jeff leven brandy billingsley university of arizona school of architecture capla community planning & design workshop city of casa grande low-income prototype housing

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genei	ral introduction	
-	project description	
	state housing meeting notes	
casa	grande demographics	
casa	grande housing and revitalization program	
	affordable housing strategies	
	introduction	
	action zone plan	
	housing photographs	
	self-help program	
	task breakdown	
	housing photographs	
	rehabilitation program	
	housing photographs	
	funding sources	
	meeting notes	
	<u>3,05,2003</u>	
	3.12.2003	
	interviews	
	self-help housing program	
	replacement housing	
	details of replacement program	
	city of casa grande block / lot map	
	demographics of existing clients of the rehabilitation program	
	construction cost estimates	
case	studies of community programs	
	habitat for humanity	
	city of tucson affordable housing	
desic	gn influences	
000.8	design guidelines	
	environmental site conditions	
	material investigation	
	sustainable materials	
	design for hot and arid climates	
	passive solar heating and cooling systems	
	exterior wall assembly comparison	
	energy performance of windows	
	floor area and material comparison	
	energy efficiency comparison	
	conclusions and recommendations	
	energy efficient mortgages	
	universal housing standards	
desig	gn diagrams	
	existing housing designs in casa grande	
	housing diagrams	
	two bedroom - one bath	
	three bedroom - two bath	
	four bedroom - two bath	
	typical housing design diagrams	
	innovative desert design diagrams	
prop	osed universal designs	
• •	site plan	
	two bedroom - one bath universal design proposal	
	one bedroom - one bath universal design proposal	
	three bedroom - two bath universal design proposal	
	four bedroom - two bath universal design proposal	an
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may 2, 2003 university of arizona school of architecture



#### project statement

to provide technical assistance and design examples to assist the city of casa grande housing program.

#### scope of project

develop prototype housing designs for city of casa grande self-help and replacement / rehabilitation housing program, recognize universal design needs and estimate total cost of construction and ownership, in addition, to conducting review of casa grande housing replacement program (especially funding) and provide proto-type house replacement designs that facilitate use of self-help labor in construction, comprise a universal design model home and/or lower cost of ownership through design elements like energy efficiency.

# casa grande project representatives rosa bruce, housing & revitalization director jose delgado, housing & community services specialist debbie dremler, administrative assistant

# community planning and design workshop team

capla, university of arizona

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brandy billingsley, pursuing bachelor of architecture / masters of planning

jeff leven, pursuing bachelor of architecture and bachelor of science in regional development corky poster, faculty advisor

# project description

### arizona department of housing

the arizona department of housing has requested technical assistance from the community planning and design workshop to provide assistance for the city of casa grande. financial support is provided by the arizona department of housing.

#### vision

affordable housing, viable communities

mission

providing housing and community revitalization to benefit the people of arizona. guiding principles the arizona department of housing will adhere to the following guiding principles in the day-to-day operations, policy and program development.

-accountability -stewardship -responsive and customer/partner focused -communication and team work -continual improvement -excellence -financial viability

#### program distribution

the community planning and design workshop of the university of arizona is a public service/community outreach arm of the college of architecture, planning and landscape architecture (capla). support funding is provided by both capla and the college of agriculture through cooperative extension. the community planning and design workshop is intended to bring the skills and knowledge of the students, faculty and staff of capla to communities in need throughout tucson, pima county and the state of arizona.

#### mission statement

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the community planning and design workshop of the university of arizona is a public service/community outreach arm of the college of architecture, planning and landscape architecture (capla) in collaboration with the roy p. drachman institute. the intent of the community planning and design workshop is to join the technical skills and knowledge of the students, faculty and staff of capla with the needs of economically and socially distressed communities and individuals throughout tucson, pima county and the state of arizona. the workshop will help fulfill the land grant/outreach mission of the university of arizona by making the resources of the college available in seeking effective solutions to the needs of neighborhoods, non-profit corporations, cities, towns, and rural areas. the *workshop* receives funding and support from capla, cooperative extension (college of agriculture), and the roy p. drachman institute.

#### community planning and design workshop (cpdw)

the workshop has assisted many groups over last ten years. projects are intended both to assist communities and to insure that students involved are meeting their educational goals. for more information on the workshop see the webpage at <a href="http://architecture.arizona.edu/outreach/cpdw/default.htm">http://architecture.arizona.edu/outreach/cpdw/default.htm</a>.

state housing meeting notes

meeting: introduction meeting with city of casa grande and university of arizona architecture dept.. attendees: corky poster, rosa bruce date: feburary 11, 2003

rosa bruce - casa grande housing and revitalization director

housing prototypes

solid housing replacement strategy, want to know how to improve design and drive down costs

ari posner – work study by h.u.d. new project replacement of old trailers. permanent structures on the same site. colonial del sol is adjacent city limits. city/county agreement, city has extended sewer main to west property line 600 units, 1500 people, manufacturing and ad ones.

demographics meet for supportive services. technical side- engineering study to asset existing infrastructure.

eligibility and real needs: started in august, colonial del sol in september

self help housing 25/yr. usda – 502 rural development loan. down to 1% in term for 100% of loan. usda 523 t.a. money for administration, counseling service, community college training, and on-site supervision. groups of ten usually, owner - builder.

contract out service. usda can only work in communities under 25,000 only good through 2000. waivers granted by past congressman kolbe and present congressman renzi. waivers appropriations committee – september 31, 2003

looking at new funding sources. sweat equity reduces the cost by \$15,000.

interested in designs that will take advantage of self-help, energy – efficiency. current plans are very conventional, not innovative, universal design, alfordable design. action zone area. 1997 money started in 1995.

housing rehab side, cdbg, home, housing trust - county wide non-profit, usda. three tax credit projects.

strategic housing plan for colonia del sol. hud- work study - ari posner.

housing design and concepts, prototypes, waiting lists. replacements have call for bids: vary in size 3br, 2br disabled, 3 housing types, and design energy efficient, supply costs, self-help or sweet equity.

45 minutes from phoenix. high costs area is not having a commercial design 10-15 to see a plan. old areas typical lot size 50'

study rosa's projects and products. develop prototype for replacement housing, low-cost usable design. september/october workshop. write up a work plan.

note source: corky poster



# total population





**conclusion:** in 1990, the population in casa grande was 16.5% of pinal county, and pinal county was 3% of the population of the state of arizona. in 2000, the population of casa grande slipped to 14% of pinal county, and pinal county had rose to 3.5% of the population of the state of arizona. between 1990 and 2000 there was a rise in the population of casa grande by 32%, pinal county's population rose 54%, and the state of arizona's population rose 45% between 1990 and 2000.



# population from 1920-2000 (pinal county and casa grande)



casa grande demographics total population

# race/ethnicity

casa grande, arizona

pinal county, arizona







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**conclusion:** between 1990 and 2000 the non-hispanic white population within casa grande declined by 6.5%, but the hispanic population rose 4.9%. in pinal county, the racial/ethnic composition remained relatively constant between 1990 and 2000 except that the american indian population rose by 2.7%. in the state of arizona between 1990 and 2000 the non-hispanic white population declined by 7.5%, while the hispanic population rose by 6.9%.



30.3%

# population less than the age of 18



**conclusion:** in general, the percentage of casa grande's population below the age of 18 was higher than both pinal county and the state of arizona. on average the population less than the age of 18 between 1990 and 2000 decreased: in casa grande (by 4% - 35% to 31%), in pinal county (by 5% - 31% to 26%), and in the state of arizona (by 1% - 28% to 27%).



**conclusion:** in general, the percentage of casa grande's population greater than the age of 65 was lower than both pinal county and the state of arizona. the percentage of population greater than the age of 65 was greatest in pinal county between 1990 and 2000, compared to casa grande and the state of arizona. on average the percentage greater than 65 population between 1990 and 2000 increased in casa grande (by 4% - 10% to 14%), in pinal county (by 2% - 14% to 16%), and in the state of arizona the population greater than 65 stayed constant at 13%.

# median income



**conclusion:** on average, the median income in the state of arizona is greater than casa grande and pinal county. in general, the median income increased in casa grande, pinal county and the state of arizona between 1990 and 2000.

# percent of population below poverty



**conclusion:** in general, casa grande's percent of the population below poverty is higher than the state of arizona but lower than pinal county. between 1990 and 2000, the percent of the population below poverty decreased in casa grande (by 1% - 17% to 16%), in pinal county (by 5% - 22% to 17%), and in the state of arizona (by 1% - 15% to 14%).

# high school graduates ages 25+



**conclusion:** in general, the percentage of casa grande high school graduates greater than the age of 25 are in between pinal county and the state of arizona. between 1990 and 2000, the state of arizona had a higher percentage of high school graduates greater than the age of 25. between 1990 and 2000, the percentage of high school graduates greater than the age of 25 in casa grande increased slightly by 1% (72% to 73%) of the total population of casa grande. between 1990 and 2000 the percentage of high school graduates greater than the age of 25 in pinal county increased the most by 6% (66% to 72%) of the total population of pinal county having a high school diploma or equivalent). between 1990 and 2000 the percentage of high school graduates in the state of arizona increased by 3% (78% to 81%) of the total population of arizona.



**conclusion:** on average, the percentage of the population living in urban areas is greatest in casa grande. In general the population living in urban areas has increased in pinal county (by 5% - 59% to 64%) and in the state of arizona (by 24.2% - 72.5% to 96.7%) between 1990 and 2000. In casa grande, the population living in urban areas decreased slightly by almost 2% (99.8% to 98%) between 1990 and 2000, though no explanation for this difference is apparent

# population living in rural areas



**conclusion:** on average the population living in rural areas is lowest in casa grande and is highest in pinal county. in general the population living in rural areas has decreased for pinal county (by 5% - 41% to 36%) and the state of arizona (by 1.1% - 12.5% to 11.4%) between 1990 and 2000. in casa grande the population living in urban areas increased slightly by almost 2% (.20% to 2.0%) between 1990 and 2000, again no explanation for this difference is apparent.

casa grande housing and revitalization program

affordable housing strategies

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in the city of casa grande, arizona there are three distinct housing programs that benfits the very low, low, and moderate income families as well as the community as a whole: action zone plan, self-help program, and rehabilitation program.

the casa grande action zone was a result of several years of dialogue between the westside neighborhood residents and the city of casa grande, arizona. the action zone was a vehicle to organize a strategic plan of action with other interested social service providers.

for the self-help program, the farmers home administration of the federal government makes affordable loans available. these loans help assit with site development as well as providing grants for technical assistance to help low-income families build homes in rural areas. individual houses are built under the supervision by a group of families who ultimately will live in the dwellings. this group of people mutually helps each other with the guidance of a construction expert. this group contributes 65% of the labor (as 'sweat equity') that is needed to build their homes.

the rehabilitation program helps very low, low, and moderate income families in the city of casa grande, arizona to upgrade their living conditions, and to improve and to preserve the quality and appearance of the housing stock and the overall environment in the community; this program is particularly focused on the designated target areas.

the rural housing service (rhs) is part of rural development (rd) in the united states department of agriculture (usda). it operates a broad range of programs that were formerly administered by the farmers home administration to support affordable housing and community development in rural areas. rhs both provides direct loans (made and serviced by usda staff) and also guarantees loans for mortgages extended and serviced by others.

casa grande, arizona uses united states department of agriculture loans, usda section 502 and section 523, as the source of the majority of the funding for the self help housing program. funds for the rehabilitation program comes from: housing & urban development (hud), community development block grant (cdbg), home, housing trust funds, usda 504 grants and loans, usda housing preservation grant (hpg), community action human resources agency (cahra), local banks and housing development funds (funded by local building fee set-aside). any rehabilitation project (based on eligibility) may have one or any combination of funds/components to accomplish the goal of providing decent housing.

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#### action zone plan

the casa grande action zone was a result of several years of dialogue between the westside neighborhood residents and the city of casa grande, arizona. the action zone initiative, funded by the state of arizona, was a vehicle to organize a strategic plan of action with other interested social service providers.

a committee was formally authorized by the casa grande mayor and council to organize all public participation, review and update all available information including neighborhood studies and create this plan; its membership consists of five neighborhood residents and representatives of for-profit and non-profit developers, social services, the elementary school board, the police department, and the mayor and council. with this initiative, there were public meetings to receive neighborhood input to compile a list of needs and opportunities.

this process was followed by a series of 'brainstorming' sessions searching for both physical and social improvements to address the identified needs. as a result, several gaps were found in terms of financial assistance and expertise.

the city will enforce property maintenance codes, aid qualified applicants with housing improvement programs, demolish dilapidated residential structures, and assist, through action zone initiatives, to bring the partnerships and resources needed. however, only the neighborhood residents and property owners can bring about change, investment, and improved living conditions.

the included action partners are: neighborhood residents, seeds of hope, headstart, usda rural development, bank of america, city of casa grande, state of arizona, jtpa, and vista. there were a total of 4.6 million dollars of funding from a variety of sources: cdbg action zone, bank of america, cdbg regional account, home, rcac loan funds, istea, headstart, usda rural development, land donations from the city of casa grande, land donations from residents of casa grande, in-kind contributions, and additional city staff (code enforcement funds 1998-1999). there were two types of action zone proposed projects: physical and social projects.

### physical

- · general neighborhood clean-up
- · street and sewer improvements
- street lights
- recreation center/public safety services
- housing rehabilitation
- · replacement of deteriorated garbage containers
- subdivision development
- · alley maintenance
- new construction affordable housing
- temporary housing-triplex
- · park ramada at casa de ensueno
- · basketball court at cruz park
- · playground & security system for headstart
- · rehabilitation materials for seeds of hope complex
- · ground cover for san carlos canal pedestrian walk
- · artwork for san carlos canal pedestrian walk

# social

- children/youth supervised activities
- additional police patrol
- · crime prevention and reduction
- skill/job training
- · transitional assistance towards self-sufficiency
- neighborhood organization/empowerment
- · childcare/headstart
- · cleaner, safer environment
- · additional code enforcement personnel
- · increased property values pride of ownership

source:city of casa grande action zone plan



community development and park - action zone program



community development and park - action zone program

# casa grande housing and revitalization program photographs of the action zone plan

#### self help housing

the farmers home administration makes loans for self-help housing, which includes site development, and grants for technical assistance to help low-income families build homes in rural areas. individual houses are built under supervision by a group of families who live in the dwellings. the group of people mutually helps each other, with the guidance of a construction expert. this group contributes 65% of the labor ('sweat equity') which is needed to build their homes.

'sweat equity' is manual labor which is exempt from license requirements and does not fall in the specialty trades category. tasks such as carpentry, roofing, insulation, flooring, painting, landscaping, cleaning, etc. are the tasks performed by the families with training and supervision on-site. each group is required to take a course for credit which will enable them to acquire the skills to be able to perform those tasks with a high level of craft and efficiency. this work results in considerable savings to the families, therefore creating the monetary difference between cost of construction and appraised value, which is considered the 'sweat equity.'

any small group of low-income families may qualify providing they cannot individually afford to build modest houses by customary methods. each family must be able to repay a loan for the cash cost of the house. the loan funds are used to buy material and to pay for any skilled labor and contract costs for work the families are unable to perform. if necessary, loans may be used to buy building sites and to prepare them for construction activity.

this program benefits the family by giving them the opportunity to 'work off' the down payment and obtain federal funding for subsidized interest financing tailored to their individual needs. the house plans also cater to the different family structures normally from 2 to 4 bedrooms, although there have been instances where more bedrooms are built if needed. these houses are designed to meet all applicable building codes, and with safety being top priority. the families also benefit from the on-site job training they receive during construction, often leading to better employment opportunities.

unlike other government housing programs which are associated with high crime and blight areas, the self-help program, by its nature reflects pride of ownership, enhances existing neighborhoods and provides for a high quality of life, making the community a cleaner more attractive prospect for developers. this varied housing stock also represents solid assessed valuations which will in turn provide for infrastructure needed to continue healthy growth. the self-help program can make a big impact by providing for in-fill in neighborhoods, not only creating a new tax base, utility fees, etc. but also increasing the value of surrounding properties.

source: city of casa grande self-help housing program





completed self help project - (house 1)



completed self help project - (house 2)

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### housing rehabilitation

the city of casa grande, arizona has funds available in the form of low interest loans through a variety of sources, mainly: housing & urban development (hud), community development block grant (odbg), home, housing trust funds, usda 504 grants and loans, usda housing preservation grant (hpg), community action human resources agency (cahra), local banks and housing development funds (funded by local building fee set-aside). any rehabilitation project (based on eligibility) may have one or any combination of funds/components to accomplish the goal of providing decent housing.

the goals of the housing rehabilitation program are: to benefit very low, low, and moderate income families in the city of casa grande, arizona in upgrading their living conditions, and to improve and preserve the quality and appearance of the housing stock and the overall environment in the community this focuses particularly in the designated target areas.

the objectives of the rehabilitation program are the following:

- secure a variety of funding sources to allow the implementation of a comprehensive rehabilitation program to bring all eligible properties into compliance with all adopted city codes
- to provide technical assistance and counseling services to all eligible families for and not limited to: ownership responsibilities, budgeting for property taxes and insurance, property maintenance, and energy conservation.
- to bring code enforcement activities in conjunction with rehabilitation service as an educational process in the target areas to remove health and environmental hazards and promote cleanliness and pride of ownership.
- to provided referral services to the various agencies offering assistance in the areas of housing, medical, financial hardship, legal aid, etc.

those goals and objectives are implemented through a variety of different tools:

- properly trained rehabilitation service personnel to provide assistance from initial contact through completion of work and loan services.
- properly trained code enforcement personal (education/human relations) to serve as liaison for all available programs as well as beautification/environmental tasks.
- to go along with the rehabilitation program, there is a voluntary demolition program, which uses city equipment and manpower to demolish vacant, abandoned, and dilapidated buildings with the property owner's permission and waiver of liability. This provides for the removal of slum and blight and allows for redevelopment of the land.
- temporary housing used to house families whose house is under construction through the rehabilitation program.

the eligibility requirements are that the property to be rehabilitated must be located in the corporate city limits, the program may assist families at very low, low, and moderate income, the property must be owner occupied, in the case of up to four family dwelling – one must be owner occupied, and the home must be suitable for rehabilitation under the time and monetary constraints of the program.



completed rehabilitation project - assessable design addition (house 3)



current replacement project (before)- front yard (house 4)



back yard (house 4)







side yard (house 4)

casa grande housing and revitalization program photographs of the rehabilition program



current replacement project (before)- (house 5)



current replacement project (before)- (house 6)



interior (house 6)



interior (house 6)









#### usda section 502

applicants must have very low or low incomes. very low income is defined as below 50 percent of average median income (ami); low income is between 50 and 80 percent of ami. In casa grande, arizona to be eligible, for the usda 502 program the total family income must not exceed 80 percent of the median income. In addition applicants must be without adequate housing, but be able to afford to the mortgage payments, including taxes and insurance. In addition, applicants must be unable to obtain credit elsewhere, yet have reasonable credit histories. priority is given to loan servicing, especially servicing for participation loans; applicants living in deficient housing; and people participating in mutual self-help housing.

the loans are for up to 33 years (38 for those with incomes below 60% of armi and who cannot afford 33-year terms). the term is 30 years for manufactured homes. there is no required down payment. the promissory note interest rate is set by rhs and was 6.75 percent in august 2002. that interest rate is not initially meaningful, however, since it is modified by payment assistance subsidy. the interest rate and amount of subsidy are determined by family income as a percentage of armi. families without leveraged loans pay from 22 to 26 percent of their income for principal, interest, taxes, and insurance (piti), but not more than the payment amount calculated using the promissory note rate. eligibility is also affected by repayment feasibility, determined using ratios of repayment (gross) income to piti and to total family debt.

#### usda section 523

used section 523 is money that is used for administrative purposes only. in casa grande, arizona, the funds are used to provide counseling and technical assistance. the counseling service topics can include: ownership responsibilities, budget/credit, property maintenance, energy conservation, property taxes, insurance, sewer/trash, and other utilities. the technical assistance that is available is for property owners willing to improve their property using the do-it-yourself method and/or private financing. these services provided can include inspections, plans/ specifications, assistance in obtaining private/conventional financing, bid proposals/cost estimates, and help with the building permit process.

#### usda section 504 loans

subsidized interest loans administered and serviced by the usda, rd, with limits that may vary from year to year. interest may be as low as one percent on a term of up to 20 years. rehabilitation staff will assist applicant in completing application on usda approved forms and by providing assistance during the approval process. rehabilitation staff will also provide the necessary work specs, blueprints, bids, etc for usda to package a loan. usda will provide the funds to the city to complete the financial package for the particular rehabilitation project. these loans are secured by a mortgage.

# usda section 504 grants

applicant must be 62 years of age or older and low income. this grant is forgiven at the end of three years as long as the dwelling is occupied by the owner. the loan becomes due and payable upon sale or transfer of the property if sale or transfer takes place prior to the 3<sup>rd</sup> anniversary. this grant is secured by a lien.

# funded by cahra

cahra grant is an outright grant for a maximum amount of \$5,000 per dwelling unit. unlike other funds, cahra requires that the family's income does not exceed 100 percent of poverty level.

# odbg funded

through the housing and community development act of 1974, the community development block grants (cdbg) were created. this program gives block grants to localities to fund neighborhood redevelopment, economic development, and community services. eligible uses include acquisition, rehabilitation or demolition of real estates and public facility provision. to be eligible and applicant city must be any central city of a metropolitan statistical area, and local government of over 50,000 people (842 jurisdictions), urban counties with at least 200,000 people (147 counties) will automatically qualify for formula-based funds. all other jurisdictions, including casa grande, receive their funds through the state. in casa grande, arizona the cdbg gives loans to eligible families at a 3 percent interest rate for 20 years.

direct loans (dl) are based on eligibility (moderate income) and repayment ability. these loans can be as low as three percent interest rate and a maximum term of 20 years. depending on repayment ability, interest rate can be higher and term can be shorter. no loan can exceed the maximum amount which is set by hud. all loans are secured by a mortgage with flexible underwriting criteria.

deferred payment loans (dpl) are a forgivable, non-interest bearing loan secured by a lien and promissory note. the note shall be forgiven at a rate of 10 percent per year for ten years, as long as the dwelling is occupied by the owner or a qualifying immediate family member who has inherited the property. the unforgiving balance of the loan shall become due and payable upon sale, exchange, or transfer of the property. the maximum amount allowed on a dpl is \$12,000. exceptions to this maximum amount may be approved by the housing director. such exceptions would be based on the individual family's situation and necessary scope of work.

conditional deferred payment loans (cdpl - which are mainly used in casa grande, arizona) are similar to dpl, except that if the family was referred to the program by the code enforcement officer due to housing conditions and overall property conditions the annual ten percent deferral would be contingent upon an inspection of the property assuring no blight conditions were found.

emergency repair grant (erg) is a grant to eliminate a threat to life, safety or health. maximum allowed on an emergency grant is \$5,000 per dwelling. exceptions to the maximum amount can be approved by the housing director, but will become a dpl not to exceed \$12,000 and is noted as an emergency dpl. this grant can address all emergency conditions.

principal reduction or interest subsidy is tailored to the individual's ability to re-pay the loan by reducing the interest rate in the principal amount. a family may be eligible for this type of assistance when mortgage funds are available from lending institutions, but the family's income is not able to afford the market interest rate. rehabilitation staff provided the applicant with assistance and guidance through the institution's application and approval process.

#### housing preservation grants

also usda funded, but administered by the city. this is similar to cdbg an outright unsecured grant based on eligibility (low); maximum grants amount is \$12,000. exceptions to the maximum amount may be approved by the housing director based on family situation and scope of work.

# home funds

based on eligibility below 80 percent of the median income for pinal county. maximum amounts for any of the grants and dpl's may vary, depending on level of funding received from the department of commerce (now the arizona department of housing).

#### htf funds

based on eligibility below 80 percent of median income for pinal county. fundable activity and maximum amount dependent on approval from the state of arizona.

### housing development fund

approved by council to create a 'local match' fund to secure **home** and other housing dollars that require a local match., funds may be used for housing purposes following the **hud** criteria used for **home** or **cdbg** funds including loans, **dpl's**, **cdpl's**, and grants. other uses include assistance to preserve and facilitate home ownership opportunities and to develop/acquire land for affordable housing purposes.

source: 2002 city of casa grande rehbilitation guidelines & millennial housing report

# casa grande housing and revitalization program funding sources used by casa grande

meeting notes

meeting:	introduction meeting with city of casa grande and university of arizona architecture dept.
attendees:	rosa bruce, jose delgado, corky poster, jeff leven and brandy billingsley
date:	march 5, 2003

#### funding sources

-hud block grant from state funding, distributed through caag

- -about two million dollars divided between 15 cities within gila and pinal area -usda 502 funding received, due to wavier received by congress allowing casa grande to be consider a rural community with a population of 25,000 (over by 224 people in the 2000 census) -received about two million dollars/yr with low interest rate (as low as 1%)
  - -noly four cities in the united states have such waivers from congress

-usda 523 grant payees for the city of casa grande to operate the program

-\$260,000/yr

#### program description

-self-help housing (new development)

-families select their own site from vacant lot list that the city provides

-lots average for about \$15,000-18,000

-families select their house design from chooses: cottage or bungalow

-total construction cost is about \$70,000 (everything included, i.e. permit, survey, block wall and etc.)

-no restriction for resale

-house payments may increase if family income increases

-families are required to attend two-credit class at cac

-the program groups six-twelve families together for construction

-families are required to have two people work 16 hours/weekend

-families construct wall framing, roof trusses, wall siding, painting, install flooring, do finish carpentry and landscaping

-construction time is 40-45 weekends / home

-examples of community development range from eleven to thirty-six lots

-homes appraised at \$85,000-95,000

-city provides counselor, low mortgage funding, bid packages, two construction supervisiors, subcontractors for foundation, insulation, drywall and countertops

-re-habitation or replacement housing

-regulated by code enforcement and risk to community welfare

-city notifies property owner of needed demolition to see if they want the city to destroy home for free

-creates vacant lots for replacement or self-help development

-built by contractor (normally four different contractors used)

-average cost

-replacement home \$65,000

-re-habitation home \$35,000

-two year wait for housing re-habilitation

#### -action-zone

-studies done to identify the neighborhood most in need, selected west neighborhood -a grant the city of casa grande applied for in 1997

-received funding in 1999 for one million dollars / two year period

-focused on Westside neighborhood, to make a big impact on a small area

-the goal was to have the neighborhood take responsibility for their neighborhood

-community has kept improving after grant done (i.e. community garden)

#### program description (continued)

-held a meeting with community to understand their needs and wants

-concerned with high crime in neighborhood

### -inspires community revitalizing

- -introduced a community garden
- -combined development with introduction of park (11-16 lots)

#### opdw design goals

- -scattered development
- -universal design
- -single car garage
- -encourages zero-landscaping (for water efficiency)
- -energy efficient
- -design that blends with neighborhood context
- -design that doesn't look "like a box"
- -integrate courtyard, so space feels bigger and provides more livable space (less space required for hallways)
- -alternative elevations

#### program benefits

- -self-help and rehabilitation programs produce 12-15 homes/yr (half & half)
- -program gives work experience to people in the program that might not have work experience -collaboration with central arizona community college (cac) so everyone in the self-help program takes a two-credit class, which has encouraged people to obtain college degrees

#### general design guidelines

- -normally four general contractors normally used
- -currently thirty lots available for construction
- -normal lot size 50' x 140'
- -setbacks 5' and 5'
- -orientation normally north and south facing
- -three upcoming re-deployment projects

note source: corky poster / brandy billingsley / jeff leven

meeting: follow-up meeting with city of casa grande and university of arizona architecture dept..
 attendees: jose delgado, jeff leven and brandy billingsley
 date: march 12, 2003

design guidelines
-average lot size
50' x 100'
-standard zoning setbacks
perimeter sides 6'
front 20'
back 20-25'
-average width of universal design home
38'
-hud grant guidelines
2 bedroom 1 bath
3-4 bedroom 2 bath

#### design issues

-security (elderly like front and back security doors)

-indoor laundry room

-livable outdoor space and/or optional place for garden

-gas stove (preferred by most elderly)

-extended family consideration

#### drawing requirements

-zoning classified drawings

plan / section / elevation

electrical / mechanical / pluming plans

framing plan with details

gas isometric

foundation plan

all details for construction

-rendering presentation drawings

to be presented to city council

diagrams

floor plan / elevations

perspectives

#### goals of casa grande

-one plan of each with 2 or 3 elevations two bedroom, three bedroom and four bedroom

-energy conservation study

ex: windows (double pane vs. single or sunscreen) wall structure (wood framing vs. masonry) landscaping

(less concerned about initial cost but long term savings)

-map of existing rehabilitation / replacement homes in casa grande

goals of the state of arizona -complete set of construction drawings (sic) -energy conservation studies utility bills -universal design

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note source: brandy billingsley / jeff leven

interviews
interviewed:	anonymous past self-help client
interviewer:	brandy billingsley
date:	march 12, 2003

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note source: brandy billingsley

interviewed: anonymous past replacement clients interviewer: brandy billingsley and jeff leven date: march 24, 2003

- did you approach the city about their housing programs? yes, I signed up for the self-help program
- how did you hear about the housing programs? through friends who had gone through the self-help program
- how long were you on the waiting list before you were helped? two years, when rosa approached me saying I was available for the replacement program instead of the self-help program
- what was your housing condition before your new home was constructed? it was very old and required a lot of maintenance, and because it was not handicap accessible, it made it very hard for my mother to get around
- where did you stay when your home was being built? was this difficult for you financially? we stayed at an apartment complex that the city provided for us (we paid only the utility expenses) yet in addition, we were still responsible for paying the utility bills for our property while our new home was being constructed
- how long did it take to construct your home? three months
- who were you in contact with at the city? we dealt mainly with rosa's staff and did speak with contractor
- were you kept informed during the replacement process of your home? no, I was only really notified three times during the process, where I was interviewed about what I was responsible in obtaining to qualify for the program, the amount of my future payments, and to pick colors for my home
- what choices did you have in the design of your home? none, I was only shown the house plans of my future home but they did make an exception to put in a bay window I had requested

did you have a choice in the outward appearance of your home? were you concerned about your home looking the same as other rehab or self-help homes in your neighborhood?

no, I did not have a choice in its appearance and had wished I had more choices, expressly because I had seen the multiple homes that the city of phoenix had produced

have your utility bills changed with your new home?

yes, the electrical cost is a lot higher because the addition of air-conditioning but the water bill has decreased because we no longer have grass or trees

were there disadvantages of obtaining your home?

a lot of additional move-in expenses (ex: laundry machines, microwave and etc.) but city did provide refrigerator and stove

# what have you or your family personally gained from the replacement program?

a new home that is handicapped accessible with less maintenance / cost for repairs

# have you seen your neighborhood change since your new home was built?

yes, many self-help homes have been built in the neighborhood and others have fixed up their homes

## what characteristics would you change about your home?

-backyard is too small (a lot smaller than original yard)

-no backyard entrance from interior of home (have to go outside)

-no back porch (slab or extended roof plane)

-step when entering or exiting any entrance of the home (not accessible)

-the carpet is very cheap and already needs to be replaced

-handicap access within our home is limited to only half of the home, my mother hasn't even seen the other half of our home

-the handicap room is much colder than the rest of the house, it should have integrated carpet areas -would like to have backyard garden plot and clothesline

-confused why smaller bedrooms have walk-in closets while master and handicap bedrooms has sliding door closets

# has the city been in contact with you after your home was finished to see if it met all of your needs?

no

#### did the program have any downfalls?

-I wasn't well informed about the process

-I had to approach the city about landscaping my front yard because it was left dirt and I was under the impression that it was going to be included. They granted me funds for landscaping and I was put in charge of getting rock and trees. However my backyard is still dirt and now is a place we rarely use.

# would you suggest the program to others?

yes, in fact many are now built in this neighborhood





past housing condition



replacement home

note source: brandy billingsley photo source: city of casa grande

casa grande housing and revitalization program replacement housing program interview

details of replacement program



source: city of casa grande, az

the data below are from clients who have had projects arleady completed within the rehabilitation program from 1998- march 2003 (source: city of casa grande housing and revitalization department). the data that is compared to the demographics of clients with already completed projects within the rehabilitation program in the following graphs are taken from the 2000 united states census.

Project	Number of	Gross		Size of	Above the
Year	Bedrooms	Income	Race/Ethnicity	Household	age of 65
1998	3	\$17,676	Hispanic	3	<u> </u>
1998	3	\$8,436	White	1	1
1998	3	\$16,548	Black	3	C
1998	3	\$10,344	White	1	1
1999	2	\$12,276	Hispanic	1	1
1999	2	\$4,848	Hispanic	2	1
1999	3	\$15,396	Hispanic	2	1
1999	3	\$10,056	Hispanic	3	1
1999	3	\$18,216	Hispanic	2	1
1999	3	\$18,084	Hispanic	5	0
1999	2	\$4,848	Hispanic	2	1
1999	3	\$19,464	White	2	C
1999	3	\$24,792	Native American	4	C
2000	3	\$22,356	White	6	C
2000	3	\$13,140	Hispanic	3	0
2000	3	\$9,048	Hispanic	2	1
2000	3	\$10,644	White	1	1
2000	2	\$18,480	Hispanic	2	0
2001	3	\$8,796		2	1
2001	2	\$6,720	Hispanic	2	1
2001	3	\$17,616	White	4	0
2001	3	\$36,192	Black	3	C
2001	3	\$8,136	Hispanic	1	1
2001	3	\$8,796	Hispanic	2	1
2002	4	\$33,540	Hispanic	3	C
2002	3	\$6,600	Hispanic	2	1
2002	3	\$12,456	White	1	C
2002	2	\$4,356	Hispanic	2	1
2002	2	\$13,056	White	2	1
2002	2	\$7,548	White	2	1
2003	3	\$16,044	Hispanic	2	1
2003	2	\$19,704	White	2	1
2003	3	\$24,096	White	3	0
					Total
Mean	2.76	\$14,494		2.36	20
Median	3.00	\$13,056		2.00	67%

source: city of casa grande housing and revitalization department

# population above the age of 65



**conclusion:** in general, previous clients of the housing rehabilitation program (1998-2003) population with one or more family members above the age of 65 is greater than the comparable measure for casa grande (2000 census). Within the population of previous clients of the housing rehabilitation program two-thirds of the total population served by the housing rehabilitation program have one or more family members greater than the age of 65.

race/ethincity



**conclusion:** in general, previous clients of the housing rehabilitation program (1998-2003) have been a majority hispanic (57.5%), while the hispanic population is only 30.2% of the population of casa grande. half of the population of casa grande consists of non-hispanic white persons (50.4%), but only 33% of the population served by the rehabilitation program have been non-hispanic white.

0	white
	african american
dia.	american indian
121	asian
	hispanic



**conclusion:** in general, the median income of previous clients of the housing rehabilitation program (1998-2003) was lower than the median income of casa grande (2000 census).

# median income of the population above the age 65 vs under the age 65



**conclusion:** in general, previous clients of the casa grande housing rehabilitation program (1998-may 2003) the population of families with one or more family member over the age of 65 had a substantially lower median income than the population of families with one or more family member under the age of 65 (1998-2003).

replacement homes construction co permits (contractor expense)	ost estimate \$800-900
termite treatment (contractor exp.)	\$800-900
foundation	\$5500-6500
framing 2" x 6" framing, roof deck, columns, arches and etc.	\$6000-6500
roofing tile, felt and etc.	\$2200-2500
slucco	\$3500-3800
mechanical ac / furnace and roof mount	\$3800
electrical wiring and lights	\$2200-2500
plumbing universal finishes & fixtures	\$4000-4500
finishes	
cabinets and countertops	\$2500
doors and trim	\$2000
floor covering tile and carpet mixture	\$2000
painting exterior and interior	\$2000

(not included are taxes, supervision, overhead and profit)

additional items provided by the city of casa grande appliances 18 sf refrigerator 30" gas range with vent hood

source: city of casa grande, jose delgado



habitat for humanity

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since its founding in 1976 by millard and linda fuller, habitat for humanity has built and rehabilitated over 70,000 houses with families in need, becoming a true world leader in addressing the issues of poverty housing.

the concept that grew into habitat for humanity international was born at koinonia farm, a small, interracial, christian farming community in americus, ga. the fullers first visited koinonia in 1965, having recently left a successful business, and all the trappings of an affluent lifestyle to begin a new life of christian service. there the concept of "partnership housing" was developed -- where those in need of adequate shelter would work side by side with volunteers to build simple, decent houses.

"what the poor need is not charity but capital, not caseworkers but co-workers. and what the rich need is a wise, honorable and just way of divesting themselves of their overabundance. the fund for humanity will meet both of these needs."

in 1968, koinonia laid out 42 half-acre house sites with four acres reserved as a community park and recreational area. capital was donated from around the country to start the work. homes were built and sold to families in need at no profit and no interest, the basic model of habitat for humanity was begun.

since 1976, habitat has built more than 125,000 houses in more than 80 countries, including some 45,000 houses across the united states. habitat houses are purchased by the homeowner families. three factors make habitat houses affordable to low-income people worldwide:

- houses are sold at no profit, with no interest charged on the mortgage.
- homeowners and volunteers build the houses under trained supervision.
- individuals, corporations, faith groups and others provide financial support.

the houses are built with no profit added and no interest charged. building is financed by a revolving fund for humanity. the fund's money would come from the new homeowners' house payments, donations and no-interest loans provided by supporters and money earned by fund-raising activities. the money in the fund for humanity would be used to build more houses.

through volunteer labor and donations of money and materials, habitat builds and rehabilitates simple, decent houses with the help of the homeowner (partner) families. habitat houses are sold to partner families at no profit, financed with affordable, no-interest loans. the homeowners' monthly mortgage payments are used to build still more habitat houses.

habitat is not a giveaway program. in addition to a down payment and the monthly mortgage payments, homeowners invest up to 400 hours of sweat equity to realize their dream of home ownership. a modest 1.5% down payment enables a family to purchase a home for about \$60,000 on a 20-year no-interest, no-profit mortgage. since the principal from the monthly payment -- which is less than \$300 - is returned to the building fund, more homes can be built. throughout the world, the cost of houses varies from as little as \$800 in some developing countries to an average of \$46,600 in the united states.

habitat houses are affordable for low-income families because there is no profit included in the sale price and no interest charged on the mortgage. mortgage length varies from seven to 30 years



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case studies of community housing programs habitat for humanity

# habitat for humanity example houses

whether in the united states, canada or in more than 80 other countries around the world, habitat for humanity houses are built according to the same guiding principles. habitat houses are:

- simple. habitat houses are modestly sized -- large enough for the homeowner family's needs, but small enough to keep construction and maintenance costs to a minimum.
- decent. habitat uses quality, locally available building materials. trained staff supervises habitat house construction and educate volunteers and partner families. house designs reflect the local climate and culture.
- affordable. the labor of volunteers and partner families, efficient building methods, modest house sizes and a no-profit, no-interest loan make it affordable for low-income people around the world to purchase a habitat for humanity house.

# habitat houses in north america

habitat houses in the united states and canada generally are built using wood frame construction, with gypsum board interior walls, vinyl siding and asphalt shingle roofs. some affiliates also use proven alternative building materials such as adobe or straw bale construction. u.s. and canadian habitat houses are modestly sized by north american standards -- for example, a 3-bedroom habitat house may have no more than 1,050 square feet of living space according to hfhi guidelines.

habitat for humanity international's commitment to build with people in need readily extends to those with disabilities. hfhi's board of directors has endorsed the concept that all habitat houses should incorporate basic accessible design features, such as a zero-step entrance and wide passage doors and hallways. houses built in partnership with families with disabilities include additional accessibility features.

# habitat houses around the world

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from the tropical islands of the philippines to the mountains of peru, habitat builds houses designed for the local setting. habitat affiliates build with locally available materials, reducing costs and making it easier for homeowners to maintain the houses. for example, houses in many african countries are constructed with fired clay bricks, with tile roofs made of cement or fired clay. houses in latin america often are built with concrete block or adobe walls and metal roofs, while houses in the pacific are often built with wood frames and are constructed on stilts.

people of different countries use their houses in different ways. habitat's house designs reflect these cultural considerations. meals are cooked outdoors in many african countries; there habitat plans call for a kitchen area outside the house rather than inside. in the philippines, laundry and other chores traditionally are done on a small outdoor utility porch. filipino habitat house designs reflect this custom.

habitat houses in developing countries are often considerably smaller than their north american counterparts. no matter where they are built, habitat house sizes always are designed to meet the homeowner families' needs while keeping costs as low as possible, thereby making the houses affordable to low-income families.







case studies of community housing programs habitat for humanity

# eligibility

families in need of decent shelter apply to local habitat affiliates. the affiliate's family selection committee chooses homeowners based on their level of need, their willingness to become partners in the program and their ability to repay the no-interest loan. every affiliate follows a nondiscriminatory policy of family selection. neither race nor religion is a factor in choosing the families who receive habitat houses.

# eligibility in the tucson, arizona affiliate

- have an income below 80 percent of pima county median for your family size (check with office for numbers)
- are legal residents of the united states, and are legally able to own property in the us
- have a need for better housing
- have a clean credit record.
- are willing to do volunteer work ('sweat equity") in partnership with habitat for humanity

are from all sectors of the community. hfht does not discriminate based on race, religion or creed. habitat can also build homes that will accommodate the physically challenged.





'save and build' helps house the poorest of the poor

in some communities, poverty is so severe that even habitat for humanity houses are out of reach for families. and in some cultures, the concept of a mortgage is completely foreign and difficult for people to accept and embrace. to address the needs of communities like these, habitat for humanity sri lanka developed the "save and build" program.

through "save and build," homeowners are organized into groups of 12 families. each family saves the equivalent of 15 cents (usd) per day for six months. during this time, homeowners also collect rocks and sand—both freely available throughout the countryside—and make their own bricks.

at the end of six months, the group's savings are sufficient to build one house, consisting of a single room with an attached kitchen and bathroom area. within 27 months, all 12 families complete their houses. if they choose to continue with the "save and build" program, the families can then add an additional room to their houses by beginning the savings and brick-making process again.

an adaptation of the "save and build" program allows an individual family to pay for a foundation and roof at the beginning of construction. then the family thatches the walls of the house with leaves, brush and grass until they can afford to purchase bricks or blocks—sometimes a few at a time—to construct permanent walls. the opportunity to purchase building supplies a little at a time, without the commitment of a mortgage, makes homeownership a more feasible reality for the sri lankan people.

"save and build" is one means of reaching families in need through flexible mortgage structures and construction processes. by respecting the realities of local communities and working creatively within them, habitat for humanity can continue to grow and thrive, helping those who need it most.

renovating substandard apartments into decent housing

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in beius, romania, habitat for humanity purchased the fourth floor of a communist-era block apartment building. the "casa noastra" ("our home") renovation project, led by the habitat for humanity beius affiliate, also involves building a fifth floor atop the building.

currently, the dormitory-style rooms of the building house families of three to five people, with as many as 50 people on a floor sharing a bathroom. the roof leaks, and water and heating are unreliable.

when renovations and additions are complete, 15 two-bedroom apartments and 10 one-bedroom efficiencies each with water boilers and wood-burning stoves—will provide decent shelter for families.

this innovative approach to building can serve as a model for other affiliates, particularly in central and eastern europe, where substandard apartment blocks can be converted into affordable housing.

source: habitat for humanity

# habitat for humanity conclusions

positive elements:

- +houses are built for about \$60,000 (north america) on a 20-year no-interest, no-profit mortgage +homeowners invest up to 400 hours of sweat equity
- + fosters teamwork and community
- +educates volunteers with job skills that can advance their careers
- +houses incorporate basic accessible design features
- +habitat house designs reflect cultural considerations (to an extent)
- +has built 125,000 house (1/4 in the united states) since 1976

negative elements:

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- -there is a 1.5 percent down payment required
- -houses are generally built with wood frame construction with minimal use of alternative building materials.
- -no renovation program in the united states
- -client is not actively involved in the design of the house
- -houses in developing countries are considerably smaller than in north america

city of tucson affordable housing

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#### I. executive summary of the city tucson affordable housing stategies

in 1996, the city of tucson and the metropolitan housing commission asked its partner agencies and the private sector to join in a commitment to increase the affordable housing stock in tucson. affordable housing strategies 1996-2000 developed strategies to further the goal of increasing and promoting affordable housing in our community. the city's goal was to build upon a base of over 8,400 households assisted by increasing the number of assisted households to 10,000 by the year 2000. the goal was achieved one year early and currently over 11,800 households have received assistance in securing safe, decent and affordable housing. this accomplishment would not have been possible without the support of local development partners and funders. the community services department is the lead entity for the city of tucson in planning and implementing local housing assistance programs. the department serves as both the local housing authority and the community development agency.

#### mission statement

to improve the quality of life for the citizens of tucson by providing housing and community service programs that strengthen and enhance the social, economic and physical environment, especially for those of lower income.

#### fundamental goals

-provide housing assistance across a spectrum of need, from the homeless to homeowner.

-maintain housing quality standards to maximize the availability of safe, decent, affordable housing to low-income

-support environmentally friendly construction and rehabilitation programs emphasizing quality work to achieve energy efficiency and low cost maintenance. encourage cost effective building styles, methods, and materials.

-as a funding resource and partner, help build the community-wide capacity of organizations that contribute to affordable housing, including the technical and financial capacity of non-profit service and housing development organizations and participation from the private sector.

-leverage city resources, wherever possible, to maximize the number of households served.

-address economic development, support services, and other community needs for low-income residents concerning short and long-term affordable housing.

-seek to influence state and federal legislation to increase funding for affordable housing. -actively promote fair housing principles in the community.

-apply a comprehensive planning process in the development and redevelopment of neighborhoods to improve community living conditions and reduce poverty.

-encourage private development and investment in affordable housing which can include homebuyer; existing homeowner rehabilitation; rental housing acquisition, rehabilitation and/or new construction.

-develop incentives for private developers to include basic access for persons with physical disabilities. -facilitate partnerships with developers and lenders to implement programs that upgrade tucson's aging housing stock.

-seek all possible avenues for preserving and utilizing quality and attractive manufactured housing as a low-income housing option.

-as continued development on the edge of the city occurs, ensure that the affordable housing needs of the community can be addressed within the balanced growth concept.

-promote productive relationships in which all parties share common goals and responsibility for program outcomes.

-provide specific incentives which would promote the inclusion of affordable housing in all new developments.



case study of community programs city of tucson afforable housing introduction to the city of tucson affortable housing program needs

the city of tucson's housing goals expand affordable housing opportunities for low-income families and to encourage development that benefits the community as a whole.

-approximately 87,000 households in the city of tucson are low-income as defined by the u.s. department of housing and urban development (0-80% mfi); this amounts to roughly one-half of the total households in the city.

-according to the 1990 census, an estimated 57,000 low-income households experience at least one of the following housing problems: their housing costs exceed 30% of their monthly income; they are living in overcrowded conditions; or the structure they occupy is in need of repair.

-an estimated 87,000 (almost one-half) of the city's existing residential units will be 50 years or older by the year 2010. the 1990 census reported that low-income households occupied 72% of all "old" housing units in the city.

-income has not kept pace with escalating housing costs. in 1990, pima county's median household income was \$25,401, which rose to \$31,983 by 1998. this is an annual growth rate of 2.6%, unfortunately, housing costs for renters and owners over the same period has risen by twice that rate.

-tucson has experienced a declining homeownership rate over the past two decades. tucson's homeownership rate is at 53%, a rate which is comparable to other similar cities throughout the nation. this compares to a national homeownership rate of 67% which includes suburban and rural areas.

-permits for the metropolitan area show that 66% of all new single family units and only 12% of new multifamily units are built outside the city of tucson. as new development continues to push out toward the city limits, older urban neighborhoods receive disproportionate investments.

#### current conditions and needs

a. population profile

tucson experienced a 22.6% increase in population between 1980-1990, and a land area increase of 61%. population within the city of tucson will continue to grow during the next 15 years; projections show growth in both the city of tucson and pima county with projected population totals for 2015 of 569,619 and 1,148,797, respectively. increased population growth will in turn increase pressure on the housing market. this increased demand is met through absorption of vacant units and construction of new units. in turn, increases in demand lead to higher rents and higher home prices. population trends are important indicators of housing needs in the future.

#### b. housing market and construction trends

currently, approximately 53% of the households in the city of tucson own their own homes. this is well below the state homeownership rate of 64% and the national homeownership rate of 67%. large-scale residential development in the city of tucson during the last ten years has taken place mostly on the outskirts of the city:

#### c. housing affordability and low-income households

as rents and housing prices have continued to rise, household income has failed to keep pace. with almost 50% of households in tucson being low-income and a significant percentage of those being either cost burdened or severely cost burdened, affordability becomes a major issue. while affordable housing programs do not directly lead to a reduction in the number of poor people, maintaining and expanding the availability of housing that is affordable to low-income families can encourage stability and prevent further economic decline.

average utility costs in tucson total between \$100 to \$180 per month to housing costs. housing affordability is impacted by this ongoing expense. these costs vary by unit size and utility service (gas or electric appliances, forced air or swamp cooler) and do not include additional utility costs for garbage service, water and telephone.

# II. city of tucson affordable housing strategies for 2000-2005

in response to the affordable housing needs, the city of tucson has developed a spectrum of housing services and formulated corresponding strategies that are designed to increase and encourage local development of affordable housing. the continuum provided by these services is an effective way of expanding opportunities and assisting families and individuals toward ultimate self-sufficiency.

#### emergency housing:

emergency housing is designed to provide temporary shelter to families and individuals in a crisis situation for up to 30 days on a one-time basis. the local emergency housing system has built-in flexibility and excess capacity that integrates services as part of the local continuum of care for the homeless. the city's role is to coordinate resources, provide technical assistance, and support local homeless service providers who work directly with homeless individuals. the city does not directly administer support services or emergency housing. therefore, strategies listed below are more broadly articulated compared to other programs where the city is a direct service provider.

-goal: reduce homelessness and foster long-term self-sufficiency and economic independence for persons who are homeless and are threatened by homelessness.

-target population: emergency housing is provided to homeless persons and households who typically have no or very little income (0-30% of median family income). this includes individuals and families who have become homeless as a result of domestic violence, illness, eviction and a lack of resources to pay ongoing housing costs.

-activities: emergency housing activities include the provision of temporary shelter, food, clothing, health care, counseling, case management and referral to transitional services. the city provides financial support for facilities and services. currently, there are 485 shelter beds in tucson and pima county.

-resources and proposed investment: the city invests approximately \$1 million per year in shelter and services for the homeless and coordinates solicitations for funding. funding includes emergency shelter grant (esg), supportive housing for the homeless (shp), community development block grant (cdbg), title xx, city general funds and city united way funds.

# transitional housing

transitional housing serves families and individuals needing shelter and support for an extended period of time. support is provided to stabilize families and individuals for ultimate transition to permanent housing, similar to emergency housing, the city assists providers in carrying out transitional housing activities, supportive services are administered by local providers, however, in transitional housing, the city has a direct role in the acquisition, development and management of units.

-goal: to increase the current number of transitional housing units and expand existing services in the community.

-target population: transitional housing is provided to persons vulnerable to homelessness and households at the low end of the income scale, but typically with some income (0-80% of area median income). this includes individuals and families who have established self-sufficiency goals in a case management plan and are transitioning from homelessness into permanent housing.

-activities: transitional housing activities include the provision of housing, food, clothing, health care, child care, counseling, transportation, case management and education and job training. currently, there are approximately 936 beds in transitional housing units in tucson and pima county.

-resources and proposed investment: the city invests approximately \$1.5 million per year in transitional shelter and services and assists in securing additional outside funding. funding includes home investment partnerships program (home), emergency shelter grant (esg), supportive housing for the homeless (shp), community development block grant (cdbg), title xx, city general funds and city united way funds.

# assisted rental housing

assisted rental housing provides permanent (ongoing) housing to renters in the community and includes all forms of subsidy, including rental payments and large project subsidies oriented toward acquisition, rehabilitation and new construction of rental housing. the level of subsidies and the available program support can be minimal (hundreds of dollars) or quite extensive (thousands or millions of dollars). the city's primary role is to manage, maintain, acquire, and construct assisted rental housing. in addition, the city leverages resources and provides technical assistance to agencies, landlords, and private sector developers and investors for assisted housing projects.

-goal: to increase assisted rental housing opportunities for low-income families and individuals in the community and increase the quality of life for low-income renters through rehabilitation and construction of site improvements.

-target population: assisted rental housing is provided to individuals and families with incomes at or below 80% of area median income. rent structures are determined on a household income or project basis.

-activities: assisted rental housing activities include public housing, rental vouchers, acquisition and rehabilitation of existing rental properties, new construction, acquisition and preservation of assisted properties with expiring subsidies, and mobile home parks. currently, there are approximately 8,700 subsidized rental units in tucson (public housing, section 8, hud 236, tax credit projects); and 343 non-profit owned subsidized rental units set aside for special populations requiring supportive services.

-resources and proposed investment: the city invests approximately \$36 million per year in assisted rental housing. funding includes public housing operating and comprehensive grant improvement funds, section 8, home investment partnerships program (home), community development block grant (cdbg), city general funds, industrial development authority bond funds, and hope vi revitalization.

#### assisted housing rehabilitation

assisted housing rehabilitation programs provide assistance to repair substandard housing occupied by low-income homeowners. the goals may be twofold, with assistance oriented toward existing homeowners for the purpose of rehabilitating dwellings while concurrently furthering municipal revitalization. the city's role is to provide resources directly to low-income homeowners and low-income housing rehab providers for the rehabilitation of existing homes.

-goal: to maintain housing quality and affordability for low-income homeowners living in substandard housing and to promote neighborhood revitalization through rehabilitation efforts.

-target population: housing rehabilitation assistance is provided to individuals and families with incomes between 30% and 80% of area median income, with special programs for the elderly and persons with disabilities.

-activities: activities include emergency home repair, minor repair, moderate and substantial rehabilitation, retro-fitting for handicapped accessibility, and replacement housing. assistance to households can be provided in the form of a grant or loan. the city currently funds approximately 600 owner-occupied housing rehabilitation projects each year.

-resources and proposed investment: the city invests approximately \$2.5 million per year on housing rehabilitation activities. funding includes home investment partnerships program (home), community development block grant (cdbg), city general funds, industrial development authority bond funds, and hope vi revitalization.

#### assisted home ownership

assisted homeownership opportunities provide resources to existing homeowners or prospective new buyers for home purchases, the city's role is to provide resources directly to low-income homebuyers and low-income housing providers and to facilitate partnerships in the community that result in new homeownership opportunities for low-income families who are otherwise shut out of the home purchasing market.

-goal: to expand homeownership opportunities and affordability among lower income groups including households up to 120% of median family income.

-target population: assisted homeownership is provided to individuals and families with incomes between 50% and 120% of area median income, with an emphasis on persons living in assisted rental housing and households with incomes between 70-120% of median family income.

-activities: activities include acquisition, rehabilitation and new construction. assistance may include down payment for existing or newly constructed homes, coordination and financing for rehabilitation, housing counseling and coordination for household management, client debt counseling, credit qualification and mortgage financing. The city and its partners generates approximately 165 homebuyer opportunities for low-income residents each year.

-resources and proposed investment: the city invests approximately \$2.7 million per year in low-income homebuyer activities. funding includes home investment partnerships program (home), community development block grant (cdbg), city general funds, and industrial development authority bond funds. mortgage revenue bonds will be a major source of support for this strategy.

## neighborhood revitalization

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neighborhood revitalization is a strategic concentration of resources in a designated geographic area of the city designed to carry out prioritized activities that: increase the quality of life for residents; arrest deterioration; increase and upgrade area assets; and create momentum for cohesive and ongoing neighborhood planning and improvements. the city's role in neighborhood revitalization is to provide resources for planning, and to leverage resources and facilitate partnerships to accomplish specific projects.

-goal: the goal of neighborhood revitalization is to provide a safe, decent, affordable and vital environment for all tucson residents to live, work, recreate and grow in the community.

-target population: neighborhood revitalization efforts are targeted to all income groups (0-120% of median family income). revitalization efforts may be directed to specific neighborhoods based on demographic, economic or land use characteristics.

-activities: activities may include vacant land development, infrastructure improvements, housing rehabilitation, landscaping, implementation of safety programs, expansion of supportive services, park enhancement or development, business development, removal of adverse environmental conditions, transportation improvements or linkages to other assets and services in the community.

-resources and proposed investment: the city of tucson invests approximately \$5-\$10 million per year in neighborhood revitalization projects. funds come from the community development block grant (cdbg) program, home investment partnerships program (home), hope vi revitalization, transportation funds, city general funds, city united way funds, and pima county.

# III. future growth and tucson's housing plan

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in 1998 governor hull signed the growing smarter act into law. that act was amended and enhanced in the spring of 2000 with the growing smarter plus legislation. these two pieces of legislation mandate cities and counties to develop general plan elements which address land use, transportation, housing, open space, environmental and cost of growth issues. the affordable housing strategies document is consistent with the city's comprehensive general plan policies regarding housing, and by reference is a portion of the housing element of that plan.

in the spring of 2000, the mayor and council adopted the balanced development policy framework to establish a context for discussion of the broader policy issues related to the growing smarter and growing smarter plus legislation and development across the city of tucson. it may also be used as a tool for more specific analysis of issues pertaining to growth, infill development and housing.

affordable housing is a key component of the housing element required by the growing smarter act, and continues to be an important issue for the mayor and council. compliance with the mandates of the growing smarter legislation within the balanced development policy framework will more closely join the city's efforts to ensure affordable housing within the broader context of the future development of the community.



# **Balanced Development Areas Map**

(City of Tucson Planning Department)

# IV. partners in affordable housing

the city of tucson community services department helps to create and preserve affordable housing through rental, homebuyer and home repair programs for low-income households who are financially burdened or threatened with homelessness. the city works with a variety of entities in the community including pima county, state and federal government, non-profit organizations, private developers and lending institutions to increase affordable housing opportunities. these partnerships and the role of each partner are vital to a healthy community.

# V. available resources

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there are a variety of resources that support the spectrum of housing services. these funding sources include local, state and federal programs for housing and supportive services. listed on the chart below are the major sources of funding and the categories within the spectrum, which are supported by these sources.

FUNDING SOURCE	EMERGENCY HOUSING	TRANSITIONAL HOUSING	ASSISTED RENTAL HOUSING	ASSISTED HOMEOWNERSHIP OPPORTUNITIES		NEIGHBORHOOD REVITALIZATION
Community Devel. Block Grant		0		0	0	0
Emergency Shelter Grant	0	0				
Supportive Housing for the Homele	ss 🛛 🕘 👘	0				
HONE Investment Partnership		0	0	0	0	0
United Way	0	•				
Public Housing/Comp. Grant			0			0
HOPE VI			-0			0
Family Self-Sufficiency			0			0
Section 8			0			0
Shelter+ Care		•	0-			
Federal Home Loan Bank			0	0	0	0
Mortgage Credit Certificates				0		0
Mortgage Revenue Bonds			0	0		0
Low-Income Housing Tax Credits			0			0
City of Tucson General Fund	0	0	0	0		

# VI. local affordable housing production goals

the above strategies are designed to assist policy makers, practitioners and the community as a whole promote safe, decent, and affordable housing as a local priority and support this priority with increased development. from 1996-2000, the city had established a goal of increasing development by 1,000 newly assisted households per year with an ultimate goal of assisting up to 10,000 households by the year 2000. as shown on the chart below, over 11,800 households received housing assistance during the past four years.



source: city of tucson, community services department

# city of tucson case study conclusions

# positive elements

- + multiple programs available to fit a wide variety of communities needs
- + financially solid program (due to city population size and federal entitlements)
- + preliminary research effective in calculating present and future needs in program so appropriate goals can be established and achieved
- +well rounded program to serve people of varying housing needs (from emergency to temporary to permanent)
- + improve effort at quality design

# negative elements

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-little public awareness of program

-inconsistency in design quality

-bureaucracy because federal requirements, which increases time, complexity and cost

-no expense used towards detailing exterior (stark and industrial looking)

-in adequate landscaping

-no integration of carport or garage

-exterior covered porch area or covered entry not integrated often enough

-little attention towards building orientation (standard use of model in any location)



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design guidelines

below you will find a general combination of design goals, design concerns and design restrictions that have been gathered from meeting discussions, one-on-one interviews and gathered research as a foundation of the design process. these general principles will be used as design standards and to encourage an inclusive design process.

#### design goals

# -universal design

-energy and maintenance affordable

-desert design

- -designed to fit neighborhood context
- -better quality of living environment
- -affordable first cost

#### design concerns expressed by families

- -security (elderly clients prefer front and back security doors)
- -indoor laundry room
- -livable outdoor space and/or optional place for garden
- -gas stove (preferred by most elderly)
- -extended family design consideration

## design restrictions

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-average lot size 50' x 100' -standard zoning setbacks perimeter sides 6' front 20' back 20-25' -hud grant guidelines 2 bedroom 1 bath 3-4 bedroom 2 bath ( ( ( 0 ĩ. ( ( ( 0 ( ( ) 11 ( ( ) (  $\square$ ( ) ( ) () 0.0 (C.). ( ) () () 0  $\bigcirc$  $\bigcirc$  $\bigcirc$ ()() $\bigcirc$ ( )0 ()0  $\bigcirc$ 0 0  $\bigcirc$ ()  $\bigcirc$ environmental site conditions  $\bigcup$ 

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wind rose

december wind rose, phoenix

# wind square

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mean wind conditions, direction/mph



the wind rose can be used to characterize the direction, speed, and frequency of wind in a particular location by month or year. it is prepared with data from the <u>airport</u> climatologically summary (u.s. dept. of commerce).

the data indicates the direction from which the wind blows. for example, a wind direction marked nne means that the wind blows from the north-northeast towards the southsouthwest.

the annual wind rose for phoenix, arizona indicates that the wind comes predominantly from the east and west with the greatest frequencies. wind roses for the months of december and july for phoenix reveal that east winds occur in the winter and west winds in the summer.

the wind square represents patterns of wind direction and speed by time of day and month of the year for phoenix, arizona. the wind square gives more time-specific information than does the wind rose. it tabulates, for 1-hr periods and for each month, the predominant wind speed, the predominant wind direction at that speed, and the percentage of time that the wind blows from that direction.

several conclusions can be drawn from the wind square. because it is organized by month and time it can be used in conjunction with the bioclimatic chart to anticipate the speed and direction of the wind when the temperature and humidity are above or below the comfort zone.

from the phoenix, arizona, wind square, one can determine that the wind comes from the east and west-northwest during the winter and from the west in the summer. wind speed is greatest during the daytime-late afternoon and lowest in the morning and at night. Also, wind speeds are faster during the summer than during the winter on average.

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7	0	- ()	1612	- 336	1255	1398	221	621	151	63	-0	(0)
8	45	32.	1012	2462	3565	3530	2760	230	1597	1191	1 Con	185
9	1051	1761	2884	1740	\$538	5543	1934	4550	4119	3121	1963	1218
10	2562	3628	1550	6535	7333	7471	6933	6357	6029	1001	3500	281
11 am	3951	5063	6276	8151	81.55	\$612	3428	7871	7465	6242	4392	3903
12 0000	5002	6027	7214	9035	9557	\$455	9253	\$623	8169	1127	5551	469
1 pm	5269	6699	7699	9335	9347	9365	9769	\$528	8003	7313	5925	187
2	\$205	8335	7871	9013	9523	9716	9356	9157	8205	6816	5356	119
3	4352	5114	6755	7945	853€	8720	8560	1923	7200	5770	4242	372
4	2919	4147	5210	6247	1073	7274	73:0	6743	53:0	4109	2793	235
5	1300	2416	3501	1217	5050	5381	5121	4731	3353	2093	1057	(12)
6	1191	161	1521	2159	2939	3003	3160	2572	1400	156	192	16
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mean hourly global horizontal illuminance, foot-candles

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sky cover monthly normals

eights of sky covered; percent of days for sky condition

average incident illuminance (klux-h)

for day-lighting purpose, sky conditions are classified as either overcast, clear, or partly cloudy. each classification has characteristics that influence day lighting design. the overcast sky is defined as one in which the position of the sun can not be determined due to density of cloud cover; the light is diffuse and relatively even over the sky dome. the overcast sky is three times brighter at the zenith than at the horizon, and the illumination is evenly distributed around the zenith. therefore, the top of the sky dome is the source of the most illumination. the overcast sky is frequently used as the minimum design condition, through the actual amount of illumination can vary from a few hundred to several thousand foot-candles, depending on the altitude of the sun and the density of the cloud cover.

illumination from the sun's direct rays is extremely powerful compared to that reflected from the sky done; however, not including the sun, the clear sky is less bright than the overcast sky. the distribution of light from a clear sky, with the exception of the sun and the area immediately around it, is opposite that of the overcast sky - three times brighter at the horizon than at the zenith. therefore, building openings that face the top of the sky dome, do not face reflective surfaces, and do not admit direct light may receive less light on clear days than on overcast days.

the illumination from a clear sky varies with the position of the sun, the season, and the amount of water vapor in the atmosphere. therefore, the amount of illumination available to any surface will change throughout the day and year may vary considerably.

# average illuminance



average december illuminance



sunlight reflected from the ground usually represent 10-15% of the total illumination reaching a vertical window, though it can account for more than 50 percent when the window is shaded from direct radiation. reflected light from the ground can be a good source of day lighting during clear sky conditions because it reflects again off the usually lighter ceiling and penetrates deeply into the room. because direct sunlight is so powerful, it is a potential source of glare and may introduce an undesirable source of heat gain.

the third classification, the partly cloudy sky, describes the most common condition. days that are either uniformly overcast or perfectly clear are the exception in most regions of the united states. most skies are partly cloudy and fall somewhere between the extremes of overcast skies that have a few clouds. overcast skies with bright spots take on some character of clear skies. clear skies with clouds are frequently very bright if both direct sunlight and light reflected from clouds are available at the same time. partly cloudy skies frequently exhibit very different amounts of illumination across the sky dome as the cloud cover changes over time.

to illustrate, in phoenix, arizona, clear condition predominates the entire year. overcast conditions begin to decrease greatly during the summer months (may through october), as the partly cloudy condition begins to increase throughout the summer months.

the percentage of exterior illumination available inside the building is called the 'daylight factor.' it is a function of window size and placement, glazing transmission, and interior reflectance. the total amount of exterior illumination available is a function of weather conditions of latitude.

exterior illuminance under clear skies varies with season and with orientation. a horizontal plane receives much more light in summer than a vertical one. in winter at temperate latitudes, the south façade receives the most light, whereas under overcast skies, orientation is relatively insignificant, under clear skies, the amount of illumination available to light buildings varies over the course of the day as the sun moves. north facades generally have stable light conditions throughout the day, while illumination on east and west orientations varies greatly.

there are two basic approaches to day lighting under clear skies: using small windows in direct sun and using moderately sized windows that 'see' an external reflector but are shaded from direct sun. in the first approach, design daylight factors should be determined using the total illuminance, including direct sunlight. in the second, since the window and reflector have different orientations, two illuminance values must be used.

the following graph is the average incident illuminance for phoenix, arizona. 'mostly cloudy' conditions have more than 50 percent cloud cover, and 'mostly clear' have less than 50 percent cover. these illuminance levels are total incident illuminance, including both direct-beam solar, diffuse sky, and ground-reflected components.

# sun path diagram



# solar radiation

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10	18:2	110	145	213	235	238	218	199	131	155	112	- 64
11 am	127	162	199	263	284	275	263	247	237	193	156	125
12 noon	161	193	230	292	310	303	207	283	267	226	181	150
1 pm	175	214	245	304	321	317	3)6	300	274	235	190.	156
2	167	202	245	291	306	311	302	283	261	218	173	143
3	139	173	216	255	273	273	261	253	230	135	136	115
1	121	132	166	20)	233	232	234	212	170.	132	91	10
5	192	. 16	112	132	162	172	172	150	107	68.	1. 38	1.3
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0. 15100 101-250 >250

mean global horizontal radiation, btu/h, ft squared

# solar radiation

ELEMENT		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HDD	10.00	201	126	101	42	4	0	0	0	0	9	74	192	750
CDD	18.3C	4	12	53	123	242	387	491	457	343	173	23	4	2312
HOD		362	227	182	75	8	0	0	0	0	17	131	345	1350
COD	65. <sup>c</sup>	8	22	95	222	436	696	884	822	618	311	41	7	4162
			AVERA	GE INCI	DENT S	OLAR R.	ADIATIO	N (Btu/s	q II/day	)				
HORIZ.	Global	1020	1350	1750	2240	2540	2650	2410	2240	1930	1550	1140	930	1810
SOUTH 90' (VS)	Global	1550	1590	1420	1160	663	720	760	990	1320	1610	1620	1540	1260
SOL	AR RADIA	TION FO	R FLAT	PLATE	COLLEC	TORS F	ACING S	SOUTH A	T A FIX	D-TILT	(kWh/sq	. m/day	)	
0*	Ave.	32	4.3	55	7.1	8	8.4	7.6	7.1	6.1	4.9	3.6	3	5.7
Lat - 15'	Ave.	4.4	5.4	6.4	7.5	8	81	7.5	7.3	6.8	6	4.9	4.2	6.4
Lat	Ave.	5.1	6	6.7	7.4	7.5	73	6.9	7.1	7	6.5	56	4.9	6.5
Lat + 15	Ave.	5.5	62	6.6	6.9	6.6	6.3	6	6.4	6.7	6.7	5.9	5.3	6.3
90'	Ave.	4.9	5	4.5	3.7	27	23	24	3.1	42	5.1	5.1	4.8	14

degree days and incident solar radiation

the sun path diagram, with existing site objects plotted, can determine the times of the day and year in which the sun will be available on a particular site. sun path diagrams show the path of the sun in the sky dome as projected onto a horizontal surface. the heavy lines running from east to west represent the path of the sun on the 21<sup>st</sup> day of each month of the year. the heavy lines running perpendicular to the sun path lines indicate hours of the day. the light lines radiating from the center of the diagram indicate the sun's azimuth. the concentric light lines indicate the sun's altitude. the sun path diagram can be used to determine the sun's position in terms of altitude and azimuth for any hour of the year.

the same diagram of altitudes and azimuths may also be used to describe the position and size of objects from a particular viewpoint on a site. trees, buildings, and hills ca be described in terms of their altitude and azimuth from that viewpoint. by plotting them on the sun path diagram, you can visualize when they will obstruct the sun and therefore shade the reference point on the site. during overheated periods shading by such obstructions may be advantageous, but during under heated periods it may be disadvantageous.

solar radiation available each hour can be used to determine times when comfort can be achieved outdoors, and to estimate potential for solar heating in buildings. the hourly solar radiation available on a horizontal surface can be used along with temperature, relative humidity, and wind speed on the bioclimatic chart to determine the potential for human comfort at a particular time and date.

# bio-climatic chart

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	Temperature ( F)					Rel Hi	umidity		Wind (kts)			Mean	( T)		
	means			extreme		(percent)		prevail		max	Cv/	max	max	min	min
	กาสช	min	ave	max	min	6 am	3 pm	dir	spd	gst	1	90	70	32	10
Jan	66	41	54	83	17	68	34	ξ	5	52	CLR	0	9	4	0
Feb	70	-44	58	92	22	63	28	Ε	6	47	CLR	4	15	2	0
Mer	75	49	62	100	25	57	25	Ε	6	45	CLA	1	23	Ę	0
Apr	84	55	70	105	37	45	17	E	6	43	CLA	9	28	Ð	0
May	93	64	79	113	40	37	14	E	6	51	CLR	22	31	0	0
Jun	103	72	83	122	51	33	12	W	8	63	CLR	29	30	0	0
Jul	105	80	23	121	65	46	21	W	7	75	CLR	31	31	0	0
Aug	103	79	91	116	61	53	24	E	6	68	CLR	31	31	0	0
Sep	93	72	86	118	47	50	23	E	6	53	CLR	28	- 30	0	0
Oct	83	61	75	107	34	52	23	Е	6	-53	CLR	15	50	0	0
Nov	75	48	52	93	27	59	28	E	5	52	CLR	4	22	3	0
Dec	65	42	54	88	55	66	35	E	5	59	CLR	0	11	3	ð
Ang	88	59	73	122	17	52	24	E	6	-75	CLR	167	293	9	0

the bioclimatic chart determines appropriate climatic responses that produce thermal comfort in a particular climate. the bioclimatic chart shows the relationship of the four major climate variables that determine human comfort. by plotting temperature and relative humidity, you can determine if the resulting condition is comfortable (within the comfort zone, too hot (above the top of the comfort zone), or too cold (below the bottom of the comfort zone).

several types of information can be gathered from a plot of twelve months. the bioclimatic chart for phoenix indicates that while the climate is cold in the winter, it rarely gets below the point that can be offset by solar radiation. the temperature-humidity lines for each day are long and fairly steeply inclined, indicating large daily temperature swings. this indicates that heating and cooling techniques that store heat or cold from one time of the day to use in another are effective. evaporation alone will work as a cooling strategy in the months of may and june. to a limited extent, wind can be used to cool. the availability of wind can be derived from the wind squares. these plots represent only outdoor conditions. a building changes its internal microclimate by virtue of the thermal lag of its materials, its controlled infiltration rate, etc.

the building bioclimatic chart identifies potential passive solar heating and cooling strategies appropriate for the building's climate. the bioclimatic chart is subdivided into zones that define passive solar heating and cooling strategies. the zones crossed by the lines plotted indicate strategies that may be appropriate for phoenix. the design strategies suggested by the building bioclimatic chart are appropriate only for residences and those other buildings with small internal heat gains. a residential rate of heat gain is assumed to be about 20kbtu/day per person.

passive solar heating is an appropriate strategy for months when the plotted lines fall below on the comfort zone. the solar heating zone is based on certain assumptions about glazing areas and insulation levels. it may be extended to lower temperatures depending on building design, radiation levels, and the desired solar savings fraction.

bio-climatic chart



interpreting the bio-climatic chart



extension of comfort zone with sun



extension of comfort zone with wind

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extension of comfort zone with evaporation

there are five cooling strategies represented by the five somewhat overlapping zones above the comfort zone: 1) natural ventilation, which depends solely on air movement to cool occupants; 2) large thermal mass, which depends on the building's materials to store heat during the day and reradiate it at night; 3) large thermal mass combined with night ventilation, which relies on mass heat storage during the day and ventilation at night to cool the mass; and two types of evaporative cooling, 4) direct, and 5) indirect. direct evaporative cooling raises the humidity and lowers the temperature of the indoor space. indirect evaporative cooling, such as the cooling of outside of a roof or wall by evaporating water on its surface, lowers the temperature of a building element, which then becomes a heart sink for the adjacent space. in phoenix, high mass with night ventilation and evaporative cooling are good strategies fro cooling, and heating can be done effectively by the sun.

## monthly temperatures



building bio-climatic chart



design influences environmental site conditions



the following is a list of orientations and their resulting effects.

# south orientation

sunlight will occur from late morning to early afternoon. during the summer months the sun will appear high in the sky and during the winter months the sun will appear low in the sky. south orientation is the best to obtain the maximum sunlight during the day, the hot summer sun can easily be controlled by properly designed overhangs. the low angle of the sun during the winter months will enable the rays to penetrate deep into the room.

# east orientation

sunlight will occur only in the morning hours. during the summer months, when the sun rises in the east, the early morning hours will have sunlight. the sun will be very low in the sky and the sun will generally not be too intense. during the winter months, the sun will rise more toward the southeast, thus providing a shorter period of sunlight.

# southeast orientation

sunlight will occur from early morning to late morning, or possibly noon. at midmorning the sun will be reasonable high in the sky and will provide a moderately intense sunlight.

# southwest orientation

sunlight will occur from early afternoon to later afternoon. the sun will be reasonably high in the sky. the rays of the sun will be much more intense than the morning sun. in some areas during the winter months the sun will se in the southwest.

# west orientation

sunlight will be present from midafternoon to later afternoon. during the summer months, the west sun will be very intense. it will set generally in the west or northwest. during the winter months, the sun will generally set in the southwest.

# north orientation

sunlight will be obtained from direct north orientation only in early morning and late afternoon in summer months
# room orientation

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individual room orientation to the sun is, to a degree a personal choice. however, there are generally accepted orientations fro different rooms within the dwelling unit. most frequently, it is very difficult to achieve the ideal orientation for each room and some compromises must be made. it is beneficial to obtain some sunlight in the dwelling during the day. a dwelling that is facing directly north and receiving no sunlight tends to be cool or dreary dwelling.

### bedrooms

sunlight streaming into the bedroom upon waking up in the morning is a pleasant feeling. this is achieved by an easterly or southeasterly exposure. west exposure should be avoided because the west sun during the summer months is strong and heats up the room during the late afternoon and early evening.

### living room

the living room should have a southerly exposure. in hot climates, a properly designed overhang will prevent direct sunlight from entering the room. in wintertime the low angle of the sun will allow sunlight to penetrate the depth of the room.

# dining area

an easterly exposure will allow sunlight to enter during the morning breakfast meals. if, however, it is desirable to view a sunset or have sunlight during the evening meal, a westerly or southwesterly exposure should be used. since lunch is a minimal meal, this usually is not a major consideration.

### kitchen and laundry areas

north is generally considered to be the best orientation for kitchens and laundry areas because it provided an even, nonglare light. however, many people prefer some sunlight in the kitchen. a great deal would depend on the personal preference of the individual.

### multipurpose area

this most often is a major activity area involving many members of the family. it should have a similar orientation to the living room.

material investigation

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# save energy

design and build energy-efficient buildings. ongoing energy use is the single greatest source of environmental impact from a building; thus a building designed for low energy use can have a significant effect on the environment. an integrated design approach takes advantage of energy saving that results from interaction between separate building elements. sample strategies:

- -incorporate high levels of insulation
- -high-performance windows to make building as airtight as possible
- -minimum cooling loads through glazing selection, lighting design and landscaping
- -meet energy demand with renewable energy resources
- -install energy efficient appliances, lighting and mechanical equipment

# create community

design communities to reduce dependence on the automobile and foster a sense of community. address transportation as part of the effort to reduce environmental impacts. even the most efficient passive solar house will carry a big environmental impact if its occupants have to drive a twenty minute commute to work. sample strategies:

-design communities that provide access to public transit, pedestrian corridors and bicycle paths -work to change zoning to mix use development so homeowners walk to stores and work

-site buildings to enhance the public space around them and maximize pedestrian access

# reduce material use

optimize design to make use of smaller spaces and utilize materials efficiency. smaller is better relative to the environment. for all materials, using less is almost always preferable, provided the durability or structural integrity of a building is not compromised. reducing the surface area of a building reduces energy consumption. reducing waste both helps the environment and reduces cost. sample strategies:

-reduce the building footprint and use space more efficiently

-simplify building geometry to save energy and materials

-design building dimensions to optimize material use and reduce waste

# maximize material longevity

design for durability and adaptability. the longer a building lasts, the longer the period over which to amortize its environmental impacts. designing and building a structure that will last a long time necessitates consideration of how the building can be modified to satisfy changing needs. sample strategies:

- -specify durable materials. usually more important than selecting materials with low embodied energy -assemble the materials to prevent premature decay
- -design for easy maintenance and replacement of less durable components
- -allocate an appropriate percentage of building funds for ongoing maintenance and improvement

# save water

design building and landscapes that use water efficiently. this is largely a regional issue. sample strategies:

- -install water-efficient plumbing fixtures
- -collect and use rainfall in landscaping
- -provide low water use landscaping (xeriscaping)
- -retain / detain water on-site when possible

# make the building healthy

provide a safe, comfortable indoor environment. the indoor and outdoor environments should be integrated related to the health of its occupants. sample strategies:

-control moisture to minimize mold and mildew

-provide for continuous ventilation in all occupied buildings

-give occupants some control of their environment with features like operable windows, task lighting and temperature controls

-utilize adjacent outdoor space (courtyard)

source: aia graphic standards for residential construction

# climate implications

although classified as arid and overheated, severe desert climates in the united states typically have four distinct periods for determining comfort strategies. the hot dry season, occurring in late spring, early summer and early fall, has dry, clear atmospheres that provide high insulation levels, high daytime air temperatures, very high solair temperatures and large thermal radiation losses at night producing a 30 – 40 degree F change. nighttime temperatures may fall below comfort limits and are useful for cooling. the later hot season occurring in july and august has nighttime temperatures that are higher than the comfort limits. thus constant refrigeration is needed to meet comfort standards. the winter season typically has clear skies, cold nights, very low dew point temperatures, a daily range in temperature 40 degrees F and the opportunity for passive meeting all heating requirements from insulation. the transitional or thermal sailing season occurs before and after the winter season and requires no intervention by environmental control systems. this season can be extended by the passive features of the building.

# minimizing solar and conductive gains

solar radiation is the greatest liability to comfort conditions in this region. summer solar intensity is highest on horizontal surfaces, a vented attic above an insulated ceiling is very effective. ideally the entire building, both transparent and opaque surfaces, should be shaded, as well as outdoor pedestrian and living spaces. plant trees to shade roof and east & west walls, and to develop a modified microclimate around the building. shape massing to minimize solar load on envelope by positioning carport or garage as a buffer on the west side or use light colored surfacing on walls and roof.

insulate envelope components in proportion to the difference between sol-air and indoor temperatures. in addition, use radiant barriers in attic and walls. perimeter insulation of slab-on-grade floors is also desirable.

# selective fenestration

shading of glass during the full overheated period also has the highest priority. minimize glass on the west. balance fenestration on north and south orientations because direct solar gain is not desired except in the cool months. for small area windows that will be shaded, single pane glazing is acceptable. with larger areas (over 20 sf), in addition to the conductive heat gain, the higher inside surface temperature of single glazing raises the mean radiant temperature and adversity effects comfort. generally fenestration should be double pane with a low "e" coating on the inside surface of the outside pane. glazing should have low conductance frames, using either thermal breaks, if metal or thermally resistant materials such as wood or plastic.

# ventilation

although nighttime breezes are slight, design for ventilation. arrange floor plans for internal air movement, especially to cool thermal mass. fans strongly recommended.

# thermal mass and insulation

un-insulated mass construction:

a vernacular house design in hot, arid regions use low mass construction for sleeping areas and high mass for daytime activities. the low mass zone, is ventilated or is mechanically cooled off quickly at night, while the high massive zone has little windows and cools off slowly.

un-insulated exterior mass delays the transfer of heat to the interior. the delay of most massing materials is approximately 40-50 minutes per inch thickness. a completely shaded, un-insulated massive wall can do no better than maintain an average daily temperature near the outdoor average, unless the space is well ventilated at night. un-insulated mass walls have low R values and generally are not economically suitable for heated and air-conditioned buildings. insulating a mass wall in a composite construction is beneficial in most climates. free standing interior walls or partitions of mass material allow thermal

# thermal mass and insulation (continued)

access to both sides and protect from the elements. sample materials:

-adobe or rammed earth

-full weight concrete block with open cells filled by a weak sand or gravel grout to add mass and conductivity

# insulated mass construction

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insulation outside the mass has the greatest benefit, it reduces heat gain while allowing the wall to discharge heat during nighttime ventilation. in winter it doubles its usefulness with thermal storage for passive solar heat. insulation is also less mass to be used to reduce interior temperature swings.

insulating inside the mass or adding mass outside an insulated frame wall (ex. brick veneer) improves performance over either case alone. an ideal wall would have thermal mass on both surfaces with resistance insulation between.



TYPICAL WALL SECTIONS

source: aia graphic standards for residential construction

# passive solar design

passive solar heating and cooling systems, which rely on natural energy flow through and around building, are divided into three categories, but systems can be combined depending on thermal needs (see corisponding diagrams on the following page):

1- direct systems

heat is collected directly within the space or, for cooling, lost or dissipated directly from the space

2- indirect systems

heat gain or loss occurs at the exterior building skin

3- isolated systems

heat gain or loss occurs away from the exterior building skin

# space heating concepts

as part of passive system development, energy conservation elements should be considered. with passive solar heating, minimizing and preventing heat loss is fundamental to ensure that the heating system is most effective. these elements include:

-adequate insulation

-building orientation

-surface-to-volume ratio

-appreciate material, texture and finish selection

the space heating success depends on adequate solar energy collection, storage, distribution and control, which all occur naturally based on three heating transfer processes: conduction, convection and radiation. effective passive solar system operation often involve some user control to alter or override energy flows within a building or at the exterior skin. such space heating concepts include:

1- solar collection:

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surfaces generally are transparent or translucent plastics or glass oriented in the southern direction. insulation should occur at these areas to control nighttime loss in extreme climates.

2- thermal storage:

materials include concrete, brick, sand, tile, stone and water. storage should be placed to receive maximum solar exposure, either directly or indirectly.

3- heat distribution:

occurs naturally by conduction, convection and radiation.

4- control mechanism:

used to balance heat distribution through the use of vents, dampers, movable insulation and shading devices

# space cooling concepts

passive solar cooling, like passive heating, tempers interior space temperatures using natural thermal phenomena. a structure designed for natural cooling should incorporate features that reduce external heat gains and dissipate internal heat gains. external heat gain should be controlled before it reaches or penetrates the exterior skin, examples of such design solutions are:

-adequate insulation -overhangs -orientation -surface color and texture -proper ventilation

when cooling is necessary, heat dissipation is accomplished by cooling interior thermal mass, air, or both with conduction, convection and radiation. evaporation in hot arid regions is a primary cooling design concept. many passive cooling concepts and methods exist:

# space cooling concepts (continued)

- 1- site cooling:
  - through vegetation control, water bodies and adjacent land forms and materials
- 2- earth cooling:
  - by using groundwater or the earth's mass
- 3- radiative cooling:

heat lost to the sky or cooler objects

4- ventilate cooling:

cross ventilation through spaces, double roofs, attics, or walls

5- vapor cooling:

evaporate cooling to remove sensible heat, dehumidification to remove sensible heat, dehumidification to remove latent heat

6- flywheel cooling:

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cooling by internal thermal mass or rock-beds

### passive solar heating design procedure

calculating heat gain and loss is a relatively straightforward procedure. The storage and control of heat in a passively heated space, however, is the major problem confronting most designers. In the process of storing and releasing heat, thermal mass in a space will fluctuate in temperature, yet the object of the heating system is to maintain a relatively consistent interior temperature. For each system, the integration of thermal mass in a space will determine the fluctuation of indoor temperature over the day. (see daily temperature fluctuation diagram below)





### direct gain

direct gain systems are characterized by daily fluctuations of indoor temperatures, which range from only 10 degrees F to as much as 30 degrees F. the heating system cannot be turned on of off, since there is little control of natural heat flows in the space. to prevent overheating, shading devices are used to reduce solar gain or excess heat is vented by opening windows or activating an exhaust fan.

the major glass area of each space must be oriented to the south for maximum solar heat gain in winter. these windows can serve other functions as well, such as openings for light and for views. each space must also contain enough mass for the storage of solar heat gain. This implies masonry in the building.

### south glazing

one criterion for the well-designed space is that it gains enough solar energy, on an average sunny day in winter, to maintain an average space temperature of 68 degree F over the 24 hour period.

in a direct gain system, sunlight can also be admitted into a space through clerestories and skylights as well as vertical south-facing windows. this approach may be taken for privacy or to avoid direct sunlight on people and furniture. use the following guidelines when designing a clerestory or skylight (see corisponding diagrams on following page):

### clerestory

locate at a distance in front of interior mass wall of roughly 1 to 1.5 times the height of the clerestory above the finished floor. make the ceiling of the clearstory a light color to reflect and diffuse sunlight down into the space.

### sawtooth clerestories

make the angle equal to or smaller than the altitude of the sun at noon on December 21, the winter solstice. make the underside of clerestories a light color

### skylight

use a smooth-facing or horizontal skylight with a reflector to increase solar gain in winter and shade both horizontal and south-facing skylights in summer to prevent excessive solar gain.

### thermal storage mass

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the two most common materials used for storing heat are masonry and water. masonry materials transfer heat from their surface to the interior at a slow rate. to accomplished this:

- 1- construct interior walls and floors of masonry at least four inches thick
- 2- diffuse direct sunlight over the surface area of the masonry either by using a translucent glazing material or by reflecting direct sunlight off a light colored interior surface
- 3- use the following guidelines for selecting interior surface color and finishes:
  - -masonry floors of a medium to dark color
  - -masonry walls of any color
  - -lightweight construction of a light color to reflect sunlight onto masonry surfaces -no wall-to-wall carpeting over masonry floors



CLERESTORY

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REFLECTING DIRECT

DIRECT GAIN SYSTEMS



BAWTOOTH CLEREBTORIEB



WATER WALL

source: aia graphic standards for residential construction

# exterior wall assemble comparison

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the efficiency of a wall as a heating system depends mainly on its thickness, material and surface color. if the wall is too thin, the space will be overheated during the day and be too cool in the evening; if it is too thick, it becomes inefficient as a heating source, since little energy is transmitted through it. the charts below gives a clear comparison of exterior wall characteristics and their advantages / disadvantages:

FOR ADDITION	VALL ASBEMBLIES IAL INFORMATION CONSULT MANUFACTURERS AND TRADE ASSOCIATIONS	WALL THICKNESS (NOMINAL) (IN.)	WEIGHT (PSF)	VERTICAL SPAN RANGE (UNSUP- FORTED HEIGHT) (FT)	WIND	RACKING RESISTANCE	SERVICE PLENUM SPACE	HEAT TRANS- MISSION COEFFI- CIENT (U FACTOR) (BTU.HR SQ FT
См. U.	GRAVEL AGGREGATE I	8 12	55 85	Up to 13 Up to 20	ntal span.	Good	None	0.56 0.49
C.M.U. INSULATED 1	HINSULATION	8 + 12 +	60 90	Up to 13 Up to 20	and horizontal	Good	Through insulation	0.21 0.20
C. M. U. AND BRICK VENEER UNBULATED I	INSULATION	4 + 4 + 4 + 8 +	75 100	Up to 13 (w/filled cavity) Up to 20 (w/filled cavity)		Good	Through insulation	0.19 0.18
CAVITY	H-BRICK VENES SUFT FURE - UNBULATONIWATER BEPELLENTI - UNBULATONIWATER BEPELLENTI - UNBULATONI WALL FID.	1+2+4 4+2+8	75 100	Up to 9 Up to 13	rkmanship	Fair	None	0.12 0.11
C.M.U. AND STUCCO IINSULATEDI	STUCCO C M.U HINSULATION INT. WALL FIU.	8 +	67	Up to 13	strengtn; workmanship;	Good	Through interior insulation	0.16
WOOD STUD	ENT WALL FIN DECEMBER BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES BARRIES	4 6	12 16	Up to 14 Up to 20 (1/d < 50)	thickness,	Poor to fair	Between studs	0.06 0.04
ERICK VENEER	MARIER VENEER BHEATHING WITH WOSTURE BHEATHING WITH WOSTURE WOOD BTUD WOOD BTUD HAMPIER HAMPIER HAMPIER	4+4	52	Up to 14	wall material	Poor to fair	Between studs	0.07
METAL STUD	EXT WALL FIN METAL STUD AT 16" O.C. INSULATION WITH VAFOR BARRIER NIT, WALL FIN,	4 5	14 18	Up to 13 Up to 17	velocity;	Poor	Between studs	0.06 0.04
BRICK	WITH UNDER WITH UNDER BARRICH WITH UNDER WITH UNDER BARRICH BARRICH WITH WARDN BARRICH WITH WARDN	4+4	54	Up to 15	building, wind	Good	Batween studs	0.07
INSULATED SANDWICH PANEL	METAL SKIN	5	6	Sea manufacturers' literature	height of bu	Fair to good	None	0.05 See manufacturers literature
CONCRETE	MANNA, A.H. CONGRETE	8 12	92 138	Up to 13 (w/reinf, 17) Up to 20 (w/reinf, 25)	P	Excellent	None	0.68 0.55
CONCRETE	INSULATION	8 •	97	Up to 13 (w/reinf. 17)	graphical loc	Excellent	Through Insulation	0.13
CONCRETE AND BRICK VENEER INSULATED)	-BRICK VENEER CONCRETE INSULATION	4 + 8 +	112	Up to 13 (w/reinf, 17)	depends on geographical location ar both inward and outward pressures	Excellent	Through insulation	0.13
PRECAST	CONCRETE (REINFORGED) INSULATION INT. WALL FINISH	2+ 4+	23 46	Up to 6 Up to 12	resistance dependence dependence of the second seco	Fair to good	Through insulation	0.99 0.85
PRECAST CONCRETE SANDWICH		5	45	Up to 14	Wind residen w	Fair to good	None	0.14
OLASS	SEE INDEX UNDER "GLASS"			SIZE RANGE MAXIMUM ALL GLASS AREA	OWA	BLE WIND	SHADING COEFFI- CIENT S.C.	
SINGLE		1/4	3.2	Four side suppor Two side suppor	ted	and the second se	Clear 0.94 Tinted 0.70	Clear/tinted 1.1 Reflective 0.8-1.1
DOUBLE GLAZING	14 GLASS 14 CAVITY	3/4.	6.4	Four side suppor Heat strengthene	d	55 SF @ 30 PSF 28 SF @ 60 PSF 70 SF @ 80 PSF 30 SF @ 200 PSF	Reflective 0.44	Clear/tinted 0.5-0.6 Reflective 0.3-0.6
TRIPLE	14" GLAGS	11/4	9.6					Clear/tinted 0.3-0.4 Reflective 0.2-0.4

RESISTANCE TO EXTERIOR AIRBORNE SOUND TRANSMISSION	HAZARD CLASSIFICATION (FIRE)	FIRE RESISTIVA RATING PER CODE AND UNDERWRITERS (HAS)	CONSTRUCTION TYPE CLASSIFICATION	SUBCONTPAC- TORS REQUIRED FOR ERECTION (FLUS FINISHES)	EXTERIOR MAINTENANCE PEQUIREMENTS	REMARKS
Fair to good	Classification provides data in regard to (1) flame spread, (2) fuel contributed, and (3) smoke devel- oped during fire exposure of mate	2-4	1, 2, and 3	Masonry	Washing, re- pointing joints, painting, sand blasting	Properties of non-engineered masonry are drastically reduced
Fair to good	rials in comparison to asbestos cerrent baards as zero and untreated red oak lumber as 100 when exposed to fire under similar conditions FUEL	2 4	1, 2, and 3	Masonry Carpentry Drywall	Washing, re pointing joints, painting, sand blasting	
Excellent	CON- SMOKE FLAME TRIB. DEVEL- SPREAD UTED OPED Paint on CMU 5-25 0-5 0-10	3-4	1, 2, and 3	Masonry Carpentry Drywall	Washing, re- pointing joints, sand blasting	
Excellent	Gypsum board surfacerl on both sides with paper 15 15 0	a	1, 2, and 3	Masonry Drywall (Carpentry)	Washing, re- pointing joints, sand blasting	Cavity increases heat storage capacity and resistance to rain penetration
Good	Gypsum board surfaced on both sides with paper, vloyt faced 25-35 0-10 15-45	2-1	1, 2, and 3	Masonry Drywall Lath and plaster (Carpentry)	Washing, paint- ing, and re stuccoing	The assembly is reversed for optimum energy conservation
Poor to fair	Untreated wood particle hoard 180 75 190	1 (combustible)	4	Carpentry Drywall (Lath and plaster)	Washing, paint- ing, and replac- ing exterior finish	Exterior wall finishes • wood, plywood, • a'uminum siding • stucco
Good to excellent	Treated wood particle board with untreated wood face veneer 25-180 10-160 10-250	1-2 (combustible)	3B. C	Masonry Carpentry Drywall	Washing, re- pointing joints, sand blasting	
Poor to lair	Vermiculite acoustical plaster 10-20 10-20 0	12	1 (nonbearing) 2 and 3	Carpentry Drywall (Lath and plaster)	Washing, paint- ing, and replac- ing exterior finish	Exterior wall finishes: • wood, plywood, • aluminum siding • stucco
Good to excellent	Glass liber batts and blankets (basic) 20 15 20	1-2	1 (nonbearing) 2 and 3	Masonry Carpentry Drywall	Washing, re pointing joints, sand blasting	
Poor to good, see manufacturers' literature	25 0 0 Treated lumber (Douglas fri)	See manufacturers' literature	See manufacturers literature	Curtain walls -erection	Washing, steam cleaning, paint ing, replacing joint sealers	Temperature change critical Minimize metal through connections
Good	(Hemleck) 10-15 5-15 0	4	1, 2, and 3	Concrete work	Washing, send blasting	Concrete walls have very high heat storage capacity
Good	Gypsum board surfaced on both sides with paper, vinyl faced 25-35 0-10 15-45 Untreated wood particle board 180 75 190 Treated wood particle board with untreated wood face veneer 25-180 10-160 10-250 Vermiculite acoustical plaster 10-20 10-20 0 Glass hitter batts and blankets (has/c) 20 15 20 (for kraft faced) 25 0 0 Treated lumber (Douglas fir) 15 10 0-5 (Henlock)	4 4	1, 2, and 3	Concrete work Drywall (Camentry)	Washing, sand blasting	
Excellent	CLASS FLAME SMOKE SPREAD DEVELOPED	4	1. 2, and 3	Concrete work Masonry Drywall (Carpentry)	Washing, re pointing joints, sand blasting	
Poor to fair	B 26-75 0-450 C 76-200 0-450 For losser classifications, permitted	1-3	1A (nonbearing) 18, 2, and 3	Curtain walls -erection Drywall (Carpentry)	Washing, sand blasting, re- placing joint sealers	Large size economical (fewer joints) units available with various finishes
Fair	refer to regulating agency quidalinas	1.3	1A (nonbearing) 1B, 2, and 3	Curtain walls -erection	Washing, sand hlasting, re- placing joint sealers	B' x 20' max size for concrete sand- wich panels. Plant quality control is very essential
Pour				Curtain walls erection (Glazing)	Washing, re placing joint sealers, gaskets	Anchorage to building is critical Anchors must isolate wall to limit building movement transmitted to glass
Fair		-		Gurtain walls -erection (Glazing)	Washing, re placing joint sealers, gaskets	Wall design must limit wall movement transmitted to glass Multions should accommodate movem through gaskets, sliding connections, e
Good	-			Curtain walls - erection IG[azing]	Washing, re- placing joint sealers, gaskets	

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source: aia graphic standards for residential construction

# ventilation openings arrangement



Two Openings-Adjacent Walls Two Openings-Opposite Walls

ventilation opening arrangements can be optimized to increase the rate of cross ventilation in a room and to move air across occupants to increase their rate of cooling. in addition to removing hot air from a room, ventilation can also affect occupant cooling, if the air is moving fat enough, by increasing the rate of evaporation from their skin. when the outside ambient air temperature is above the comfort zone, vents should be designed for occupant cooling as well as for heat removal.

the average interior air velocity is a function of the exterior free wind velocity, the angle at which the wind strikes the inlet, and the location and size of the opening. for openings two-thirds of the all width, rooms that have only one opening in one wall have average velocities of 13-17 percent of the outside air velocity, depending on the wind direction. the difference in this velocity is small between openings that vary from 33-100 percent of the all area. for two openings placed in the same wall, average velocities are higher, about 22 percent of the outside air velocity, because one opening acts as an inlet and the other as an outlet.

when openings in a room are located in two walls, the average interior velocity is much higher, 35-65 percent of outside air velocity, because one opening will always be in a higher pressure zone than the other. the volume of air flow, and thus the heat removed, is greatly influenced by the size of the openings.

the location of the openings and interior partitions in both plan and section influence the route of the air flow through the room. therefore, air velocity varies within the room. although, air velocity varies openings in opposite walls create rapid movement, openings in adjacent walls and wind directions oblique to the window encourage both turbulence and air mixing, and thus a more even velocity distribution and cooling effect throughout the room. openings should be located so that air moves past the occupants to be cooled. if the openings are all near the ceiling or all near the floor, the maximum velocity will not occur in the occupied zone, usually 1-6 ft above the floor. if the openings are mid-height in the wall or if some are high and some are low, then higher velocities will occur in the occupied zones.

range = wind 45 degress to perpendicular to opening

# shading coefficients for internal shading

CONSTRUCTION TYPE	Shading Coefficient	1/4" Heat Absorb. Glass Out. Clear Glass In	Î
1/8" Clear Glass, in & out		Venetian Blinds Between (ight/medium)	0.28/0.30
Venetian Binds Between (light/medium)	0.33/0.36	Venetian Blinds Inside (light/inadium)	0.36/0.39
Venetian Binds Inside (Eght/medium)	0.58/0.62	Louvered Sun Screen Belween	0,37
Louvered Sun Screen Between Special Shaped Mirrored Louvers Between	0.43	Opaque Roller Shade Inside (white/translucent/dark)	0 22/0.30/0.40
Opaque Roller Shade Inside (white transucent/dark)	0.35/0.40.0.71	Draperles Inside open weave/dark color sem-open weave/medium color	0.47 0.41
Draperies Inside	1212	closed weave light color	0,35
open weave/dark color semi-open weave/medium color closed weave/light color	0.62 0.52 0.42	shading coefficients for double glazing with internal and between-glass shading	

well-placed windows can reduce winter heat loss. within well-insulated, skin-load-dominated buildings the primary causes of heat loss are infiltration and windows. The size, number, and orientation of windows greatly affect the building's energy uses for heating. in the daytime during the heating season, windows are simultaneously losing heat because it is warmer inside than out and gaining heat because direct or diffuse solar radiation is passing through the glass and heating the interior. at night the windows only lose heat. If a window gains more heat than it loses over the course of the heating season, it reduces the heating requirements of the building. windows that do not face south usually lose more energy than they gain and therefore increase the building's heating requirements. non-south windows on each orientation should be limited to 10-15 percent of the total window area, but should be large enough for effective daylight.

A moveable insulation layer can be placed over windows to reduce heat loss at night. Windows are usually the weakest link in the building envelope in terms of heat loss during cold weather. Heat flows out through a double-glazed window 10 times faster, or more, than it does through a well-insulated wall. there are almost an infinite variety of movable insulation schemes.

Rigid panels, which require the most storage space, can be completely removed and stored in racks, hinged at the top or bottom, or mounted on sliding rails. The economic benefit of window insulation can be increased if it is usable not only when it is in the closed position, but also when it is open. An example of this is the reflecting insulating trombe wall shutter, which serves as a reflecting surface to increase the solar radiation collected. Rigid panels may be used in the plane of the windows like sliding pocket doors or broken into insulated louvers. The louvers may be adjusted to reflect light to the thermal mass without causing glare.

Flexible covers take much less storage area than rigid covers and may be motorized and automatically closed at night and opened during the day. The trombe wall example uses a self-inflating curtain made of several radiant reflective layers that are rolled to storage in a recessed ceiling cavity.

The use of night insulation increases solar heating performance significantly in most climates because it allows heat gain when the sun is out and minimizes heat loss when the sun is not out. An alternative to the use of movable insulation is to use glazing with a much higher r-value, but to capture solar heat and admit sufficient daylight, it must have a high shading coefficient or solar heat gain coefficient.

While external operable shades can be very effective at stopping solar gain, they are also subject to degradation by the elements, collect dirt easily, and can be difficult to maintain. Controllable shading placed inside the glass or between layers in double and triple-glazed window and envelope systems can reduce solar heat gain in the summer, reflect daylight to the interior, reduce glare, protect the shading from pollution and weather, and reduce maintenance time and effort.

If blinds are placed between the glazing, the shading coefficient will be relatively low, because solar gain is removed at the window before entering the space. A lower shading coefficient blocks more solar heat. The shading coefficient for shading between glazing layers will be somewhere between the low shading coefficient of external shading and the higher shading coefficient of internal shades. Three things happen to solar radiation as it passes through a glazing material: some is transmitted, some is reflected, and the rest is absorbed. These three components determine many of the other energy-performance properties of a glazing material. The four basic properties of glazing that affect radiant energy transfer are transmittance, reflectance, absorption, and emittance.

Conduction transfers through the window are controlled by the windows u-factor, which indicates the rate of heat flow through a material. Lower u-factors (or higher r-values) indicate better insulation. Glass has a much lower resistance to heat than most other building materials. In skin-load-dominated buildings, windows can dominate the building's heating and cooling loads. Therefore, window u-factors should generally decrease as the severity of the outdoor climate increases.

The figures on this page illustrate the solar heat gain and visible light transmittance for common glazing types used in manufactured windows. The figures are for the center of the glass only; the characteristics of the frame must be included to obtain performance information on the whole window unit. The darker arrows indicate the total transmitted and total rejected solar energy. The lighter arrows indicate the amount of transmitted and reflected daylight. Daylight that is neither transmitted nor reflected is absorbed.



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source: architectural graphic standards for residential construction

# floor area comparison

the cost per square foot of single-family residences will vary primarily because of the ratios of floor area to wall area and of floor area to plumbing cost. the general as the floor area/shape becomes more abnormal the overall built cost rises, mainly due to the additional wall area required. in addition when adjusting for space, disregard small jogs, bays and entrances which add very little perimeter wall and figure first-story shape only.

single-family floor area/shape configurations



### material price comparison

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type	exterior walls	interior finish	lighting / plumb- ing	heat	cost per s.f.
average	wood frame, some trim, good asphalt shingles	plaster or drywall, hardwood, carpet, vinyl composition	adequate lighting/ plumbing per building codes	forced air	54.23
good	wood frame, stucco, roof shingles	good plaster or drywall, some ornamentation, carpet	good lighting and outlets, one bathroom per two bedrooms	package a.c.	74.71
very good	wood frame, stucco, brick or stone trim, concrete tile roof	very good plaster, detail, good quality carpet	top-quality standard fixtures, electrical and plumbing	heat pump system	87.66
average	block or brick, good asphalt shingle roof	drywall or tinted plaster, car- pet, vinyl composition tile	adequate lighting/ plumbing per building codes	forced air	58.51
good	block and stucco or brick, roof shingles	good plaster or drywall, some ornamentation, carpet	good lighting and outlets, one bathroom per two bedrooms	package a.c.	81.51
very good	good block, trim, concrete tile roof	very good plaster, detail, good quality carpet	top-quality standard fixtures, electrical and plumbing	heat pump system	96.24

source: marshall valuation service

these proposed building systems were checked with the 1995 mec requirements in res check version 3.5 release 1c (formerly mec check) and comply with the mandatory requirements listed in the res check inspection checklist. the proposed building systems were checked using casa grande, az's local energy building codes. to verify percentages in another location use res check from the u.s. department of energy.

res check was developed by pacific northwest national laboratory for the department of housing and urban development and the rural economic and community development under direction of the u.s. department of energy's office of codes and standards.

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### Checked By/Date

# 1995 MEC

REScheckSoftware Version 3.5 Release 1e

Data filename: C:\Documents and Settings\Jeffrey Leven.CAPLA-9EUK8DVRL\My Documents\U of A\Spring 02-03\Arc 402\Casa Grande Prototype Housing\Energy Comparison\Wood Frame WalLrck

TITLE: Wood Frame Wall

CITY: Casa Grande STATE: Arizona HDD: 1573 CONSTRUCTION TYPE: Single Family

DATE: 05/04/03 NOTES: Wood frame construction with interior insulation and stuceo applied to the exterior

COMPLIANCE: Passes

Maximum UA = 502 Your Home UA = 455 9.4% Better Than Code (UA)

	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Ceiling 1: Flat Ceiling or Seissor Truss	950	0.0	38.0		24
그는 것은 그는 것이다. 여러, 집에 집에 가지 않는 것이 같은 것이다. 이 것은 것이 같은 것이 같이 같이 같이 같이 않는 것이다.					
Wall 1: Wood Frame, 16" o.e.	1250	0.0	21.0		75
Window 1:					
Metal Frame with Thermal Break:Double Pane with Low-R	215			0.710	153
Duor 1: Solid	36			0,360	13
Door 2: Glass	64			0.500	32
Floor 1: Slab-On-Grade:Unheated	160		11.0		158
Insulation depth: 0.3'					
the second se					

Heat Pump 1: Air Source, 6.8 HSPF, 12 SEER

# Checked By/Date

# 1995 MEC

RES check Software Version 3.5 Release 1c

Data filename: C:\Documents and Settings\Jeffrey Leven.CAPLA-9EUK8DVRL\My Documents\U of A\Spring 02-03\Are 402\Casa Grande Prototype Housing\Energy Comparison\Steel Frame WalLrek

TITLE: Steel Frame

CTTY: Casa Grande STATE: Arizona HDD: 1573 CONSTRUCTION TYPE: Single Family

DATE: 05/04/03 DATE OF PLANS: 5.04.03

NOTES:

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Steel frame construction with interior insulation and stuceo applied to the exterior

### **COMPLIANCE:** Passes

Maximum UA = 502 Your Home UA = 418 16.7% Better Than Code (UA)

	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Ceiling 1: Flat Ceiling or Scissor Truss	950	0.0	38.0		24
Wall 1: Steel Frame, 16" o.c.		2.00.21			
Window 1:	1250	0.0	20.6		40
Metal Frame with Thermal Break:Double Pane with Low-E	215			0.710	153
Door 1: Solid	36			0.360	13
Door 2: Glass	64			0.500	32
Floor 1: Slab-On-Grade:Unheated Insulation depth: 0.4'	160		11.0		156
Heat Pump 1: Air Source, 6.8 HSPF, 12 SEER					

design influences energy efficiency comparison - steel frame

### Checked By/Date

# 1995 MEC

REScheckSoftware Version 3.5 Release 1c

Data filename: C(Documents and SettingsUeffrey Leven.CAPLA-9EUK8DVRLMy DecumentsU of A\Spring 02-03\Arc 402\Casa Grande Prototype Housing\Energy Comparison\CMU Wall interior insulation.rck

TITLE: Masonary Wall

CITY: Casa Grande STATE: Arizona HDD: 1573 CONSTRUCTION TYPE: Single Family

DATE: 05/04/03 NOTES: These figures are based on 8" concrete masonary unit with one coat of stucco on the exterior, and insulation on the interior with an interior finish

### COMPLIANCE: Passes

### Maximum UA = 513 Your Home UA = 418 18.5% Better Than Code (UA)

	Gross Area or Perimeter	Cavity <u>R-Value</u>	Cont. <u>R-Value</u>	Glazing or Deor U-Factor	<u>UA</u>
Ceiling 1: Flat Ceiling or Seissor Truss	950	0.0	38.0		24
Wall 1:					
Masonry Block with Empty Cells:Interior Insulation	1250	0.0	21.2		38
Window 1:					
Metal Frame with Thermal Break:Double Pane with Low-E	215			0.710	153
Door 1: Solid	36			0.360	13
Door 2: Glass	64			0.500	32
Floor 1: Slab-On-Grade:Unheated Insulation depth: 0.3'	160		11.0		158
Heat Pump 1: Air Source, 6.8 HSPF, 12 SEER					

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# REScheck Compliance Certificate 1995 MEC

### Checked By/Date

REScheckSoftware Version 3.5 Release 1c

Data filename: CADocuments and Settings/Jeffrey Leven.CAPLA-9EUK8DVRLMy Documents/U of AlSpring 02-03/Arc 402/Casa Grande Prototype Housing/Energy Comparison/CMU Wall exteriror insulation.rek

TITLE: Masonary Wall

CITY: Casa Grande STATE: Arizona HDD: 1573 CONSTRUCTION TYPE: Single Family

DATE: 05/04/03 NOTES:

These figures are based on  $8^\circ$  concrete masonary unit with three coats of stucco and  $2^\circ$  of polystyrene on the exterior. On the interior there is a 2 x 4 furring with no insulation and interior finish materials.

COMPLIANCE: Passes

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Maximum UA = 552 Your Home UA = 415 24.8% Better Than Code (UA)

	Gross Area or Perimeter	Cavity <u>R-Value</u>	Cont. <u>R-Value</u>	Glazing or Door <u>U-Factor</u>	<u>UA</u>
Ceiling 1: Flat Ceiling or Scissor Tross	950	0.0	38.0		24
Wall 1:					
Masonry Block with Empty Cells:Exterior Insulation	1250	0.0	23.6		35
Window I:					
Metal Frame with Thermal Break:Double Pane with Low-E	215			0.710	153
Door 1: Solid	36			0.360	13
Door 2: Glass	64			0.500	32
Floor 1: Slab-On-Grade:Unheated Insulation depth: 0.3	160		11.0		158
Heat Pump 1: Air Source, 6.8 HSPF, 12 SEER					

Checked By/Date

# 1995 MEC

REScheckSoftware Version 3.5 Release 1c

Data filename: CADocuments and SettingsUeffrey Leven.CAPLA-9EUK8DVRLMy Documents/U of A/Spring 02-03/Arc 402/Casa Grande Prototype Housing/Energy Comparison/CMU Wall.rck

TTTLE: Integra Block

CITY: Casa Grande STATE: Arizona HDD: 1573 CONSTRUCTION TYPE: Single Family

DATE: 05/04/03 NOTES:

Integra block with two coats of sturco applied to the exterior. On the interior 2 x 4 furring strips with interior finish applied. The R value for Integra is taken from Superlite, and the total installed cost is between \$4.00 and \$4.50 per square foot (source: Superlite).

### COMPLIANCE: Passes

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Maximum UA = 552 Your Home UA = 405 26.6% Better Than Code (UA)

	Gross Area or <u>Perimeter</u>	Cavity <u>R-Value</u>	Cont. <u>R-Value</u>	Glazing or Door <u>U-Factor</u>	<u>UA</u>	
Ceiling 1: Flat Ceiling or Seissor Truss	950	0.0	38.0		24	
Wall 1: Masonry Block with Integral Insulation:w/ Additional I	exterior Insul	ation				
	1250	0.0	33.0		25	
Window 1:						
Metal Frame with Thermal Break:Double Pane with Low-E	215			0.710	153	
Deor I: Solid	36			0.360	13	
Door 2: Glass	6-1			0.500	32	
Floor 1: Slab-On-Grade:Unheated Insulation depth: 0.3	160		11.0		158	
Heat Pump 1: Air Source, 6.8 HSPF, 12 SEER						

design influences energy efficiency comparison - integra in conclusion, integra block system has the highest percentage above code 26.6% (casa grande) than wood frame, steel frame, or other cmu wall systems.

integra = +26.6%masonry wall with no interior insulation = +24.8%masonry wall with interior insulation = +18.5%steel frame = +16.7%wood frame = +9.4%

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this is a summary of the previous material investigation research along with the incorporation of the suggestions of the city of casa grande and of previous clients. the following is a list of suggested building materials and methods. these suggestions are based on hot and arid climates, energy efficiency, maintenance costs and design requirements.

# material recommendations

#### foundation

-insulated slab on grade -reduce building footprint

### walls

-full weight concrete block (for interior thermal mass and exterior insulation for transfer of heat to the interior)

### roof

-ventilated roof air cavity -radiant barriers in attic and walls

### windows

-double pane windows with low "e" coating

-vinyl or hybrid window frame

-operable windows for natural ventilation

-south facing clerestory windows and skylights for direct gain in the winter season

### exterior space

-courtyard (outdoor gathering and livable spaces) -covered entry-way and back porch area

### landscaping

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-xeriscaping to provide low water consumption

energy efficient mortgages

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energy efficient mortgages (eem) recognize that reduced utility expenses can permit a homeowner to pay a higher mortgage to cover the cost of the energy improvements on top of the approved mortgage. fha eems provide mortgage insurance for a person to purchase or refinance a principal residence and incorporate the cost of energyefficient improvements into the mortgage. the borrower does not have to qualify for the additional money and does not make a down payment on it. the mortgage loan is funded by a lending institution, such as a mortgage company, bank, or savings and loan association, and the mortgage is insured by hud.

### eligibility requirements

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- the borrower is eligible for maximum fha financing, using standard underwriting procedures. the borrower must make a 3-percent cash investment in the property. this 3- percent cash investment is based on the sales price. closing costs are not included in the 3- percent calculation but may be used to satisfy the requirement, any upfront mortgage insurance premium can be financed as part of the mortgage.
- eligible properties are one- to four-unit existing and new construction.
- the cost of the energy-efficient improvements that may be eligible for financing into the mortgage is the greater of 5 percent of the property's value (not to exceed \$8,000), or \$4,000.
- to be eligible for inclusion in this mortgage, the energy-efficient improvements must be cost effective, meaning that the total cost of the improvements is less than the total present value of the energy saved over the useful life of the energy improvement.
- the cost of the energy improvements and estimate of the energy savings must be determined by a home energy rating report which is done by a home energy rating system or energy consultant. the cost of the energy rating may be financed as part of the cost-effective energy package.
- the energy improvements are installed after the loan closes. the lender will place the money in an escrow account. the money will be released to the borrower after an inspection verifies that the improvements are installed and the energy savings will be achieved.
- the maximum mortgage amount for a single-family unit depends on its location, and it is adjusted annually. as of january 1, 2001, for most parts of the country it was \$132,000 for single-family homes. in high-cost areas it can be as much as \$239,250, the cost of the eligible energy-efficient improvements is added to the mortgage amount, the final loan amount can exceed the maximum mortgage limit by the amount of the energy-efficient improvements.

source: home and communities - united states departement of housing and urban development

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universal housing standards

# introduction

the next generation universal home is an example of how housing may evolve over the next 15 to 20 years in response to present and future demographic and marketing trends. the concepts and solutions it presents are based on existing technologies and coincide with popular design approaches. the next generation universal home's innovation is not based on manufacturing or technological advances, but rather on a change in thinking about how people actually live in their homes. this change is universal design and this section on universal housing standards, lays out the need, range of solutions and possible future of this housing concept.

### common terms

overtime the common terms such as universal design, barrier-free design and accessibility have changed to meet social standards.

# universal design

although universal design was intended to focus on equality and social justice by design, in the united states it has been labeled as a design approach that implies separation not equal use. unfortunately, some people use the term of universal design as a trendy synonym for compliance with americans with disabilities act standards for accessible design. as a response poor designs have been developed because thoughtfulness has created a tack-on design method. such an example is the new construction ramps, where no ramp would have been needed if the designer would of originally considered the needs of the users, rather than a technical requirement to be added at the end of the design process.

### barrier-free design

barrier-free design was the initial term used around the world to represent the removal of barriers for disabled people from the built environment. more recently in the united states the term has been perceived negatively, as a feature prescribed only for use by disabled people.

### accessibility

the term accessibility was first established in europe and became widely known in the united states in the 1970's as a more positive term for barrier-free design, however it was and is still linked to legislated requirements.

# demographic trends

single-family housing in the united states today is built much as they were fifty years ago, with the exception of the use of better materials. however, the housing industry must adapt to the growing diversity in family types in the united states. in 1972, the most common type of household consisted of married couples with children at 45 percent. but in 1998, the number had dropped to 26 percent, a dramatic shift from a generation ago. and additionally the population is aging. by 2030, there will be close to seventy million older adults, more than twice the number in 1996 (american association of retired persons, 1997).

a growing community of designers, researchers and educators worldwide has recognized that the built environment cannot be designed for one specific population, but for a dynamic range of people and abilities. housing of the future must posses, in addition to being environmentally sensitive and sustainable, an ability to adapt to the differing needs and requirements of the users, no matter their age or strength or ability. this design approach, known as universal design, strives to make the practical day-to-day tasks involved in living possible and safer for everyone.

# history

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universal design was originated by ronald I. mace, f.a.i.a., in the early 1980s. it was shape by his recognition that the community of people with disabilities has been relegated to a parallel universe and through a new design approach to the built environment, he and other members of the disability community could take their rightful place as integral members of a common universe.

# history (continued)

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as understood today, universal design respects, values and strives to accommodate the broadest possible spectrum of human ability in the design of all products and environments. it encourages and goes beyond the accessible, adaptable and barrier-free design concepts of the past. it helps eliminate the need for special features and spaces for a specific group of people, eliminating the stigma and additional expense that specializing and special products often generate. universal design works to pro-actively address human needs within the mainstream.

# universal design features

several cities in the united states in the last few years have passed legislation requiring new single-family housing to have universal design features. a few changes in design and construction significantly expand housing options for much of the population when the following are included:

- -one no-step entrance
- -all doors with at least 32 inch clear opening
- -one half or full bedroom on the entry level that a person with a mobility aid may enter and use
- -reinforcing installed in bathroom walls around toilet and bathing fixtures for future installation of grab bars

these and other universal features make day-to-day activities possible for some and easier for many. universal design in housing far exceeds the minimum specifications of legislated barrier free and accessible mandates. universal design can be applied to all spaces and elements to create housing that is usable by and marketable to a broad cross section of potential buyers. it minimizes and may even eliminate tragic experiences such as older adults who are forced to leave the security and comfort of familiar surroundings and a community of friends because they are no longer able to climb stairs in their own home. because features in a universal home have more than one function or can be easily adapted later, costly renovation often may be avoided, fostering a sense of security and helping to maintain a sense of place and community.

source: universal design handbook



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Visually impaired person with long cane.



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source: residential design handbook



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Typical dimensions

source: the accessible housing design file

House with Extended Roof Boarding Shelter



### entrances

an entrance is made up of several components that can affect the accessibility: the door, the interior and exterior floor surrounding the door, the structure of the building and the accessible pedestrian entrance approach. there are essential features that must be incorporated in every entrance to improve its usability for everyone:

- -level clear floor space both inside and outside of the door
- -threshold must be flush or less than a 1/4" change in level
- -width of the door must be at least 36"
- -no more than 5 lbs. of pressure should be required to open a door
- -lever handled latch

Garage for Van Plus Access Aisle to House



5'- 0" to 8'- 0" wide access aisle depending on type of vehicle and lift

Garage for Van and Car Plus Access Alsle to House



minimum access aislo, 6'- 0' or wider preferred



Lever Handles Can Be **Operated Easily by Everyone** 





Acceptable Threshold



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source: the accessible housing design file



### doorways

accessible doors must have certain features to be usable: wide enough to pass through; adjacent floor space in front and to the sides of the door to allow for opening and closing; the threshold must be flush with the floor surface to prevent tripping; the door handle must be operable without grasping and the door must be opened and closed with a minimal amount of effort. there are essential features that must be incorporated in every doorway to improve its usability for everyone:

-hall widths must be at least 3'-6" to allow for a 90 degree turn into or out of a 32" clear door opening -eliminate difficulty of closing door by adding a auxiliary handle on the pull side of door -modify door width or door swing to add addition clearance by installing swing-away hinges that increase the clear space by 1.5"





design influences universal housing doorway specifications


#### windows

to be usable by mobility impaired people, windows must have several features: a surrounding clear floor space to allow close distance to window; comfortable reach window locks and operable with one hand. there are essential features that must be incorporated in every window to improve its usability for everyone:

-minimum size of clear floor space at windows for wheelchair users is 2'-6" x 4'-0"

-sliding, awning and casement windows are the easiest to operate (double hung windows strongly discouraged)

-bedroom windows are often used as emergency exits and require a minimum 30" width of opening and window sills should be no higher than 24"





Large Casement Windows with Dual Locks

source: the accessible housing design file



#### kitchens

kitchens are one of the focal points of any home and require individual requirements based on the disabled user, for both standing and sitting mobility impaired users, the key design issues include adequate maneuvering space and the installation of features within a designated reach range. while for both visually and hearing impaired users, the key design issues revolve around appropriate signals and controls. the following design information provides general design guidelines for three broad categories of people (people with walking and standing limitations which require sitting while performing tasks, people who use crunches, canes or walkers and wheelchair users.)

-each feature must have a minimum of 2'-6" x 4' clear floor area, perpendicular or parallel for the approach of a wheelchair

-clear floor space is also required to extend under countertops for knee space, the minimum knee space is 30" wide, 27" high and 19" deep (this space can be concealed with swinging retractable cabinet doors)

-the kitchen space has to allow for a 180 degree turn of a wheel chair which can be accommodated by a 5' circular area or a 3' x 3' T-shaped area within the kitchen area and in small kitchens turning can occur at an open end or through a mid under-counter T-turn knee space

-countertop heights for seated people should be 30-34" high (standard 3'), moveable counter tops preferred

-swing cabinet doors are a hazard for blind people, swing-up cabinet doors eliminate protruding objects

-standard ranges are hard for multiple people to use due to back mounted controls and mobility access, so it is suggested to use:

-front-mounted range controls

-drop-front oven with adjacent knee space on either side of the oven

-pull out shelf under oven at the oven's full width to allow for minimum lifting -separate flush burner cooktop unit with knee space below

ale ilusi burilei cookiop unit with knee space below

-space beside burners for placing and maneuvering pots (minimum of 12") -kitchen sinks should be shallow in depth at a maximum of 6.5" and plumbing should be close to the

back to not encroach on knee space

-corner placement of sinks is preferred to provide more reachable area

-dishwasher should be placed adjacent to sink counter space for easy use -side-by-side refrigerators are preferred because they provide spaces at all levels of reach

-ice and water dispensers may be a necessity for many mobility impaired people

-kitchen switches (i.e. lights, exhaust fans and disposal) should be placed at the top of rear cabinets -looped cabinet handles are recommended because most standard handles require gripping or twisting

-traffic flow is most efficient when a work triangle is used for adjacency



design influences universal housing kitchen specifications



#### bathrooms

to be used by mobility impaired people, bathrooms need not to be particularly large, but must be carefully designed. attention must be given to what type of bathing fixtures is preferred by the potential user: tub, a transfer shower or a roll-in shower. in addition, careful planning must be done to provide critical clear floor space at each fixture. knee space at sinks, faucets and controls, as well as grab bar size and position must be considered. there are essential features that must be incorporated in every bathroom to improve its usability for everyone:

-sinks recommended counter height of 32"-33" (base of sink 29" minimum)

-clear floor space extends under sink 19" to accommodate knee space

-single-lever or blade handles for facets is suggested

-toilets seats should a standard of 18" high (typical 15")

-front and side approach require uniform federal accessibility standard (ufas) / american national standards institute's A117.1 (ansi) use of 4' x 5'-6" clear floor space

-side approach requires ufas / ansi standards of 4'-8" x 5'

-ufas / ansi standard guide bars should be a minimum of 42" long for side bar and the rear bar ranges from 24"-36"

-grab bar should be 1.25"-1.5" in diameter and 1.5" mounting distance from wall -there are three types of bathing fixtures:

-standard bathtub with built-in transfer surface or removable seat

-transfer surface should be flush with tub and a width of 1' x 3"

-3' x 8' preferred clear floor space in front of tub with built-in transfer surface

-5' x 5' clear floor space required in front of tub if no transfer surface

-ufas / ansi standards require four horizontal grab bars

-hydraulic seats or hydraulic boom lifts can also be incorporated

-a special 3' wide by 3' deep transfer shower stall with a corner seat

-5' x 3' clear floor space required in front of shower

-foldable corner L-shape seat, preferably padded

-ufas / ansi standards require three horizontal grab bars

-L-shaped grab bar

-a roll-in shower stall that is large enough to showering within wheelchair

-the toilet can also be implemented into the shower

-special fixtures to be used in each bathing condition:

-floors should slope gently to drain

-hand controls

-lever handle control valves



Tub with Removable Seat



## 3' x 3' Transfer Shower

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UFAS requires that controls be located on a side wall

ANSI permits controls to be located on either the back or side walls

5' x 5' Roll-in Shower





3' x 3' Transfer Shower



Custom Built 3' x 3' Shower with Padded, Folding Seat







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source: the accessible housing design file



#### bedroom

conventionally designed bedrooms are commonly used by disabled people. however, mobility impaired people have significant space requirements that need to be planned carefully so that they may be used independently. ideally, all spaces and features of the room should be usable by the occupants. access to door, windows, closet, beds and other furnishings can be achieved when particular attention is given to providing adjacent maneuvering space and clearances as well as appropriate assistive devices. these topics should be carefully considered during initial space planning.

-minimum width for a wheelchair to pass by objects is 3'

-larger width required in path if turning corner 3'-6"

-clear floor space in front of windows requires 2.5' x 4' space

-minimum perpendicular clear floor space need for a wheelchair person to get into bed is 3' x 4'

-a boom lift or overhead track lift can also be used

-items that should be in close reach from the bed include: environmental control system, intercom, sufficient number of outlets and phone

-closets

-best if doors swing back 180 degrees in a small closet

-double wide doors provide space for angled approach and allows left or right handed reach -bi-fold doors provide a wide clear opening

-roll in closets are highly suggested because often there is a lot of assistive / medical equipment that the user would like to keep out of sight

-storage shelf heights should be adjustable for each individual

-seated people are limited to a 3'-4' tall cloths rod and self with an additional shoe rack that is 15" off the ground level

-standing people are limited to a 3' to 5'-6" clothing rod and shelf with also a 15" shoe rack

-storage drawers should pull out fully on sliders



design influences universal housing bedroom specifications Walk-in Closets Provide Both Front and Side Access to Contents



Minimum Suggested L-Shaped Roll-in Closet Plan



5'-0" diameter clear turn around space 1'-0" or less under clothing in-swinging door permissible, out swinging preferred

Minimum Suggested Parallel Roll-in Closet Plan



Minimum Suggested U-Shaped Roll-in Closet Plan



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Wide Closet with Narrow Door Difficult to Use



Wide Closet with Wide Doorway Easy to Use



When Open, BI-fold and Double Doors Provide Wide Clear Openings

5' or 6' door opening preferred for maneuvering space and clear view of contents

source: the accessible housing design file

design influences universal housing bedroom specifications



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existing designs in casa grande





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source: city of casa grande - housing & revitalization department

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typical housing design diagrams

sleeping / bathing	livin	living / dining	
	entry	kitchen	

## simple rectanglar plan

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the rectangle plan is the simplest and one of the most common plan types. most minimal or economical homes utilize this kind of plan because it encloses greater floor area per exterior wall length than other plans. its simplicity also results in uncomplicated framing. the plan is compact, which results in a minimum of circulation space. a garage or carport is generally located alongside the kitchen or the front of the house.

because of its compactness, there is a minimum of separation between the living and sleeping activities, there for lessening the amount of privacy. this type of house is usually referred to as a "ranch" type.

a variation on the simple rectangle plan is the offset rectangle where the living area is pushed forward.



## in-line plan

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the in-line plan is an excellent solution for many unusual site conditions. on a narrow lot it allows access to side patios and outdoor areas. it can have good circulation (at the expense of a long corridor) and good orientation for all the rooms.

the plan may be adapted to a two-story house, where it helps to concentrate circulation and utilities, while retaining the advantage of providing the best orientation for both floors.



# T plan

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the t plan is the placement of the living and sleeping areas at right angles to each other. by such juxtaposition, excellent separation and privacy of two functions is achieved. it may also be possible to achieve better orientation for both functions since they are relatively independent of each other.

the internal circulation is compact and access to all rooms direct if the entrance is located at the junction of the two wings.

this plan type is best on a flat site. if the site slopes, it is possible to locate the garage, recreation, and utility areas under one of the wings.



# L plan

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a variation of the t plan is the I plan. this occurs when the living area is located at the top or bottom of the sleeping wing instead of at the center.



the reoccurring square represents the change in floor print from the simple rectangular plan

# H plan

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h and u plans divide living and sleeping units into separate sections. this layout is especially applicable to a utility core concept in which the kitchen becomes part of the connecting link. excellent separation of activities is achieved, and useful patio afford shelter and privacy. in addition, each room can receive cross ventilation. the chief disadvantage of these types is in the long perimeter walls (almost 50 percent more than the same space in a simple rectangle), resulting in higher construction cost as well as increased expense of heating and air conditioning.



# utility-core plan

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the rectangular utility-core plan has several advantages. the house may be almost square and very compact, with a good concentration of utilities. in addition, the core acts as a buffer between the sleeping and living zones. the problems of this plan include the difficulty of property relating the kitchen, garage, and main entrances, and the excessive circulation space that is often required. this can be helped by opening up the exterior walls and actually using the lots as circulation and access in areas of mild climate.

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innovative desert design diagrams



courtyard housing organization typology

## introduction to courtyard homes

this section is devoted to the study of courtyard homes. the common element is an open landscaped courtyard partially or completely surrounded by living walls. the major source of light and air is through the open garden courtyard.

historically, this type of house dates back several thousand years to egyptian, greek and roman houses. where all the living areas opened out to the courtyard, creating a secluded indoor-outdoor space. this inward-directed house provides maximum privacy and livability.

courtyards make efficient use of the lot and adjacent generally can be located on a much narrower lot than a conventional detached house. when enclosed by high walls or parts of the indoor living space, the house complete shuts off the outside world assuring protection from intruders, and the ability to control the quality of the adjacent visual environment.

courtyard houses are especially valuable in affordable housing. ordinarily the restricted cost of affordable housing does not allow for a large room. despite the increase in exterior wall perimeter, courtyard homes allow for a large "room without a roof" at a much lower cost.

source: residential design handbook image source: courtyard housing in los angeles



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design diagrams innovative desert design diagrams

# courtyard circulation diagrams













note: circulation paths repesented with arrows



# courtyard design diagrams





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U plan

note: integrated courtyrads increase the livable area of a home but at a reduced square footage cost



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site plan

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average lot size = 50' x 100' setbacks perimeter sides = 6' front = 20' back = 25'

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front elevation

note: not to scale



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two bedroom - one bath universal design proposals

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diagrammatic plan

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three bedroom - two bath design proposal



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diagrammatic plan



front elevation



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front elevation

note: not to scale

proposed universal designs three bedroom - two bath design proposal



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four bedroom - two bath universal design proposals

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bath	courtyard
sleeping	dining
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sleeping	kitchen
sleeping	living

diagrammatic plan



front elevation



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diagrammatic plan



front elevation

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proposed universal designs four bedroom - two bath design proposal



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