating elongated components. This arrangement could work for attached housing.

L G
B



An alternate conventional layout with kitchen/dining forward.

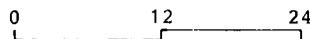
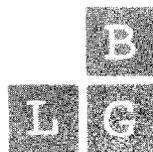
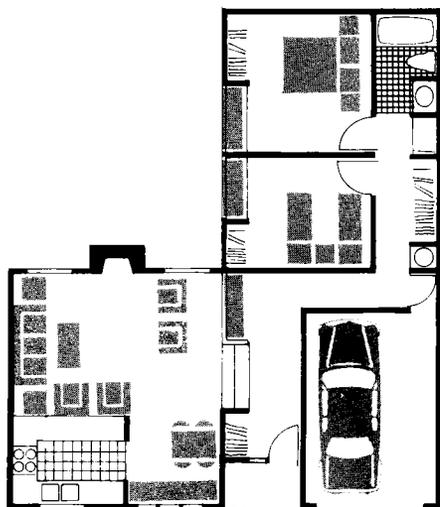
B L
G



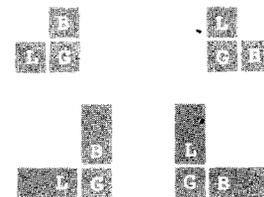
Type D Floor Plan and Variations

A quite different arrangement of components that generates patio or courtyard type plans. The patio house, while popular in Europe, has had relatively little use in the U.S. With the need for higher density solutions due to increasingly smaller affordable lot sizes, (40'- 50' width range), this type of planning concept deserves further study.

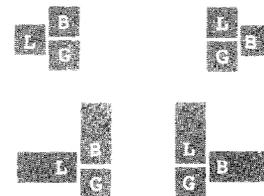
As opposed to many zero lot-line site plans which create narrow, difficult-to-use side yards, the patio concept concentrates exterior space in private, well-protected and well-proportioned courtyards. This concept also works well with the solar access requirement of passive solar heating.



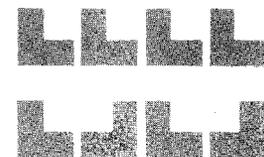
Variations in the proportions of components will produce a variety of courtyard sizes. This plan will also work for two-story housing but will require design ingenuity to maintain privacy.



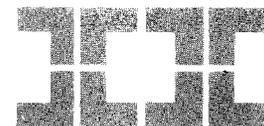
Components can be offset in relation to each other to create both front and rear courtyards.



Houses can be detached and oriented south for solar access.

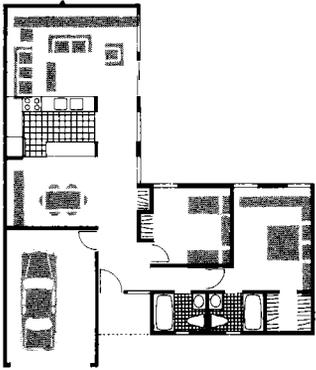


Houses can be attached and can front on common courts or pedestrian ways.



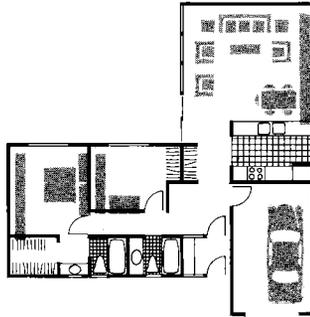
An elongated living room component allows for separate dining and living rooms.

L
B
G



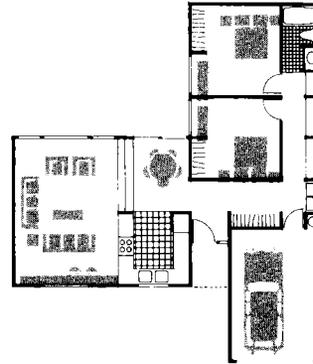
A compact plan which could easily include a two-story bedroom wing with the addition of a stair at the entry.

B
L
G



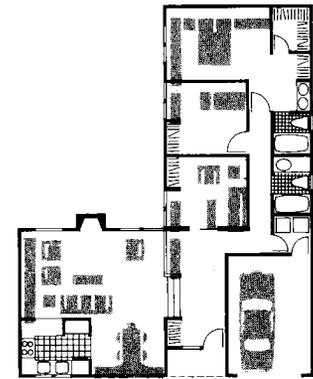
A plan with the living area afforded a dual exposure and the kitchen oriented to the front.

B
L
G



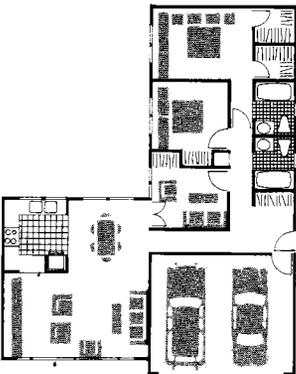
An elongated plan that uses level changes and an open study/bedroom to create interest.

B
L
G



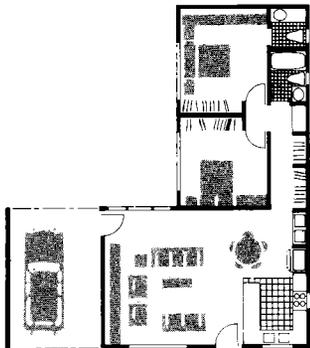
A plan that uses a side entry to allow for shorter, more central circulation and a larger garage.

L
B
G



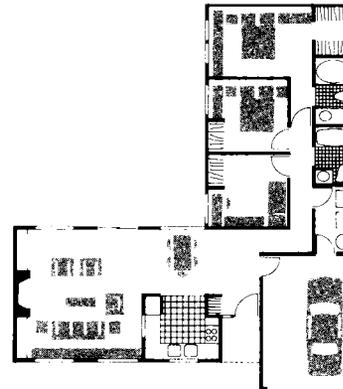
A different component arrangement with the garage/carport at the end of the living room.

B
L
G



Oriented south, the elongated living room is adaptable to passive solar concepts.

B
L
G



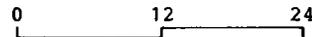
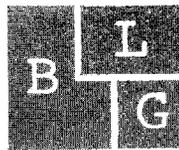
0 12 24

Interlocking Plan Variations

While the plan types on the preceding pages are characterized as having bedroom and living area components that abut each other but do not necessarily overlap, in this plan type, at least one component is "L" shaped and interlocks with the others.

The living room frequently serves as the organizational center to which other components are joined. Often quite different plan arrangements, including pin-wheel types, can be generated.

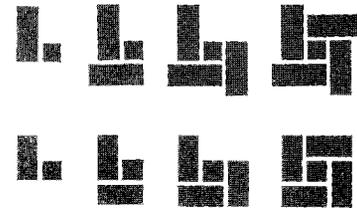
As in all plans, the location of the kitchen is a major generator of plan variations.



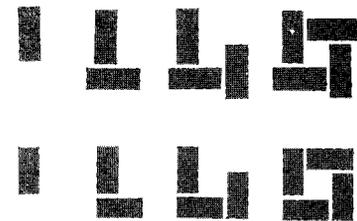
An "L" shaped bedroom component interlocks with an "L" shaped living area component, or with two or more rectangular components that form an "L" shape.



Components can "pin-wheel" around a central living area core. Elements can overlap or be aligned.



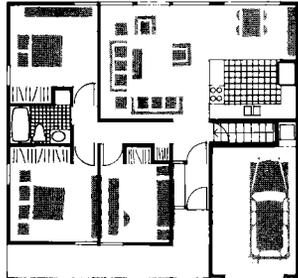
Components can "pin-wheel" around a central space forming open or closed courts.



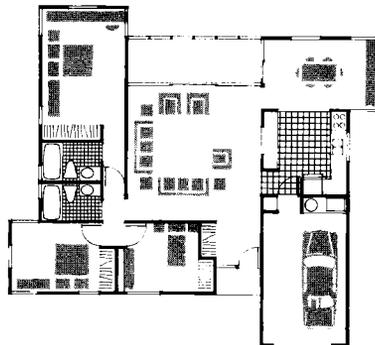
"H" or "U" shaped configurations can also generate plan variations.



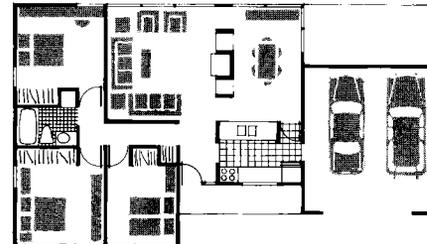
A typical compact plan arrangement affording a central entrance to the living area.



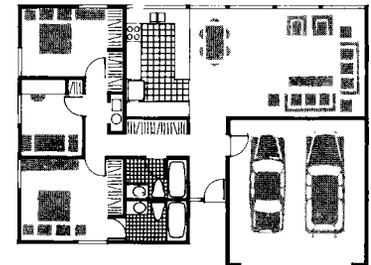
A plan with elements that "pinwheel" around a living room that is oriented to a solarium.



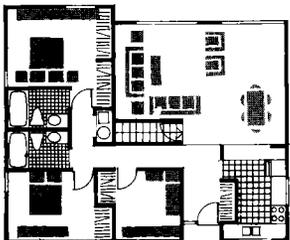
A plan similar to type "B" floor plans but with an "L" shaped bedroom component.



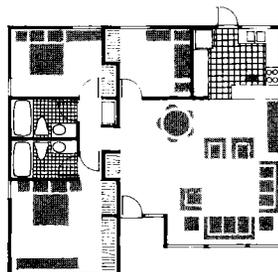
A variation on the "L" shaped bedroom component with the bathrooms at the bottom leg.



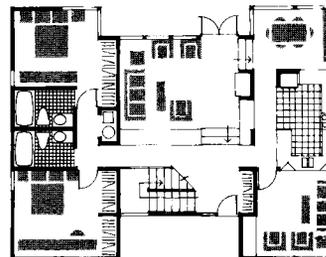
A plan variation that locates the kitchen at the front of the home.



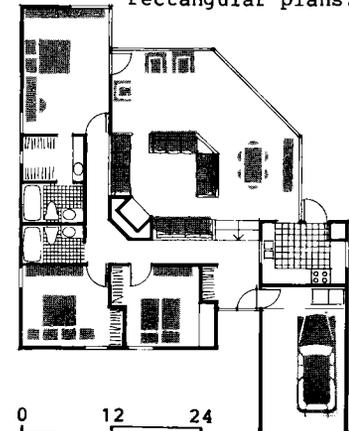
A plan with the bedroom component wrapping the rear of the house causing the living area to orient to the front.



An "H" shaped plan organized around a sunken living room. As in many of these plans, a second story loft is possible.



Angular geometries have dynamic relationships to rectangular plans.



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