A COMMUNITY GUIDE TO BASIC AND COST-SAVING CONSTRUCTION IN THE AMERICAN SOUTHWEST

GUÍA COMUNITARIA PARA LA CONSTRUCCIÓN BÁSICA Y LA REDUCCIÓN DE COSTOS EN EL SUROESTE DE LOS ESTADOS UNIDOS
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PATH (Partnership for Advancing Technology in Housing) is a private/public effort to develop, demonstrate, and gain widespread market acceptance for the next generation of American housing. Through the use of new or innovative technologies the goal of PATH is to improve the quality, durability, environmental efficiency, and affordability of tomorrow’s homes.

PATH is managed and supported by the U.S. Department of Housing and Urban Development (HUD). In addition, all Federal Agencies that engage in housing research and technology development are PATH partners including the Departments of Energy and Commerce, as well as the Environmental Protection Agency (EPA) and the Federal Emergency Management Agency (FEMA). State and local governments and other participants from the public sector are also partners in PATH. Product manufacturers, home builders, insurance companies, and lenders represent private industry in the PATH partnership.

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La Asociación para el Avance de la Tecnología en la Vivienda (PATH) es un organismo de carácter público y privado cuyos fines son desarrollar, demostrar y lograr que el mercado acepte ampliamente las viviendas de la nueva generación en los Estados Unidos. Mediante el uso de tecnologías nuevas e innovadoras, el objetivo de PATH es mejorar la calidad, durabilidad, rendimiento ambiental y accesibilidad financiera a la vivienda del mañana.

El Departamento de Vivienda y Desarrollo Urbano (HUD) administra y respalda a la PATH. También son socios de la PATH todas las agencias federales que participen en la investigación y la tecnología de vivienda, incluyendo los Departamentos de Energía y de Comercio, la Agencia para la Protección del Medio Ambiente (EPA) y la Agencia Federal para el Manejo de Emergencias (FEMA). Los gobiernos estatales y locales y otros organismos del sector público son también asociados de la PATH. Los fabricantes de productos, constructores de vivienda, compañías de seguros y prestamistas representan a la industria privada dentro del marco de los socios de la PATH.

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Despite the extensive efforts of the U.S. Department of Housing and Urban Development (HUD) in developing, supporting, and promoting proven, cost-effective, and cost-saving advancements in housing construction technology, the implementation of these strategies lags in many parts of the rural Southwest U.S. This book is written for non-profit housing developers, local housing advocates, self-help homeowners, and community groups that provide housing in the rural Southwest, and is intended to showcase the cost benefits of energy-efficient home construction and rehabilitation.

HUD’s Partnership for Advancing Technology in Housing (PATH) is a public-private initiative dedicated to accelerating the development and use of housing technologies that improve the quality, durability, energy efficiency, environmental performance, and affordability of housing. As part of the PATH program, leaders of the homebuilding, product manufacturing, insurance, and financial industries have joined forces with representatives of federal agencies concerned with housing. Although the PATH initiative has improved the way homes throughout the U.S. are built, PATH research and resources have not reached housing providers in many parts of the rural Southwest. The objective of this book builds on the research conducted under PATH and showcases the research appropriate for housing construction in that region.

Although the quality of the housing stock in the rural Southwest has improved over the last 20 years, much of it remains inefficient, unsafe, low quality, and costly to operate. This book shows that implementing low- or no-cost construction techniques can improve the quality and energy efficiency of a home. A home that is more energy efficient consumes less energy, which results in lower utility bills and more resources for the occupant to use toward other living expenses. Even though some energy-efficient
technologies cost more to implement initially, this extra cost can be offset by long-term operating savings and by Energy Efficient Mortgages (EEMs), which recognize the benefits of energy efficiency and allow homeowners to include the costs associated with energy upgrades into the total mortgage amount.

This book presents several cost-efficient practices that, when implemented, can help affordable housing providers and owners to improve a home’s performance, resulting in projects that are high quality, safe, comfortable, energy efficient, and more affordable. These practices are intended as examples for housing providers and homeowners to ensure cost-efficient construction; they are presented under the following categories:

- Project Development
- Site Selection
- Architect-Engineer Selection
- Design Development
- Construction and Inspections
- Closing

This book presents more than 30 cost-saving strategies for housing construction in the rural Southwest. The description and benefits of the strategy, skill level required for implementation, the types of projects where the strategy is applicable, and installation details are included. The strategies are represented in the following stages of construction:

- Site Planning & Development
- Sewer & Water Service
- Whole House Systems
- Planificación y desarrollo del sitio
- Suministro de agua y eliminación de aguas negras
- Sistemas para toda la casa
- Cimientos
- Estructuras
- Paredes y acabados exteriores
- Ventanas
There are a number of obstacles that can prevent or limit affordable housing development, and they are important to understand before projects begin so that they can be considered. This book discusses regulatory obstacles to affordable housing development and those that result from peoples’ perceptions or views. These barriers include the following:

Regulatory Obstacles:
- Zoning Restrictions
- Impact and Development Fees
- Deed Restrictions
- Building Codes
- Conflicting Jurisdiction
- Environmental Regulations
- Accessibility Regulations

Obstacles due to Prejudices and Location:
- Negative Views of Construction Choices
- Negative Views of Community Residents

Son varios los obstáculos que pueden impedir o restringir el desarrollo de viviendas asequibles; es preciso entender dichos obstáculos antes de iniciar el proyecto, para poder tenerlos en cuenta. Este libro analiza dos tipos de obstáculos para el desarrollo de vivienda asequible, los relacionados con el cumplimiento de normas, y aquellos que se originan en la percepción o la opinión de las personas. Dichos obstáculos son, entre otros:

Obstáculos por cumplimiento de normas:
- Restricciones de demarcación
- Cuotas por impacto y desarrollo
- Restricciones de las escrituras
- Requisitos y aplicación del código de construcción
- Conflictos de jurisdicción relacionados con la construcción de vivienda
- Normas ambientales
- Normas de accesibilidad

Obstáculos por prejuicios de la gente y ubicación de la obra:
- Percepción negativa de la selección que se hace para la construcción
- Percepción negativa de los residentes de la comunidad
- Aislamiento rural y falta de consenso en la comunidad

Se ha incluido tres estudios de casos prácticos, para ilustrar cómo la incorporación de técnicas y estrategias para reducir los costos ha dado como resultado el desarrollo con éxito de viviendas asequibles. Los estudios de casos prácticos demuestran un enfoque único para lograr viviendas asequibles en el condado de Hidalgo, Texas, cómo se lograron casas más asequibles...
Rural Isolation and Lack of Community Consensus

Three case studies are included as examples of how incorporating cost-saving techniques and strategies have resulted in the successful development of affordable housing. The case studies showcase the unique approach to affordable housing in Hidalgo County, Texas; how new construction techniques increase affordability in Brownsville, Texas; and how low-maintenance construction saves homeowners money in Phoenix, Arizona.

It is HUD's hope that this book will spur other housing success stories across the rural Southwest United States.
TRADITIONAL HOUSING AND THE USE OF TECHNOLOGY IN THE RURAL SOUTHWEST

TRADITIONAL HOUSING TYPES

Traditional housing types in the rural Southwest vary widely. Housing in Colonias — rural villages located along the U.S.-Mexican border — typically is the most rudimentary in the rural Southwest. The earliest of these Colonias villages were established in the early 1900s to house mostly Mexican agricultural workers who could not afford housing in cities or other areas. Many of the earliest villages started as small plots of land that lacked infrastructure (sewer systems, paved roads, water, flood control).

Early Colonias residents usually built their own homes using local materials (such as Mexican concrete block), without guidance from building codes or skilled builders (Fig. 2-1). Early Colonia housing, built as money and time allowed, consisted of tents and other poorly constructed buildings of wood, cardboard, metal, and other scraps. Homes were single story and included one or two rooms to accommodate a family of six or more. These older homes are extremely rough, lacking plumbing and electricity, and are nearly all ruins today (Fig. 2-2 and Fig. 2-3). A number of federal, state, and local programs established to spark the development of affordable and safe housing along the U.S-Mexico border region, have improved the quality of housing in Colonias, although many of the older housing types still exist.

Mobile homes (called manufactured or HUD-Code homes since 1976) are one of the most common housing construction types in the rural Southwest. This is so partly because they are low in cost compared to site-built homes, and because they are quick and easy to install (Fig. 2-4). Because many residents are farm workers, mobile homes have fit the bill for temporary housing in labor camps established by U.S. farmers. The U.S. Bureau of the Census uses the term “mobile home” to describe factory-built housing sited with its chassis and wheels intact. The term “manufactured housing” is used to describe a home built in accordance with the requirements of the 1976 HUD Code, which requires that the factory-built units be sited on a permanent chassis. Although the 1976 HUD Code has improved the quality of mobile or manufactured home design and construction, many of these older mobile homes still exist.

TIPOS TRADICIONALES DE VIVIENDA

Los tipos tradicionales de vivienda en el suroeste rural son muy variados. Las viviendas de las colonias –pueblos rurales a lo largo de la frontera entre México y EE.UU.– son por lo general las más rudimentarias de todo el suroeste rural. La primera de dichas colonias se estableció a principios del siglo XX para acoger sobre todo a los trabajadores agrícolas mexicanos que no tenían los medios para alojarse en las ciudades o en otras áreas. Muchas de las primeras colonias comenzaron en terrenos pequeños carentes de la debida infraestructura (eliminación de aguas negras, caminos pavimentados, agua potable, control de inundaciones).

Los residentes de las colonias construyeron generalmente sus propias casas empleando materiales locales (como los bloques de concreto mexicanos), sin guiar por los códigos de construcción ni por constructores calificados (Fig. 2-1). Las primeras casas de las colonias, que se construían con las limitaciones que el tiempo y el dinero imponían, no eran más que tiendas de campaña y otras edificaciones construidas muy deficienciamente con madera, cartón, metal y otros desechos. Las casas eran una planta y tenían uno o dos cuartos para albergar a familias de seis o más miembros. Estas casas más viejas son muy rústicas; no cuentan con instalación de plomería ni electricidad, y casi todas están hoy en ruinas (Fig. 2-2 y Fig. 2-3).

Las casas móviles (que desde 1976 se conocen como casas manufacturadas o con código del HUD) son uno de los tipos de construcción más frecuentes en el suroeste rural. Esto se debe en parte a su bajo costo, en comparación con las casas construidas en su ubicación final, y a la facilidad y rapidez con que se instalan (Fig. 2-4). Muchos de los residentes son trabajadores agrícolas, por lo que las casas móviles han sido la solución utilizada por los granjeros estadounidenses para proveerles un alojamiento temporal. La Oficina del Censo de los Estados Unidos llama “casas móviles” a las casas construidas en fábricas, que se colocan en su sitio dejando intactas en ellas el chasis y las ruedas. Por “vivienda manufacturada” se entiende una casa construida según los requisitos del código HUD de 1976, en el que se exige que las unidades construidas en fábricas se instalen en su sitio sobre un chasis permanente. Con el código HUD de 1976 se mejoró la calidad del diseño y construcción de las casas móviles o manufacturadas. Sin embargo, existen todavía muchas casas móviles del tipo más antiguo, deterioradas e inseguras (Fig. 2-5).
and are in broken-down and unsafe condition today (Fig. 2-5).

Single-story wood-framed, site-built housing is the most predominant type in the rural Southwest, followed by concrete block homes. Most of the wood-frame houses utilize slab-on-grade foundations, 2x4 16-inch-on-center framing, plywood or oriented-strand board, wood siding, and flat or pitched roofs with asphalt shingles (Fig. 2-6).

Concrete block homes use the same materials except for the framing and siding (Fig. 2-7 and Fig. 2-8). These homes usually have painted exterior walls and are popular because they are believed to be high in quality and strength. They tend to have cooler interior environments than wood-frame homes due to their “thermal mass” and ability to store “coolness” from nighttime through the next day. Depending on the age of the home, single- or double-pane window glass is used (newer homes use the latter).

The remote location of much of the housing in the rural Southwest limits access to utilities. However, most rural housing has electricity, the most common source of energy. In many places, propane is used for cooking and electricity is used for lighting and heating water (Fig. 2-9). In other locations, propane is used for cooking and for heating water and electricity is used for lighting only.

Because of the climate, heating is not usually necessary although there are places that have cool nights, especially at higher altitudes. Older homes usually don’t have heating systems. Today, many sources of funding assistance require that housing providers include heat in the units they build, although many believe that this is not necessary and only adds to development costs.

Commonly, evaporative coolers, commonly called “swamp coolers,” are used to cool homes.

Many recently constructed homes include central air conditioning, and a number of housing providers offer it as an option. If air conditioning is not provided, ceiling fans are often used to help cool the house.

Adobe construction is another historically significant housing construction type of the rural Southwest (Fig. 2-10). Because adobe construction is...
time, skill, and labor intensive, it is rarely used today. Historic adobe homes are scattered throughout the region. In many places, stringent historical building regulations have been developed to protect them. Adobe homes, like concrete block homes, usually have cooler interiors than wood-frame homes, which makes them appropriate for the arid Southwest climate.

Self-help housing, or housing built with construction assistance from homeowners, is a method that some housing providers use to reduce costs associated with homeownership for extremely low- to very-low-income families who cannot qualify for traditional mortgages (Fig. 2-11). In such circumstances homeowners often finance their homes through the housing provider, who takes on the role of the lender.

CURRENT USE OF TECHNOLOGY
The quality and energy efficiency of much of the housing constructed in the rural Southwest over the past decade has improved as a result of federal, state, and local programs that provide assistance in construction and rehabilitation to housing providers. To qualify for financial assistance, homes must be designed and constructed according to certain standards established by the funding agency. However, many of the residents cannot qualify for housing assistance under these programs because their incomes are too low. Also, housing providers in these areas might not be aware of the benefits of efficient home construction and rehabilitation. As a result, much of the housing stock in rural areas is inefficient, which translates into high utility bills.
Better energy efficiency means lower utility bills, which makes homes less expensive for homeowners to maintain and operate. For example, many standards require double-pane, low-e windows, which reduce the amount of heat from the sun transmitted through the glass and into the home. This makes the house more comfortable in a hot, arid climate.

Many utility companies offer economic incentives for housing providers who build energy-efficient homes. To qualify for such assistance by the utility companies, homes must be built according to standards set by the utilities. These standards are designed to increase the quality and energy efficiency of homes by incorporating certain construction materials and techniques.

**COST-SAVING CONSTRUCTION TECHNIQUES**

There are many low- or no-cost housing construction techniques that result in energy efficiency (Fig. 2-12). Several housing providers in the rural Southwest have been pioneers in using such low-cost techniques and products because of the economic benefits (Fig. 2-13 and Fig. 2-14). However, many housing providers are not aware of such low-cost features and construction practices, or they mistakenly perceive energy-efficient construction as expensive and time consuming. In addition, local inspectors may not permit the use of certain technologies; however, as these inspectors become informed about the benefits of many new housing technologies, more of them are being permitted.

Incorporating passive solar design in a home will provide a more com-
fortable interior while using less energy (Fig. 2-15). Passive solar strategies use certain design features to block the heat of the sun from making interior environments too hot, or encourage natural cooling ventilation. Since the home's south side will be most exposed to direct sun, homes in the rural Southwest should be shaded as much as possible. This can be accomplished with overhangs or shutters. Cross ventilation is encouraged by orienting the house toward prevailing breezes. A properly insulated home and energy-efficient lighting are no- or low-cost techniques that create more comfortable interior environments and reduce the amount of energy required.

It is important for housing providers to realize that many people in the rural Southwest might perceive cost-saving construction techniques and features as "cheap" or "low quality." These views usually stem from cultural experiences. For example, a number of housing providers will not use metal roofs because they are perceived as "cheap" and suggest the makeshift housing which many of the residents born in poor rural villages in Mexico remember. They've come to the U.S. in search of the American dream, and metal roofing is seen as a step in the wrong direction (Fig. 2-16). Wood roofs are perceived as higher in quality. As a result, realizing the energy benefits of metal roofs (such as the ability to reflect as much as 70% of the sun's heat, resulting in cooler indoor temperatures) might not be possible in some rural Southwest developments. In addition, 2x4, 24-inch-on-center framing for exterior walls as a material-saving option to the standard and more costly 2x4, 16-inch-on-center framing, might also be perceived by some as low-quality interior environments. También se valen de la ventilación natural para enfriar las casas. El costado sur de las casas es el más expuesto a la luz directa del sol; por esto, las viviendas en el suroeste rural deben protegerse con tanta sombra como sea posible. Esto se logra instalando voladizos o persianas. La ventilación cruzada se propicia orientando la casa hacia las brisas más frecuentes. Una casa bien aislada, y una iluminación eficiente en cuanto a consumo de energía representan técnicas de bajo costo o gratuitas que proporcionan ambientes interiores más cómodos y reducen además la cantidad de energía requerida.

Es importante que los proveedores de vivienda entiendan que en el suroeste rural muchas personas podrían percibir las técnicas y características de construcción para reducir los costos como algo "vulgar" o de "baja calidad". Esta percepción por lo general tiene su raíz en antecedentes culturales. Por ejemplo: varios proveedores de vivienda no emplean techos metálicos porque los perciben como "vulgares", y porque evocan el tipo de vivienda provisional que recuerdan muchos de los residentes, nacidos en México en poblaciones rurales pobres. Se trata de personas que vinieron a los Estados Unidos en busca del Sueño Americano, pero quienes emplean techos de metal es como dar marcha atrás (Fig. 2-16). Los techos de madera se perciben como techos de mejor calidad. Por esto, quizás no sea posible en ciertas urbanizaciones del suroeste rural aprovechar las ventajas para la energía que brindan los techos de metal (como la capacidad de reflejar hasta 70% del calor del sol, lo que propicia temperaturas más bajas en el interior). Por otra parte, si en las paredes exteriores se usan estructuras centrales con elementos de 2 x 4 a 24 pulgadas para ahorrar en materiales, en lugar de los elementos estándar de 2 x 4 a 16 pulgadas (más costosos), algunas personas podrían percibir este cambio también como algo de baja calidad. Antes de poner en práctica cualquiera de las técnicas de construcción que se explican en este libro, es importante que los proveedores de vivienda obtengan el apoyo de la comunidad.
quality. Before implementing any construction techniques outlined in this book, it is important for housing providers to get community support.

**THE ENERGY EFFICIENT MORTGAGE**

The biggest benefit of using energy-efficient features and construction techniques in new and existing homes is lower utility bills, which result in a house that costs less to maintain and operate, putting more money in the pocket of homeowners (Fig. 2-17 and Fig. 2-18). Simply put, energy efficiency can save operating costs, and this adds to the affordability of the home (by allowing that money to be used for other expenses). While some energy-efficiency measures might cost extra, the good news is that these extra costs can be offset by Energy Efficient Mortgage (EEM) programs, which include the cost of energy upgrades into the total mortgage amount (Fig. 2-19).

Energy Efficient Mortgages can make a house more affordable because they eliminate the need to acquire separate loans, in addition to mortgages, to finance upgrades for energy efficiency. Once the upgrades are in place, homeowners can immediately benefit from lower utility bills (Fig. 2-20).

To qualify for an EEM, the estimated savings from energy upgrades must be determined before the mortgage process begins. The savings must be determined by either an energy consultant or someone who knows about Home Energy Rating Systems (HERS). Some EEMs require that the energy rating be determined by a HERS provider, so it’s important to speak with your...
lender about the rating requirement. Energy ratings can cost between $250 and $600 per home, depending on a number of factors including its location and size. However, EEM programs (such as the Federal Housing Administration’s [FHA] EEM program) might provide funds to offset rating costs (which can also be rolled into the mortgage amount).

A HERS rating report evaluates the energy efficiency of a home. The report includes a “rating score” on a scale of 100 points—the higher the score, the more efficient the home. It also includes estimated costs of the energy upgrades, estimated savings, the expected life of the upgrades, and an estimated total annual energy cost for the home without the energy upgrades. Insulation levels, window efficiencies, climate, and utility costs are several factors used in determining the energy rating. A home built to the requirements of the 1993 Model Energy Code achieves a HERS rating of approximately 80; one that qualifies for EPA/DOE’s Energy Star program is at 86, with each percentage point representing a 5% change.

In addition to the programs listed below, there may be other financing opportunities (such as state, utility, and charitable programs for very-low and low-income homebuyers) available for financing energy upgrades in the rural Southwest, which translates into more affordable housing for homeowners.

FEDERAL HOUSING ADMINISTRATION’S EEM PROGRAM
The FHA’s EEM program allows borrowers to include the costs associated with energy-efficient upgrades to new or existing housing into the home cost of obtaining the rating (which can also be added to the mortgage amount).

En el informe de calificación de HERS se evalúa la eficiencia energética de una casa. En dichos informes se incluye un “puntaje de calificación” en una escala de 100 puntos. Entre más alto el puntaje, más eficiente es la casa. Se incluye además el costo estimado de las mejoras energéticas, la cantidad que se ahorraría, la vida útil que se espera de las mejoras, y el costo estimado de la energía anual que consumiría la casa si no se realizan las mejoras. La cantidad de aislamiento, la eficiencia de las ventanas, el clima y el costo de los servicios públicos son algunos de los factores que se emplean para determinar la calificación energética. Una casa construida según los requisitos del Código Energético Modelo de 1993 recibe una calificación HERS cercana a 80, mientras que una que califica para el programa Energy Star de la EPA (Agencia para la Protección del Medio Ambiente) o el DOE (Departamento de Energía) alcanza 86. Cada punto porcentual representa una variación de 5%.

Además de los programas que se listan más abajo, es posible obtener otras fuentes de financiamiento (como los programas estatales, de las compañías de servicios públicos, y de organismos caritativos para personas de bajos o muy bajos recursos que compran casa disponibles para financiar las mejoras energéticas en el suroeste rural del país, lo que resulta en viviendas más asequibles para los propietarios.

PROGRAMA EEM DE LA ADMINISTRACIÓN FEDERAL DE VIVIENDA (FHA)
Mediante el programa EEM de la FHA los prestatarios pueden incluir en la hipoteca de la casa el costo de las mejoras que se hagan en viviendas nuevas o existentes para aumentar la eficiencia en el uso de la energía. No obstante, el costo de las mejoras energéticas debe ser menor que el monto que se podría ahorrar durante la vida útil de la mejora. Las EEM garantizadas por la FHA sólo cubren el costo de mejoras energéticas cuyo valor no sobrepase el 5% del valor de la propiedad (hasta $8,000) o $4,000, tomando la cantidad que sea mayor. Este límite es adi-
mortgage. However, the cost of the energy upgrades must be less than the amount of money that could be saved over their lifetime. FHA-insured EEMs cover only the cost of upgrades for energy efficiency that do not exceed 5% of the property value (up to $8,000) or $4,000, whichever is greater. This limit is in addition to the maximum mortgage amount.

Those enrolled in FHA’s Section 203(b) affordable first-time-buyer insurance program, which (among other benefits) allows borrowers to finance, in some cases, up to 97% of the value of the home, are eligible for FHA’s EEM program. In addition, borrowers under FHA’s Section 203(k) rehabilitation program (which insures long-term rate loans to cover the acquisition and major rehabilitation of a property); Section 203(h) program for victims of Presidentially declared disasters; and the Title I Home Improvement Loan program, which finances the rehabilitation of properties (excluding property acquisition and refinancing) may also qualify for the EEM program.

VETERANS AFFAIRS (VA) EEMS
The VA department provides EEMs for qualified military personnel and veterans. The VA’s EEM program covers energy efficiency upgrades for borrowers purchasing existing homes. A maximum of $3,000 in energy upgrades may be financed into the mortgage amount. An energy rating is not required to qualify for a VA EEM; financing is based on documented costs. However, up to $6,000 may be financed if the upgrades are determined to be cost effective by the VA.

HIPOTECAS EEM DEL DEPARTAMENTO DE ASUNTOS DE VETERANOS (VA)
El Departamento de Asuntos de Veteranos (VA) brinda hipotecas EEM para el personal militar y los veteranos que califiquen. El programa de hipotecas EEM del VA cubre el costo de mejoras de eficiencia energética para los prestatarios que compran casas ya existentes. Se puede financiar un máximo de $3,000 en mejoras energéticas, añadiendo este monto al total de la hipoteca. No es necesario presentar una calificación energética para obtener una hipoteca EEM de VA; el financiamiento se basa en la documentación de los costos. No obstante, pueden financiarse hasta $6,000 si a juicio del VA las mejoras serán efectivas en función de los costos.

HIPOTECAS EEM DE FANNIE MAE Y FREDDIE MAC
Fannie Mae
Fannie Mae es una empresa privada dedicada a aumentar la disponibilidad y accesibilidad de la propiedad de vivienda. La empresa compra hipotecas a prestamistas, sin prestar ella misma.
FANNIE MAE AND FREDDIE MAC EEMS

Fannie Mae

Fannie Mae is a private corporation whose purpose is to increase the availability and affordability of homeownership. It purchases mortgages from lenders and does not lend money directly to homeowners. However, Fannie Mae has an EEM program and provides incentives to lenders if they offer the program to borrowers purchasing new or existing homes. Under Fannie Mae’s EEM program, homeowners must provide a home energy rating. There are no limits on the cost of energy upgrades for new construction. However, the cost of energy upgrades to existing homes cannot be greater than 15% of the home’s total cost. Homeowners participating in Fannie Mae’s EEM program can finance 100% of the energy upgrades without increasing the downpayment.

Freddie Mac

Freddie Mac is a private corporation that buys mortgages from banks and creates securities that are sold to investors, resulting in lower housing costs for homeowners and renters.

Freddie Mac provides incentives to banks that offer EEMs. However, Freddie Mac EEMs are limited to the purchase of existing energy-efficient homes or homes to be renovated for energy efficiency. Like Fannie Mae, homeowners must provide a home energy rating. Freddie Mac allows a greater level of energy-efficient improvements than most EEM programs.

Fig. 2-17 and Fig. 2-18 Sealing the air space around plumbing penetrations and installing high-efficiency windows helps to keep the interior of the home cool. Fig 2-19 In this example, energy improvements to an existing home at the time of purchase results in a monthly savings of $35.77 and an annual savings of $429.24. Fig. 2-20 Energy Efficient Mortgage (EEM) process.
When you . . .

Find a home to buy OR Determine that you want to make upgrades to your current home

Tell your lending agency you want an Energy Efficient Mortgage.

Have an energy rating performed on the house (check mortgage guidelines for specific requirements) and have the results sent to the lending agency.

If your home qualifies (i.e. the projected savings as a result of improvements is greater than the cost of the measure over its lifetime), then the lender puts funds equivalent to improvement costs into an escrow.

Loan closes.

Once energy improvement measures are complete, the funds are released, and you start saving money.

<table>
<thead>
<tr>
<th></th>
<th>With $4,000 in Energy Improvements</th>
<th>Without Energy Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Mortgage Payment</td>
<td>$ 478.73*</td>
<td>$ 454.50*</td>
</tr>
<tr>
<td>Monthly Energy Costs</td>
<td>$ 90.00</td>
<td>$ 150.00</td>
</tr>
<tr>
<td>Total Monthly Mortgage and Utilities</td>
<td>$ 568.73</td>
<td>$ 604.50</td>
</tr>
<tr>
<td>Monthly Savings Resulting from Energy Improvements</td>
<td>$ 35.77</td>
<td>0</td>
</tr>
<tr>
<td>Annual Savings Resulting from Energy Improvements</td>
<td>$ 429.24</td>
<td>0</td>
</tr>
</tbody>
</table>

*Assumes 6.5% interest rate over 30 years. Mortgage payment amounts vary according to the interest rate, which may be more or less than indicated.
The steps to make a project happen begin long before the construction of a house or a subdivision takes place. A lot of work goes into planning the project, lining up partners, clarifying goals, selecting the most appropriate sites, designing the most appropriate homes, etc. Often, the initial stages of a project will last about two to four times longer than the actual construction. Yet, careful project planning is the key to making a successful project happen. Although the processes for developing and constructing self-help and contractor-built housing differ in their use of skilled and unskilled labor, most of the key project stages are similar.

Below are some best practices, listed in the order in which they should happen, that can help affordable housing providers and homeowners to produce quality, durable, efficient, and more affordable projects.

**PROJECT DEVELOPMENT (PLANNING/PROGRAMMING)**

- Form partnerships to develop and carry out the project. Different organizations can pool their distinct resources to achieve projects that meet their individual and shared goals.
- Clearly define the project goals—write them down. Share the project goals with all the key stakeholders and get buy-in from them.
- Clearly define roles and responsibilities of those involved in the project.
- Define and maintain clear communications between key stakeholders.
- Review local codes, zoning laws, and other regulations that may affect the project (such as density limits, energy efficiency requirements, etc.).
- Conduct frequent marketing and outreach efforts during the project. This way, community members, officials, potential homeowners, as well as organizations that could provide funding, will be aware of the project and possibly support it in some way.
- Secure project financing as soon as possible.
- Take advantage of federal, state, and local programs that could be compatible with the project.

**DESARROLLO DEL PROYECTO (PLANEACIÓN Y PROGRAMACIÓN)**

- Establezca asociaciones para desarrollar y realizar el proyecto. Con frecuencia, diferentes organizaciones pueden combinar sus diversos recursos para lograr proyectos que cumplan con sus objetivos comunes y particulares.
- Defina claramente los objetivos del proyecto y escríbalos. Comunique los objetivos del proyecto a las principales partes involucradas, y obtenga su opinión y aprobación.
- Defina claramente las funciones y responsabilidades de los participantes en el proyecto.
- Establezca y mantenga una comunicación clara entre las principales partes involucradas en el proyecto.
- Examine los códigos locales, leyes de zonificación y otras normas que podrían afectar al proyecto (p. ej., límites de densidad, requisitos de eficiencia energética, etc.).
- Realice con frecuencia tareas de mercadotecnia y divulgación entre la población durante el proyecto. De este modo los miembros de la comunidad, los funcionarios, los posibles propietarios de vivienda y las organizaciones que podrían brindar financiamiento se enterarán del proyecto y quizás le presten algún tipo de apoyo.
- Obtenha financiamento para el proyecto tan pronto como pueda.
- Aproveche los programas federales, estatales y locales, que podrían combinarse para lograr un mejor proyecto. Por ejemplo: en el sur de Texas, Community Resources Group, un urban-
bined to achieve a better project. For example, in southern Texas, Community Resources Group, a non-profit developer, combined financing from the Community Action Weatherization Program, 306 Funds from the U.S. Department of Agriculture (USDA), and grants from the Texas Department of Housing and Community Affairs (TDHCA) to rehabilitate houses. Community Action funds were used to pay for insulating the houses, and to install better windows and doors; USDA 306 funds were used to install bathrooms, kitchen sinks and cabinets, and water heaters; TDHCA grants were used to install septic systems (required before USDA 306 funds could be used) and to build additions.

SITE SELECTION

- Conduct a site and soils investigation to learn about the following:
  - Availability of water;
  - Ability of soil to percolate, which will allow use of a septic system;
  - Contamination of the site (e.g., lead, asbestos, industrial hazards);
  - Stability of soil to support structures.
- If possible, select sites with existing roads, sewer, and water service.
- If possible, select sites above the 100-year flood elevations.
- If possible, select sites that have site features that could be a plus for the project, (such as natural drainage, trees).

ARCHITECT-ENGINEER (A-E) SELECTION

- Where possible, seek help from local design centers or universities that offer free design services.
- Ask organizations developing similar projects to recommend A-Es they have worked well with.
- Select A-Es based on qualifications and experience, not just fees.
- Make sure that the A-Es are licensed to work where the project will be built.

SELECCIÓN DEL SITIO

- Realice un estudio del sitio y del suelo para averiguar lo siguiente:
  - Disponibilidad de agua;
  - Capacidad de filtración del suelo, lo que permitirá el uso de un sistema séptico;
  - Contaminación del sitio (p. ej. plomo, asbesto, residuos industriales peligrosos);
  - Estabilidad del suelo para soportar estructuras.
- Si es posible, seleccione sitios que cuenten con carreteras de acceso, eliminación de aguas negras y suministro de agua.
- Si es posible, seleccione sitios por encima de la altitud a la que llegó la peor inundación de los últimos 100 años.
- Si es posible, seleccione sitios cuyas características podrían dar una ventaja adicional al proyecto (p. ej. drenaje natural, árboles).

3. SELECCIÓN DEL ARQUITECTO Y EL INGENIERO (A-I)

- Siempre que sea posible, procure obtener ayuda de los centros de diseño o las universidades locales que ofrezcan servicios gratuitos de diseño.
- Pida a las organizaciones que están diseñando proyectos similares que le recomiendan los A-I con los que ellos hayan trabajado satisfactoriamente.
- Seleccione los A-I teniendo en cuenta sus calificaciones y experiencia, no sólo la comisión que cobran.
- Asegúrese de que los A-I tengan licencia para trabajar en el sitio de la obra, y que conozcan
and that they know about all federal, state, and local laws and codes.

Consider hiring design-build firms that can build the homes they design. This can save in separate contracts and fees for the designer and contractor. Be aware that once the contract with the design-build firm is signed, changes of any sort are very costly.

**DESIGN DEVELOPMENT**

- Use basic designs that can be embellished with options such as carports, porches, additional bedrooms, etc.
- Designs should have spaces that can serve more than one function (e.g., laundry area in bathrooms, combined eating/dining/living area).
- Take advantage of site features to help make the house comfortable, such as trees for shading, prevailing winds for natural ventilation.
- Consider how the home’s plan and the way it is placed on the lot might make it easy to add onto later.
- Make sure that plans meet local codes, zoning ordinances, and other regulations.
- The design should have detailed specifications that emphasize overall performance of the house.
- If using “stock” plans, make sure they are changed to meet local codes, and to take advantage of specific site features and locally available materials and products.

**CONSTRUCTION AND INSPECTIONS**

- Develop a detailed “scope of work” for everyone hired to work on the project.
- Get bids from at least three different trade contractors.
- Make sure that contractors are licensed and bonded.
- Consider getting estimates for materials and products from at least three suppliers.
- Hold a pre-construction workshop with all the trade contractors so that they understand the project goals.
- Hold a pre-construction workshop with the future homeowners to inform them about the construction process and schedule. At this time, consider discussing options in the home (floor covering, air-conditioning), if any.
- Encourage contractors to figure out ways to produce a more affordable home without sacrificing quality.
- Where possible, encourage contractors to produce house parts/components off-site (such as walls sections and roof trusses). This cuts down the time needed for on-site construction, where bad weather might slow down the project.
- Develop checklists for walk-through inspections with the contractors during different phases of the project. These inspections should be done, and corrections made, before the local building inspector visits.
- If possible, make yourself available during the building inspector’s visit to help resolve any issues or questions that might arise.

CLOSING

- Hold a post-construction workshop with the homeowners to inform them about the features of their house, the required maintenance, warranties, and where to go for help if something malfunctions.
- Celebrate successes — give credit and appreciation to everyone involved in the project. This will foster partnerships and community pride.

Cierre

- Anime a los contratistas a que presenten ideas para hacer la casa más económica sin tener que sacrificar la calidad.
- Siempre que sea posible anime a los contratistas para que produzcan las partes y los componentes de la casa fuera del sitio (p. ej. secciones de paredes y vigas de refuerzo para el techo). De este modo tardará menos tiempo la construcción en el sitio, una etapa en la que el mal tiempo podría causar atrasos.
- Elabore listas de control para realizar inspecciones recorriendo a pie la obra junto con los contratistas durante las diversas etapas del proyecto. Estas inspecciones deberán hacerse, junto con las correcciones correspondientes, antes de la visita de los inspectores de construcción.
- Si es posible, esté presente durante la visita del inspector para responder a las preguntas o problemas que puedan surgir.

- Al finalizar la construcción, celebre una reunión de trabajo con los propietarios de vivienda, para comunicarles las características de sus casas, el mantenimiento requerido, las garantías, y a quién pueden pedir ayuda en caso de que algo funcione mal.
- Celebre el éxito logrado. Demuestre su aprecio y reconocimiento a todos los participantes en el proyecto. De este modo estará impulsando las asociaciones y el orgullo de la comunidad.
This chapter presents more than 30 proven, cost-saving strategies, techniques, and technologies for residential construction in the rural Southwest. The strategies are presented by stage of construction:

- Site Planning & Development
- Sewer & Water Service
- Whole House Systems
- Foundation
- Framing
- Exterior Walls & Finishes
- Windows
- Roofing
- Insulation
- Heating, Ventilation, & Air Conditioning (HVAC)
- Electrical & Plumbing
- Interior Walls & Finishes
- Landscaping

Note that these strategies and technologies should be used with a “whole building” approach in mind. The “whole building” approach recognizes that the components and systems of a house are interdependent—one component or system could positively (or adversely) affect another. For example, building 2x6 exterior walls at 24 inches-on-center will result in increased insulation, which may downsize heating/air conditioning equipment and result in material reductions for the developer and utility bill reductions for the homeowners.

Each strategy, technique, or technology is presented using the following easy-to-follow template:

**Benefits:** Indicates the benefits from implementing this technology/strategy.
- **R** = Reduces labor, or use of materials and other resources
- **A** = Cost-effective alternative material
- **O** = Reduces operating costs (i.e., more durable, saves energy, reduces water use, easy to maintain, etc.)

En este capítulo se presentan más de 30 estrategias, técnicas y tecnologías comprobadas para reducir los costos que pueden aplicarse a la construcción de viviendas en el suroeste rural del país. Las estrategias se desarrollan en las siguientes etapas de la construcción:

- Planeación y desarrollo del sitio
- Suministro de agua y eliminación de aguas negras
- Sistemas para toda la casa
- Cimientos
- Estructuras
- Paredes y acabados exteriores
- Ventanas
- Techado
- Aislamiento térmico
- Calefacción, ventilación y aire acondicionado (HVAC)
- Sistema eléctrico y de plomería
- Paredes y acabados interiores
- Diseño de jardines (paisajismo)

Note que estas estrategias y tecnologías deben aplicarse teniendo en cuenta un enfoque del “edificio completo”. Bajo este enfoque del “edificio completo” se considera la interdependencia entre los componentes y sistemas de una casa; un componente o sistema puede afectar a otro adversa o favorablemente. Por ejemplo, si se construyen paredes exteriores con elementos de 2x6 a 24 pulgadas en el centro aumenta el aislamiento, lo que permite reducir el tamaño del equipo de aire acondicionado. Esto reduce la cantidad de materiales que requiere el urbanizador y los gastos por servicios públicos del propietario de la vivienda.

Cada estrategia, técnica o tecnología se presenta conforme a esta guía, muy fácil de seguir:

**Beneficios:** Indica los beneficios que se obtienen por poner en práctica esta tecnología o estrategia.
- **RR** = Reduce la mano de obra o el uso de materiales y otros recursos
- **MA** = Material alternativo, eficaz en función de los costos
- **RC** = Reduce los costos de funcionamiento (p. ej. mayor durabilidad, menor consumo de energía y de agua, facilidad de mantenimiento, etc.)
- **MAB** = Contribuye a lograr viviendas y entornos saludables y preferibles desde un punto de vista medioambiental.
H = Contributes to healthful, environmentally preferable homes and environments

Skill Level: Indicates the minimum skill level required to implement or install this technology/strategy.
- U = Unskilled
- SS = Semi-skilled
- S = Skilled

Application: Indicates the types of projects where the technology/strategy is applicable.
- N = New construction
- R = Rehab
- S = Single-family, scattered sites
- D = Subdivision

Description: Summary description of the technology/strategy.

Installation: Details of how to install/implement this technology/strategy.

Limitations: Describes constraints in installing this technology/strategy or any constraints caused by implementing this technology/strategy.

Code/Regulation: Describes any code/regulation that you should be aware of that may affect installing this technology/strategy.

Availability: Suggests where this technology might be procured.

Resources: Lists where you can find out more information about this technology/strategy or where it might be purchased.

Although efforts have been made to confirm the acceptance of the strategies presented herein in regions of the Southwest, users of this manual are advised to consult with local building code authorities concerning the acceptability of specific practices in particular situations.

Users of this manual are encouraged to share their knowledge and contribute their own best practices for others to learn and implement.

Habilidades: Indica las habilidades mínimas necesarias para aplicar o instalar esta tecnología o estrategia.
- NC = Mano de obra no calificada
- SC = Mano de obra semicalificada
- CL = Mano de obra calificada

Aplicación: Indica el tipo de proyectos aptos para la aplicación de esta tecnología o estrategia.
- CN = Construcción nueva
- RH = Rehabilitación
- VUF = Vivienda unifamiliar en lotes separados
- SD = Subdivisión

Descripción: Resumen de la tecnología o estrategia.

Instalación: Detalles de la instalación o aplicación de la tecnología o estrategia.

Limitaciones: Restricciones para aplicar la tecnología o estrategia, o restricciones originadas por la aplicación de la tecnología o estrategia.

Códigos y normas: Descripción de todos los códigos y normas que pueden afectar la aplicación de la tecnología o estrategia.

Disponibilidad: Sugerencias sobre dónde obtener la tecnología.

Recursos: Datos sobre sitios donde se puede encontrar información sobre esta tecnología o estrategia, o los lugares donde puede adquirirse.

Se ha hecho todo lo posible para confirmar que las estrategias que aquí presentamos tienen aceptación en las regiones del suroeste del país. No obstante, aconsejamos a los lectores de este manual que consulten con las autoridades encargadas de hacer cumplir los códigos locales de construcción si las prácticas específicas, en situaciones particulares, son aceptables.

Pedimos a los lectores de este manual que divulguen su conocimiento y que contribuyan con su mejor trabajo para que otros también las aprendan y las apliquen.
PHASE: Site Planning & Development
STRATEGY: Alternatives to Sidewalks & Driveways

Benefits: R, A, O
Skill Level: SS
Application: N, S, D

DESCRIPTION:
Sidewalks can be constructed on one side rather than both sides of local streets, and eliminated entirely on lightly traveled streets, dead-end streets, and cul-de-sacs. Further, sidewalks can be replaced by pathways installed where they will be used—linking housing clusters, stores, playgrounds, and other community facilities. Less costly gravel and asphalt can be used for sidewalks or pathways instead of concrete. In addition to eliminating sidewalks, swales and shoulders (depressed areas running parallel to the street) can be substituted for curbs and gutters in many developments at less cost and more benefit to the environment. Open drainage systems typically cost less overall than closed systems and are environmentally preferable.

Asphalt or crushed rock driveways are acceptable alternatives to driveways made out of concrete, which is much more costly. Common driveways may be provided to serve more than one house. Driveways may be designed as two-wheeled paths or ribbon strips instead of solid, full-width concrete pads. Each of these methods of driveway design and construction reduces development costs when compared with typical construction. A side benefit of gravel or ribbon driveways is that more water will penetrate the soil to control stormwater run-off and erosion.

Installation: Alternatives to conventional sidewalk and driveway designs are constructed similarly to their conventional counterparts.
**Limitations:** N/A

**Code/Regulation:** Although these technologies are widely accepted, check local codes for any restrictions related to alternative sidewalk and driveway designs and materials.

**Availability:** N/A

**Resources:** Cost-Saving Construction Opportunities and the HOME Program: Making the Most of HOME Funds. Prepared by National Association of Home Builders Research Center for the Affordable Housing Research Division, Office of Policy Development and Research, U.S. Department of Housing and Urban Development.

http://www.toolbase.org/Docs/MainNav/Affordability/2529_HOME_program.pdf?TrackID=&CategoryID=1232&DocumentID=2529

**Códigos y normas:** Aunque estas tecnologías son ampliamente aceptadas, conviene comprobar en los códigos locales si existen restricciones en cuanto a los diseños y materiales para aceras y vías de acceso alternativas.

**Disponibilidad:** Ver No es del caso.

**Recursos:** Cost-Saving Construction Opportunities and the HOME Program: Making the Most of HOME Funds. Redactado por la División de Investigación sobre Vivienda Asequible del Centro de Investigación de la Asociación Nacional de Urbanizadores, Oficina de Desarrollo Normativo e Investigación, Departamento de Vivienda y Desarrollo Urbano de los EEUU. http://www.toolbase.org
PHASE: Site Planning & Development
STRATEGY: Narrower Residential Streets

**Benefits:** R, O, H
**Skill Level:** S
**Application:** N, D

**DESCRIPTION:**
Streets are often overdesigned because codes rely on standards developed for highways. Currently, many rural communities have residential streets that are 32, 36, and even 40 feet wide. These wide streets provide two parking lanes and two moving lanes, but provide much more parking than is actually necessary. In many rural residential settings, streets can be as narrow as 22 to 26 feet without sacrificing emergency access, on-street parking, or vehicular and pedestrian safety. Even narrower access streets or shared driveways can be used when only a handful of homes need to be served. This strategy will reduce development costs as well as impervious surfaces, which contribute to stormwater run-off and erosion. Narrow streets also tend to lower the speed of vehicles and act as traffic calming devices for pedestrian safety.

**Installation:** Building narrower streets is no different than building wider streets. Generally, narrower streets can be used in residential development settings that generate 500 or fewer average daily trips (ADT), serving about 50 single-family homes, and may sometimes also be feasible for streets that are projected to have 500 to 1,000 ADT. However, narrower streets are not feasible for arterials, collectors, and other street types that carry greater traffic volumes, or are expected to have a constant traffic volume over time.

**Limitations:** Developers often have little flexibility to design narrower streets, as most communities require wide residential streets as a standard element of their local road and zoning standards. Revisions to current local road standards are often needed to promote more widespread use of narrower residential streets. In addition, local communities may lack the authority to change road standards when the review of public roads is retained by state.
Agencies. In these cases, street narrowing can only be accomplished if the street is private (i.e., maintained by residents rather than a local or state agency). Communities that want to change their road standards to permit narrower streets need to involve all the stakeholders who influence street design in the revision process. Several excellent references on narrow street design are provided in the Resource section.

**Code/Regulation:** Check local road standards or zoning ordinances for possible restrictions on narrow streets.

**Availability:** N/A

Cohen, A. Narrow Streets Database. Congress for the New Urbanism. Available online at:
“http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool4_Site
_Design/www.sonic.net/abcaia/narrow.htm”
www.sonic.net/abcaia/narrow.htm

Calles pueden generalmente construirse en conjuntos residenciales en los que diariamente se originan 500 o menos salidas en promedio, sirviendo a unas 50 casas unifamiliares. Es posible que se adapten también para calles en las que se prevén entre 500 y 1,000 salidas diarias en promedio. Sin embargo, las calles más estrechas no son aptas para servir de carreteras principales, colectoras ni otro tipo de calles de mayor circulación, o en las que se prevé que con el tiempo habrá un tránsito constante.

**Limitaciones:** Los urbanizadores son por lo general poco flexibles cuando se trata de diseñar calles más angostas, ya que en la mayoría de comunidades se exigen calles residenciales anchas como un elemento estándar en las normas de carreteras y zonificación locales. Se requiere a menudo enmendar las normas locales de carreteras para promover el uso generalizado de calles residenciales más angostas. Por otra parte, es posible que las comunidades locales no tengan autoridad para cambiar las normas de carreteras en lugares donde las agencias estatales son las encargadas de la revisión de las carreteras públicas. En estos caso, la única posibilidad para construir calles más angostas es cuando se trata de calles privadas (mantenidas por los residentes y no por una agencia estatal o local). Las comunidades que deseen modificar las normas de carreteras de su área, para que se permitan calles más estrechas, deben hacer participar a todos los actores involucrados en el diseño de las calles durante el proceso de revisión. En la sección de recursos encontrará varias referencias excelentes sobre el diseño de calles angostas.

**Códigos y normas:** Examine las normas locales de carreteras o las ordenanzas de zonificación para comprobar si hay o no restricciones para la construcción de calles angostas.

**Disponibilidad:** No es del caso.

Cohen, A. Base de datos sobre calles angostas (Narrow Streets Database). Congreso para el Nuevo Urbanismo (Congress for the New Urbanism). Disponible en línea en: www.sonic.net/abcaia/narrow.htm
PHASE: Sewer & Water
STRATEGY: Shared Wastewater Treatment Systems

Benefits: R, A, O, H
Skill Level: S
Application: N, R, D

DESCRIPTION:
In conventional on-site wastewater treatment, one complete system is constructed for each residence. Shared wastewater treatment systems, sometimes called shared septic systems, consist of a single larger drainfield/treatment area connected to each house’s individual septic tank. They are an affordable, space-saving solution to wastewater treatment most appropriate for sites with failed absorption fields, narrow or oddly-shaped lots, high water tables, high bedrock, and low soil percolation.

Shared systems should last longer than individual systems because maintenance is generally more frequent and comprehensive, and they will likely be installed on more permeable soil. Treated water is high quality and in some situations could be released to a river or aquifer recharge.

Because the bulk of the septic system is confined to one area, residential construction in new subdivisions can be consolidated, providing more contiguous open area and common space. Maintenance, although more frequent, is shared by the community, and therefore should be comparable to individual systems.

Installation: Systems must be custom designed and built. Less excavation is required than for multiple independent systems. The possibility exists for retrofitting onto some existing septic system components.

En los sistemas convencionales de tratamiento de aguas in situ se construye un sistema completo para cada vivienda. Los sistemas compartidos para tratamiento de aguas residuales, a menudo llamados tanques sépticos compartidos, consisten en un área única y más grande de drenaje y tratamiento, que se conecta al tanque séptico individual de cada casa. Se trata de una solución asequible y que ahorra espacio, para el tratamiento de aguas residuales. Su uso es en particular apto en aquellos terrenos con absorción deficiente, lotes estrechos o de forma irregular, manantiales altos, sustratos rocosos altos, y terrenos de baja percolación.

La vida útil de los sistemas compartidos es generalmente superior a la de los individuales, dado que reciben a menudo un mantenimiento más completo y frecuente, y se instalan con mayor probabilidad en suelos más permeables. El agua tratada es de alta calidad y puede en ciertos casos vertirse en un río o incrementar la recarga de acuíferos.

La mayor parte del sistema séptico se ubica en una sola área, facilitando la consolidación de las viviendas en subdivisiones nuevas y dejando libre un espacio contiguo y área común más amplios. Como el mantenimiento a pesar de ser más frecuente lo realiza la comunidad, el resultado es semejante al de los sistemas individuales.

Instalación: Los sistemas deben diseñarse y construirse a la medida. Se requieren menos trabajos de excavación que en el caso de varios sistemas independientes. Existe la posibilidad de remodelar empleando componentes de los tanques sépticos ya instalados.

Limitaciones: Un sistema compartido requiere un control más frecuente que un sistema individual, debe realizarse cada seis meses, aproximadamente. Quizás se necesita que los par-
**Limitations:** A shared system must be monitored more frequently than individual systems, approximately every six months. The participants may need to have a contractual agreement to allocate responsibilities.

**Code/Regulation:** Costs will increase if the local health departments do not recognize the practice of shared systems or will not allow adequate reduction of the combined drainage field.

**Availability:** Shared systems are available for custom installation in the Southwest using conventional materials and components.

PHASE: Whole House  
STRATEGY: Hybrid Modular/Panelized Housing  
Benefits: R, S  
Application: N, S, D  

DESCRIPTION:
In factory-built, modular housing, large house sections (2 or more make up the whole house) are bolted to a foundation, hooked up to services, and moved into. Some manufacturers regularly combine the advantages of modular housing with the design flexibility and efficiency of panelized components, such as porches, sunrooms, and garages, building complex designs faster than site-built housing, with potential cost savings. This is known as hybrid modular/panelized construction.

An option in the hybrid modular market is the use of core modular units. In even the most complicated designs it may be worthwhile to modularize at least the bathroom and mechanical core (room with furnace, water heater, electrical closet, and blower). These sections of the house have concentrations of the most complex elements and require the highest construction skills (plumbing, electric, appliances, fixtures, HVAC, controls, tiles, cabinets, etc.). Adjacent rooms can be constructed with panelized and precut wall and roof sections. Complex roofs and second stories can be site-built above modular sections.

Most modular housing is limited by highway constraints: width/length limits and underpass heights, which usually accommodate a rectangular module of 14 to 18 feet wide, 66 feet long, and 13 to 14 feet high. However, wider modular units may be permitted to be transported over public roads and highways in many parts of the Southwest. In addition, the units must be able to withstand the dynamic stresses during transport of braking, acceleration, and turning. Designs with projections, cantilevers, and jogged plans may become less economical to deliver than a site built or strictly panelized approach.

The main advantages of hybrid modular come more from scheduling than reduced first cost. Because panels and modules can be built while the site is Fig. 4-4 and Fig. 4-5 Factory-built modular housing  
Fig. 4-4 y Fig. 4-5 Vivienda modular construida en fábrica  

ETAPA: Sistemas para toda la casa  
ESTRATEGIA: Viviendas híbridas, modulares y por paneles  
Beneficios: RR, CL  
Aplicación: CN, VUF, SD  

DESCRIPCIÓN:
En las viviendas modulares construidas en fábrica amplias secciones (la casa entera se divide en 2 o más secciones) se unen con pernos a los cimientos, se conectan los servicios públicos, y la casa queda lista para ser ocupada. Algunos fabricantes combinan a menudo las ventajas de las casas modulares con la flexibilidad de diseño y eficiencia de los componentes por paneles, como los porches, sunrooms y garajes, construyendo diseños complejos más rápido de lo que tardaría la construcción in situ. Esto puede redundar en una reducción de los costos. Esta técnica se conoce como construcción híbrida (entre modular y por paneles).

Una opción en el mercado híbrido modular es emplear unidades centrales modulares. Incluso en los diseños más complicados puede resultar ventajoso construir por módulos al menos el baño y el centro de equipos mecánicos (el cuarto con la caldera, calentador de agua, closet eléctrico y el soplador). En esta parte de la casa se concentran los elementos más complejos, y se requiere mano de obra más capacitada (plomería, electricidad, electrodomésticos, accesorios, calefacción, ventilación y aire acondicionado, controles, azulejos, armarios, etc.). Los cuartos contiguos pueden construirse con secciones de techos y paredes con paneles cortados con anterioridad. Los techos más complejos y las segundas plantas pueden construirse in situ sobre las secciones modulares.

El tamaño de casi todas las viviendas modulares se limita a las restricciones que impone el tamaño de las autopistas, con límites para el ancho, la longitud y la altura de los pasos inferiores. Se puede generalmente acomodar un módulo rectangular de entre 14 y 18 pies de ancho, 66 pies de largo, y entre 13 y 14 pies de alto. Sin embargo, es posible que se permita el transporte de unidades modulares más anchas en muchas de las carreteras y autopistas públicas del suroeste del país. Las unidades deben además ser capaces de resistir las cargas dinámicas que reciben durante el transporte por el frenado, la aceleración y los giros del vehículo. El transporte de diseños con proyecciones, secciones en voladizo, y planos desplazados puede resultar menos económico que su construcción in situ o construcción estrictamente por paneles.

Las ventajas principales de un diseño híbrido modular se derivan más de las posibilidades de programación de la obra, y no de una reducción en los costos primarios. Los paneles y los
prepared, the construction cycle can be far less than that of an entirely site-built house. Savings come in reduced construction loan interest, and land that generates income sooner.

**Installation:** Factory panelization of some house parts falls part way between on-site building and modular prefabrication. Factory panelization of some components offers a compromise between site building and full factory assembly. Site building elements that do not conform to “modular unit” delivery, such as garages, and some bays and dormers, can add a significant amount of work to a job. By utilizing advanced facilities with state-of-the-art technology, factory panelization is faster and easier than site panelization. Garages are most economical to build as panels bolted together on site.

**Limitations:** Not all designs are most cost-effectively built using hybrid or modular systems. Factors such as local labor and site accessibility may preserve site building as the most viable option for certain projects. Public perception of factory-built housing and architects/builders’ lack of knowledge of manufacturers’ capabilities continue to limit its market. Some of the public confuses modular construction with manufactured or “mobile” homes and may be ill-informed as to its quality and durability. Modular construction includes factory-built floors, which are not compatible with slab-on-grade foundations (although panelized construction is compatible).

**Code/Regulation:** Like conventional site-built construction, all modular housing must comply with codes in the region in which they are delivered.

**Availability:** Many manufacturers build panelized extensions onto their modular units. To control shipping costs and to locate a climate-specific design, consider a manufacturer in your region.

**Resources:** PATH Inventory—Hybrid Modular/Panelized Housing, http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryId=1402&DocumentID=2107

módulos pueden construirse al tiempo que el sitio de la obra se prepara, por lo que el ciclo de construcción es muy inferior al de una casa que se construye enteramente in situ. Los ahorros se derivan del menor interés sobre el préstamo para construcción, y del hecho de que la propiedad empieza a generar ingresos más pronto.

**Instalación:** La división por paneles de ciertas partes de la casa desde la fábrica es un punto medio entre la construcción in situ y la prefabricación modular. La división por paneles de ciertos componentes desde la fábrica permite una transigencia entre la construcción in situ y el ensamblando total en fábrica. Los elementos de la construcción que no se pueden entregar en “unidades modulares”, como los garajes, los entrantes de pared y las buhardillas, pueden incrementar notablemente el trabajo para completar la obra. Gracias al empleo de técnicas avanzadas en las instalaciones, la construcción por paneles es más fácil y rápida en fábrica que in situ. Los garajes son más económicos de construir ya que basta con unir con pernos los paneles in situ.

**Limitaciones:** No todos los diseños son más efectivos en función de los costos cuando se construyen mediante sistemas híbridos o modulares. En ciertos proyectos es posible que debido a factores como la mano de obra local y la accesibilidad al sitio, la construcción in situ siga siendo la opción más viable. La manera en que el público percibe las casas prefabricadas, y el desconocimiento que los arquitectos y constructores tienen sobre la capacidad de los fabricantes, son factores que continúan restringiendo este mercado. Un sector del público confunde la construcción modular con las casas manufacturadas o “móviles”, y probablemente está mal informado sobre su calidad y durabilidad. La construcción modular incluye pisos construidos en fábrica, que no son compatibles con los cimientos de losas de concreto a nivel del terreno (aunque parte de la construcción por paneles sí lo es).

**Códigos y normas:** Como sucede con la construcción convencional in situ, todas las viviendas modulares deben acatar los códigos de la localidad en que se entregan.

**Disponibilidad:** Muchos fabricantes construyen ampliaciones por paneles en sus unidades modulares. Para limitar los costos de envío y conseguir diseños adaptados a un clima específico le recomendamos tener en cuenta a los fabricantes de su región.

**Recursos:** Inventario del PATH—Viviendas híbridas, modulares y por paneles http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryId=1402&DocumentID=2107
PHASE: Whole House
STRATEGY: Manufactured House

Benefits: A
Skill Level: U
Application: N, S, D

DESCRIPTION:
A manufactured home is a single-family house constructed largely in a controlled factory environment, built to the Federal Manufactured Home Construction and Safety Standards (better known as the HUD Code). The federal standards regulate manufactured housing design and construction, strength and durability, transportability, fire resistance, energy efficiency and quality. The HUD Code also sets performance standards for the heating, plumbing, air conditioning, thermal and electrical systems. Manufactured homes may be single- or multi-section, one- or two-stories, and can be set adjacent (called “attached,” although they are separate except for cladding). On-site additions, such as garages, decks and porches, available from the manufacturer or a separate dealer, are often added to enhance the home’s value and appearance.

A manufactured home can be a lower-cost and/or higher-quality alternative to a site-built home. The potential higher quality and/or affordability of manufactured housing is mainly attributable to the efficiencies of the factory process. The controlled environment and assembly-line techniques remove many of the problems encountered in building homes on-site, such as labor shortages, bad weather, theft, vandalism, and damage to building materials stored on site. Some or all of the savings from factory construction are offset by the cost of transporting the home to the site and completing it on site.

Installation: A manufactured home must be set over a crawl space and not directly on a slab (although providing a complete or partial slab on the ground under the home is a good idea). The home should be installed by someone familiar with moving and setting manufactured homes. Regardless of whether the home is purchased directly or through a dealer, be sure to

ETAPA: Sistemas para toda la casa
ESTRATEGIA: Casas manufacturadas

Beneficios: MA
Habilidades: NC
Aplicación: CN, VUF, SD

DESCRIPCIÓN:
Una vivienda manufacturada es una casa unifamiliar construida casi por completo en el entorno controlado de una fábrica, acatando las normas federales para la construcción y seguridad de casas manufacturadas (conocido como el código HUD). Las normas federales rigen el diseño y construcción de las casas manufacturadas, su resistencia, durabilidad, facilidad de transporte, resistencia a incendios, eficiencia en el uso de la energía y calidad. En el código del HUD se establecen además las normas sobre el rendimiento de la calefacción, la plomería, el aire acondicionado, y los sistemas eléctricos y térmicos. Las casas manufacturadas pueden ser de una o varias secciones, una o dos plantas, y pueden colocarse junto a otras (se conocen como casas pegadas, aunque están separadas excepto por el revestimiento). A menudo se añaden elementos in situ, como garajes, patios y porches, disponibles con el fabricante u otro distribuidor, con el fin de aumentar el valor y mejorar la apariencia de la casa.

Una casa manufacturada puede ser una opción más económica o de mayor calidad que una casa construida in situ. La probabilidad de que la casa manufacturada sea de mejor calidad o más económica se deriva ante todo del eficiente proceso que se realiza en la fábrica. Gracias al ambiente controlado y las técnicas de cadena de montaje se puede eliminar muchos de los problemas que ocurren cuando las casas se construyen in situ, como escasez de mano de obra, mal tiempo, robo, vandalismo y daño a los materiales almacenados en el sitio de la obra. Parte o todo el capital que se ahorra gracias a la construcción en fábrica se invierte luego en el costo del transporte de la casa y en su terminación in situ.

Instalación: Una casa manufacturada debe instalarse dejando un espacio por debajo de ella, y no directamente en una losa de concreto (aunque no es una mala idea instalar una losa completa o parcial en el suelo, por debajo de la casa). La instalación de la casa debe confiarse a personal con experiencia en el transporte y asentamiento de casas manufacturadas. Sin importar que la casa se haya comprado directamente o a través de un distribuidor, asegúrese de comprobar las calificaciones del instalador, seleccionando uno que cuente con la debida licencia y fianzas, y que pueda suministrar una cotización por escrito tomando en cuenta una especificación detallada del rendimiento requerido.
check out the qualifications of the installer, and to choose a bonded and insured installer who provides a written quote based on a detailed performance specification.

If the home is to be financed with a conventional mortgage, the home's foundation will have to meet the secondary lender's standard for a "permanent" foundation. A permanent foundation typically involves a masonry or concrete wall around the perimeter of the home, resulting in a foundation comparable in cost to a slab-on-grade. With a permanent foundation, the home is either rolled into place on special rollers, or is set by crane (at an extra cost).

If the home is financed using a personal property ("chattel") loan at a higher interest rate, as is typical in manufactured home communities, a substantial reduction in the cost of the foundation is possible by using a "pier and tie-down" system. There are many such systems in use, and each should be explored for stability, durability, and cost-effectiveness. The home is driven by the transporter directly into place on a slab or partial slab, or on ground that has been crowned to drain water away from the house. It is then lowered onto piers, leveled, and braced against the wind with an anchorage system. Some kind of skirting is needed to close up the resulting high crawl space. While corrugated vinyl skirting is common and inexpensive, its appearance brands the home and is widely disliked. A more "home-like" appearance can be achieved using masonry skirting, but this raises the cost close to that of a permanent foundation.

Cost/Benefit: The crucial step in comparing prices is to match the specifications of the manufactured home with the site-built home, item by item, to come as close as possible to an "apples to apples" comparison. In areas with high site labor costs, a new manufactured home meeting the same specifications as a site-built home can be lower in cost. In other cases, the home may be comparable in cost, although production in the factory typically results in a better product. It is important to include the cost of the foundations in making price comparisons, as well as the cost of transportation and of "marrying" the home sections and hooking up utilities during installation.

Si se piensa financiar la casa con una hipoteca convencional, los cimientos deben cumplir con la norma del segundo prestamista con relación a un cimiento permanente. Un cimiento permanente generalmente se compone de una pared de mampostería o concreto alrededor del perímetro de la casa, lo que resulta en un cimiento comparable en costos a uno de lasas a nivel del terreno. Con el cimiento permanente listo, la casa se desliza a su sitio mediante rodillos especiales o se coloca mediante una grúa (con un costo adicional).

Si la casa se financia mediante un préstamo avalado por algún bien inmueble, a una tasa de interés más alta, como sucede generalmente con las viviendas manufacturadas, puede reducirse notablemente el costo de los cimientos usando un sistema con "pilares y amarres". Son varios los sistemas de este tipo que se emplean; conviene estudiar cada uno teniendo en cuenta su estabilidad, durabilidad, y eficiencia en función de los costos. El transportista lleva la casa directamente hasta su sitio sobre una losa o losa parcial, o bien sobre un terreno que se ha levantado ligeramente para que el agua escurra lejos de la casa. Se procede entonces a bajar la casa sobre unos pilares, nivelándola y asegurándola para resistir al viento mediante un sistema de andamiaje. Es necesario instalar un faldón guardaguas para encerrar el espacio alto y abierto que se crea entre la casa y la tierra. Los faldones de vinilo corrugado son comunes y económicos; sin embargo, su apariencia puede dar una mala imagen a la casa, por lo que casi todo el mundo los desaprobaba. Una apariencia más propia de una "verdadera casa" se logra instalando un faldón de ladrillos; aunque se elevan los costos hasta casi el mismo precio de los cimientos permanentes.

Costos y beneficios: El paso crucial al comparar precios es cotejar las especificaciones de la casa manufacturada con las de la casa construida in situ, punto por punto, intentando en la medida de lo posible comparar el mismo tipo de elementos. En las zonas en las que la mano de obra sobre el terreno es muy costosa, una casa manufacturada nueva con las mismas especificaciones puede ser más económica que una construida in situ. En los demás casos el precio puede ser equiparable; sin embargo, la producción en fábrica resulta casi siempre en un producto de mejor calidad. Es importante incluir el costo de los cimientos al hacer la comparación de precios, y también los gastos de transporte, de empalme de las diversas secciones de la casa, y de conexión de servicios públicos durante la instalación.

Limitaciones: En muchas áreas hay restricciones de zonificación que restringen la ubicación de casas manufacturadas en lotes privados. Las casas manufacturadas se venden generalmente a través de distribuidores, que las compran del fabricante pagando en efectivo, y añaden un margen comercial al precio. Si un urbanizador desea comprar la casa directamente de fábrica, es posible que se exijan arreglos especiales para financiarla, a fin de cumplir con
**Limitations:** Many sites have zoning or restrictive covenants that limit the placement of manufactured homes on private lots. Manufactured homes are typically sold through dealers, who pay cash to the manufacturer, then add a markup to the price. If a developer wishes to purchase the home direct from the factory, special financing arrangements may be needed to accommodate the manufacturer's expectation of payment on delivery. Check the lender’s qualification requirements for buyers, which may differ from those for site-built homes.

**Code/Regulation:** Manufactured homes must be built to the HUD Code. On-site additions, such as garages, decks and porches, and permanent foundations, must be built to local, state or regional building codes. Some states now enforce strict installation standards, and all are required to do so by 2005. Before leaving the factory, each manufactured home must have a numbered certification label affixed to the exterior of each section of the home. This label certifies to the homebuyer that the home has been inspected in accordance with the HUD enforcement procedures and that it complies with the HUD building code.

**Availability:** Manufactured homes are widely available through manufacturers or retailers. Developers or homebuyers should look for a manufacturer that offers a long-term warranty with few exclusions.

**Resources:** Consumers Union, http://www.consumersunion.org/mh/

Manufactured Housing Institute (www.manufacturedhousing.org)

Information and statistics on Manufactured Housing. Link to Developer Resources, Technical Resources, Community Resources, publications, and news.


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Las expectativas del fabricante de que el pago se realizará con la entrega. Examine las calificaciones que el prestamista exige a los compradores; es posible que no sean las mismas que aquéllas para casas construidas in situ.

**Códigos y normas:** Las casas manufacturadas deben construirse acatando el código del HUD. Los elementos añadidos in situ, como garajes, patios, porches y cimientos permanentes deben construirse conforme a los códigos de construcción locales, estatales o regionales. En algunos estados se han impuesto estrictas normas de instalación, que deben observarse en todos los estados para el año 2005. Antes de salir de fábrica, cada casa manufacturada debe tener una etiqueta con la debida certificación numerada, en el exterior de cada una de las secciones. Esta etiqueta certifica al comprador que la casa se ha inspeccionado conforme a los procedimientos establecidos por el HUD para hacer cumplir las normas, y que cumple con las disposiciones del código de construcción del HUD.

**Disponibilidad:** Las casas manufacturadas pueden obtenerse fácilmente de fabricantes o vendedores minoristas. Es conveniente para los urbanizadores o compradores de vivienda seleccionar un fabricante que ofrezca una garantía a largo plazo con pocas excepciones.

**Recursos:** Unión de Consumidores (Consumers Union) http://www.consumersunion.org/mh/

Instituto de Casas Manufacturadas (Manufactured Housing Institute)

Información y estadísticas sobre casas manufacturadas. Enlaces hacia recursos para los urbanizadores, recursos técnicos, recursos comunitarios, publicaciones y noticias.


Guía sobre cimientos y sistemas de apoyo de casas manufacturadas (Guide to Foundation and Support Systems for Manufactured Homes), publicado por la Alianza de Investigación sobre Casas Manufacturadas para la Oficina de Desarrollo de Políticas e Investigación del Departamento de Vivienda y Desarrollo Urbano de los Estados Unidos, New York, NY, marzo 29 de 2002.

Guía para la instalación de casas manufacturadas (Manufactured Home Installation Guide), George Porter, Instituto de Casas Manufacturadas (Manufactured Housing Institute),


PHASE: Whole House System
STRATEGY: Mold Prevention

Benefits: O, H
Skill Level: U
Application: N, R, S, D

DESCRIPTION:
Mold is a growing concern for builders and residents, and is especially problematic to those sensitive to it. Symptoms for some may include wheezing, stuffy nose, eye or throat irritation, and other allergic reactions. Mold is often a sign of a moisture problem. For mold to grow, it needs warmth, a food source—leaves, wood, paper, cloth, carpet, leather, wood, drywall, even dust—and moisture. Mold grows by digesting, and thereby destroying, what it grows on. As such, it can seriously damage rugs, walls and at worst case, the structure of a house, making it harmful for some to occupy.

Installation:
Builders and residents can help prevent mold growth and control moisture.

Builders

■ If subject to rainfall, store materials under roof. If not feasible, cover and store materials with clearance above the ground to avoid wetting from storm runoff and permit air circulation from below.

■ Inspect material shipments like framing packages to ensure that there are no signs of mold or moisture damage.

■ Allow a suitable amount of drying time following wetness before “closing in” building components. Closing in is considered the point at which components are covered up with additional materials that restrict their ability to dry.

■ In tight, energy-efficient houses ensure sufficient ventilation to remove humidity from the house. Note that although oversized air conditioning can
quickly cool a house or room, the frequent short cycles do not allow it to adequately remove moisture or humidity from the house.

- In bathrooms and kitchens, install exhaust fans that vent to the outside.
- Vent clothes dryers to the outdoors.
- Install proper vapor and air barriers in accordance with the climate zone in which you are building. Air seal the home. Caulk around sinks and tubs in bathrooms and kitchens.
- Install proper flashing.
- Grade away from the house so that rainwater drains away from the house. Install gutters and extended downspouts to get roof water runoff away from foundations.
- Install wallboard in high moisture areas such as bathrooms (at least behind bath surrounds) and kitchens.
- Consider installing bath surrounds that come in several pieces, as opposed to one integral piece, because they are less likely to crack as a result of expansion and contraction that may result from intense Southwest summer heat. Cracks are a source of water penetration, which may lead to mold growth behind the bath surrounds.

Homeowners/Residents
- Repair water leaks in the roof, plumbing, windows, or any other part of the home as soon as possible.
- If there are gutters and downspouts, make sure they are clear of debris that may block the flow of water from the roof. Make sure the area under the downspouts is properly graded so that rainwater from the roof flows away from the foundation. Splash blocks and/or downspout extensions can help rainwater to flow in the proper direction.
- Make sure other areas around the foundation are graded so that rainwater does not flow toward the house.
- If there is a clothes dryer, make sure it is vented to the outdoors.
- If the home has a basement, consider using a dehumidifier there. The cool basement floor and walls can be a source of moisture build-up. Do not carpet basement.
- If the home has an attic, make sure it is properly insulated and ventilated.
- En los baños y cocinas, instale ventiladores de escape que descarguen el aire en el exterior de la casa.
- Haga que los conductos de salida de las secadoras de ropa den al exterior.
- Instale barreras adecuadas contra vapor y aire según la región climática en la que se construya. Selle la casa contra fugas de aire. Aplique calafateado alrededor de fregaderos y tuberías en baños y cocinas.
- Instale los debidos elementos de escumiento.
- Rebaje el terreno alrededor de la casa de modo que el agua de lluvia se aleje de ella. Instale canalones y bajantes extendidos para que el agua que escurre del techo caiga lejos de los cimientos.
- Instale planchas de yeso resistentes al agua (planchas verdes) o planchas de cemento en áreas de mayor humedad como los baños (al menos detrás del perímetro del baño) y cocinas.
- Considere la posibilidad de instalar el perímetro del baño en varias piezas en lugar de una entera; así será menos probable que se agrieten como resultado de la expansión y contracción que causa el intenso calor del suroeste del país en verano. El agua puede penetrar por las grietas, y el moho puede proliferar detrás de las paredes del baño.

Propietarios de vivienda y residentes
- Repare las goteras del techo y las fugas en tuberías, ventanas, o cualquier parte de la casa, tan pronto como sea posible.
- Si hay canalones y bajantes, asegúrese de que estén libres de desechos que pueden bloquear el flujo del agua del techo. Compruebe que el área alrededor del extremo de los bajantes cuenta con la debida inclinación de modo que el agua de lluvia proveniente del techo no se acumule en los cimientos. Con bloques antisalpicaduras o extensiones del bajante puede hacerse que el agua de lluvia fluya en la dirección correcta.
- Compruebe que las demás áreas alrededor de los cimientos estén inclinadas, de modo que el agua de lluvia no fluya hacia la casa.
- Si tiene una secadora de ropa, asegúrese de que el conducto de escape dé al exterior.
- Si la casa tiene sótano, considere la posibilidad de instalar allí un deshumidificador. La temperatura fresca del sótano en pisos y paredes puede ser una fuente de acumulación de moho.
- Si la casa tiene ático, asegúrese que esté debidamente aislado y ventilado.
- Si hay un espacio por debajo de la casa, cubra la tierra de éste con plástico polietileno de 6 mm. Selle cuidadosamente todos los bordes. En climas húmedos, no ventile los espacios por debajo de la casa.

Limitaciones: Ninguna.
If there is a crawl space under the house, cover the soil in the crawl space with 6-mil polyethylene plastic. Seal all edges thoroughly. In humid climates, do not vent crawl spaces.

**Limitations:** None.

**Code/Regulation:**
Mold prevention is not covered in building codes. However, builders should follow local requirements for indoor air quality and air exchange rates.

**Availability:**
N/A

**Resources:**


PHASE: Whole House
STRATEGY: Passive Solar Techniques

Benefits: O, H
Skill Level: U
Application: N, R, S, D

DESCRIPTION:
Passive solar techniques use the sun's energy—without employing mechanical means—for the heating, cooling, and natural ventilation of spaces in the house. These techniques apply to the siting of the house, house design, and the landscaping. Passive solar techniques are effective in reducing energy use only if they are combined with, not substituted for, energy conservation techniques. Passive solar design typically uses the following key techniques: proper orientation, placement, amount, and type of glazing; proper shading using overhangs, landscaping, etc.; appropriately distributing thermal mass; and proper natural ventilation.

Installation:
Siting and landscaping
- Position the long ends of the house along the east-west direction.
- If possible, make use of natural slopes by berming the house into the ground. Berming protects from wind, reduces heat loss during the heating season, and reduces heat gain during the cooling season.
- Plant evergreens to shield the house from hot winds.
- Plant native plants or plants adapted to the local climate.

House design in year-round mild climates such as southern California:
- Place most windows north and south. South-facing windows allow solar gain during heating periods. Opposing north-facing windows allow good cross ventilation during cooling periods.
- Use south-facing clerestories with operable windows to bring sun and light deeper into the house and to ventilate. Ventilation can be enhanced with ceil-

Fig. 4-8 Overhangs above south-facing windows shade the summer sun and let in the winter sun.

ETAPA: Sistemas para toda la casa
ESTRATEGIA: Técnicas solares pasivas

Beneficios: RC, MAB
Habilidades: NC
Aplicación: CN, RH, WUF, SD

DESCRIPCIÓN:
Las técnicas solares pasivas emplean la energía del sol—sin valérsene de medios mecánicos—para la calefacción, enfriamiento y ventilación natural de los ambientes de una casa. Estas técnicas se aplican a la colocación y el diseño de la casa, y al diseño de los jardines. Las técnicas solares pasivas son eficaces para reducir el consumo de energía sólo si se combinan (no si se reemplazan) con técnicas de conservación de energía. En el diseño solar pasivo se tiene en cuenta generalmente las siguientes técnicas: orientación adecuada de la casa; la colocación, cantidad y tipo de revestimiento; sombreado apropiado mediante voladizos, diseño de jardines, etc.; distribución apropiada de la masa térmica; y ventilación natural adecuada.

Instalación: Ubicación de la casa y diseño de jardines
- Ubique los extremos largos de la casa en un sentido este-oeste.
- Si es posible aproveche las colinas naturales creando una berma entre la casa y el terreno. Esta berma protege a la casa de los vientos, reduce las pérdidas de calor durante los meses que requieren calefacción, y la absorción de calor durante los meses que requieren enfriamiento.
- Plante vegetación de hoja perenne para aislarlo la casa de los vientos calientes.
- Plante vegetación nativa o adaptadas al clima local.

Diseño de casas en climas templados todo el año, como el sur de California:
- Coloque la mayoría de las ventanas al norte y al sur. Las ventanas que dan al sur permiten ganar calor del sol durante los meses que requieren calefacción. Las ventanas opuestas que dan al norte permiten una buena ventilación durante los meses que requieren enfriamiento.
- Instale triforios en las ventanas que abren de cara al sur para permitir el ingreso del sol y la luz más al interior de la casa, y para ventilar. La ventilación puede reforzarse con ventiladores de techo o de escape.
- Use la masa térmica (ladrillos, concreto, tejas, planchas gruesas de yeso) en los cuartos expuestos al sol (más que todo al sur, pero también al este y al oeste) para moderar y almacenar el calor del sol.
■ Use thermal mass (brick, concrete, tiles, thick gypsum board) in rooms with solar exposure (most importantly south, but also east and west) to moderate and store solar heat.

■ Build minimum 2-foot overhangs on south-facing walls to shade windows. Shade east- and west-facing windows with deep porches or vertical fins.

■ Encourage natural ventilation by placing windows on opposite parts of the house, such as south and north, or low and high. If there are dominant breezes, place larger operable windows on the side towards which the wind is blowing (the leeward side).

In hot and dry climates, such as Arizona, New Mexico, and Nevada, with year-round high temperatures during the day and cool or cold nights:

■ Place most windows on the south side, some on the north side, and few, if any, on the west side. East windows can help heat recovery from cold nights, if the glass area is not too big, so that it does not create overheating during the late morning.

■ Use south-facing clerestories to bring sun and light deep into the house.

■ Build minimum 2-foot overhangs on south-facing walls to shade windows. Shade east- and west-facing windows with deep porches or vertical fins.

Interior shading (e.g., blinds) is of little effectiveness because the hot air layer created between the blinds and glass cannot release heat to the outside, where it is also hot.

■ Use thermal mass (brick, concrete, tiles, thick gypsum board) throughout the house, including exterior and interior walls, and floors, to moderate and store solar heat. Earth berming can also provide desirable, year-round cooling.

■ Encourage natural ventilation by placing windows on the north and south sides and high and low parts of the house.

In hot and humid climates with year-round high temperatures, small variations between day and night, and extended periods of high humidity, such as southern Texas:

■ Place most windows on the north side, fewer on the south, and as few as possible on the east and west.

■ Instale voladizos de al menos 2 pies en las paredes que dan al sur para brindar sombra a las ventanas. Proporcione sombra a las ventanas del este y del oeste mediante porches largos o planos verticales.

■ Fácilite la ventilación natural poniendo las ventanas en partes opuestas de la casa, p. ej. al sur y al norte, o arriba y abajo. Si hay brisas dominantes, ponga las ventanas más amplias que se abren en el costado hacia el cual sopla el viento (lado de sotavento).

En los climas calientes y secos como el de Arizona, Nuevo México, y Nevada, en los que la temperatura durante el día se mantiene alta todo el año y las noches son frescas o frías:

■ Ponga la mayoría de las ventanas de cara al sur, algunas en el norte y pocas o ninguna en el costado oeste. Las ventanas que dan al este pueden ayudar a recuperar el calor durante las noches frías, siempre que la superficie del cristal de la ventana no sea muy grande para no causar un calentamiento excesivo durante las horas avanzadas de la mañana.

■ Instale triforios de cara al sur para permitir el ingreso del sol y la luz más al interior de la casa.

■ Instale voladizos de al menos 2 pies en las paredes que dan al sur para dar sombra a las ventanas. Proporcione sombra a las ventanas del este y del oeste mediante porches largos o planos verticales. Las persianas en el interior de las ventanas son poco eficientes, ya que la capa de aire caliente que se crea entre éstas y el cristal de la ventana no puede eliminar el calor hacia fuera, donde la temperatura es también alta.

■ Use la masa térmica (ladrillos, concreto, tejas planchas gruesas de yeso) en toda la casa, incluidas las paredes exteriores e interiores y los pisos, para moderar y almacenar el calor del sol. La creación de una berm en el terreno puede además brindar un enfriamiento agradable todo el año.

■ Fácilite la ventilación natural poniendo las ventanas en los costados norte y sur, o en partes altas y bajas de la casa.

En los climas calientes y húmedos en los que la temperatura es alta todo el año, con variaciones ligeras entre el día y la noche, y períodos prolongados de humedad como en el sur de Texas:

■ Ponga la mayoría de las ventanas de cara al norte, menos en el sur, y tan pocas como sea posible en los costados este y oeste.

■ Instale voladizos de al menos 2 pies en las paredes que dan al sur para dar sombra a las ventanas. Proporcione sombra a las ventanas del este y el oeste mediante porches largos o planos verticales.

■ Fácilite la ventilación natural poniendo las ventanas en lados opuestos, o en partes altas y bajas de la casa.

■ La creación de una berm en el terreno puede también brindar un enfriamiento agrad-
■ Build minimum 2-foot overhangs on south-facing walls to shade windows.
■ Shade east- and west-facing windows with deep porches or vertical fins.
■ Facilitate natural ventilation by placing windows on the opposing sides and high and low parts of the house.
■ Earth berming can also provide desirable, year-round cooling because the ground several feet below the surface remains at a constant temperature of about 50°F.

Limitations: Lot location, and existing lot or house conditions may prevent the implementation of some passive solar techniques.

Code/Regulation: Check local codes regarding earth berming.

Availability: N/A

Cooling Your Home Naturally; http://www.eere.energy.gov/erec/factsheets/coolhome.html
PHASE: Foundation
STRATEGY: Insulating Concrete Forms (ICFs)

Benefits: A, O, H
Skill Level: SS
Application: N, S, D

DESCRIPTION:
Insulating concrete forms (ICFs) are rigid plastic foam forms that hold concrete in place during curing and remain in place afterwards to serve as thermal insulation for concrete walls. The foam blocks, panels, or planks are lightweight and result in energy-efficient, durable construction.

ICFs consist of insulating foam, commonly expanded polystyrene (EPS) or extruded polystyrene (XPS). The three basic types are hollow foam blocks, foam planks held together with plastic ties, and 4 x 8 panels with integral foam or plastic ties. ICFs can be used to form various structural configurations, such as a flat standard wall, grid or post and beam. They provide backing for interior and exterior finishes.

Typical ICF insulation values range from R-17 to R-26. ICF energy performance also benefits from the large thermal mass of the concrete, which absorbs heat to moderate against wide temperature swings. Concrete construction is inherently airtight. ICF walls allow less than one-third as much sound to pass through as do ordinary frame walls filled with fiberglass. Also, in fire wall tests, ICFs stood exposure to intense flame without structural failure longer than did common frame walls. Note that some insurance carriers offer a discount on a homeowner’s policy for an ICF home.

The strength of ICF structures relative to wood-framed ones depends on configuration, thickness, and reinforcement. While ICF homes cost about two to five percent more than wood-framed construction, they may be cost-competitive when installed in combination with certain wall exteriors such as exterior insulation and finish systems (EIFS), which can be applied directly to the foam without additional substrate. See EIFS-Drainable Systems.
Installation: ICFs allow homeowners or trade contractors to construct concrete walls without a significant investment in wood and metal forms. ICFs are commonly installed on standard spread footings or on-grade concrete slabs. Layout lines are snapped and the ICFs are stacked or set in place, typically in an interlocking fashion. Steel rebar is placed where required in the hollow cores. Concrete is poured, typically with a concrete pump, and is consolidated with care so as not to create a “blowout,” or to rupture the form. After curing, standard construction materials are used to complete the roof, floors, and interior walls. Interior and exterior finishes are applied to the foam.

Limitations: Appropriate concrete placement equipment (such as a pump truck) may not be available in rural areas. Some concerns exist for ICF used below grade because some plastic foams may not be accepted by some building codes due to the potential for termite infestation. ICFs change the construction sequence, which requires a greater amount of coordination initially. Methods for attaching interfacing materials are different from traditional building materials. For example, utilities must be routed behind the wall surface by cutting grooves in the foam.

Code/Regulation: ICFs with flat wall configurations must meet standard prescriptive structural design requirements for cast-in-place concrete walls in the building codes, but the plastic foam insulation on the interior surface requires special attention to meet some fire resistance provisions. Currently, manufacturers of post-and-beam and grid systems provide design and engineering assistance to help builders obtain local code approvals.

Availability: There are many manufacturers of ICFs. In the Southwest, some distribute directly to concrete contractors or builders, while others distribute through authorized building products distributors.

Resources: PATH Technology Inventory—Insulating Concrete Forms  

Instalación: Gracias a los ICF los propietarios o contratistas pueden crear paredes de concreto sin tener que invertir demasiado en madera reutilizable y moldes de metal. Los ICF se instalan habitualmente en los apoyos extendidos de cimentación estándar o en lasos de concreto a nivel del terreno. Las líneas de colocación se retiran y los ICF se apilan o colocan en su sitio, por lo general trabajándolos entre sí. Una barra de refuerzo de acero se coloca donde se requiera en los núcleos vacíos. Se procede entonces a verter el concreto, generalmente con una bomba, y se asienta con cuidado para evitar que “crezca” o rompa el molde. Después del fraguado, se emplean materiales estándar de construcción para terminar el techo, los pisos y las paredes interiores. Se aplican luego sobre la espuma los acabados interiores y exteriores.

Limitaciones: Es posible que en las zonas rurales no sea posible ubicar adecuadamente el equipo para el concreto (p. ej. un camión bomba). Existe cierta inquietud sobre el empleo de ICF bajo el nivel del piso, ya que es posible que en ciertos códigos de construcción no se acepten algunas espumas de plástico debido a la probabilidad de que se infesten con termitas. Los ICF modifican la secuencia de la construcción, lo que exige inicialmente un mayor grado de coordinación. Los métodos para fijar los conductos difieren de los que se realizan con materiales convencionales de construcción. Por ejemplo, las líneas de agua y luz deben disponerse detrás de la superficie de la pared cortando ranuras en la espuma.

Códigos y normas: En configuraciones con paredes planas los ICF deben cumplir los requisitos normativos estándar para el diseño estructural de paredes de concreto moldeado in situ según los códigos de construcción; sin embargo, debe prestarse especial atención al aislamiento de espuma de plástico en la superficie interior para que cumpla con ciertas normas sobre resistencia a incendios. En la actualidad los fabricantes de sistemas con enrejados o con pilares y vigas brindan asistencia para el diseño e ingeniería colaborando con los constructoras para obtener la aprobación de los códigos locales.

Disponibilidad: Existen muchos fabricantes de ICF. En el suroeste del país varios de ellos los distribuyen directamente a los contratistas a cargo del concreto o a los constructores; otros los distribuyen mediante concesionarios autorizados de productos para la construcción.

Recursos: Inventario del PATH—Encofrados aislantes para el concreto http://www.toolbase.org
PHASE: Foundation
STRATEGY: Post-Tensioned Slabs

Benefits: R, A
Skill Level: S
Application: N, S, D

DESCRIPTION:
Poor soil conditions in parts of the Southwest make it difficult to build on. An alternative to reinforced slab-on-grade, which would have to be engineered (at a higher cost), is a post-tensioned slab on grade. Post-tensioning is a method of reinforcing (strengthening) concrete or other materials with high-strength steel strands or bars, typically referred to as tendons. The tendons force the concrete to act in compression, optimizing its structural capacity (concrete is very strong in compression and very weak in tension).

Post-tensioned slabs-on-grade can be used for home construction to reduce problems with cracking and differential settlement in areas where there are expansive clays or soils with low bearing capacity. Post-tensioned slabs are usually thinner than conventional reinforced slabs-on-grade, saving materials cost.

Installation: There are two main types of post-tensioning: unbonded and bonded (grouted). An unbonded tendon is one in which the prestressing steel is not actually bonded to the concrete that surrounds it except at the anchorages. The most common unbonded systems are monostrand (single strand) tendons, which are used in slabs and beams for homes and buildings and parking structures. A monostrand tendon consists of a seven-wire strand that is coated with a corrosion-inhibiting grease and encased in an extruded plastic protective sheathing. The anchorage consists of an iron casting and a conical, two-piece wedge that grips the strand.

In bonded systems, two or more strands are inserted into a metal or plastic duct that is embedded in the concrete. The strands are stressed with a large, multi-strand jack and anchored in a common anchorage device. The

ETAPA: Cimientos
ESTRATEGIA: Losas post-tensadas

Beneficios: RR, MA
Habilidades: CL
Aplicación: CN, VUF, SD

DESCRIPCIÓN:
Las deficientes condiciones del suelo en áreas del suroeste del país dificultan la construcción. Una alternativa para las losas de concreto reforzadas colocadas a nivel del terreno, que requieren un diseño por parte de un ingeniero (aumentando los costos), la ofrecen las losas post-tensadas colocadas a nivel del terreno. La post-tensión consiste en el refuerzo del concreto u otros materiales con cordones o barras de acero de alta resistencia, conocidas habitualmente como “tendones”; los tendones obligan al concreto a actuar bajo compresión, optimizando así su capacidad estructural (el concreto es muy resistente a la compresión y muy poco a la tensión).

Las losas post-tensadas colocadas a nivel del terreno pueden emplearse para la construcción de casas con el fin de reducir los problemas de agrietamiento y asentamiento desigual en zonas con suelos arcillosos expansivos o suelos con baja capacidad de soporte. Las losas post-tensadas son por lo general más delgadas que las losas convencionales reforzadas colocadas a nivel del terreno, lo que permite reducir el costo de materiales.

Instalación: Existen dos tipos principales de post-tensión: desligado y ligado (con lechada de cemento). En un tendón desligado el acero pretensado no realmente ligado al concreto que lo rodea, salvo en los anclajes. Los sistemas desligados más comunes contienen tendones de un solo cordón, y se emplean en losas y vigas para viviendas, edificaciones y estacionamientos. Un tendón de un solo cordón consiste en un cordón de siete hebras cubierto con grasa anticorrosiva y enfundado en un revestimiento protector de plástico extruido. El anclaje comprende una pieza de hierro y una cuña cónica de dos piezas que sujeta el cordón.

En los sistemas ligados, dos o más cordones se insertan en un ducto metálico o plástico que se empotra luego en el concreto. Estos cordones se tensan mediante un enorme gato para varios cordones, y se anclan en un elemento común. Se inyecta entonces en el ducto una lechada de cemento que protegerá al cordón contra la corrosión, y ligará el tendón al concreto que rodea al ducto. Los sistemas ligados se emplean más frecuentemente en puentes.
duct is then filled with a cementitious grout that provides corrosion protection to the strand and bonds the tendon to the concrete surrounding the duct.

**Limitations:** Proper installation of post-tensioning requires workers highly skilled in its use and execution. This skilled labor may not be available in remote areas. Also, post-tensioned slabs-on-grade shrink more than conventionally reinforced slabs due to the axial anchor forces.

**Code/Regulation:** The International Building Code, International Residential Code, and the National Fire Protection Association Building Code state special foundations have to be designed in areas with expansive soils. Post-tension slabs-on-grade designed using the Post-Tensioning Institute’s procedures (described in Design and Construction of Post-Tensioned Slabs-on-Ground) qualify as one of these special foundations.

**Availability:** Materials used to construct post-tensioned slabs-on-grade are widely available at local lumber yards and concrete/cement supply houses.

**Resources:** Post-Tensioning Institute; http://www.post-tensioning.org

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**Fig. 4-11a:** The concrete does not bond to the steel rods during curing. **Fig. 4-11b:** After the concrete has cured, the steel rods are tensioned with a hydraulic jack and anchored to the ends of the slab.

**Fig. 4-11a:** El concreto no se liga a las varillas de acero durante su fraguado. **Fig. 4-11b:** Después del fraguado del concreto las varillas de acero se tensan con gato un hidráulico y se anclan a los extremos de la losa.
PHASE: Framing

STRATEGY: Advanced Framing

Techniques: Optimum Value Engineering (OVE)

Benefits: R, O, H

Skill Level: U

Application: N, R, S, D

DESCRIPTION:

Optimum Value Engineering (OVE) refers to framing techniques that reduce the amount of lumber or metal used to build a home while maintaining the structural integrity of the building. Using OVE techniques results in lower material and labor costs and improved energy performance for the home. While the system can be applied as a whole package, many of its components can be used independently, depending upon the specific needs of the project.

OVE uses engineering principles to minimize material usage while meeting model building code structural performance requirements.

The basic techniques of OVE framing include:

- Modular layout and increased spacing of framing members (designing and building to a 24-inch module and using 24 inches-on-center wall and floor framing) can maximize framing material cost savings;
- In-line framing, where floor, wall, and roof framing members are vertically aligned directly below or above one another so loads are transferred directly downward (eliminating the need for double top plates on bearing walls);
- Right-sized headers, where each header is sized for its particular load and span (minimally sized headers only are needed in non-bearing walls; single flat 2x4 members may be used as headers for openings up to 8 feet if the distance to the ceiling above is less than 24 inches);
- T-intersection alternatives, where alternatives to extra studs are used to

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ETAPA: Estructuras

ESTRATEGIA: Técnicas avanzadas para estructuras: Diseño de valor óptimo (OVE)

Beneficios: RR, RC, MAB

Habilidades: NC

Aplicación: CN, RH, VUF, SD

DESCRIPCIÓN:

El diseño de valor óptimo (OVE) es una técnica de construcción de estructuras que reduce la cantidad de madera o metal, pero sin deteriorar la integridad estructural del edificio. La aplicación de técnicas OVE logra reducir la mano de obra y los materiales empleados, así como un mejor desempeño de la casa en la utilización de la energía. El sistema puede aplicarse como un paquete, y algunos de sus componentes también pueden usarse por separado, según las necesidades específicas del proyecto.

El diseño OVE se vale de principios de ingeniería para reducir al mínimo el gasto de material, sin dejar de cumplir con los requisitos de rendimiento estructural plasmados en el código modelo de construcción.

Las técnicas básicas de diseño estructural OVE comprenden:

- Disposición modular, aumento del espaciamiento entre los miembros estructurales (se diseña y se construye según un módulo de 24 pulgadas, separando los miembros 24 pulgadas medidas de centro a centro, en las estructuras de paredes y pisos). De este modo se puede reducir al máximo el costo de materiales estructurales;
- Estructuras alineadas en las que los miembros estructurales de pisos, paredes y techos se alinean verticalmente directamente por debajo o por encima unos de otros, de modo que las cargas se transmiten directamente hacia abajo (haciendo innecesario emplear un traviesa superior doble en las paredes de carga);
- Travesaños de tamaño correcto, determinándose el tamaño de cada uno según la carga particular que portará y el vano (los travesaños de tamaño mínimo solo se necesitan en las paredes que no llevan cargas; pueden emplearse miembros separados planos de 2x4 como travesaños en vanos de hasta 8 pies, siempre que la distancia hasta el cielo raso no sobrepase las 24 pulgadas);
- Alternativas a la intersección en “T” en lugar de añadir montantes (studs) adicionales para
provide drywall backing at T-intersections;

- Two-stud or California corners, where only two studs are used at an outside building corner, one at the end of each framed wall (any additional framing is needed only to support the interior wall surface at the corner).

**Installation:** Constructing with OVE techniques does not require any special tools or equipment beyond conventional framing tools. However, builders unfamiliar with OVE techniques may need training, and the initial use of these techniques may temporarily slow down framing operations. Material cost savings should be balanced against replacing wrong-sized headers, changing stud spacing, and slowing down the framing process.

To gain maximum economy, careful planning is also needed. Pay special attention to the spacing of window and door openings. For designs that are built repeatedly, it pays to produce wall-framing layout drawings to guide the building crews. Crews are likely to be slowed down until they are used to being careful to avoid using unnecessary studs, instead of simply adding a stud where needed. Some method of coding partitions on the plans will also help builders in determining which openings need headers, and what size.

Once the builders are used to the OVE techniques, installation should be slightly easier because it will be more predictable, and it will be quicker because fewer parts are installed.

**Limitations:** Working to a module typically works best on simple plans. Non-bearing partitions typically cannot be held to the module. Floor decking, cladding and interior finish materials need to be sized to span the added dimension (24 inches) without undesirable deflection. Model codes allow load bearing walls framed with 2x4 studs spaced at 24 inches-on-center; however, in high-wind zones, 16 inches-on-center framing may be necessary to meet with loads.

**Code/Regulation:** OVE techniques are accepted by all building codes. In high-wind areas, check with local code authorities about any restrictions on single top plates or 24 inches-on-center framing at exterior load bearing walls.
**Availability:** Materials for implementing OVE techniques, including drywall clips, are widely available from local lumber yards.

**Resources:** PATH Inventory—Advance Framing Techniques: Optimum Value Engineering (OVE)


Buildings for the 21st Century Technology Fact Sheet—Advanced Wall Framing. 2000

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**Disponibilidad:** Los productos para aplicar las técnicas OVE, incluidas las grapas para planchas de yeso, están ampliamente disponibles en los almacenes de madera locales.

**Recursos:** Inventario del PATH—Técnicas avanzadas para estructuras: Diseño de valor óptimo (OVE) http://www.toolbase.org

Cost-Saving Construction Opportunities and the HOME Program: Making the Most of HOME Funds. Redactado por la División de Investigación sobre Vivienda Asequible del Centro de Investigación de la Asociación Nacional de Urbanizadores, Oficina de Desarrollo Normativo e Investigación, Departamento de Vivienda y Desarrollo Urbano de los EEUU. http://www.toolbase.org

Hoja de datos sobre la tecnología de construcción para el siglo 21—Técnicas avanzadas para estructuras de paredes. 2000

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**Fig. 4-13a** Position clip support for gypsum board so it does not interfere with trim nailing.

**Fig. 4-13b** Backer support for gypsum board.

**Fig. 4-13c** The first drywall sheet is installed against the side with clip or backer.
PHASE: Framing
STRATEGY: Engineered Trusses

Benefits: A, O
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Engineered roof and floor trusses offer consistent performance, predictable quality, and superior structural characteristics. Usually made of 2x4s connected by metal-plates, they are cost-effective alternatives to solid wood framing. For example, raised heel roof trusses (or energy trusses) allow a full thickness of attic insulation all the way out to the eaves, unlike conventional trusses where insulation is held back or compressed. In homes with crawlspaces or more than one story, open-web, or parallel flat-chord floor trusses allow for simpler and less expensive installation of plumbing, electrical work, and ductwork within the trusses than with conventional solid wood or I-joist floor joists.

Products exist that combine an open-web floor truss and a trimmable section of dimensional lumber or wooden-I joist at the ends, allowing the product to be trimmed at the construction site, eliminating the need for custom-made floor trusses. This adds flexibility to the product that does not exist with the typical open-web floor joist.

Installation: Installation of raised heel roof trusses is similar to conventional roof trusses. They can usually be installed at 24 inches-on-center. Consider ordering trusses with an enlarged, center bottom chord to allow for attic storage.

Installation of open-web floor trusses is similar to conventional floor joists. They can usually be installed at 24 inches-on-center. The installation of a trimmable floor joist made with I-joists on the end is similar to the installation of an I-joist. The installer must follow installation details, which often include squash blocks at center bearing points, web stiffeners, and blocking and/or reinforcement at cantilevers and other locations. Bracing...
perpendicular to the truss may be required depending on the span and the manufacturer. The details for the truss made with dimensional lumber for the trimmable ends include the typical bridging or bracing seen with wood floor trusses. Because the ends are solid dimensional lumber, the details at bearing points and cantilevers are not as complicated as with the truss that uses an I-joist on the trimmable end.

**Limitations:** Engineered trusses need to be specifically engineered for the application. While some developers use variations on the same plan, be sure to get the trusses resized when any changes are made to the house structure.

**Code/Regulation:** Engineered trusses are accepted by all codes. However, they must be designed to the appropriate structural provisions of applicable building codes. Often, code officials will accept an approved design provided by the distributor, as is typical with I-joists and floor trusses. Check with the local code authorities on any documentation that may be required.

**Availability:** Engineered trusses can be special ordered from lumber supply houses. The manufacturer contacts below can provide a listing of distributors in the Southwest, or otherwise provide ordering information.

**Resources:** PATH Technology Inventory—Trim-able Open Web Floor Truss


**Manufacturers:** TrimJoist Corporation; http://www.trimjoist.com/
Open Joist 2000; 800-374-8784 or 800-567-8644; www.cwp.org
SpaceJoist TE, LLC, 1101 N. Great SouthWest Parkway, Arlington, TX 76011; 800-238-8678; Fax: 817-652-3079; www.spacejoist.com

**Fig. 4-15 Raised heel truss allows installation of insulation all the way out to the eaves.**

**Fig. 4-15 Las armaduras con talón elevado permiten la instalación del aislamiento hasta el canalón del alero.**

**Disponibilidad:** Las armaduras calculadas pueden pedirse con las características particulares deseadas en los almacenes de madera. Comunicándose con los fabricantes indicados más abajo obtendrá una lista de los distribuidores en el suroeste del país, y otros datos sobre cómo hacer pedidos.

**Recursos:** Inventario de tecnología del PATH—Armadura para pisos, recortable y con alma abierta http://www.toolbase.org

**Fabricantes:** TrimJoist Corporation http://www.trimjoist.com/
Open Joist 2000; 800-374-8784 o 800-567-8644; www.cwp.org
SpaceJoist TE, LLC, 1101 N. Great SouthWest Parkway, Arlington, TX 76011; 800-238-8678; Fax: 817 652-3079; www.spacejoist.com
PHASE: Framing
STRATEGY: Residential Light Gauge Steel Framing

Benefits: A
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Residential steel framing utilizes cold-formed steel members for walls, floors, and roofs. Although there are a variety of shapes available, the primary shapes used in residential construction are the C-shape stud and the U-shaped track with standard dimensions similar to wood framing members in stick-framed construction. Framing members are generally produced in thickness of 14 to 24 gauge, are dimensionally stable, and are resistant to corrosion, warping, and termites. Steel framing members also have pre-punched holes that allow for easy installation of electrical wiring and plumbing.

Steel framing contains up to 28% recycled material and construction waste generated during framing is 100% recyclable. Steel framing provides excellent design flexibility due to the inherent strength of steel, which allows it to span increased distances, and it can be designed to withstand high wind and seismic loads.

Framing weighs up to two-thirds less than conventional materials. Lightweight steel framing lends itself to panelization techniques that can speed the on site construction process by allowing the assembly of walls in controlled environments. Depending on the fluctuation of prices for wood framing, steel framing can be a cost-effective alternative.

Installation: Site-built or conventional steel framing is typically a one-for-one substitution for wood framing members used for both non-load-bearing and load-bearing applications. The advantage of steel framing is that it is lighter and more resistant to corrosion and termites. Steel framing members can be pre-punched, allowing for easy installation of electrical wiring and plumbing.

Fig. 4-16a Steel-framed metal roof, Primavera Builders, Tucson, AZ
Fig. 4-16b Techo metálico con estructura de acero, Primavera Builders, Tucson, Arizona
bearing and load-bearing applications. The steel studs, joists, and rafters fit into a top and bottom track. Steel framing members can be cut with a chop saw, aviation snips, or electric shears. The primary fastener used in steel framing is the self-drilling screw.

Typically, the top track is not capable of transferring vertical loads. Therefore, studs, joists, and rafters must be aligned vertically to transfer vertical loads. This framing technique is called in-line framing.

**Limitations:** Steel conducts heat/cold in a process called thermal bridging. When a steel stud channels the exterior climate across its width, the effectiveness of the cavity insulation is compromised. Installers must install a thermal break—in the form of an air gap, rigid insulation, or exterior insulating sheathing—to prevent thermal bridging. Also, while the steel frame lays out similarly to the wood, there can be a significant learning curve for the carpenter.

Steel framing is often used with wood framing components in special locations, such as door and window framing.

**Code/Regulation:** Steel framing is recognized by all major building codes. A set of prescriptive methods for residential steel framing was adopted by the Council of American Building Officials (CABO), in the CABO One and Two Family Dwelling Code, and International Residential Code (IRC 2000). The prescriptive methods contain tables for stud sizing and spacing, joist and rafter spans, fastener schedules, and construction details. In areas that have adopted these recent codes, the prescriptive methods will allow construction of site-built framed steel homes without the certification of a professional engineer. Otherwise, a professional engineer may be required to design, review, and seal plans.

**Availability:** Steel framing is widely available from local sources. Steel framing is often used with wood framing components in special locations, such as door and window framing.

**Fig. 4-16b** Interior steel framing, Primavera Builders, Tucson, AZ.

**Fig. 4-16b** Estructura de acero para interiores, Primavera Builders, Tucson, Arizona.

**Fig. 4-16b** Estructura de acero para interiores, Primavera Builders, Tucson, Arizona.

**Fig. 4-16b** Estructura de acero para interiores, Primavera Builders, Tucson, Arizona.
lumber yards or directly from manufacturers’ distributors.

**Resources:** PATH Technology Inventory—Residential Light Gauge Steel Framing

Light Gauge Steel Engineers Association, 1726 M Street, NW, Suite 601, Washington, DC 20036-4523; 202-263-4488; Fax: 202-785-3856; www.lgsea.com

Steel Framing Alliance (SFA), (Formerly North American Steel Framing Alliance), 1726 M Street, NW, Suite 601, Washington, DC 20036-4523; 202-785-2022; Fax: 202-785-3856; www.steelframingalliance.com
PHASE: Exterior
STRATEGY: EIFS-Drainable Systems

Benefits: A, O
Skill Level: S
Application: N, S, D

DESCRIPTION:
Exterior Insulation and Finish Systems (EIFS), also called synthetic stucco, are available in drainable or barrier systems that resemble traditional masonry stucco finishes. EIF systems are aesthetically attractive to many people due to the variety of colors and textures available, and special architectural features that are easily created. They are also less prone to surface cracking than traditional stucco. While about the same cost as brick veneer, drainable EIFS, if properly applied, can benefit the homeowner by providing an insulating exterior finish without the worries of water damage associated with barrier EIFS (a barrier EIFS resists water penetration at its outer surface but does not allow water that gets behind the exterior surface to drain out of the wall system).

Installation: Drainable EIF core systems consist of an extruded (XPS) or expanded polystyrene (EPS) or a polyisocyanurate foam glass fiberboard. They are applied with special mechanical fasteners or adhesives to a metal, plastic, or glass fiber mesh, creating a drainage plane. Alternatively, a grooved foam board can allow drainage. The mesh covers a weather-resistant barrier, such as building paper or housewrap, which in turn covers the sheathing or substrate. OSB, plywood, and exterior-grade gypsum sheathing are the most common substrates. A base coat of a cement/polymer mixture covers the insulation board and provides a base for embedding a fiberglass mesh. A flexible, acrylic-modified finish coat in the desired color and texture is applied over the base coat. Application of a special sealant and flashing are also required to provide water-tight seals and to divert water from critical junctions between EIFS and building components.

Note that only manufacturer-trained installers using materials made or approved by the manufacturer or their distributors should be employed for EIFS installations.
approved by a single manufacturer should install EIFS. Proper design and careful selection and installation of materials, such as weather-resistive barriers, flashing, and sealants are critical in order to avoid water intrusion problems and to maintain manufacturer warranties. The developer, architect, or builder should be fully aware of all special requirements and conditions, including those of the manufacturer and the EIFS Industry Manufacturers Association (EIMA), to ensure that requirements are followed without exception.

**Limitations:** Water accumulation problems that occur with barrier EIFS can also occur with drainable systems if incorrectly designed or installed. Water intrusion, impact damage, cracking, adhesion failure, finish delamination, and staining from dirt, mold, or mildew can occur. Colder temperatures and wet conditions usually hamper installation and special protection during construction may be necessary to protect uncured materials. Some builders’ insurance carriers will not cover houses with drainable and/or barrier EIFS due to the problems with barrier systems. This may change, as drainable systems become more accepted and less prone to water intrusion.

Because drainable systems for residential application are relatively new, a limited number of trained and experienced installers are available. The EIFS product manufacturer should be contacted for a listing of trained installer contractors.

**Code/Regulation:** Some building codes restrict the use of barrier EIFS. Some areas allow only drainable systems and require third-party inspections during construction phases of the EIFS system.

**Availability:** Most EIFS manufacturers now market drainable EIFS. EIFS system components are typically available to trained contractors through specialty distributors.

**Resources:** PATH Inventory—EIFS-Drainable Systems


EIFS Industry Members Association (EIMA), 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260; 800-294-3462; http://www.eima.com
PHASE: Exterior
STRATEGY: Fiber-Cement Siding

Benefits: A, O
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Fiber-cement siding and panels are cost-effective alternatives to wood siding and panels (such as T1-11). Supposedly more durable than wood, fiber-cement siding and panels are especially appropriate for hot and humid climates because they are resistant to rot, fungus, and termite infestation. They are non-combustible, warranted to last 50 years, and have excellent weathering characteristics, strength, and impact resistance. Fiber-cement siding and panels come in a variety of textures that are said to provide the appearance of wood without the cost associated with maintaining wood.

Fiber-cement siding and panels are composed of cement, sand, and cellulose fiber that has been autoclaved (cured with pressurized steam) to increase its strength and dimensional stability. The fiber is added to reinforce the concrete and to prevent cracking, which is inherent in concrete. The planks come in 5-inch to 12-inch widths and are about 5/16 inches thick. Panels come in 4-foot-wide sheets up to 12 feet long.

The installed costs of fiber cement are reported to be less than traditional masonry or synthetic stucco, equal to or less than hardboard siding, but more than vinyl siding.

Installation: Like wood siding, fiber-cement siding is installed over studs or exterior wall sheathing with an appropriate water-resistant barrier, using galvanized nails or screws that penetrate into wall studs. The fiber-cement planks can be cut with a carbide-tipped saw blade, snapper shears, or with a guillotine-type cutter. For finishing, fiber-cement products come either primed or unprimed. They require an alkaline-resistant primer, and manufacturers generally recommend using a 100% acrylic topcoat.

Like exterior sheathing/finish panels (T1-11), fiber cement panels are...
installed over studs using galvanized nails or screws that penetrate into wall studs (Fig. 4-18). The fiber-cement panels can be cut with a carbide-tipped saw blade, snapper shears, or with a guillotine-type cutter. For finishing, fiber-cement products come either primed or unprimed. They require an alkaline-resistant primer, and manufacturers generally recommend using a 100% acrylic topcoat.

Limitations: Color is surface-applied and the topcoat requires maintenance. There are restrictions on blind nailing products with greater widths due to wind uplift. Face nailing can be used with all products, but staples cannot be used at all. Dust protection and control are required when cutting with a circular saw.

Code/Regulatory: Fiber-cement siding is recognized as an exterior cladding by the National Evaluation Service (NES), Inc. and has issued National Evaluation Reports (NER). Information on these NERs can be obtained by contacting NES at its web site shown below.

Availability: Fiber-cement products are widely available from local lumber yards.

Resources: PATH Inventory—Fiber Cement Siding
National Evaluation Service, Inc., 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041; 703-931-2187; Fax: 703-931-6505; www.nateval.org
North American Fiber Cement Assoc. (NAFCA), 1210 W. Northwest Hwy., Palatine, IL 60067; 847-991-8628
PHASE: Exterior
STRATEGY: Mortarless Brick Veneer

Benefits: R, A, O
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Mortarless brick veneer is an exterior wall system that uses concrete bricks cast in special shapes that require no mortar and can be installed by anyone with basic carpentry skills. Like traditional split-face brick, the system is strong and durable and will not dent, chip, or fade in color. The installed cost of the system is less than conventional brick veneer walls.

The dimensions and appearance of the brick faces are similar to traditional split-faced bricks. While they are installed in staggered rows, hidden from view is the unusual shape of the cast block, which allows shingle-like overlapping. Because the system uses the existing wall framing structure to support the weight of the bricks, it does not require footings or mortar, and can be used on new or existing homes.

The mortarless character of the system avoids pointing and moisture problems associated with deteriorated mortar, and limits damage that might occur from movement and cracking during settling or seismic activity. Also, the system resists seasonal freeze-thaw cycles and water penetration by providing an interior drainage plain from the barrier wrap.

Installation: The manufacturer provides an installation manual to assist with project planning. It takes 6.1 blocks to cover one square foot of wall area. Additional cast block profiles are available for inside and outside corners, and window sills.

Exterior walls must be covered with conventional OSB sheathing and barrier wrap, and fall within certain size guidelines to support the weight of the block material. Windows and openings require proper barrier flashing. Furring and starter strips are then installed on the OSB at each stud location, using corrosion-resistant screws. To begin the installation of the brick fac-
ing, each block in the first (bottom) row requires attachment with two screws
to the starter strip. From this point, each course of block is laid out the same
as a traditional brick wall. The shape of the blocks allows subsequent rows
to interlock, so that connections need to be made only on every fourth course
by screwing the upper tab of the brick into the furring strips.

The installation manual outlines procedures for constructing inside and outside corners, accommodating windows, doorways, or other architectural features, and recommends terminations to the soffit. A PVC starter strip and window trim profiles are also available.

Limitations: The weight of the bricks is borne by wall framing, but it must be remembered that the weight added to the structure will be significant. The installation manual provides basic guidelines for proper support and maximum wall sizes, and these should be carefully followed. Installers must pay special attention to the condition of the framing and to the weight transfer above wall setbacks, windows, and foundations.

Moisture that enters through the mortarless brick joints can drain over the surface of the barrier wrap. Careful attention should be given to the proper installation of the barrier wrap and flashing.

Code/Regulation: The mortarless system complies with governing local codes and regulations with regard to masonry when installing units. The concrete units have a minimum 28-day compressive strength of 3,500 psi, exceeding the minimum requirements in ASTM C 90 and are classified as Type II nonmoisture-controlled units, Grade N. The manufacturer, as recommended by the Uniform Building Code, has tested the performance of mortarless brick attachments under wind suction and they have exceeded the requirements for brick attachments.

Availability: This patented system is licensed to regional manufacturers. Specific locations of such manufacturers are listed on the company’s web site referenced below. Each manufacturer distributes the product to a network of dealers.

Códigos y normas: El conjunto de ladrillos sin mortero cumple con los códigos y normas locales concernientes a la instalación de unidades de mampostería. Las unidades de concreto presentan en 28 días una resistencia a la compresión mínima de 3,500 libras por pulgada cuadrada, por encima de los requisitos mínimos fijados por la norma ASTM C 90. Las unidades se clasifican como tipo II, no controladas por humedad, grado “N”. Cumpliendo con las recomendaciones del Código Uniforme de Construcción, el fabricante ha sometido a pruebas de rendimiento de las uniones de ladrillo sin mortero bajo condiciones de succión por viento. El resultado obtenido fue superior a los requisitos para las uniones de ladrillo normales.

Disponibilidad: Este sistema patentado tiene licencia para su uso por parte de los fabricantes regionales en los Estados Unidos. La ubicación específica de dichos fabricantes aparece en el sitio Web de la compañía, que listamos más abajo. Cada uno de los fabricantes distribuye el producto a una red de distribuidores en su territorio designado. El fabricante puede entregar a los posibles clientes una lista de los instaladores locales en el área. Cada fabricante cuen-
dealers in its assigned territory. The manufacturer can provide a list of installers in the local area to prospective customers. Each manufacturer has its own cost structure and line of colors. They are based on local labor and material costs as well as the type of aggregate available in the area.

**Resources:** PATH Inventory—Mortarless Brick Veneer  
Novabrik International Inc., 8138, Metropolitain East, Montreal Quebec, H1K 1A1, Canada; 800-265-2522; Fax: 514-355-2922; www.novabrik.com
PHASE: Exterior
STRATEGY: Plastic Exterior Trim

Benefits: R, A, O
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
An alternative to wood exterior trim is high density, plastic exterior trim. It is more durable, not subject to bacterial rot and does not shrink or swell like wood, and has a lower installation cost than wood. It can be molded into shapes and profiles that resemble more expensive hand-carved wood or multi-layered moldings.

Plastic exterior trim is normally sold primed and ready for paint, or with a stain for a simulated wood finish. PVC plastic trim is less costly than polyurethane plastic, but its surface must be lightly sanded prior to painting.

Installation: Installing plastic exterior trim is very similar to wood molding, and with few exceptions uses the same process, tools, and fasteners. When splicing pieces together on long runs, a “butt” joint (molding cut with square ends) is used instead of a “miter” (molding cut with a 45-degree bevel) common with wood moldings. Unlike wood corners, plastic exterior molding is mitered, not cope (cutting one piece of molding with a “coping” saw to match the contour of the adjoining piece).

Adhesives are typically used to attach plastic trim, although nails may be used to attach molding to a wall temporarily until the adhesive has hardened. Adhesive is placed on all joints (corners and splices) to prevent gaps from opening during the life of the structure. Nail holes, gaps, and indentations can be filled with any suitable filler. Some manufacturers of plastic trim do not recommend flashing their materials, which provides additional savings in labor and materials.

Limitations: Plastic trim and moldings are new to many installers. Some...
manufacturers have order lead times of greater than one week. Purchasers must be careful to order the correct amount and installers must minimize mistakes during installation for on-time project completions.

**Code/Regulation:** Some manufacturers use a fire-resistant coating on their plastic exterior trim to meet flame-spread requirements.

**Availability:** Plastic exterior trim is available from local lumber yards, or from manufacturers and local distributors.

PHASE: Windows
STRATEGY: Low-E Glass and Spectrally Selective Glazing

Benefits: O
Skill Level: S
Application: N, R, S, D

DESCRIPTION:
Innovations in windows, such as double-glazed, gas-filled (usually with argon or krypton) windows, provide greater insulation and improved energy efficiency. Low-emissivity (low-e) coatings on glass are used in double-pane windows to control thermal radiation, with the type and placement of the coatings varying according to the climate where the window will be used. Tints or reflective surfaces may also be incorporated to achieve better performance.

Spectrally selective glazing uses low-e coatings that filter out the heat-producing parts of the solar spectrum, but still allow the greatest possible visible light transmittance. Windows with spectrally selective glazing allow more natural light into homes while controlling radiated heat, providing maximum energy efficiency and reducing heat loads, especially in areas where cooling costs are high.

Installation: The National Fenestration Rating Council (NFRC) has established a labeling system to aid in the process of window selection.

Energy performance data on NFRC window labels includes a listing of the Solar Heat Gain Coefficient (SHGC), which is the amount of heat transmitted through a window expressed as a decimal factor between 0.0 and 1.0. In the Southwest, where the heating and cooling costs are roughly equivalent, or cooling dominated, a low SHGC rating (under 0.45) is desirable to reduce the effect of solar radiation on air-conditioning costs. This also reduces heat loss from warmed interior space to cold outside air.

Spectrally selective glazing is indicated by a low SHGC rating (0.45 or less) and a high T_{vis} rating (0.50 or greater), which is the percentage of light transmittance. Spectrally selective glazing uses low-e coatings that filter out the heat-producing parts of the solar spectrum, but still allow the greatest possible visible light transmittance. Windows with spectrally selective glazing allow more natural light into homes while controlling radiated heat, providing maximum energy efficiency and reducing heat loads, especially in areas where cooling costs are high.
mitted through glass. Where possible, specify windows with a solar heat gain coefficient under 0.45 and a visual light transmittance rating of over 0.50.

**Limitations:** Spectrally selective glazing windows may not be readily available from local lumber yards.

**Code/Regulation:** The Model Energy Code and some local building codes require energy rated window assemblies for new construction.

**Availability:** Most window manufacturers offer high performance lines that incorporate low-e coatings. Not all have spectrally selective products, or identify them as such. Check availability with local lumber yards or window/door suppliers.


National Fenestration Rating Council, P.O. Box 7031, Silver Spring MD 20910; 301-589-1776; www.nfrc.org

Fig. 4-23 National Fenestration Rating Council (NFRC) labeling system.

Fig. 4-23 Sistema de etiquetado del Consejo Nacional de Calificación de Ventanas (NFRC).
PHASE: Roof  
STRATEGY: Cool Roofing

Benefits: A, O, H  
Skill Level: SS  
Application: N, R, S, D

DESCRIPTION:
Cool roofs are based on simple science: dark materials absorb more heat than light materials. Most traditional dark-colored roofs absorb 70% or more of the solar energy striking them—resulting in peak roof temperatures of 150 to 190°F. By comparison, white, reflective roofs are 50 to 60°F cooler on hot days. The resulting reductions in the transfer of heat into the air-conditioned spaces below can decrease cooling cost by 20% on average. In addition to reducing energy consumption, cool roofs offer many other benefits, including decreased roofing maintenance and replacement costs; improved home comfort; and reduced impact on surrounding air temperatures (heat island effect).

Cool roofing exists for both low-sloped (flat) and sloped roofs. There are several types of cool roofing:

- Cool roofing asphalt shingles are light-colored roofing products composed of asphalt-saturated mats made from organic felts or fiberglass. The asphalt is protected from the sun’s ultraviolet light by roofing granules pressed into the shingle while it is hot and soft. Cool asphalt shingles are a good choice for homes with sloped roofs.

- Cool roof coatings are light-colored (white/silver) surface treatments best applied to flat roofs in good condition. With the consistency of thick paint, these coatings have additives that improve their adhesion, durability and resistance to dirt, algae, and fungus. “Cementitious” coatings have cement particles, while “elastomeric” coatings contain polymers to improve adhesion and reduce brittleness.

- Cool single-ply roofing is a light-colored (white) roofing product that is applied as a single sheet in a single layer. These single-ply products are made out of a variety of materials, including PVC (polyvinyl chloride), TPO (thermoplastic polyolefins), Hypalon (synthetic rubber developed by Dupont), CPA (pololetinas termoplasticas), Hypalon (un caucho sintetico creado por Dupont), CPA (aleacion de copolimero) y alquitrán modificado SBS (alquitrán estireno butadieno estireno modificado, que no es en realidad de un solo pliegue puesto que se aplica en más de una capa). Las capas de un solo pliegue...
(copolymer alloy), and SBS Modified Bitumen (styrene butadiene styrene modified bitumen, and not actually a single-ply since it should be applied in more than one layer). Single-plys are a good choice for a new flat roof or a flat roof that requires extensive repair.

Cool roofing tiles are light-colored tiles installed on homes with sloped roofs. Cool tiles are usually made of clay, concrete, or fiber cement.

Note that although metal can be highly reflective, it has a low emissivity. Therefore, most metal-based coatings and bare metal roofing have emittance values less than 80%.

**Installation:** Cool roofing asphalt shingles: Installation is similar to conventional asphalt shingles. Check the cool asphalt shingles' installation instructions for surface preparation and installation details.

Cool roof coatings: Roof coatings are applied over an appropriate new or existing roofing membrane (e.g., metal roofing, built-up roofing, modified bitumen roofing, etc.). Installation is similar to conventional aluminum coatings. Cool coatings cannot plug leaks or fix an unsound roof. Repairs must be made prior to coating a roof. Check the cool roof coating's installation instructions for surface preparation and application details.

Cool single-ply roofing: Installation is similar to conventional single-ply roofing. Check the single-ply roofing product's installation instructions for surface preparation and installation details.

Cool roofing tiles: Installation is similar to conventional roofing tiles. Check the roofing tile's installation instructions for surface preparation and installation details.

**Limitations:** Cool roofing usually comes in white or light colors only and may not be attractive to some homeowners.

Cool asphalt shingles are not as durable as cool roofing tiles. However, it is often the more cost-effective choice for sloped roofs. Also, cool roofing tiles are heavy and may require additional roof structures to support the weight.

**Code/Regulation:** Cool roofing products are accepted by all codes.

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Las tejas frescas son tejas de color claro que se instalan en casas con techos inclinados. Las tejas frescas son generalmente de barro, concreto o fibrocemento.

Note que los metales pueden ser altamente reflectores y sin embargo presentar una baja emisividad. Por consiguiente, la mayoría de los revestimientos con componentes metálicos y los techos de metal presentan una capacidad de emisión inferior al 80%.

**Instalación:** Tejas frescas de asfalto: La instalación es parecida a la de las tejas convencionales de asfalto. Consulte en las instrucciones de instalación de estas tejas acerca de la preparación de superficies y los detalles de instalación.

Revestimientos frescos para techos: Los revestimientos para techos se aplican sobre una membrana de techado apropiada, nueva o ya instalada (p. ej. techo de metal, techo multicaspas, techo de alquitrán modificado, etc.). La instalación es parecida a la de los revestimientos convencionales de aluminio. Los revestimientos frescos no detienen las goteras ni sirven para reparar un techo deteriorado. Las reparaciones deben hacerse antes de aplicar el recubrimiento del techo. Consulte en las instrucciones de instalación del revestimiento acerca de la preparación de superficies y los detalles de aplicación.

Capas frescas de un solo pliegue para techos: La instalación es parecida a la de las capas de un solo pliegue convencionales. Consulte en las instrucciones de instalación del producto acerca de la preparación de superficies y los detalles de instalación.

Tejas frescas: La instalación es parecida a la de las tejas convencionales. Consulte en las instrucciones de instalación acerca de la preparación de superficies y los detalles de instalación.

**Limitaciones:** Los techos frescos vienen por lo general en color blanco o claro, un detalle que puede resultar poco atractivo para algunos propietarios.

Las tejas frescas de asfalto no son tan durables como las tejas para techos frescos. No obstante, a menudo resultan una opción más efectiva en función de los costos, en particular si se trata de techos inclinados. Las tejas frescas son pesadas y puede requerirse el uso de estructuras adicionales para soportar su peso.

**Códigos y normas:** En todos los códigos se aceptan los productos para techos frescos.

**Disponibilidad:** Los productos para techos frescos están ampliamente disponibles en la mayoría de almacenes de madera o distribuidoras de productos para techos.
Availability: Cool roofing products are widely available from most lumber supply houses or roofing supply centers.

Resources: California Cool Roofs Information, http://www.coolroofs.info
         Cool Roof Rating Council, www.coolroofs.org

Recursos: Información sobre techos frescos en California (California Cool Roofs Information)
          http://www.coolroofs.info
          Consejo de calificación de techos frescos (Cool Roof Rating Council) www.coolroofs.org
          Base de datos sobre materiales para techos frescos (Cool Roofing Materials Database)
          http://eetd.lbl.gov/coolroof/
PHASE: HVAC
STRATEGY: Evaporative Coolers

Benefits: A, O
Skill Level: S
Application: N, R, S, D

DESCRIPTION:
Evaporative coolers, commonly called “swamp coolers,” use evaporative cooling—the reduction in air temperature that occurs when water evaporates—to cool homes. Evaporative coolers have a low first cost, use much less electricity than conventional air conditioners, and do not use refrigerants such as, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), that can harm the environment.

In a direct evaporative cooler, a blower forces air through a permeable, water-soaked pad. As the air passes through the pad, it is filtered, cooled, and humidified.

Evaporative coolers are sized based on cubic feet per minute (cfm) of airflow. Airflow is typically higher than conventional air conditioning systems. Two to three cfm per square foot, or three to four cfm per square foot in arid desert climates is typical. Improperly sized evaporative coolers will waste water and energy and will not be comfortable. Two-speed coolers are available that can handle varying cooling loads.

Windows or ceiling vents need to be open when an evaporative cooling system is operating. The large volume of fresh air added to the home replaces a significant amount of air that exits. Many systems incorporate a bleed-off valve that purges water about every six hours. This leads to an additional five gallons of water used per hour, but may be necessary to avoid mineral build-up. Bleed-off valves are generally recommended.

Indirect, or two-stage evaporative coolers are available that do not add humidity to the air, but cost more than direct coolers. Two Stage Evaporative Coolers combine indirect with direct evaporative cooling. This is accomplished by passing air inside a heat exchanger that is cooled by evaporation on the outside. In the second stage, the pre-cooled air passes through a water-soaked pad.
pad and picks up humidity as it cools. The result, according to the manufacturer, is cool air with a relative humidity between 50 and 70%, dependent on the regional climate. A traditional system would produce about 80% relative humidity air.

**Installation:** Most evaporative coolers are roof mounted, but others are mounted through the wall or on the ground in a shaded area. They can be adapted into existing ductwork, designed with dedicated ductwork, or exhausted directly into a diffuser located in a central area of the home. Dedicated ductwork is preferable, but not usually practical, because it requires higher airflows and larger ductwork. Monthly service and maintenance is highly recommended.

**Limitations:** Evaporative coolers are best suited for hot, dry regions. Studies have shown that evaporative coolers use between 3.5 and 10.5 gallons of water per hour of run time. Coolers with a bleed-off valve use more water than those without.

**Code/Regulation:** Evaporative coolers are accepted by all building codes. Check with local code authorities for any restrictions on their use.

**Availability:** Evaporative coolers are widely available from local HVAC supply houses, especially in dry areas of the Southwest.

**Resources:** PATH Inventory—Evaporative Coolers; http://www.toolbase.org/tertiaryT.asp?TrackID=6&CategoryId=1402&DocumentID=2095

**Manufacturers:** AdobeAir, Inc., 500 S. 15th St., Phoenix, AZ 85034; Fax: 602-257-1349; www.adobeair.com

American Water Works Association, 6666 West Quincy Ave., Denver, CO 80235; 303-794-7711; www.awwa.org

Davis Energy Group, 123 C Street, Davis, CA, 95616; 530-753-1100; www.davisenergy.com
PHASE: HVAC
STRATEGY: HVAC Equipment and Duct Installation Within Conditioned Space

Benefits: O, H
Skill Level: S
Application: N, S, D

DESCRIPTION:
Heating, ventilating, and air conditioning (HVAC) equipment and, especially, associated ductwork, is often placed in crawlspaces, attics, and garages. It has been shown that equipment and ductwork in these spaces can result in a loss of 20 to 35% of the energy supplied due to a combination of air leakage and conduction.

Placing HVAC equipment and ductwork fully inside the insulated and air-sealed shell of the house, known as conditioned space, can result in lower initial equipment costs. The required system heating and/or cooling capacity, and ducts themselves, can be downsized, and material and installation costs for duct insulation can be reduced.

Installation: Installation of ductwork may occur in dropped ceilings or interior soffits, within floors (possibly including insulated slabs), or within attics or crawl spaces that are designed as conditioned spaces. When this approach is integrated within more efficient building envelopes, location of outlet registers becomes less critical, eliminating some of the complexity that may be involved in extending ductwork to windows and other remote locations.

Limitations: Running ductwork within floors and walls is often more difficult than running them in generally unconfined spaces like attics and crawl spaces and may also affect the construction sequence. Design/layout of the house itself may be affected because space for HVAC equipment and ductwork within the house is needed.

Limiting combustion equipment within the house may complicate exhaust duct runs and may pose some increased risk of exposure to backdrafted combustion gases.

ETAPA: Calefacción, ventilación y aire acondicionado (HVAC)
ESTRATEGIA: instalación de equipos y conductos de HVAC dentro de espacios acondicionados

Beneficios: RC, MAB
Habilidades: CL
Aplicación: CN, VUF, SD

DESCRIPCIÓN:
El equipo de calefacción, ventilación y aire acondicionado (HVAC), y en particular sus conductos, se instalan habitualmente en áticos, garajes y el espacio entre el piso de la casa y el suelo. Se ha demostrado que el equipo y sus conductos pueden, en dichos espacios, causar una pérdida de entre 20 y 35% de la energía suministrada, debido a fugas de aire y pérdidas por conducción térmica.

Cuando el equipo de HVAC y sus conductos se instalan por completo dentro del caparazón aislado y hermético de la casa, conocido como el espacio acondicionado, se pueden reducir sus costos iniciales. Puede también reducirse la el esfuerzo de calefacción o enfriamiento que se requiere del sistema, así como los conductos y los costos de materiales e instalación de estos.

Instalación: La instalación de la red de conductos puede efectuarse dentro de techos suspendidos, sofitos, dentro de pisos (incluso los de posos con aislamiento), o dentro de áticos o espacios debajo de la casa que se hayan diseñado como espacios acondicionados. Cuando este método se combina con un caparazón más eficiente en las edificaciones, la ubicación de las salidas no es tan importante y desaparece así el problema de extender los conductos hasta las ventanas y otros puntos lejanos.

Limitaciones: La extensión de los conductos dentro de pisos y paredes es generalmente más difícil que su colocación en espacios menos cerrados como áticos y espacios debajo de la casa. También es posible que deba modificarse la secuencia de construcción. Incluso puede afectarse el diseño y trazado de la casa, dado que se necesita un espacio dentro de ésta para instalar el equipo y los conductos de HVAC.

Si se coloca un equipo de combustión dentro de la casa puede complicarse la instalación de conductos de escape y aumentará el riesgo de exposición a los gases de combustión que puedan entrar en la casa, con un contenido potencial de monóxido de carbono. Es probable que el ruido de los ventiladores del sistema de HVAC se note más cuando la unidad se coloca dentro de la casa; no obstante, esto puede resolverse colocando el debido aislamiento alrededor del equipo.
Combustion products, potentially including carbon monoxide. Noise from HVAC system fans may be more evident when placed within the house, although this can potentially be addressed by insulating around such equipment.

**Code/Regulation:** Placing ducts and HVAC equipment within conditioned space should not require any special code approval, although certain requirements for supplying combustion air to furnaces, for example, may apply when these appliances are placed within the house. In areas where energy codes are in place, this method may allow easier or alternate methods of compliance. For example, California’s Title 24 Efficiency Standards provide an efficiency credit for ducts and HVAC equipment placed within conditioned space.

**Resources:** PATH Inventory—HVAC Equipment and Duct Installation within Conditioned Space; http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2092

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**Códigos y normas:** Lo más probable es que para la colocación de los conductos y equipos de HVAC dentro del espacio acondicionado no se requiera la aprobación de un código especial; sin embargo, es posible que se apliquen ciertos requisitos, como los relacionados con el suministro del aire para combustión a los quemadores, cuando los equipos se colocan dentro de la casa. En las áreas en las que se ha impartido un código energético, este método puede facilitar o brindar opciones para el cumplimiento de las normas. Por ejemplo, en el Título 24 de las Normas para Eficiencia de California se proporciona un crédito por eficiencia cuando los conductos y equipos de HVAC se colocan dentro del espacio acondicionado.

**Recursos:** Inventario del PATH—Instalación de equipos y conductos de HVAC dentro de espacios acondicionados http://www.toolbase.org

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**Fig. 4-24** Dropped ceiling or soffit system for single-story houses. The figure shows a sealed-combustion furnace located in a closet indoors and ducts in a dropped ceiling in the hallway and bathroom. The dropped ceiling is sealed and insulated to prevent leakage and heat loss to the attic.

**Fig. 4-25** Webbed floor joist system for two-story houses. As in Figure 4-24, the sealed combustion furnace is located in an inside closet, but supply ducts are located in the space between the floors. This space is sealed from the wall cavities, to prevent conditioned air from leaking out through the attic and crawlspace.

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**Fig. 4-24** Sistema en techos suspendidos o sofitos para casas de una planta. En la figura puede verse un quemador de combustión sellada, ubicado en un closet dentro de la casa, con los conductos en el techo suspendido, en el pasillo y el baño. El techo suspendido está sellado y aislado para evitar las fugas y el escape de calor en el sótano.

**Fig. 4-25** Piso con armadura de viguetas para casas de dos plantas. Como en la Figura 4-24, el quemador de combustión sellada se coloca dentro de un closet, aunque los conductos de suministro necesarios se instalan en el entresuelo. Este espacio se sella de las cavidades de las paredes para evitar que escape el aire acondicionado a través del sótano y del espacio entre la casa y el suelo.
**PHASE: HVAC**  
**STRATEGY:** HVAC Sizing Practices

**Benefits:** R, O, H  
**Skill Level:** SS  
**Application:** N, R, S, D

**DESCRIPTION:**
Rules of thumb often used to size HVAC equipment can result in improperly sized equipment and dissatisfied homeowners. Proper sizing of HVAC equipment can mean savings in initial and operating cost of mechanical equipment and increased comfort to occupants. Equipment oversizing causes frequent cycling of equipment and poor dehumidification during cooling. Decreased cost of HVAC equipment from proper sizing can offset increases in cost associated with increasing the energy efficiency of a home.

It is recommended that builders use the Air Conditioning Contractors of America (ACCA) guidelines, ACCA Manual J Residential Load Calculation, for sizing HVAC equipment and ductwork. This enables contractors to estimate heating and air conditioning loads more accurately. Using Manual J, a contractor calculates heat loss from the building through walls and ceilings, leaky ductwork, and infiltration through windows, doors, and other penetrations as well as heat gain into the building from sunlight, people, lights, and appliances, doors, walls, and windows, and infiltration though wall penetrations. Design conditions for the area are also used as inputs into load calculations.

**Installation:** Most of the information needed for sizing cooling loads in new homes can be taken directly off house plans. Essential information includes solar gain, which is a function of window area, orientation of the house, window type and glazing (such as low-e, gas-filled), shading from landscaping and building overhangs, and shingle and siding color. In addition, infiltration levels of the house need to be determined and may require the use of a blower door test. In retrofit applications, blower door testing is more important for load calculations. Load calculations should be done on a room-by-room basis so that ductwork can be sized accordingly.
Independent contractors are available to perform blower door testing. Learning load calculation software is not difficult, but taking a class can help. If a number of homes with similar plans are being calculated, costs may be lower. However, the additional cost is usually recouped immediately because the system can typically be downsized.

Limitations: There is an increased cost associated with performing Manual J calculations over simply using rules of thumb. Additional costs are incurred if a blower door test is conducted.

Code/Regulatory: Some jurisdictions, such as California, require load calculations.

Availability: The guide, Manual J Residential Load Calculation, is available through ACCA. There are several software packages available that perform Manual J calculations with user-specified inputs. Software packages include: Right-J, HVAC-Calc, RHVAC, Residential 3.0, and RL5M. Most software packages cost around $400 or $500.

Air Conditioning Contractors Association, 2800 Shirlington Road, Suite 300, Arlington, VA 22206; 703-575-4477; Fax: 703-575-4449; www.acca.org

Código de las cargas debe hacerse cuarto por cuarto de modo que el tamaño de los conductos correspondientes pueda calcularse debidamente.
Es posible contratar a contratistas independientes para que efectúen la prueba de soplador en puerta. Aunque no es difícil aprender a usar el software para calcular las cargas, es conveniente tomar una clase. Si se hace el cálculo para varias casas con planos similares, pueden reducirse los costos. No obstante, el costo adicional se recupera habitualmente de inmediato porque casi siempre puede reducirse el tamaño del sistema.

Limitaciones: El cálculo de cargas valiéndose del Manual J implica más gastos que cuando se hace siguiendo las reglas habituales. La realización de una prueba de soplador en puerta produce gastos adicionales.

Códigos y normas: En algunas jurisdicciones como California se exige hacer un cálculo de cargas.

Disponibilidad: La guía mencionada, Manual J Residential Load Calculation, puede obtenerse de la ACCA. Existen varios paquetes de software que realizan los cálculos según el Manual J, tomando como base los datos que introduce el usuario. Algunos de estos paquetes de software son: Right-J, HVAC-Calc, RHVAC, Residential 3.0, y RL5M. La mayoría de los paquetes de software cuesta entre $400 y $500.

Recursos: Inventario del PATH—Cálculo del tamaño del equipo de HVAC http://www.toolbase.org
Air Conditioning Contractors Association, 2800 Shirlington Road, Suite 300, Arlington, VA 22206; 703-575-4477; Fax: 703-575-4449; www.acca.org
PHASE: HVAC
STRATEGY: Programmable Thermostats

Benefits: O, H
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Programmable thermostats save energy by allowing temperatures to be set according to whether or not the house is occupied. It is estimated that cost savings of approximately 10% per year are possible for heating and cooling by setting temperatures back to 10 to 15% of the comfort level eight hours each day. Programmable thermostats can automatically store and repeat settings daily with allowance for manual override. By eliminating manual setback, which is easy to forget, they allow the setting of more comfortable temperatures in the morning before occupants wake. Temperature setback can be adjusted for both heating and cooling seasons. When purchasing a programmable thermostat, it is necessary to ensure the thermostat is compatible with the HVAC system.

Installation: The installation of most programmable thermostats is relatively safe and simple because they are connected to low-voltage wiring, but may become complicated if such wiring does not already exist. Only qualified electricians or HVAC contractors should install line-voltage programmable thermostats for electric baseboard heaters because the wiring carries higher voltages.

Limitations: Limitations on use vary according to HVAC system type. For example, turning the heating temperature back in heat pumps will often cause the auxiliary electric resistance heating to turn on, defeating any potential energy gains.
**Code/Regulation:** Utility companies or government agencies in some areas may provide incentives or rebates for installing programmable thermostats.

**Availability:** Programmable thermostats are readily available from various HVAC contractors/suppliers and home centers. The EPA maintains a list of Energy Star programmable thermostats.

**Resources:** PATH Inventory—Programmable Thermostats http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=3719
PHASE: HVAC
STRATEGY: Water Heaters With Space-Heating Capability

Benefits: R, A, O
Skill Level: S
Application: N, R, S, D

DESCRIPTION:
There are several types of combination water heater and space heating (either forced air or hydronic) systems: modular, integral, and tankless. A modular unit has a high output water heating tank connected to a separate air handler by pipes. An integral unit is the most common with both the high output water heater and the air handler in one cabinet. A tankless unit is a hot water on-demand system that will heat the water to the desired temperature (see Tankless Water Heaters). It is generally placed near the source of hot water output, such as the bathroom or kitchen. The water heater portion of the combination system can be fired by gas, oil, propane, electric, solar power, or a combination of any of these, while the tankless system is either electric or gas.

For forced-air systems, hot water is provided by a domestic water heater. Recirculating loops of pipe connect the water heater to the air handler. Heat transfer takes place in a finned tube coil in the air handler. Heated air is then forced out by a blower and circulated through the house via ductwork.

If a hydronic system is used, the same principle applies for the hot water heater, but instead of heating up air, the hot water is pumped through radiant heating pipe under the insulated floor or in pipes along the baseboards. Water is then recirculated back to the water heater to be reheated.

The combination unit costs slightly more than a typical system with separate water heater and furnace, but installation costs are reduced due to the elimination of the furnace. Since only one source of heat is required, multiple utility hook-ups are not necessary. Also, fewer moving parts allow easier maintenance and less service. If the tankless water heater is used, only a small space near the sink is required, thus eliminating an entire area dedicated as a utility room.
**Installation:** The modular or integral systems are singular units designed for new construction or entire system replacements. There are some retrofit units available that can use an existing water heater, but check with the specifications and consult the supplier. Supply and return runs of copper pipe are required for the pump attachment to the heat distribution line. Recently, plastic piping has been approved for use in some areas, as an alternative to the more expensive copper pipes. The air distribution system is conventional galvanized ductwork, and should be sealed to prevent leakage of air or allow dirt/dust to enter the system.

The tankless water heater system is designed for installation near the water source. Pipes are then run from this unit to either baseboard heaters or to a radiant floor system.

**Limitations:** The cost of buying a new or retrofit unit can be considerably higher than buying a separate furnace and water heater. To maintain the efficiency of heat distribution, unheated spaces should be insulated to minimize heat loss. This could be expensive in retrofit installations.

**Code/Regulation:** Most systems are UL (Underwriter’s Laboratories) and AGA (American Gas Association) certified. However, check with the local building permit department before installation. Since the water in the coil mixes with the domestic hot water, some inspectors might request a pump timer because the water could become stagnant.

**Availability:** These water heaters are widely available from local plumbing supply houses.

**Resources:** PATH Inventory—Water Heaters With Space Heating Capability http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2084

**Instalación:** Los sistemas modulares o integrales son unidades independientes diseñadas para instalarse en construcciones nuevas o reemplazar sistemas completos. Aunque hay unidades de actualización disponibles que se valen de un calentador de agua ya instalado, recomendamos comprobar las especificaciones y consultar con el proveedor. Se necesitan tramos de tubería de cobre de suministro y retorno para conectar la bomba a la línea de distribución de calor. El uso de tuberías de plástico se aprobó recientemente en ciertas áreas, como alternativa para las tuberías de cobre, más costosas. El sistema de distribución de aire consiste en una red de conductos galvanizados convencionales. Debe sellarse para evitar las fugas de aire o la penetración de polvo y suciedad al sistema.

El sistema calentador de agua sin tanque se ha diseñado para instalarse cerca de la fuente de agua. Las tuberías se extienden desde esta unidad hasta calentadores a lo largo de los zócalos o hasta un sistema radiante instalado en el piso.

**Limitaciones:** El costo de una unidad nueva o actualizada puede ser considerablemente más alto que cuando se compra por separado una caldera de calefacción y un calentador. Para mantener la eficiencia en la distribución del calor debe reducirse su pérdida aislando los ambientes que no requieren calefacción. Esto puede representar un gasto importante si se trata de obras de remodelación.

**Códigos y normas:** La mayoría de sistemas cuenta con certificación UL (Underwriter’s Laboratories) y AGA (American Gas Association). A pesar de esto, recomendamos consultar al departamento local de permisos de construcción antes de efectuar la instalación. Siendo que el agua de los radiadores se mezcla con el agua para consumo doméstico, es posible que algunos inspectores exijan la instalación de un temporizador en la bomba, para evitar que el agua se estanque.

**Disponibilidad:** Estos calentadores de agua están ampliamente disponibles en las distribuidoras locales de plomería.

**Recursos:** Inventario del PATH—Calentadores de agua con capacidad para calentar ambientes interiores http://www.toolbase.org
PHASE: Plumbing  
STRATEGY: Air Admittance Valves

Benefits: R, A, O  
Skill Level: SS  
Application: N, R, S, D

DESCRIPTION:
Air admittance valves (AAVs) are pressure-activated, one-way mechanical venting ports, used in a plumbing system to eliminate the need for conventional pipe venting and roof penetrations. Wastewater discharges cause the AAV to open, allowing air to circulate for proper drainage. When not in operation the valve remains closed, preventing the escape of sewer gas and maintaining the trap seal. Using AAVs can significantly reduce the amount of venting materials needed for a plumbing system, increase plumbing labor efficiency, allow greater flexibility in the layout of fixtures, and reduce long-term maintenance problems where conventional vents break the roof surface.

AAVs are typically made from polyvinyl chloride (PVC) plastic materials with ethylene propylene diene monomer (EPDM) rubber valve diaphragms. Vents come in two sizes: one for fixture venting and a larger size for system venting. They fit standard diameter pipes, ranging from 1-1/4 to 4 inches. Screening protects the valves from foreign objects and vermin.

Installation: Plumbing contractors commonly install AAVs, using conventional tools. The larger units can serve multiple fixtures. They are attached to 2-inch or 4-inch vertical lines in place of a vent stack in the attic or in a wall accessed by recessed plastic box. Some manufacturers make units for interior use only, others offer insulating collars for exterior use. The smaller single-drain vents come with tapered threaded connectors that allow chemical welding to 1-inch or 2-inch pipe. Adapters are available for 1-inch pipe diameter. Single AAVs are often placed on drain lines inside cabinets below sinks, between the trap and the wall. The location must be accessible, and in a space where air can move freely. Devices are compatible with both PVC and ABS piping.

Manufacturers should supply exact installation guidelines, and sometimes the equipment comes with installation manuals. AAVs are usually installed by plumbers or HVAC contractors. The installation process involves connecting the valve to the drain line, ensuring proper alignment with the trap, and verifying that the connection is tight. Screening is added to protect the valve from foreign objects and vermin.
offer software and/or design assistance for laying out the system. Although air admittance valves can eliminate the need for multiple roof vents, one fresh air vent per structure is usually required, especially when used with a septic system.

**Limitations:** Although air admittance valves are accepted by model building codes, some code jurisdictions have been reluctant to accept them due to an underlying concern about their ability to prevent sewer gas from entering the living environment. To address these concerns, it is standard practice to use one standard fresh air vent per structure when designing the plumbing system, with AAVs used to eliminate the need for additional vents, or for special layout/design situations. Some plumbers may also be reluctant to use non-traditional layouts, or to learn new installation procedures. Air admittance valves cannot be used with chemical or non-neutralized waste systems, and cannot be placed in air plenums.

**Code/Regulation:** AAVs are accepted by major model building and plumbing codes, including IRC 2000, for single- or multifamily residential construction, and by the American Society of Sanitation Engineers (ASSE). However, some local code authorities may be unfamiliar with air admittance valves or reluctant to accept them despite code listing. Prior to using an AAV, an installer should contact the local building code official for specific approval status. One open-air vent per structure is still generally required.

**Availability:** AAVs are currently available throughout the U.S. from plumbing supply distributors, contractors, or direct from the manufacturers.

**Resources:** PATH Inventory—Air Admittance Vents; http://www.toolbase.org/tertiaryT.asp?TrackID=6&CategoryID=1402&DocumentID=2127

**Manufacturers:** Studor, Inc., 2030 Main St. Dunedin, FL, 34698; 800-447-4721; www.studor.com
Oatey, 4700 West 160th Street, P.O. Box 35906, Cleveland, OH 44135; 216-267-7100; www.oatey.com
Durgo, Inc., 1719 Trade Center Way, Suite #1, Naples, FL 34109; 239-592-9899; www.durgo.com

Los fabricantes deben brindar los detalles precisos de instalación; no es raro que ofrezcan un software o que colaboren con el diseño de distribución del sistema. Las válvulas de aireación pueden hacer innecesaria la instalación de varios conductos de ventilación en el techo; no obstante, se requerirá con frecuencia al menos uno de éstos por cada edificio, en particular si se usa un sistema séptico.

**Limitaciones:** En los códigos modelo de construcción se aceptan las válvulas de aireación. Sin embargo, ciertas jurisdicciones pueden tener reservas para aceptarlas por el temor de que no puedan evitar la entrada del gas de aguas residuales en el ambiente residencial. Para solucionar estas inquietudes se dispone normalmente un conducto estándar de aire fresco en el diseño de plomería de cada edificio, haciendo innecesario el trazado y diseño especial o las entradas de ventilación adicionales gracias a las válvulas AAV. Es posible que algunos plomeros se muestren reacios a emplear una distribución no convencional o a aprender nuevos procedimientos de instalación. Las válvulas de aireación no pueden emplearse con sistemas químicos o no-neutralizados para eliminación de aguas residuales. No pueden tampoco instalarse en colectores de aire.

**Códigos y normas:** En la mayoría de los códigos modelo de construcción y de plomería se aceptan las válvulas de aireación, incluido el Código IRC 2000, para su instalación en construcciones residenciales unifamiliares o multifamiliares. También las acepta la Sociedad Estadounidense de Ingenieros Sanitarios (ASSE). No obstante, es posible que ciertas autoridades a cargo de los códigos locales desconozcan las válvulas de aireación o se muestren reacios a aceptarlas, a pesar de su inclusión en los códigos. Antes de proceder, el instalador de las válvulas de aireación debe comunicarse con el funcionario encargado del cumplimiento de los códigos local para comprobar su aprobación específica. Con todo, se requiere generalmente un conducto de aireación abierto al aire por cada estructura.

**Disponibilidad:** Las válvulas de aireación (AVV) pueden obtenerse en todos los Estados Unidos con los distribuidores de artículos de plomería, contratistas, o directamente de los fabricantes.

**Recursos:** Inventario del PATH—Válvulas de aireación http://www.toolbase.org

**Fabricantes:** Studor, Inc., 2030 Main St., Dunedin, FL 34698; 800-447-4721; www.studor.com
Oatey, 4700 West 160th Street, P.O.Box 35906, Cleveland, OH 44135; 216-267-7100; www.oatey.com
Durgo, Inc., 1719 Trade Center Way, Suite #1, Naples, FL 34109; 239-592-9899; www.durgo.com
PHASE: Plumbing
STRATEGY: Low-Flow Plumbing Fixtures

Benefits: A, O
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
The Energy Policy Act of 1992 established water conservation standards for toilets, showerheads, faucets, and replacement aerators. Since then, low-flow, cost-competitive plumbing fixtures have been developed that save substantial amounts of water compared to conventional fixtures while providing the same function. The maximum flow rates for various fixtures are as follows:

<table>
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<tr>
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<tbody>
<tr>
<td>Toilets</td>
<td>1.6 gallons per flush (gpf)</td>
</tr>
<tr>
<td>Showerheads</td>
<td>2.5 gallons per minute (gpm)</td>
</tr>
<tr>
<td>Faucets</td>
<td>2.5 gallons per minute (gpm)</td>
</tr>
<tr>
<td>Replacement Aerators</td>
<td>2.5 gallons per minute (gpm)</td>
</tr>
</tbody>
</table>

For retrofit projects, there are several alternatives to replacing an older, gravity-flush tanked toilet:
- Displacement devices, including bags or bottles, can reduce water flow by approximately 0.75 gpf. They function by displacing flush water stored in the tank. The devices are inexpensive and easy to install, but do require regular maintenance. Bricks or other porous objects should never be used as displacement devices because the crumbled pieces can prevent proper closure of the flapper and damage flow valves.
- Toilet dams are flexible plastic inserts placed on the bottom of the toilet tank. They work by damming the water behind them, keeping 0.5 to 1.0 gal-

ETAPA: Plomería
ESTRATEGIA: Accesorios de plomería de bajo caudal

Beneficios: MA, RC
Habilidades: SC
Aplicación: CN, RH, VUF, SD

DESCRIPCIÓN:
Mediante la ley de 1992 sobre políticas energéticas (EPACT) se fijaron normas para la conservación del agua en inodoros, rociadores de ducha, grifos y aireadores de reemplazo. Desde entonces se han ido creando accesorios de bajo caudal, competitivos en función de los costos, que logran economizar una cantidad notable de agua en comparación con los accesorios convencionales y prestan el mismo servicio. Los caudales máximos para los diversos accesorios son:

Accesorio Caudal máximo conforme a la ley de 1992 sobre políticas energéticas Inodoros 1.6 galones por descarga (gpd) Rociadores de ducha 2.5 galones por minuto (gpm) Grifos 2.5 galones por minuto (gpm) Aireadores de reemplazo 2.5 galones por minuto (gpm)

En los proyectos de remodelación son varias las alternativas posibles para remodelar un inodoro antiguo con tanque y descarga por gravedad:
- Dispositivos de desplazamiento, como bolsas o botellas, que reducen el caudal unos 0.75 gpd. Estos dispositivos desplazan el agua almacenada en el tanque. Son muy económicos y fáciles de instalar, aunque requieren un mantenimiento regular. No deben emplearse ladrillos ni otros objetos porosos como objetos de desplazamiento, ya que éstos al desmoronarse emitirían partículas que pueden evitar el cierre correcto de la chapaleta y avertir las válvulas de flujo.
- Las llamadas “presas” son elementos flexibles de plástico que se colocan en el fondo del tanque del inodoro. Retienen el agua que está detrás de ellas, manteniendo entre 0.5 y 1.0 galón por cada ciclo de descarga. Estas presas duran entre cinco y seis años.
- Las chapas de interrupción de descarga reemplazan a la válvula de descarga del tanque del inodoro. Pueden ajustarse para optimizar el rendimiento, ahorrándose entre 0.5 y 2 gpd. Las chapas de interrupción de descarga son económicas y pueden casi siempre instalarse en 10 o 15 minutos.
- El desviador de línea de llenado es un múltiple de plástico que se coloca con una presilla en el tubo de desbordamiento del inodoro, desviando parte del agua excesiva de llenado y manteniéndola en el tanque.

Instalación: La instalación de los accesorios de plomería de bajo caudal es parecida a la de los accesorios convencionales. No se necesitan conexiones o adaptadores especiales para la
ion out of each flush cycle. Dams will last five to six years.

- Early closure flapper valves replace the existing flush valve in the tank. These devices are adjustable to optimize performance and can save 0.5 to 2 gpf. Early closing flappers are inexpensive and usually can be installed in 10 to 15 minutes.

- Toilet fill-line diverter is a plastic manifold that clips over the toilet’s overflow pipe, diverting some of the excess refill water and keeping it in the toilet tank.

Installation: Installation of low-flow plumbing fixtures is similar to that of conventional fixtures. The majority of these fixtures require no special connections or fittings.

Limitations: The initial introduction of low flow toilets generated complaints that the low-flow toilets had trouble clearing the bowl and frequently clogged. Flushing performance has improved in recent years but some models may still not perform as well as older, high-flow toilets.

Code/Regulation: Low-flow plumbing fixtures must meet the appropriate American National Standards Institute (ANSI) standards listed by the International Association of Plumbing and Mechanical Officials (IAPMO).

Availability: Low-flow faucets and fixtures as well as gravity-flush toilet retrofit devices are widely available from local plumbing supply centers and lumber yards.


Manufacturers: Niagara Conservation; www.niagaraconservation.com

AM Conservation Group; http://www.amconservationgroup.com/products.htm
PHASE: Plumbing  
STRATEGY: Plastic Plumbing Manifold System

Benefits: R, A  
Skill Level: SS  
Application: N, R, S, D

DESCRIPTION:
Manifold plumbing systems use control centers for hot and cold water that feed flexible supply lines to individual fixtures. Plastic manifolds together with flexible plastic piping can be installed more quickly than rigid plumbing systems with fewer fittings and without the need for piping tees and elbows. By downsizing supply piping, water velocity is increased and delivery of hot water to fixtures is faster. Heat loss in the piping may be less than a copper system because plastic has better thermal insulating properties. Also, maintenance is relatively simple with plastic manifolds because valves at the manifold for each fixture line permit individual fixture control, shutoff, and maintenance.

Plumbing manifolds work by having separate manifolds serve hot and cold water lines. The cold water manifold is fed from the main water supply line and the hot water manifold is fed from the hot water heater. Water pressure in the manifolds is maintained by the incoming service line. A dedicated water supply line feeds each fixture from a port in the manifold.

There are several types of plastic manifold plumbing systems, including thermoplastic manifolds and opposing port manifolds. Generally, manifolds are 1-inch in diameter—larger than most service lines—to enable adequate water flow to individual fixtures. A continuous built-in reservoir provides equalized water flow and helps maintain constant water pressure in all supply lines. Shutoff valves are built into each port for individual control of lines and of flow to individual fixtures.

Manifold systems can use 3/8-inch supply lines for individual fixtures because fewer fittings are required (hence, less pressure drop occurs in the lines) compared to traditional, rigid 1/2-inch lines. Cross-linked polyethylene (PEX) piping is used because of its resistance to temperature extremes, chemicals, and deformation, and its adaptability to water flow to individual fixtures.
ical attack, and creep deformation, and its suitability for hot water.

**Installation:** Usually plastic plumbing manifolds are mounted in a convenient, accessible location such as a basement wall or a service closet to allow access for shut off to individual fixtures. Thermoplastic manifold is installed near, but not too close to, the water heater.

Copper can be used for the main line into the house, and with slab type foundations copper is sometimes used for underground lines on the first level. Special fittings allow the plastic pipe to be attached to the copper. The PEX pipe slides over the fittings and a metal collar is crimped to seal the connection. PEX pipe can be used under concrete slabs, however it tends to move around before and during the placement of the concrete.

**Limitations:** The additional length of plastic pipe needed compared to rigid piping systems can add to material costs. Use and handling restrictions associated with PEX pipe require site supervision to ensure proper installation. Not all PEX piping is compatible with manifold systems, and special piping installation equipment may be needed. Manifold systems require planning to determine optimal manifold location and routing of PEX branch lines.

**Code/Regulation:** PEX tubing and metal insert fittings are required to comply with excessive temperature and pressure specifications of ASTM of standard F877, “Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.”

**Availability:** Plastic manifold plumbing systems are widely available from local plumbing supply houses.

**Resources:** PATH Inventory—Plastic Plumbing Manifold; http://www.toolbase.org/tertiary?asp?TrackID=&CategoryID=1436&DocumentID=2128

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**Instalación:** Los múltiples de plástico se instalan generalmente en un punto conveniente y accesible, como una pared en el sótano o un armario de servicio, para permitir el corte del agua a cada uno de los accesorios de plomería. El múltiple de termoplástico se instala cerca del calentador de agua, aunque no demasiado.

Puede emplearse tubería de cobre para la tubería principal de alimentación de la vivienda. Con frecuencia se emplea también el cobre para las líneas de la primera planta si existen cimientos de losa de concreto. Mediante herrajes especiales se puede conectar la tubería de plástico a la de cobre. La tubería de PEX se desliza dentro del herraje, y un collar metálico se estrecha alrededor de ella para sellar la conexión.

La tubería de PEX puede emplearse bajo lasas de concreto; no obstante, tiende a desplazarse antes y durante el vertido del concreto.

**Limitaciones:** La extensión adicional de la red de tubería de plástico empleada, en comparación con los sistemas de tubería rígida, puede aumentar el costo de los materiales. Dadas las restricciones en el uso y manejo de la tubería de PEX se requiere supervisión al pie de la obra para garantizar su instalación adecuada. No toda la tubería de PEX puede acoplarse en sistemas de múltiples. También es posible que se requieran herramientas especiales para la instalación de tuberías. Con estos sistemas se requiere hacer un diseño para determinar la ubicación óptima de los múltiples y la disposición de las líneas de PEX.

**Códigos y normas:** Es necesario que la tubería de PEX y los herrajes metálicos de acoplamiento cumplan con las especificaciones sobre temperatura y presión excesiva plasmadas en la Norma F877 de la ASTM: “Sistemas de plástico para distribución de agua caliente y fría con plástico de polietileno reticulado (PEX).”

**Disponibilidad:** Los múltiples de plástico para plomería están ampliamente disponibles en las distribuidoras locales de plomería.

PHASE: Plumbing
STRATEGY: Tankless Water Heaters

Benefits: A, O
Skill Level: S
Application: N, R, S, D

DESCRIPTION:
Tankless water heaters provide unlimited hot water without storage, thereby reducing or eliminating standby losses. They can be used for supplementary heat or to meet all hot water needs, are compact in size, and can provide warm water at remote points of use (less water is wasted while waiting for warm water to reach a remote faucet). Tankless water heaters last longer than tank-type heaters—up to 20 years compared to 10 to 15 years for tank-type water heaters—because they are less subject to corrosion.

Tankless water heaters have an electric, gas, or propane heating device that is activated by the flow of water. Once activated, the heater provides a constant supply of hot water. Gas tankless water heaters typically have larger capacities than electric tankless water heaters. Electric tankless water heaters require a relatively high electric power draw because water must be heated quickly to the desired temperature. Large units intended for whole house water heating are located centrally while, in point-of-use applications, the water heater usually sits in a closet or under a sink.

Installation: Whole house tankless water heaters can be installed centrally. Tankless gas water heaters generally require a power vent. Because of the power draw, multiple circuits and/or heavier wire will be necessary for installation of electric units. Otherwise, installation of tankless hot water heaters does not require any special plumbing or electrical tools.

Limitations: Electric units will draw more instantaneous power than tank-type water heaters. If electric rates include a demand.

Fig. 4-34 Tankless water heater.
charge, operation may be expensive. More complicated electronics in tankless systems may require more attention than conventional tank units.

**Code/Regulation:** Gas tankless water heaters must be vented in accordance with code.

**Availability:** Tankless water heaters are widely available from local plumbing supply houses or directly from the manufacturer.

**Resources:** PATH Inventory—Tankless Water Heaters; http://www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2138

**Manufacturers:**
- Advanced Conservation Technology, Inc., Meltund System, 3176 Pullman Street, Suite 119, Costa Mesa, CA 92626; 800-638-5863; 714-668-1200; Fax: 714-668-1927; www.gothotwater.com
- Envirotech Systems Worldwide, Inc., 7835 East Gelding Drive, Suite F, Scottsdale, AZ 85260, 800-251-6612; Fax: 800-375-9641; www.tankless.com
- Microtherm, Inc., Seisco, 223 Airtex, Houston, Texas 77090; 888-296-9293; 281-876-3322; Fax: 281-876-3338; www.seisco.net
PHASE: Electrical & Plumbing
STRATEGY: Energy Efficient Appliances & Lighting

Benefits: A, O, H
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Appliances and lighting can account for 20 to 40% of home energy use. After heating, cooling, and hot water heating equipment, refrigerators are among the largest energy consumers in the home, accounting for approximately 5% of total energy consumption in U.S. households. Dishwashers can also consume a great deal of energy, mostly for heating the water. Improvements in appliances and lighting have resulted in models that are more energy efficient and cost competitive with conventional models.

Appliances include, but are not limited to, refrigerators, ovens, clothes washers, dishwashers, room air conditioners, and dehumidifiers. Energy efficient models use 10 to 50% less energy and water than standard models.

Nearly 90% of the energy used for incandescent lights (the type normally used in homes) is converted to heat, adding to the air conditioning load. Recessed lights, if not the air-tight type (most are not), can increase heating and cooling costs due to increased air leakage. Energy efficient alternatives include air-tight recessed light fixtures (which can reduce air leakage and reduce moisture problems associated with this air leakage) and fluorescent lamps and fixtures (which will reduce internal heat gain, lessening the amount of work the air conditioner needs to do in order to cool the house). Fluorescent lamps are about three to five times as efficient as standard incandescent lamps and can last about 10 to 20 times longer. Technological advances, especially in the electronic ballasts, have eliminated flicker and hum often associated with fluorescents. Also, improved fluorescent lamps produce light qualities very similar to that of incandescent lights.

To the degree possible, one should also design for maximum natural lighting, while giving proper consideration to heat loss or gain that might result from using windows or skylights.

Fig. 4-35 Compact fluorescent light bulbs.
Fig. 4-35 Bombillas fluorescentes compactas.
The Energy Star program, sponsored by the US Environmental Protection Agency (EPA) and the Department of Energy (DOE), identifies household products that meet strict energy efficiency guidelines set by EPA and DOE.

**Installation:** Installation of energy efficient appliances is similar to conventional appliances. If possible, do not locate refrigerators near stoves, ovens, dishwashers, and direct sunlight.

Installation of fluorescent and energy-efficient light fixtures and ceiling fans is similar to conventional models. Screw-base compact fluorescent lamps (CFLs) can be used in retrofits to replace incandescent lamps in conventional fixtures.

**Limitations:** CFLs emit electromagnetic frequency wavelengths, which can interfere with household signals to television and radio. For this reason manufacturers recommend positioning these lamps at least eight feet away from such devices. There has been concern that the disposal of fluorescent components may allow toxic chemicals into our environment.

PCBs are associated primarily with magnetic ballasts, but all fluorescent lamps contain mercury. Alternatives include low-mercury lamps and lamp recycling.

**Code/Regulation:** None.

**Availability:** Energy efficient appliances and lighting are widely available from local appliance distributors, lighting centers, and lumber yards.

**Resources:**
- PATH Technology Inventory—Appliances and Lighting
- American Council for an Energy Efficient Economy (ACEEE) www.aceee.org
- Consumer Guide to Home Energy Savings
- The Most Energy-Efficient Appliances
- Energy Star; www.energystar.gov

prestando siempre la debida atención a las pérdidas o ganancias de calor que podrían resultar con el uso de ventanas o claraboyas.

Mediante el programa Energy Star, patrocinado por la Agencia para la Protección del Medio Ambiente (EPA) y el Departamento de Energía (DOE) de los Estados Unidos, se clasifica a los productos para el hogar que cumplen con las estrictas normas para el uso eficiente de la energía que establecen ambos organismos.

**Instalación:** La instalación de electrodomésticos eficientes en el uso de la energía es similar a la de los electrodomésticos convencionales. Siempre que sea posible es mejor no colocar las neveras cerca de las estufas, hornos y lavaplatos, ni exponerlas a la luz directa del sol.

La instalación de luces fluorescentes, apliques de luz eficientes en el uso de la energía y ventiladores de techo es parecida a la de los modelos convencionales. En las obras de remodelación, las lámparas fluorescentes compactas con casquillo de rosca (CFL) pueden reemplazar a las bombillas incandescentes de los apliques de luz convencionales.

**Limitaciones:** Las CFL emiten longitudes de onda en el espectro electromagnético, que podrían interferir con las señales de televisión y radio en el hogar. Por esto, los fabricantes recomiendan que las lámparas CFL se coloquen al menos a ocho pies de distancia de dichos dispositivos. Ha surgido también inquietud por la posibilidad de que los componentes de las lámparas fluorescentes liberen al desecharse substancias tóxicas en el medio ambiente. Los bifenilos policlorados (PCB) se relacionan más que todo con los balastos magnéticos; no obstante, todas las lámparas fluorescentes contienen mercurio. Otras alternativas Una alternativa posible es usar lámparas con bajo contenido de mercurio y el reciclaje de las lámparas.

**Códigos y normas:** Ninguno.

**Disponibilidad:** La iluminación y los electrodomésticos eficientes en el uso de la energía pueden obtenerse fácilmente de los distribuidores locales de electrodomésticos, centros de productos para la iluminación, y almacenes de madera.

**Recursos:** Inventario de tecnología del PATH—Electrodomésticos e iluminación;
- Energy Star; www.energystar.gov
PHASE: Interior Walls & Finishes  
STRATEGY: Drywall Clips & Stops

Benefits: R, O  
Skill Level: U  
Application: N, R, S, D

DESCRIPTION:
Drywall clips and stops support drywall or wood paneling at corners and replace blocking at top plates, end walls, and corners. They can be used in conjunction with advanced framing techniques to optimize the use of framing materials. Drywall clips and stops can save a significant amount of wood/metal framing, reduce labor, and prevent drywall cracking by allowing floating corners.

Drywall clips are small pieces of hardware that function as structural backing/fastening for drywall. The clips are fitted onto the edge of the drywall by hand as it is installed on wood or steel studs.

Drywall stops are small, non-wooden pieces of hardware that function as stops for drywall installation. Stops, like wood blocking, are fastened to structural members before drywall installation. They are available in galvanized or sheet metal, recycled high-density polyethylene or metal wire. Plastic and metal wire stops offer several advantages over some sheet metal stops. The non-corrosive plastic stops can be stapled, nailed, or screwed to wood members. Sharp talons of the metal wire stops grip the wood, eliminating the need for tools or nails.

Metal wire clips grip the stud and provide a surface against which drywall perpendicularly butting into the stud, or drywall fastened to the stud, may be supported. They require no tools to affix, and once installed do not present sharp surfaces which could cause injuries. They are particularly useful for interior one-stud partition walls and wall-to-ceiling junctions, allowing a floating drywall corner, reducing the risk of drywall cracking due to the normal expansion, contraction and movement of most wood framing.

Beneficios: RR, RC  
Habilidades: NC  
Aplicación: CN, RH, VUF, SD

DESCRIPCIÓN:
Las grapas y topes especiales sostienen las paredes de yeso o paneles de madera en las esquinas, reemplazando los bloques en travesaños superiores, extremos de paredes y esquinas. Pueden emplearse junto con técnicas estructurales avanzadas para hacer rendir los materiales al máximo. Con las grapas y topes para planchas de yeso se puede economizar una cantidad importante de la estructura de madera y metal, reducir la mano de obra, y evitar el agrietamiento de las planchas ya que éstas pueden desplazarse en las esquinas.

Fig. 4-37 Drywall clip.  
Fig. 4-37 Grapa para plancha de yeso.
**Installation:** At two-stud corners, other corners, and intersections the metal and plastic drywall stops are installed 16 inches-on-center, though some are allowed up to 24 inches-on-center for installation, from the top to bottom of the wall. Then the first sheet of drywall is hung against the stops. The second sheet is installed against the first. At top plates, the stops are installed at 16 inches-on-center (or up to 24 inches-on-center for some). The drywall is installed with the ceiling panels first, as usual.

Sheet metal stops are nailed to studs, though the sharp installation prongs provide convenient initial attachment. The metal wire stops are installed by hand, squeeze-fit to the stud, with the extension wire arm surface providing an effective rigid area against which the drywall may be supported/stopped.

The plastic stops are T-shaped flanges that can be installed any time after framing, although they could also be used by the drywallers. They have an anti-skate surface grid against which the drywall sits, as well as a tapered flat “arm” that may be fastened through (stapled, screwed, or nailed). Plastic stops are attached to framing at wall-to-wall and wall-to-ceiling junctions, 16 inches-on-center typically, and up to 24 inches-on-center. Plastic stops allow the corners to be screwed and hard fastened, but some manufacturers recommend leaving the corners floating. By trimming off the backs of the stops, installers can attach them to the face of a stud to support a dropped ceiling.

**Limitations:** Problems can occur with any of the drywall stops when a stud has a rounded corner, making it difficult to install the fastener. Clips and plastic stops can be used in conjunction with steel studs, unlike the sheet metal and metal wire drywall stops.

**Code/Regulation:** Building codes do not specifically address drywall clips, stops, and/or fasteners. Rather, they reference the Gypsum Associations’ standards, Fig. 4-38a and Fig. 4-38b Gypsum board installation with drywall clips. Fig. 4-38a y Fig. 4-38b Instalación de plancha de yeso mediante grapas.

**Instalación:** En las esquinas de dos montantes y otras esquinas e intersecciones, los topes de metal y plástico para planchas de yeso se instalan de arriba a abajo de la pared, a 16 pulg. medidas de centro a centro, aunque en ocasiones se permite la instalación a una distancia de 24 pulg. medidas de centro a centro. Se procede a colgar de los topes la primera plancha de yeso. La segunda plancha se instala contra la primera. En los travesaños superiores, los topes se instalan a 16 pulg. medidas de centro a centro (o hasta 24 pulg. centro a centro en ciertos casos). Como es costumbre, se instalan primero las planchas de yeso más cercanas al techo.

Aunque los topes chapa se fijan con clavos en los montantes, están dotados de dientes agudos para su instalación inicial. Los topes de alambre metálico se instalan manualmente, presionándolos para fijarlos al montante. La cara con el saliente de alambre brinda una superficie rígida eficaz para sostener o detener la plancha de yeso.

Los topes de plástico son abrazaderas en forma de “T” que pueden instalarse en cualquier etapa posterior a la terminación de la estructura de la pared, aunque los encargados de montar las planchas de yeso también pueden emplearlos. Tienen una superficie de malla antiderrapante contra la cual reposa la plancha de yeso, y un “brazo” plano afilado que puede fijarse a través de la plancha (con grapas, tornillos o clavos). Los topes de plástico se fijan en la estructura de las paredes en la confluencia de una pared con otra o con el techo, generalmente a 16 pulg. medidas centro a centro, o hasta 24 pulg. medidas centro a centro. Aunque los topes de plástico permiten atornillar y fijar firmemente las esquinas, algunos fabricantes recomiendan dejarlas libres para que puedan desplazarse. Rebañando la parte posterior de los topes, el instalador puede fijarlos en la cara de un montante con el fin de sostener un techo suspendido.

**Limitaciones:** Los montantes con esquinas redondeadas pueden causar problemas con cualquiera de los topes para planchas de yeso, ya que dificultan la fijación de los sujetadores. Las grapas y topes de plástico pueden emplearse junto con montantes de acero, contrariamente a lo que sucede con los topes de chapa y alambre metálico para planchas de yeso.

**Códigos y normas:** En los códigos de construcción no se menciona separadamente las grapas, topes o sujetadores para planchas de yeso.
which themselves allow clips/fasteners if tested and approved according to ASTM standards.

**Availability:** Except for the plastic stop, the metal and wire drywall clips and stops are available from local lumber yards and drywall suppliers.

**Resources:** PATH Inventory—Drywall Clips & Stops; http://www.tool-base.org/tertiaryT.asp?TrackID=&CategoryID=1402&DocumentID=2114

**Fig. 4-39a and Fig. 4-39b Metal wire clips. Images courtesy of Stud-Claw**

**Fig. 4-39a y Fig. 4-39b Grapas de alambre metálico. Imágenes cortesía de Stud-Claw**
**PHASE:** Interior Walls & Finishes  
**STRATEGY:** Drywall Returns

**Benefits:** R, A
**Skill Level:** SS  
**Application:** N, R, S, D

**DESCRIPTION:**
Returning gypsum wallboard (drywall) to the face of the windows and using drywall corners instead of using wood stool and casings saves money. Similarly, using drywall returns on bi-fold or bypass closet doors eliminates wood jambs and casings.

**Installation:** Installing drywall returns is similar to installing drywall in other places. No special tools, equipment, or material is needed.

**Limitation:** Drywall finishers must pay more attention to detail than when trim is installed.

**Code/Regulation:** None

**Availability:** N/A

**Resources:** Cost-Saving Construction Opportunities and the HOME Program: Making the Most of HOME Funds. Prepared by National Association of Home Builders Research Center for the Affordable Housing Research Division, Office of Policy Development and Research, U.S. Department of Housing and Urban Development; http://www.toolbase.org/Docs/MainNav/Affordability/-2529_HOME_program.pdf?TrackID=&CategoryID=1232&DocumentID=2529

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**ETAPA:** Paredes y acabados interiores  
**ESTRATEGIA:** Doblar las planchas de yeso

**Beneficios:** RR, MA  
**Habilidades:** SC  
**Aplicación:** CN, PH, VUF, SD

**DESCRIPCIÓN:**
Una solución para ahorrar dinero consiste en doblar las planchas de yeso (drywall) hasta la cara de las ventanas y emplear esquinas de plancha de yeso, en lugar de madera, para las repisas y marcos de las ventanas. De manera semejante, se puede doblar las planchas de yeso en las puertas dobles o correderas de los armarios reemplazando así las jambas y marcos de madera.

**Instalación:** La instalación hecha doblando las planchas de yeso es semejante a la instalación de éstas en otras situaciones. No se requieren herramientas, equipos ni materiales especiales.

**Limitaciones:** Los encargados de aplicar el acabado a las paredes deben tener más cuidado que cuando se instalan molduras normales.

**Códigos y normas:** Ninguno.

**Disponibilidad:** No es del caso.

**Recursos:** Cost-Saving Construction Opportunities and the HOME Program: Making the Most of HOME Funds. Redactado por la División de Investigación sobre Vivienda Asequible del Centro de Investigación de la Asociación Nacional de Urbanizadores, Oficina de Desarrollo Normativo e Investigación, Departamento de Vivienda y Desarrollo Urbano de los EE.UU. http://www.toolbase.org
PHASE: Interior Walls & Finishes
STRATEGY: Drywall Finishing Accessories

Benefits: R, A
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Drywall finishing accessories include structural drywall corners as well as systems used to create smooth drywall butt joints. Structural drywall corners save time, labor, and materials, and come in a variety of designs and specifications. The highly workable inside and outside corners can correct hanging and framing imperfections and withstand movement and impact. Drywall butt joint systems provide slightly inset drywall butt joints that require less finishing and sanding, and result in flat, seamless finished butt joints that are also less prone to cracking due to framing movement because the butt joints are allowed to float.

Structural drywall corners are made of bonded paper faced and joint tape copolymer plastic. They are self-straightening, do not crack, bend, tear, wrinkle, or fuzz. The corners can be classified according to their basic characteristics: flexible and fixed. The different flexible corners are applied on inside corners greater than 90 degrees and all outside corners for walls, ceilings, doors, windows, skylights, and 3-foot minimum diameter arches. The bullnose and fixed corners are designed for economical 90-degree installations.

There are two types of drywall butt joint systems (also known as “backers”). One consists of a long piece of wood with regularly attached metal braces. The other system consists of a long, thin piece of metal that is flat down the major width of the centerline and has a triangular section along the lengthwise edges. Both function the same way: the centers provide the backing for the drywall butt joint and the braces/edges provide the resistance against which the drywall assumes the proper inset shape along the butt joint.

Installation: Plastic drywall corners are placed in pre-applied taping joint compound, which acts as an adhesive between the drywall and the corner. Structural drywall corners are placed in pre-applied taping joint compound, which acts as an adhesive between the drywall and the corner.

ETAPA: Paredes y acabados interiores
ESTRATEGIA: Accesorios para el acabado de paredes de plancha de yeso (drywall)

Beneficios: RR, MA
Habilidades: SC
Aplicación: CN, RH, VUF, SD

DESCRIPCIÓN:
Los accesorios para el acabado de paredes de plancha de yeso incluyen esquinas estructurales y elementos para alisar los empalmes a tope (butt joints) de las planchas. Gracias a las esquinas estructurales para paredes de plancha de yeso, que vienen en varios diseños y especificaciones, es posible ahorrar tiempo, mano de obra y materiales. Las esquinas, interiores y exteriores, pueden moldearse fácilmente corrigiendo las imperfecciones de las estructuras de unión de las planchas, además de soportar movimientos e impactos. Los sistemas de empalme a tope en paredes de plancha de yeso son ligeramente embutidos por lo que requieren menos acabado y lijado y resultan en empalmes planos cerrados menos propensos al agrietamiento causado por los movimientos de la estructura de la pared, ya que los empalmes pueden desplazarse.

Las esquinas estructurales para paredes de plancha de yeso se fabrican con papel aglomerado y cinta plástica de copolímero para empalmes. Se trata de materiales que se alisan por sí mismos, no se agrietan, danlan, rasgan, arrugan ni despiden pelusa. Las esquinas pueden clasificarse según sus características básicas: flexibles y fijas. Las diversas esquinas flexibles se aplican en ángulos interiores mayores de 90° y en todas las esquinas exteriores de paredes, techos, puertas, ventanas, claraboyas y arcos con un mínimo de 3 pies de diámetro. Las esquinas redondeadas y fijas se diseñan para económicas instalaciones a 90°.

Hay dos tipos de empalmes a tope para paredes de plancha de yeso. Se conocen también como respaldos (backers). El primero consiste en una pieza larga de madera con anclajes metálicos a intervalos. El segundo consiste en una pieza larga y delgada de metal que se prolonga pegada a lo largo de toda la línea central, con una sección triangular a lo largo de los bordes. Ambos tipos funcionan de la misma manera: el centro brinda el respaldo para el empalme de las planchas de yeso, mientras que los anclajes metálicos y bordes brindan el apoyo contra el cual las planchas adoptan la forma embutida adecuada a lo largo del empalme.

Instalación: Las esquinas de plástico para paredes de plancha de yeso se colocan aplicando primero una cinta con un compuesto para empalmes, que funciona como adhesivo entre las
itself. Using standard tools and joint treatment to “feather” the edges, the structural drywall corners can cover up to 1 1/2-inch voids, require no top coating or finish sanding, and accept all paints.

The butt joint systems are installed by cutting the backer to the desired length. One board of the drywall is mounted so that the butt edge lands approximately midway between framing studs. Next, the backer is slid behind the drywall butt edge so that the centerline of the backer coincides with the drywall butt edge. The edge of the board is then screwed to the backer. If there is a drywall sheet above or below the butt joint, it is also attached to the backer with one screw, centered on the backer. Lastly, the backer is adjusted if necessary (i.e. the braces are rotated to a horizontal position) and the second drywall board is conventionally mounted to the wall studs while its butt edge adjacent to the other drywall butt edge is screwed to the backer. The joint is then taped and spackled as usual.

Limitations: The learning curve to use the structural drywall corners efficiently and economically may take some time initially.

Code/Regulation: Impact and racking tests, in accordance with ASTM Standards, were conducted by the NAHB Research Center for the structural corners. Drywall butt-joint systems are not addressed by current code standards, and their use should be checked with local code officials.

Availability: Drywall structural corners are sold by distributors throughout the U.S. and Canada. The drywall butt-joint backers are available through local drywall suppliers.


Limitaciones: El proceso de aprendizaje para el empleo eficiente y económico de las esquinas estructurales para paredes de plancha de yeso puede llevar mucho tiempo.

Códigos y normas: El centro de investigación de la NAHB sometió las esquinas estructurales a pruebas de impacto y sacudidas conforme a las normas de la ASTM. No existen en la actualidad en los códigos normas referentes a los sistemas de empalme a tope para paredes de plancha de yeso, por lo que su uso debe verificarse con los funcionarios a cargo de hacer cumplir los códigos locales.

Disponibilidad: Distribuidores en todos los Estados Unidos y Canadá venden las esquinas estructurales para paredes de plancha de yeso. Los respaldos (backers) para empalmes de paredes de plancha de yeso pueden obtenerse con proveedores locales.

PHASE: Site Planning & Development
STRATEGY: Alternative Pavers

Benefits: A, O, H
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Alternative pavers are permeable or semi-permeable materials that can replace solid asphalt and concrete in low traffic areas such as driveways, sidewalks, and walkways. Alternative pavers allow water to infiltrate directly into the ground, reducing stormwater runoff and erosion. They are also generally less expensive than asphalt or concrete. The two broad categories of alternative pavers are paving blocks and other surfaces including gravel, cobbles, wood, mulch, brick, and natural stone.

Paving blocks are concrete or plastic grids with gaps between them. They make the surface more rigid and gravel or grass planted inside the holes allows for infiltration. Depending on the use and soil types, a gravel layer can be added underneath to prevent settling and allow further infiltration.

Other alternative surfaces—gravel, cobbles, wood, and mulch—also allow varying degrees of infiltration. Brick and natural stone arranged in a loose configuration allow for some infiltration through the gaps. Gravel and cobbles can be used as driveway material and wood and mulch can be used to provide walking paths.

Installation: Installation of paving blocks require some skilled labor. Refer to the specific product’s installation instructions for surface preparation and installation details. Installation of the other alternative surfaces can be done with unskilled labor, following conventional techniques for the materials. Be sure to install geotextile (a mesh fabric) under the paving material to prevent weed growth.

Fig. 4-42 Alternative paving blocks (porous paving).
Fig. 4-42 Bloques alternativos para pavimento (pavimento poroso).
Limitations: Alternative pavers are not recommended for high traffic volumes for durability reasons. Access for wheelchairs is limited with alternative pavers. Depending on the material used, maintenance costs are almost always higher than conventional asphalt or concrete.

Code/Regulation: Check local codes for possible restrictions on any of the alternative pavers.

Availability: Alternative paving blocks are sometimes available from sand/gravel/aggregate yards. Otherwise, they can be special ordered through local lumber yards, landscaping centers, or local distributors. Other alternative paving surfaces are widely available from local lumber yards, landscaping centers, and sand/gravel/aggregate yards.

Resources: The Stormwater Manager’s Resource Center; http://www.cwp.org
Low Impact Development Center; http://www.lowimpactdevelopment.org/
PHASE: Landscaping
STRATEGY: Rainwater Harvesting Systems

Benefits: O, H
Skill Level: SS
Application: N, R, S, D

DESCRIPTION:
Rainwater is a free source of water. Rainwater harvesting systems capture rainwater for reuse for irrigation, household use, or if filtered and purified, consumption.

Systems are most cost-effective in parts of the country where the water supply is of poor quality, erratic, or expensive. In areas not served by a municipal water supply, or in drought-prone areas, installing a rainwater catchment system may actually be the most convenient and economical option. In regions where the municipal water quality is questionable, filtered rainwater can be a sales asset for the home builder.

A complete system includes the catchment area (a roof), a rainwater conveyance system (gutters and leaders), holding vessels (cisterns), a roof-wash system (usually the first 10 to 20 gallons of rain are diverted from the cistern), a delivery system (pumps) and a treatment system (filters and/or purifiers). Systems can be as simple as a barrel with valves and outlets, or purchased as a package from manufacturers, or custom designed and built on site. The components may be added by retrofitting existing gutter/leader and roof systems. Uncoated stainless steel or galvanized steel with a baked-enamel finish that is certified as lead-free are considered the best choices for rainwater catchment.

Installation: Installation depends on whether the roof and/or drainage system need to be modified or replaced. Check the composition and condition of the roof and/or drainage system, and the intended use of the water. Drinking water systems require a leach-free metal or fiberglass roof and drainage sys-

Fig. 4-43a and Fig. 4-43b Rain barrels used to capture rainwater from roofs. Rain barrels can be connected to provide more storage capacity.

Fig. 4-43a y Fig. 4-43b Barriles para la recolección de agua de lluvia de los techos. Los barriles pueden conectarse para aumentar la capacidad de almacenamiento.

ETAPA: Diseño de jardines (paisajismo)
ESTRATEGIA: Sistemas recolectores de agua de lluvia

Beneficios: RC, MAB
Habilidades: SC
Aplicación: CN, RH, VUF, SD

DEScripción:
La lluvia representa una fuente gratuita de agua. Los sistemas de recolección capturan el agua de lluvia para el riego, uso doméstico, o para consumo humano después de filtrarla y purificarla.

La eficiencia de estos sistemas en función de los costos resulta superior en aquellas zonas del país en las que el suministro de agua es de baja calidad, irregular, o costoso. En áreas sin acueductos municipales o próximas a las sequías, la instalación de un sistema de recolección de agua de lluvia puede de hecho ser la opción más conveniente y económica. En las regiones en las que la calidad del agua del acueducto municipal es dudosa, el sistema de agua de lluvia filtrada puede aumentar el valor de venta de la vivienda.

Un sistema completo incluye el área de recolección (el techo), un sistema de canalización (canalones y bajantes), depósitos (cisternas), un sistema para lavado del techo (por lo general los primeros 10 a 20 galones de agua de lluvia se desvían sin pasar a la cisterna), un sistema de suministro (bombas) y un sistema de tratamiento (filtros, purificadores, o ambos). Los sistemas pueden ser tan sencillos como un barril con válvulas y bocas de salida, comprarlos a los fabricantes en un conjunto, o diseñarlos a la medida para montarlos sobre el terreno. Los componentes pueden añadirse también remodelando los canalones, bajantes, y techos de una vivienda. Se considera que el acero inoxidable sin recubrimiento, el acero galvanizado, con un acabado de esmalte certificado sin plomo y secado al horno, son las mejores opciones para la recolección de agua de lluvia.

Instalación: La instalación varía según tenga o no que modificarse o reemplazarse el techo o el sistema de drenaje. Examine los materiales y la condición del techo y el sistema de drenaje, y el uso que se prevé para el agua. Para los sistemas de agua potable se requiere un techo de acero galvanizado, con un acabado de esmalte certificado sin plomo y secado al horno, que no se lesione. Para sistemas de agua no potable, se puede elegir un techo de acero inoxidable sin recubrimiento, y componentes para el filtrado y purificación. La mayoría de estos componentes, en un conjunto, se montan fácilmente en un canalón.
tem in addition to filtration or other purifying components. The majority of the components simply bolt-on. A roof-wash system, for instance, is relatively easy to attach to a gutter.

**Limitations**: If an old roof is used as the catchment area, if it is under tree branches, if the building relies on wood heat, or if the air is too polluted, you need to be wary of elevated contaminant or toxin levels. Roofs with wood shakes, concrete or clay tiles, or asphalt shingles can support unwanted biological growth, such as mold or bacteria, which will require adequate treatment. Some materials, such as tene coating, lead solder, or treated wood, can leach unwanted toxins.

**Code/Regulation**: Codes and restrictions regarding water supply are not nearly as restrictive as those governing water disposal. In Texas, an air gap must exist between the public water and the rainwater if a backup system is used, like a city water line feeding into a rainwater cistern. The Health Department will insist on a covered cistern, to avoid mosquito breeding. The local building or health department should be contacted prior to installing a rainwater harvesting system.

**Availability**: Materials and parts needed to make a simple rain barrel are widely available from local lumber yards. Packaged systems can be ordered directly from manufacturers. Consultants and special dealers are widely available in Texas to design custom systems. Replacement parts are widely available from local lumber yards.


American Rainwater Catchment Systems Association (ARCSA), P.O. Box 685283, Austin, TX 78768-5283
**PHASE:** Landscaping  
**STRATEGY:** Xeriscaping

**Benefits:** A, O, H  
**Skill Level:** U  
**Application:** N, R, S, D

**DESCRIPTION:**
If landscapes are designed using plants that thrive in typical local rainfall patterns, significantly less water will be needed for irrigation. This is the simple concept behind xeriscaping, a term coined by western land planning authorities dealing with water shortages in the 1970s. Xeriscaping refers to selecting plants for their drought tolerance, and/or ability to thrive without regular maintenance in the climate conditions where they will be used. With water use issues being a major concern in the Southwest, xeriscapes offer a viable alternative for landscaping without consuming dwindling water resources, investing in expensive engineered irrigation systems, and creating excessive cuttings or plant waste.

**Installation:** Several considerations must be made before implementation, such as the physical characteristics of the site, seasonal shading, runoff patterns, and individual aesthetic preferences. Some soil improvements or additives might be required before planting can begin. For some well-adapted xeric plants, loosening the soil may be all that is needed. Contact local agencies and authorities for information on local soil characteristics.

Although most successful xeriscapes are low maintenance, they are not maintenance free. Most of the work—planning, designing, and establishing plants—is required in the beginning. Less work is required as the xeric landscape matures. Properly timed pruning, fertilizing, pest control and weeding will preserve the landscape's beauty and water efficiency.

**Limitations:** Xeriscaping cannot completely alleviate the need for landscaping maintenance and watering. Some plants may need more watering during the period that they are becoming established in the environment. Designers...
and developers must plan and specify layouts more carefully to place appropriate vegetation in appropriate locations.

**Code/Regulation:** Xeriscaping requires a common-sense approach. While local code authorities may need to approve some site plans, xeriscaping techniques do not usually involve code or regulatory issues.

**Availability:** Native species are widely available at local garden and landscaping centers.


American Nursery & Landscape Association, 1250 I Street NW, Suite 500, Washington, DC 20005-3922; 202-789-2900; Fax 202-789-1893; www.anla.org

American Horticultural Society, 7931 East Boulevard Drive, Alexandria, VA 22308; 703-768-5700; Fax 703-768-8700; www.ahs.org

Sustainable Building Sourcebook; www.greenbuilder.com/sourcebook/Xeriscape.html

![Fig. 4-45 Xeriscaping at an affordable housing subdivision, Life Rebuilders, Superior, AZ.](image)

![Fig. 4-45 Diseño de un jardín para zonas áridas en una subdivisión de vivienda asequible, Life Rebuilders, Superior, Arizona.](image)
Despite the fast growth of housing in many parts of the Southwest, the housing needs of low-income families are not being met, due in part to a number of obstacles that can slow or stall affordable housing development. Some of these obstacles are regulatory (laws that have to be met in all development projects). Other obstacles to affordable housing are the result of people’s prejudices or the location of the projects. These concern choices of materials, technology, and where affordable housing should be built.

Some of the regulatory obstacles that may limit or prevent affordable housing development in the rural Southwest are:

- Zoning Restrictions
- Impact and Development Fees
- Deed Restrictions
- Building Codes
- Conflicting Jurisdiction
- Environmental Regulations
- Accessibility Regulations

**ZONING RESTRICTIONS**

Local town governments have the authority to develop rules and laws that dictate how land is zoned and developed. This power allows the town government to control the type of construction and number of houses built. The amount of affordable housing within a town can be affected by local laws that determine the minimum size of a buildable lot, minimum distances from the road or street to the house (setback), and the minimum amount of interior space a home must have (total square footage).

Zoning laws in some communities may prevent housing developers and builders from producing the necessary number of units to meet the demand for affordable housing because the required minimum lot size might be too large (driving up the cost of the house), setbacks might be too large (which...
results in smaller houses on the lots), or the minimum size of the house might be too large (known as minimum square footage, which can also increase the cost of the house).

In addition to zoning requirements, costs such as "impact fees" and "development fees" may be required of housing developers and builders by municipalities. These fees help to pay for the infrastructure (roads, sidewalks, sewers, septic systems, etc.) necessary to support new developments. High impact fees along with zoning restrictions may make the development of affordable housing too expensive.

In order to provide enough affordable housing to meet the growing demand in the rural Southwest, town governments might consider reducing requirements for such items as buildable lot sizes, setbacks, and minimum square footages. Reducing lot size, setbacks, and area makes it possible to build smaller houses on smaller lots, which can make the development of affordable housing easier and less costly for builders and developers.

IMPACT AND DEVELOPMENT FEES

Housing growth increases the need for community services and infrastructure. To recover the costs associated with providing them, local governments charge "impact" and "development" fees on homebuilders and developers. High impact and development fees often stop affordable housing from being built, because development budgets are usually very tight. Often, the fees are passed on to the homebuyer or renter in the form of higher home prices and rents. Housing quality might also suffer, as builders cut corners in construction to lower their costs. Low housing quality can mean more money spent by the homeowner or renter to take care of and maintain the house.

What can be done? Local governments might consider reducing impact and development fees for affordable housing builders and developers, or look at other options that can reduce the costs of additional services and infrastructure.

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Reducing or eliminating impact and development fees can lessen the cost of building affordable housing.

**DEED RESTRICTIONS**

Property owners or community associations often include in a property deed all kinds of development restrictions, which must be followed by future owners. Deed restrictions are similar to zoning regulations, except that deed restrictions are determined by the property owners, instead of by the town or local government. Deed restrictions affect the way property is developed and are designed to protect property values in the community. Restrictions can include the minimum size of a home built on the property and the type construction materials used, both of which can increase the construction cost. Before purchasing land for the construction of affordable housing, housing providers must understand the deed requirements and their potentially negative affect on development. Understanding limitations on development before property is purchased will allow housing providers to consider other options.

**BUILDING CODES**

Local governments usually adopt building codes to control the quality of housing constructed. Although town governments often adopt the building code adopted by the state or a nationally recognized code, they have the power to amend the codes they adopt and tailor them to local conditions. Towns can also choose not to adopt a building code at all, which is common in remote rural areas outside county limits, including the rural Southwest. Housing developers and homebuilders are often confused about whether a certain code is in force, since they can vary from town to town. Code requirements always have an affect on development costs. Very strict requirements can raise the cost of homebuilding and development.

Often, building inspectors can read the same code and interpret it differently. It is not uncommon that one inspector will approve the construction of the same home that is failed by another inspector. Or, that one inspector will permit the use of a particular housing technology that is not permitted by another. Such conflicts can cause delays in development, which then adds to the cost of housing. Resolving conflicting views can result in long project delays.

Los propietarios de vivienda o las asociaciones comunitarias incluyen habitualmente en las escrituras de propiedad todo tipo de restricciones contra la urbanización, que deben ser acatadas por los dueños futuros. Las restricciones de las escrituras son semejantes a las regulaciones de zonificación, salvo que son los mismos propietarios, y no el gobierno de la población o local, los que las determinan. Las restricciones de escrituras, que afectan la manera en que una propiedad se desarrollará, se crean para proteger el valor de las propiedades en una comunidad. Dentro de dichas restricciones puede incluirse el tamaño mínimo de una casa que se construye en la propiedad y el tipo de materiales de construcción; ambos factores pueden aumentar el costo de construcción. Antes de comprar terrenos para la construcción de vivienda asequible, los proveedores de vivienda deben entender los requisitos de las escrituras y su posible efecto negativo sobre la urbanización. Si los proveedores de vivienda entienden las limitaciones sobre la urbanización antes de comprar la propiedad, pueden considerar otras opciones.

Los gobiernos locales adoptan por lo general códigos de construcción para controlar la calidad de las viviendas que se construyan. Con frecuencia los gobiernos de las poblaciones adoptan el mismo código de construcción que adopta el estado, o bien un código reconocido en todo el país. Sin embargo, tienen poder para enmendar los códigos que adoptan, adaptándolos a las condiciones locales. Las poblaciones pueden también impedir que se adopte un determinado código de construcción, una situación común en áreas rurales remotas fuera de los límites de los condados, incluido el suroeste rural. Los urbanizadores y constructores de vivienda se enfrentan habitualmente a situaciones confusas sobre los códigos que están vigentes, ya que éstos pueden variar de una ciudad a otra. Los requisitos de los códigos siempre afectan los costos de desarrollo. Si los requisitos son muy estrictos pueden aumentar el costo de construcción y el desarrollo de vivienda.

Los inspectores de construcción pueden con frecuencia interpretar de manera distinta un mismo código. No es raro el caso de un inspector que apruebe la construcción de una casa mientras que otro la niega. Otra posibilidad es que un inspector permita el uso de cierta tecnología de vivienda que otro inspector no permitirá. Estos conflictos pueden resultar en atrasos en el desarrollo, lo que a su vez aumenta los costos de la vivienda. La resolución de opiniones divergentes puede significar largos atrasos en el proyecto.

La adopción de un código único por parte de todas las poblaciones locales, unida a la capacitación de funcionarios e inspectores respecto a dicho código puede evitar los atrasos y los altos costos que surgen cuando existe confusión sobre los códigos o cuando los inspectores emiten aprobaciones e interpretaciones divergentes.
The adoption of a single code by all local towns, in addition to the education of code officials and inspectors, can prevent delays and the high costs associated with code confusion and conflicting inspector approvals and interpretations.

CONFLICTING JURISDICTION

Often, housing construction is regulated by more than one government agency. For example, the town’s building department may approve a home’s design and grant a building permit. But, if a home is built with the help of funds from a state or federal agency, that organization may not approve the proposed house. How does this happen? The funding agency might require specifications to be provided by the builder, which are not required by the local building department. In addition, other programs that offer financial support to homeowners (such as utility programs that reduce utility costs if homes include certain specifications required by the program) may also conflict with what is required by local and funding source requirements.

Because a housing developer or builder must comply with the local code in order to obtain building permits, financial assistance, and utility program financial incentives, satisfying the construction requirements of a number of organizations and government programs often results in higher construction costs. Streamlining the construction requirements of the town, state, or federal funding source, utility programs, and others may reduce the cost of housing for developers and builders.

ENVIRONMENTAL REGULATIONS

Federal and state governments have laws designed to protect the environment from being degraded by over-development, which can tax natural resources. Many local governments also have environmental laws in place. Environmental laws might require that homebuilders submit site plans, certified by a licensed landscape architect or professional surveyor, indicating the site’s natural vegetation. Based on the site plan, homebuilders may not remove vegetation (this can prevent the destruction of the natural environment) or might be required to replant removed vegetation. In this example, fees for a landscape architect or professional surveyor, and the cost of replanting, might drive up cost of the house.
Although environmental regulations are helpful, federal, state, and local governments might consider financial assistance or cutting costs for affordable housing providers as a solution to increased developmental costs.

ACCESSIBILITY REGULATIONS

Federal laws mandate that certain projects comply with design and construction requirements designed to provide access to housing for people with disabilities. Two of the federal laws that require accessibility in housing are Section 504 of the Rehabilitation Act of 1973 (Section 504) and the Fair Housing Amendments Act of 1988 (FHA).

When do these laws apply? Well, if a developer or homebuilder receives federal financial assistance for a project, and there are at least five units constructed (regardless of whether they are on the same site) then the Section 504 law applies. This law should be of concern to nonprofit, affordable housing providers since they usually receive federal financial assistance. Section 504 covers the new construction and rehabilitation of dwelling units. In a project with at least five newly constructed units, Section 504 requires that 5% of units, or at least one (whichever is greater) be designed and constructed to be accessible to people with physical disabilities. An additional 2%, or at least one unit, (whichever is greater) must be designed and constructed to be accessible to people with visual or hearing disabilities. Section 504 also requires accessibility in existing housing that is rehabilitated (with some limits).

For a multifamily housing project with at least four units in one building, built for first occupancy after March 13, 1991, the FHA requires that all units in buildings with elevators and ground floor units in buildings without elevators be accessible. If there are at least four units in a building, the FHA applies even if a project doesn’t receive financial assistance from the federal, state, or local government, or whether the units are owned or rented. In addition to federal laws, there may be state and local laws and building code requirements for accessible design.

Depending on the jurisdiction, homebuilders and developers might also have to comply with “visit-ability” regulations, which require certain minimum levels of accessibility in single-family detached homes so that they can be visited by people with disabilities. The visit-ability movement is gaining strength and
regulations are in place in a number of states and localities across the country. The reason for accessibility laws is to provide people with disabilities the same opportunities to housing as are provided to people without disabilities. In many instances, housing providers (homebuilders and developers) are not even aware that the laws exist, and do not realize that the cost of making housing accessible is cheaper when the house is built, compared to fixing the problem later on. To avoid federally mandated retrofits for violating fair housing laws, housing providers must be informed about applicable laws that affect design, construction, and ultimately project budgets.

People’s perceptions or views, often based on misinformation or outdated ideas, and the isolation and remoteness of many Southwest developments, can prevent affordable housing from being built. In the rural Southwest, these obstacles include the following:

- Negative Views of Construction Choices
- Negative Views of Community Residents
- Rural Isolation and Lack of Community Consensus

NEGATIVE VIEWS OF CONSTRUCTION CHOICES

Recent developments and improvements in low-cost materials and methods of construction offer many more choices in homebuilding. Such improvements can potentially reduce the overall cost of building a house, without sacrificing the quality of construction. Since some of these advances in construction materials and techniques are relatively new, they might be viewed negatively by the general public and by building inspectors and code officials. For example, manufactured housing (also known as “HUD-Code housing” and “mobile homes”) is often viewed by members of the public and by local town governments as “cheap” construction, which can bring down the value of nearby properties. Despite the fact that the HUD Code pre-empts local building codes, many building inspectors and code officials in small towns question the standard to which manufactured housing is built, blocking the use of such housing. More commonly, zoning regulations that challenge the pre-emption of HUD-Code housing are put in place to prevent the use of manufactured housing. The prejudice against HUD-Code homes spreads to include modular homes, which are built in the factory to local codes, and which are often far from federal laws, which would require a retroactive update for violating the laws on housing. The prejudice against HUD-Code homes spreads to include modular homes, which are built in the factory to local codes, and which are often far
superior in construction to site-built homes. Consumers share these prejudices, which deters developers from turning to factory-built housing as a viable, low-cost but high-quality housing choice for affordable communities. Education geared especially for people who live in rural communities and for building officials about the high quality of low-cost building materials and techniques may provide the comfort level necessary to change negative perceptions.

NEGATIVE PERCEPTIONS OF COMMUNITY RESIDENTS

Providers of affordable housing often meet with resistance by local residents where affordable communities are to be built. Local residents might fear that affordable housing developments are crime ridden, dirty, ugly, and will lower the community’s property values. Additionally, communities fear the impact on local services and infrastructure, including roads and schools. Community residents usually don’t know that new, innovative materials and cost-cutting construction techniques can result in attractive housing and safe neighborhoods, in which people take great pride.

The “Not in My Back Yard” (NIMBY) attitude often forces housing providers to build on alternate sites. Sometimes these sites are too remote to make affordable housing feasible. Remoteness drives up the cost of affordable housing because of the potential lack of infrastructure and the long distances construction workers and material suppliers, for example, must travel. Community meetings and outreach to ease residents’ fears might be a way to eliminate negative perceptions and to encourage support for affordable housing.

RURAL ISOLATION AND LACK OF COMMUNITY CONSENSUS

Among the more challenging roadblocks to affordable housing development are building departments in small, rural communities. Many have only the most rudimentary government, perhaps a tiny local office staffed with one or two people. These rural communities are essentially helpless when it comes to the time-consuming processes demanded by federal and state development assistance. Small towns often have difficulty raising the money necessary to build affordable housing or to improve existing housing; most builders and contractors can make more money working in larger towns and cities where they can earn higher wages. As a result, many small-town residents construct or rehab

PERCEPCIÓN NEGATIVA POR PARTE DE LOS RESIDENTES DE LA COMUNIDAD

Los proveedores de vivienda asequible se enfrentan con frecuencia a la oposición de los residentes de los sitios en donde se pretende construir viviendas asequibles. Es posible que los residentes locales teman que las urbanizaciones asequibles estarán plagadas de crimen, serán sucias, feas y reducirán el precio de la propiedad en la comunidad. Por otra parte, la gente de las comunidades puede temer el impacto que habría en los servicios e infraestructura locales, incluidas las carreteras y las escuelas. Los residentes de las comunidades no saben generalmente que gracias al uso de materiales innovadores y técnicas de construcción para reducir los costos se puede producir viviendas atractivas y vecindarios seguros, de los que los residentes pueden enorgullecerse.

Esta actitud de “¡en mi patio trasero no!” obliga a menudo a los proveedores de vivienda a construir en otros sitios. A veces estos sitios son demasiado remotos para posibilitar la construcción de vivienda asequible. La lejanía del sitio hace aumentar el costo de la vivienda asequible porque es posible que allí no exista la infraestructura necesaria, y por las grandes distancias que los obreros y proveedores de material, por ejemplo, deben recorrer. Las asambleas comunitarias y la información a la población, con el fin de mitigar los temores de los residentes, pueden ser un medio para eliminar las percepciones negativas y activar el respaldo a la vivienda asequible.

AISLAMIENTO RURAL Y FALTA DE CONSENSO EN LA COMUNIDAD

Los departamentos de construcción de las comunidades rurales pequeñas constituyen uno de los obstáculos más difíciles para el desarrollo de viviendas asequibles. Muchos de ellos sólo cuentan con la administración más rudimentaria, acaso solo una pequeña oficina local con uno o dos empleados. Para estas comunidades rurales es prácticamente imposible tramitar los abrumadores procesos necesarios para obtener asistencia federal y estatal para el desarrollo. Para las poblaciones pequeñas es difícil reunir el dinero necesario para construir viviendas asequibles o para mejorar las viviendas ya existentes; la mayoría de constructores y contratistas pueden ganar más dinero si trabajan en poblaciones o ciudades más grandes, en donde pueden obtener mayores ganancias. Por esto, muchos residentes de poblaciones pequeñas construyen o rehabilitan sus propias casas, lo que puede resultar en viviendas mal construidas e inseguras.

La falta de participación de los residentes en las campañas populares para proporcionar vivienda más asequible y de mayor calidad mediante el uso de tecnologías innovadoras constituye una seria barrera social. Muchos residentes piensan que participar en los grupos populares comunitarios equivale a “trabajar contra el gobierno.” Por esto, temen las consecuencias. El orgullo es otra barrera que se opone a la participación comunitaria. Muchas personas son demasiado orgullosas para aceptar asistencia del gobierno y prefieren hacer las cosas por sí mismas.
their own homes, which can result in poorly constructed, unsafe homes.

The lack of participation by residents in grassroots campaigns to provide better, more affordable housing through innovative housing technology is a major social barrier. Many residents believe that getting involved in grassroots community groups is the same as “working against the government.” As a result, they fear the consequences. The “pride factor” is also a barrier to community involvement. Many people are too proud to accept government assistance and prefer to make it on their own.

A large number of residents in rural communities speak no English and dread the idea of speaking at community meetings or to government representatives. Many believe that to improve local conditions requires them to understand a different language and to be involved with the government on a level that is not comfortable. As a result, many rural communities become isolated socially and economically.

Many people in small, rural communities have little or no knowledge of available resources. Many federal, state, and local affordable housing programs are available to those in rural communities. These resources can be combined with other forms of housing assistance (low-income tax credits, private donations, utility incentives, and others) to add to the pot of money available to improve housing technology. Many do not have the skills or resources to identify these funding opportunities, which are intended to improve housing quality.

What can be done? Reducing the isolation of rural communities is the first step to improving housing technology and the quality of life. Establishing community resource groups, similar to those established in Texas under its Colonia program, is a way to promote consensus and community involvement on a level with which residents are comfortable. Such information centers can serve as the community's voice and enable residents to help shape future programs and policies. These centers help empower community residents and foster programs that address many issues, including housing, healthcare, job services, and human services, among others.

Muchos residentes de las comunidades rurales no hablan inglés, y temen hablar en reuniones comunitarias o con representantes del gobierno. Muchos piensan que para mejorar las condiciones locales tienen primero que entender una lengua que no es la suya y relacionarse con el gobierno en situaciones incómodas. Como consecuencia de esto muchas comunidades rurales terminan aisladas social y económicamente.

Muchas personas en comunidades rurales pequeñas saben muy poco o nada sobre los recursos disponibles. Sin embargo, son muchos los programas federales, estatales y locales de vivienda asequible disponibles para estas comunidades rurales. Estos recursos pueden combinarse con otros tipos de asistencia para vivienda (créditos impositivos para personas de bajos ingresos, donaciones privadas, incentivos de las empresas de servicios públicos y otros) para incrementar el dinero disponible para mejorar la tecnología de vivienda. Muchas personas no cuentan con la habilidad o con los recursos para aprovechar estas oportunidades de financiamiento, cuyo objetivo es mejorar la calidad de la vivienda.

¿Existe alguna solución? El primer paso para mejorar la tecnología de la vivienda y la calidad de vida es reducir el aislamiento de las comunidades rurales. Para promover el consenso y hacer que la comunidad participe de una manera en que sus residentes se sientan cómodos, una posibilidad es establecer grupos de recursos comunitarios como los que se establecieron en Texas bajo el Programa para las Colonias. Estos centros de información pueden ser la voz de la comunidad y habilitar a los residentes para colaborar en la creación de futuros programas y políticas. Los centros ayudan a dar peso a la voz de los residentes de la comunidad y auspician programas que prestan atención a diversos asuntos, incluidos la vivienda, la atención a la salud, los servicios para el trabajo y los servicios humanos, entre otros.
CASE STUDY 1: UNIQUE APPROACH BREAKS DOWN OBSTACLES TO HOMEOWNERSHIP
Proyecto Azteca, Hidalgo County, Texas

Started in 1991 by the United Farm Workers (UFW) and Texas Rural Legal Aid (TRLA), Proyecto Azteca is a non-profit housing developer that provides affordable housing for Colonia residents in Hidalgo County, Texas. Families served by Proyecto Azteca make about $4,500 to $13,500 per year, usually from seasonal employment as migrant farm workers, farm workers, or construction workers. These families are attracted to Colonia villages because plots of land can be bought from developers for very little money. Colonia villagers can purchase an $8,000 to $12,000 plot of land from developers for as low as $100 down. If they can afford it with the little money left over, families typically build substandard, unsafe, makeshift homes. Sometimes, one late payment to the developer results in the loss of the land and the home. Developers often apply penalties and other fees for unsubstantiated “violations.” If residents cannot afford the fees, developers can apply previous mortgage payments to the fee amount, reducing any equity in the property—and the cycle continues.

Proyecto Azteca ends the cycle that renders Colonia residents powerless by refinancing the land and ending the relationship between the family and the developer. Proyecto Azteca’s unique approach has broken down the obstacles to affordable homeowner-

Fig. 6-1 Typical cascarone
ship. Its goal is to offer only as much home as a family can afford. The strategy here is to provide homes that are not fully completed. Known as cascarones, or “shells,” the homes are 80% finished. They are fully framed and enclosed, including doors, vinyl siding, an asphalt shingle roof; all mechanical, plumbing, and electrical systems; the kitchen sink and all bathroom fixtures (Fig. 6-1). Cascarones do not include flooring, sheetrock, insulation, kitchen and bathroom cabinets, and other amenities (Fig. 6-2). Homeowners are expected to complete the unfinished home at their own pace, as they choose, and as money allows (Fig. 6-3). This approach to housing development has significantly reduced the cost of homeownership in Hidalgo County.

Proyecto also offers fully constructed homes to families that can afford them (Fig. 6-4). Both the cascarones and fully constructed homes are 1,000 square feet (a simple rectangular plan 24 feet by 36 feet) with three bedrooms and one bathroom. Fully constructed homes can be bought for as little as $27,500; cascarones sell for about $12,500. Home prices include labor, materials, and closing costs.

Homebuyers qualify for the Proyecto program only if they own a plot of land in a Colonia. Once a family is selected by Proyecto and goes through the self-help process, the payments for both the lot and the home are combined into one mortgage payment that is made to Proyecto.

Housing construction can begin within two to three days after purchase from Proyecto. Using 100% self-help labor, the complete homes and the cascarones are constructed off-site from the final location of the home on a large lot of land owned by Proyecto Azteca (Fig. 6-5). Usually more than one home is constructed in this manner.

Fig. 6-2 Cascarones come equipped with all necessary plumbing fixtures, but walls, floors, and cabinetry are completed by the homeowner. Fig. 6-3 Cascarone kitchen finished by the homeowner. Fig. 6-4 Typical kitchen installed in a complete home.

Fig. 6-2 Los “cascarones” vienen equipados con todos los elementos de plomería necesarios, aunque el propietario debe hacerse cargo de terminar las paredes, el piso, y los armarios. Fig. 6-3 Un propietario de vivienda termina la cocina de un “cascarón”. Fig. 6-4 Cocina típica instalada en una casa terminada.
structed at the same time by a number of families (Fig. 6-6 and Fig. 6-7). While one construction crew is building a house on the Proyecto lot, another is at the site where the home will be delivered, preparing the foundation. Cascarones can be constructed within six to eight weeks, while fully complete homes may take several more weeks to finish. When the homes are ready for delivery, the modules are trucked to the site and lowered onto the foundation (Fig. 6-8). All plumbing, mechanical, and electrical hookups are done by professionals (Fig. 6-9 and Fig. 6-10).

A cascaron can be purchased from Proyecto Azteca’s Azteca Community Loan Fund, which was established to fund their construction. The loan fund is managed by the non-profit and provides 0% interest loans to finance cascarones. The housing provider offers 20-year mortgages for completed self-help housing, and 7-year mortgages for cascarones. Lending terms guarantee that annual housing costs will not exceed 10% of the family’s yearly income. Monthly payments do not exceed $100.

Low default rates (less than 5%) are thanks in part to homeowner training activities that the non-profit conducts as part of the home-buying process. These training sessions and counseling services are an important part of teaching families about the importance of responsible homeownership. Homeowners learn how to operate and maintain a home, manage financing, pay off debt, and save money, among other things.

Proyecto’s traditional self-help housing program is funded by rural housing development assistance provided by the U.S. Department of Agriculture, the U.S. Department of Housing and Urban Development, and the Texas State Department of Housing. Proyecto Azteca also receives foundation grants to cover costs associated with administrating its housing programs. Because the

el lote del Proyecto Azteca, la otra está en el sitio en el que ésta se instalará, preparando los cimientos. Los “cascarones” pueden construirse en un período de seis a ocho semanas, mientras que las casas terminadas pueden requerir varias semanas adicionales para terminarse. Cuando las casas están listas para su entrega, los módulos se envían por camión hasta el sitio de instalación y se colocan sobre los cimientos (Fig. 6-8). Las conexiones mecánicas, de plomería y de electricidad las hacen profesionales (Fig. 6-9 y Fig. 6-10).

Los “cascarones” pueden comprarse mediante el Fondo de Préstamos Comunitarios del Proyecto Azteca, que se estableció para financiar su construcción. La agencia sin fines de lucro administra el fondo de préstamos, ofreciendo préstamos con un interés del 0% para financiar los “cascarones”. El proveedor de vivienda ofrece hipotecas de 20 años para las casas terminadas con el método de autoayuda, y de 7 años para los “cascarones”. Según los términos del préstamo, los costos anuales por la vivienda no sobrepasarán el 10% de los ingresos anuales de la familia. Los pagos mensuales no son superiores a $100.

Las bajas tasas de incumplimiento (menos del 5%) se logran parcialmente gracias a las actividades de entrenamiento de los propietarios, que la organización sin fines de lucro realiza como parte del proceso de compra de vivienda. Estas sesiones de entrenamiento, junto con los servicios de asesoría, son un aspecto relevante en la educación de las familias respecto a la importancia de ser un propietario de vivienda responsable. Entre otras cosas, los propietarios de vivienda aprenden cómo optimizar el uso y el mantenimiento de una casa, a administrar las finanzas, pagar sus deudas y ahorrar dinero.

El programa tradicional de vivienda de autoayuda del Proyecto Azteca recibe fondos de asistencia para el desarrollo de vivienda rural del Departamento de Agricultura y el Departamento de Vivienda y Desarrollo Urbano de los Estados Unidos, y del Departamento de Vivienda del estado de Texas. El Proyecto Azteca recibe además subsidios de diversas fundaciones para cubrir los costos administrativos de sus programas de vivienda. Como el mercado de residentes a los que sirve el Proyecto Azteca no cumple con los requisitos de crédito y de ingresos que piden muchos programas del gobierno, las posibilidades de obtener fondos públicos son limitadas. Una de las actividades permanentes del Proyecto Azteca es la búsqueda de
market of residents served by Proyecto falls below the income and credit requirements of many government programs, public funding options are limited. Searching for funding sources is an ongoing activity of Proyecto since there is never one steady source of financial assistance.

Because it realized that land issues between Colonia residents and exploitive developers are a major barrier to homeownership, Proyecto was able to put a system in place that dissolved bad relationships between residents and developers. This nonprofit has successfully learned how to leverage and layer its financing options so that it can provide more affordable housing to families in Hidalgo County.
CASE STUDY 2: NEW CONSTRUCTION TECHNIQUES INCREASE AFFORDABILITY

Community Development Corporation, Brownsville, Texas

The Community Development Corporation of Brownsville, Texas (CDCB) is a non-profit housing developer that was started in 1974 to provide affordable housing to very low-income residents of the counties including and surrounding Brownsville. The CDCB typically builds new single-family detached housing and rehabilitates existing housing in the Texas-Mexico border region for families who earn no more than 50% of the area's median family income. Because the CDCB works with several investor banks, it has the ability to provide financing to homebuyers who could not ordinarily qualify for traditional mortgages. Its rehabilitation program generally involves demolishing existing and dilapidated housing and rebuilding new homes in their place (Fig. 6-11 and Fig. 6-12).

In addition to keeping its development costs low by acquiring and layering financing opportunities from a number of federal, state, and local programs and private donations, CDCB further defrays costs by focusing on and utilizing efficient low-cost construction practices, some of which include:

- Recycling windows, doors, and other materials that are salvaged from rehabilitated or demolished homes.
- Using volunteer labor from the Mennonite Partnership Building Initiative, church groups, and YouthBuild (Fig. 6-13).
- Compra de los materiales para la construcción a los proveedores locales, lo que reduce los costos.
- Empleo de mano de obra de voluntarios de Mennonite Partnership Building Initiative, grupos de iglesias y YouthBuild (Fig. 6-13).
- Compra de los materiales para la construcción a los proveedores locales, lo que reduce los costos.
- Compra de los materiales para la construcción a los proveedores locales, lo que reduce los costos.

La Corporación para el Desarrollo Comunitario de Brownsville, Texas (Community Development Corporation of Brownsville, o CDCB) es un organismo sin fines de lucro dedicado al desarrollo de vivienda, que se lanzó en 1974 para brindar vivienda asequible a los residentes de muy bajos ingresos en la zona de Brownsville y los condados vecinos. La CDCB construye generalmente viviendas unifamiliares nuevas y separadas, y rehabilita viviendas ya construidas en la frontera entre Texas y México para familias cuyos ingresos no superan el 50% del ingreso promedio por familia en esta área. La CDCB trabaja con varios bancos inversionistas, lo que le permite proporcionar financiamiento a aquellos compradores de vivienda que normalmente no calificarían para obtener una hipoteca tradicional. Su programa de rehabilitación comprende por lo general la demolición de viviendas en muy mal estado para construir en su sitio casas nuevas (Fig. 6-11 y Fig. 6-12).

Además de mantener bajos los costos de urbanización obteniendo y diversificando las oportunidades financieras con varios programas federales, estatales y locales, así como con donaciones privadas, la CDCB reduce aún más los costos concentrándose en la aplicación de técnicas de construcción eficientes y de bajo costo, como las siguientes:

- Reciclaje de ventanas, puertas y otros materiales que se recuperan de las casas rehabilitadas o demolidas.
- Empleo de mano de obra de voluntarios de Mennonite Partnership Building Initiative, grupos de iglesias y YouthBuild (Fig. 6-13).
- Uso de materiales de construcción donados por los proveedores locales, cuando es posible.
Using donated construction materials from local building material suppliers whenever possible.

Purchasing construction materials from local suppliers, which reduces transportation costs.

Incorporating low-maintenance building materials (such as vinyl flooring instead of carpet).

To further reduce the cost of providing affordable housing options to residents of the Brownsville region, the CDCB works with HUD’s Partnership for Advancing Technology in Housing (PATH) program to identify potential areas for improvements to its standard design and construction practice, including more efficient framing, advanced plumbing features, and improved insulation levels. For example, the CDCB worked with PATH on the redesign of its typical cottage-style, 864-square-foot house (Fig. 6-14), which made the house more resource-efficient and affordable. Because CDCB qualifies buyers on the basis of their total living expenses (rather than just principal, interest, taxes, and insurance) it is possible to add cost to the building for features that save money, while actually reducing the cost of ownership. Nevertheless, CDCB is interested in anything that will reduce costs, especially rising lumber prices, and the cost of meeting the new, stricter state energy code.

A look at the cut list for the standard home showed that inefficient building habits, tradition, and the accumulation of added requirements by code officials had resulted in excessive amounts of material in many places, and a deficit in other places. For instance, bringing the PATH-prototype home up to the new Texas wind code substantially reduced the overall lumber used, while increasing the number of hurricane clips and slab anchors, resulting in an overall cost savings (Fig. 6-15 and Fig. 6-16). A careful layout of the roof sheathing showed how cut-off ends could be reused elsewhere. These savings more than offset a recent hike in lumber prices.

The prototype roof is stick-framed and constructed by “free” YouthBuild labor, although framing trainers are hired. Typical practice in the area does not allow for the installation of an assembly of four-way trusses (a detail that was overlooked by the building inspectors), so additional members of wood were used to ensure the safety of the structure. The result was a more economical solution (Fig. 6-16).

Para reducir aun más los costos y ofrecer la posibilidad de vivienda asequible a los residentes de la región de Brownsville, la CDCB trabaja con la Asociación para el Avance de Tecnología de la Vivienda (Partnership for Advancing Technology in Housing o PATH), un programa del HUD, con el fin de descubrir qué aspectos de su diseño y técnicas de construcción estánndar pueden mejorar, incluidos entre otros una estructura más eficiente, características avanzadas de plomería, y mejoras en el aislamiento. Por ejemplo, la CDCB colaboró con la PATH en el nuevo diseño del plano típico de su casa pequeña, de 864 pies cuadrados (Fig. 6-14), haciendo más eficiente el uso de recursos y más asequible. La CDCB califica a los compradores tomando en cuenta sus gastos esenciales totales en lugar de considerar sólo el principal del préstamo, los intereses, los impuestos y el seguro. De este modo es posible añadir costos a la construcción por características que resultarán luego en un ahorro, a la vez que se logra reducir el costo de ser propietario. Sin embargo, a la CDCB le interesa cualquier posibilidad de reducir los costos, en particular por el precio cada vez más alto de la madera, y el costo para cumplir con el nuevo y más estricto código de energía del estado.

Un examen de la lista de materiales de la casa estándar demostró que en varios casos había un exceso en otros un déficit de materiales, debido a los hábitos ineficientes de construcción, a la tradición, y a la adición constante de requisitos impuestos por los funcionarios encargados de hacer cumplir los códigos. Por ejemplo, cuando se hizo que la casa prototipo del PATH cumpliese con el nuevo código de Texas para resistir al viento, se redujo notablemente la cantidad de madera empleada y se aumentó el número de sujetadores contra huracanes y anclas de concreto. El resultado final fue una reducción en los costos (Fig. 6-15 y Fig. 6-16). Una distribución cuidadosa del recorte del techo demostró que los cortes que se quitan de los extremos pueden emplearse en otros puntos. Gracias a esta reducción en los costos se pudo más que compensar el reciente aumento en el precio de la madera.

El prototipo del techo consiste en una estructura de vigas que se monta en su sitio con mano de obra “gratuita” que aporta YouthBuild, aunque se contrata también a entrenadores de ensamblaje. La práctica típica de la zona no permite soportar adecuadamente las vigas de cumbre para un techo de cuatro aguas (un detalle que pasaron por alto los inspectores de construcción), de modo que se añadieron elementos de madera de

![Fig. 6-13 Brownville, TX Community Development Corp. (CDC) YouthBuild volunteers](image)
not properly support the roof’s hip ridges (a fact ignored by building inspectors), so lumber was added as economically as possible to bring this element up to code. Because gable roofs are easier to frame than hip roofs, it made sense to increase the short ends of the roof (which face the street and back yard). This extended the length of the main ridge so that the middle 40% of the roof could use simple gable-roof framing. The steeper pitch is also a plus because it increases the visual impact of the home as seen from the street (higher-end homes in the area all have much steeper roof pitches, so a low-pitched roof is stigmatized as “cheap”). While it was not possible to reduce the amount of framing in the outside walls (it was actually increased to meet the new code), interior walls were framed 24-inches-on-center (as opposed to the standard 16-inches-on-center) and headers were eliminated from non-bearing walls.

Adding increased levels of insulation to the prototype slightly raised the cost, but mortgage payments will actually be reduced as a result, due to reduced energy costs. The savings in the framing helped pay for low-e double-glazed windows and SEER-12 (higher-efficiency) air conditioning units, both new requirements of the Texas energy code. SEER-14 equipment would have proved cost-effective, but the unit for the home was only 1.5 tons, and SEER-14 equipment is not available in that size.

Other features introduced in this home, both new to the area, was a plastic manifold PEX water supply system (Fig. 6-17), in which durable plastic tubing runs from a central set of valves to each fixture. This reduces the time it takes for hot water to reach outlying fixtures, cutting both water waste and energy needed to heat water. The system is very easy to install and may cost little or no more than a standard copper system. A big advantage of plastic
pipes is that they don’t corrode—a very common problem with copper piping in the area because of extremely hard water. Also used were air-admittance valves, which allow fixtures to be vented without running a pipe through the roof (saves time and materials).

The new techniques and materials used in Brownsville required adjustments in how contractors and tradespeople do their work. Even when motivated to try new ideas, the YouthBuild team fell back on traditional methods in many cases. It therefore has proved desirable to phase the changes in over a series of homes, allowing tradespeople (and building inspectors) to adjust gradually. This also allows comparison of different system brands, and the introduction of new techniques that were overlooked in the prototype. Examples include radiant barrier sheathing and vinyl windows, which reduce heat gain in the home. The phased approach may work well because the same home design is built, one-by-one, in the same area by the same contractor.

Other features include fluorescent circle-line lighting fixtures throughout, an Energy Star refrigerator and overall home rating, and a supply-only intake duct for house ventilation. Whether the overall package reduces or raises the first cost, the homeowner will pay less per month in utilities because of its efficiency. The PATH prototype design reduces energy consumption, saves water and lumber, increases durability and wind resistance, lowers maintenance costs, and dramatically improves comfort.
CASE STUDY 3: LOW MAINTENANCE SAVES HOMEOWNERS MONEY

Life Rebuilders, Inc., Phoenix, Arizona

From its inception in 1990, Life Rebuilders, Inc. (LRI) a real estate development and building corporation, has combined resources with local communities to successfully develop affordable housing neighborhoods in Arizona, California, New Mexico, and Texas (Fig. 6-18). LRI’s goal is to provide comfortable and functional homes that use quality building products and materials. LRI realizes the value of building affordable homes that are easy to maintain. Low maintenance means more available cash that the homeowner can use for other living expenses. Many of LRI’s low maintenance techniques are simple in concept and logical. They can be applied to various parts of the home and are particularly applicable in the rural Southwest. Because many of LRI’s customers are first-time homebuyers, they are given a “Homebuyers Guide” on how to maintain their new home. In addition, LRI staff conducts a detailed demonstration or “walk through” in each home after the closing.

Extreme temperature fluctuations are characteristic of many parts of the Southwest. In the hottest part of the summer, as the sun beats down on a home’s exterior walls, the temperature in these walls can rise to 120°F while air conditioning cools the interior side of the hot exterior walls to about 70°F. During the night, the temperatures of the exterior walls are reduced significantly. These extreme fluctuations in temperature commonly cause bathtubs and their enclosing walls to expand and contract. As a result, over time bathtubs and typical one-piece surrounds often crack, which results in costly maintenance for the homeowner (Fig. 6-19). LRI

Fig. 6-18 Typical home in Superior, AZ constructed by Life Rebuilders, Inc.
Fig. 6-18 Casa típica en Superior, Arizona, construida por Life Rebuilders, Inc.
has addressed this problem by installing the bathtub surround in three separate pieces, which provides enough flexibility to reduce the stresses that cause cracking. The three separate pieces move or slide against each other as the exterior walls expand and contract, eliminating potential cracking. Bathtubs and their surrounds installed as separate pieces are virtually maintenance free.

LRI has also found a solution of another movement problem, this one in the house’s foundation. In many locations throughout the Southwest, expansive clays cause movement in slab foundations. Cracks due to differential settling are common. In these instances, LRI uses post-tensioned slabs, which incorporate steel cables, to tie the slab together as one unit. The post-tensioning resists differential settling, significantly reduces cracks in the slab, and eliminates the high costs associated with fixing resulting problems (Fig. 6-20).

With an eye to lowering a home’s maintenance costs while improving its appearance, units constructed by LRI are landscaped with plants that are common to the region, and thrive in its arid conditions. This reduces the need to water lawns to keep them green, and reduces the costs of lawn maintenance. This landscaping concept, called “xeriscaping,” is an effective way to reduce demands on water, which is not available in abundant supply in many areas of the rural Southwest (Fig. 6-21). Grass or sod is never used in xeriscaping because its watering costs are too high.

The concept of passive-solar design, which helps to reduce energy costs and improve comfort through intelligent use of simple ideas to reduce heat-gain, is another LRI approach. Roof overhangs on low-cost houses are typically between 12 and 18 inches, which are not deep enough to shade exterior walls and windows from the sun during the summer months. The
reason for this is simple: deeper overhangs require more materials, which is viewed as a higher “first cost.” The fascia, truss tails, and underboards are all components of roof overhangs. Because of the intense heat in many parts of the Southwest, the fascia and truss tails may twist and split and underboards may separate from the trusses and delaminate. Extra maintenance and funds are required to remedy this problem. The solution, LRI has found, is to simply eliminate the overhangs as they are commonly designed and constructed. Instead, LRI uses an angled piece of oriented strand board (OSB) to enclose all the overhangs, and covers the OSB with stucco, which gives the appearance that the enclosed overhang is an extension of the exterior wall (Fig. 6-22 and Fig. 6-23). Because stucco finishes require far less on-going maintenance and costs than repairing damaged materials associated with wood overhangs, this detail translates into a more affordable home. Enclosed overhangs also eliminate insect infestation, which commonly occurs under exposed overhangs.

In the kitchen, LRI uses a cost-saving technique that employs the same simplicity and logic found throughout its home construction. Generally, microwave ovens installed above ranges must be located according to the manufacturer’s recommended height, or else the warranty for the equipment is void. In an effort to reduce development costs, microwave ovens are usually not a standard feature in affordable housing units. To make their installation easier to accomplish by the homeowner at a later time, developers typically use a 15-inch-tall cabinet above range cooktops. If a microwave is installed under a 15-inch cabinet, its warranty will be voided because its bottom edge is too close to the cooktop. To ensure that the warranty for the microwave remains valid, LRI installs an 11-inch-tall cabinet above the range.
so that if the homeowner chooses to replace the standard vent hood with a microwave oven, its bottom edge will be far enough above the range. LRI also includes a electrical box and outlet in the wall cabinet for a future microwave (Fig. 6-24).
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<th>RESOURCE DESCRIPTION/TITLE</th>
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<tr>
<td><strong>Non-Profit Housing Developers/Community Development Organizations</strong></td>
<td><strong>Urbanizadores sin fines de lucro y Organismos de desarrollo comunitario</strong></td>
<td></td>
</tr>
<tr>
<td>Southern Rural Development Initiative</td>
<td>Resource for building capital and capacity for poor communities.</td>
<td>SRDI 128 E. Hargett Street, Ste. 202 Raleigh NC 27601 (919) 829-5900 <a href="mailto:srdi@srdi.org">srdi@srdi.org</a></td>
</tr>
<tr>
<td>Corporation for Supportive Housing</td>
<td>Resources addressing the prevention of homelessness.</td>
<td>CSH 50 Broadway, 17th Floor New York, NY 10004</td>
</tr>
<tr>
<td>Center for Community Change</td>
<td>A resource for community development and empowerment.</td>
<td>Center for Community Change 1000 Wisconsin Ave., NW Washington, DC 20007 (202) 339-9338</td>
</tr>
<tr>
<td>The Housing And Community Development Knowledge Plex</td>
<td>A web-based resource for affordable housing and community development.</td>
<td>4000 Wisconsin Ave., NW North Tower, Suite One Washington, DC 20016-2804 (877) 363-PLEX</td>
</tr>
<tr>
<td>Council of State Community Development Agencies</td>
<td>Link to the National Governors Association Rural Development Best Practices.</td>
<td>COSCDA 1825 K Street, Ste. 515 Washington, DC 20006 (202) 293-5820</td>
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<tr>
<td>Manufactured Housing Research Alliance (MHRA)</td>
<td>The research arm of the Manufactured Housing Institute (MHI). Organismo de investigación del Instituto de Casas Prefabricadas (Manufactured Housing Institute MHI). Description of MHRA activities conducted with PATH. Descripción de las actividades que el MHRA realiza junto con el PATH.</td>
<td>MHRA 2109 Broadway, Ste. 203 New York, NY 10023 (212) 496-0900</td>
</tr>
<tr>
<td>Housing Assistance Council (HAC)</td>
<td>Resource for rural housing development; funding assistance. Recursos para el desarrollo de la vivienda rural y ayuda para obtener financiamiento.</td>
<td>HAC 1025 Vermont Ave., N.W., Ste. 606 Washington, D.C. 20005 (202) 842-8600</td>
</tr>
<tr>
<td>Rebuilding Together</td>
<td>Non-profit community-based builder. Urbanizador sin fines de lucro compuesto por miembros de la comunidad.</td>
<td>Rebuilding Together 1536 16th Street, NW Washington, DC 20036 (800) 4-REHAB-9</td>
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<tr>
<td>Habitat for Humanity International</td>
<td>National non-profit affordable housing developer. Urbanizador nacional sin fines de lucro especializado en vivienda asequible. Resources related to all aspects of affordable housing development. Recursos relacionados con todos los aspectos del desarrollo de vivienda asequible. Online information sharing for Habitat affiliates, in English and Spanish. Divulgación de datos en línea sobre las afiliadas de Habitat, en inglés y español.</td>
<td>Habitat for Humanity International Partner Service Center 121 Habitat St. Americus, GA 31709 (229) 924-6935 Department of Construction and Environmental Resources (CAER) Phone: (229) 924-6935 mail to: <a href="mailto:ConsEnv@hfhi.org">ConsEnv@hfhi.org</a></td>
</tr>
<tr>
<td>Rural Community Assistance Corporation</td>
<td>Resource for training, and technical assistance. Recursos para entrenamiento y asistencia técnica.</td>
<td>RCAC 3120 Freeboard Drive, Ste. 201 West Sacramento, CA 95691 (916) 447-2854</td>
</tr>
<tr>
<td>National Rural Housing Coalition</td>
<td>National non-profit providing resources for the attainment of affordable housing. Organismo nacional sin fines de lucro que brinda recursos para la obtención de vivienda asequible.</td>
<td>National Rural Housing Coalition 1250 Eye Street, NW, Ste. 902 Washington, DC 20005 mail to: <a href="mailto:nrhc@nrhcweb.org">nrhc@nrhcweb.org</a></td>
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<td>Energy and Environmental Building Association</td>
<td>Non-profit energy-efficient housing developer. Urbanizador sin fines de lucro especializado en viviendas eficientes en el uso de energía.</td>
<td>Energy &amp; Environmental Building Association 10740 Lyndale Avenue South, 10W, Bloomington, MN 55420-5615 (952) 881-1098 mail to <a href="mailto:information@eeba.org">information@eeba.org</a></td>
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<tr>
<td>National Resources / Recursos nacionales</td>
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<tr>
<td>National Affordable Housing Network</td>
<td>Resource for affordable housing design. Recursos para el diseño de viviendas asequibles.</td>
<td>NAHN PO Box 3706 Butte, MT 59702 (406) 782-5168</td>
</tr>
<tr>
<td>National Conference of State Legislatures</td>
<td>Incentives to improve home energy efficiency. Incentivos para hacer más eficiente el consumo de energía en los hogares.</td>
<td>NCSL 444 North Capitol Street, NW Ste. 515 Washington DC 20001 (202) 624-5400</td>
</tr>
<tr>
<td>National Low Income Housing Coalition</td>
<td>Resources for low-income housing. Recursos destinados a la vivienda para familias de bajos ingresos.</td>
<td>NLIHC 1012 14th St., NW, Ste. 610 Washington, DC 20005 (202) 662-1530</td>
</tr>
<tr>
<td>Technical Assistance Collaborative, Inc.</td>
<td>Affordable housing solutions. Soluciones para crear viviendas asequibles.</td>
<td>TAC One Center Plaza, Ste. 310 Boston, MA 02108 (505) 742-5657</td>
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<td>Local Initiatives Supportive Corporation ñ Center for Home Ownership</td>
<td>Resources for community development corporation for neighborhood redevelopment.</td>
<td>LISC 733 3rd Avenue, 8th Floor New York, NY, 10017 (212) 455-9800</td>
</tr>
<tr>
<td>The US Affiliate of Green Cross International</td>
<td>Resources for energy-efficient affordable housing.</td>
<td>Global Green USA 227 Broadway Street, Ste 302 Santa Monica, CA 90401 (310) 394-7700</td>
</tr>
<tr>
<td>Partnership for Advancing Technology in Housing (PATH)</td>
<td>Tools and resources for incorporating low-cost innovative technologies in affordable housing.</td>
<td>PATH US HUD 451 7th St. SW, Rm. 8134 Washington, DC 20410 (202) 708-4370</td>
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<tr>
<td>National Center for Appropriate Technology (NCAT)</td>
<td>Resource for information and access to affordable technologies that improve economically disadvantaged communities. Recursos para la obtención de datos y el acceso a técnicas económicas que resultan en avances para las comunidades menos privilegiadas.</td>
<td>NCAT PO Box 3838 Butte, MT 59702 (406) 494-4572</td>
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<td><strong>National Housing Institute</strong></td>
<td>Publishers of Shelterforce, the Journal of Affordable Housing and Community Building.</td>
<td>National Housing Institute 439 Main Street Ste. 311 Orange, NJ 07050 (973) 678-9060</td>
</tr>
<tr>
<td><strong>Center for Housing Policy/National Housing Conference</strong></td>
<td>Affordable Housing Clearinghouse. Centro de información sobre vivienda asequible. Paycheck to Paycheck: Working Families and the Cost of Housing in America. De sueldo a sueldo: Las familias trabajadoras y el costo de la vivienda en Estados Unidos (Pay check to Paycheck: Working Families and the Cost of Housing in America).</td>
<td>Center for Housing Policy/National Housing Conference 815 Fifteenth Street, NW, Ste. 538 Washington, DC 20005 (202) 393-5772</td>
</tr>
<tr>
<td><strong>Rural Housing Services (RHS)</strong></td>
<td>Resource for rural affordable housing financial assistance.</td>
<td>RHS, Department of Agriculture Washington, DC 20250 (202) 720-1474</td>
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<td><strong>Other Resources (including state and university-based resources)</strong></td>
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<tr>
<td>State of Texas Website</td>
<td>Information regarding the Colonia Initiatives Programs in Texas.</td>
<td>Texas 1019 Brazos Austin, TX 78701 (512) 463-8948</td>
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<tr>
<td>State Energy Conservation Office (SECO), Texas</td>
<td>Information on energy efficiency and human health programs in the state of Texas.</td>
<td>SECO P.O. Box 13528, Capitol Station Austin, Texas 78711-3528 <a href="mailto:wosgi@cpa.state.tx.us">wosgi@cpa.state.tx.us</a></td>
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<tr>
<td>California State Energy Commission</td>
<td>Information on state low income housing and energy programs.</td>
<td>California Energy Commission Media and Public Communications Office 1516 Ninth Street, MS-29 Sacramento, CA 95814-5512</td>
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<tr>
<td>Arizona State Energy Office</td>
<td>Information on state low income housing and energy programs.</td>
<td>Arizona Department of Commerce 1700 W. Washington, Ste. 600 Phoenix, AZ 85007 (800) 528-8421</td>
</tr>
<tr>
<td>New Mexico State Minerals and Natural Resources Department</td>
<td>Information on state low income housing and energy programs.</td>
<td>Energy Conservation Management Division 1220 South St. Francis Drive Santa Fe, NM 87505 (505) 476-3310</td>
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<td>Center for Housing and Urban Development ñ Texas A&amp;M University College of Architecture</td>
<td>Link to colonias Program ñ dedicated to improving the quality of life in Texas Colonias.</td>
<td>College of Architecture, Texas A&amp;M University 3137 TAMU College Station, TX 77843-3137 (979) 845-1221</td>
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<td></td>
<td>Enlace al Programa para las colonias, que se dedica a mejorar la calidad de vida en las colonias de Texas.</td>
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<td>Fostering Resident Empowerment in the Colonias</td>
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<td>Cómo brindar posibilidades a los residentes de las colonias (Fostering Resident Empowerment in the Colonias).</td>
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<td>Center for Environmental Resource Management ñ University of Texas at El Paso.</td>
<td>No Esperes a Que Se Enferme El Niño Para Tapar El Pozo. ADOBE Ahorrar Energía es Sufrir?</td>
<td>Center for Environmental Resource Management, University of Texas 500 W. University Avenue El Paso, TX 79968-0645 (915) 747-5494 <a href="mailto:cerm@utep.edu">cerm@utep.edu</a></td>
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<td>No Esperes a Que Se Enferme El Niño Para Tapar El Pozo. ADOBE ¿Ahorrar Energía es Sufrir?</td>
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<td></td>
<td>Housing pamphlets in Spanish. Folletos sobre vivienda, en español.</td>
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<tr>
<td>Lyndon B. Johnson School of Public Affairs, University of Texas at Austin</td>
<td>Colonia Housing and Infrastructure</td>
<td>School of Public Affairs, University of Texas at Austin P.O. Box Y Austin, TX 78713-8925 (512) 471-4962</td>
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<td></td>
<td>La vivienda y la infraestructura en las colonias (Colonia Housing and Infrastructure).</td>
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<tr>
<td>Joint Center for Housing Studies, Harvard University</td>
<td>List of research publications.</td>
<td>J CHS, Graduate School of Design Harvard University 1033 Massachusetts Avenue, 5th Floor Cambridge, MA 02138 (617) 495-7908</td>
</tr>
<tr>
<td>Texas Low Income Housing Information Service</td>
<td>Technical assistance for low income housing in Texas.</td>
<td>Texas Housing Income Housing Information Service 508 Powell St. Austin, TX 78703</td>
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<tr>
<td>Design Matters College of Architecture University of Illinois at Chicago</td>
<td>A clearinghouse for best practices in affordable housing.</td>
<td>City Design Center, College of Architecture University of Illinois 1301 University Hall 601 South Morgan Street Chicago, IL 60607-7113 (312) 996-4717</td>
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<td>Change Communications</td>
<td>Web-based list of community development organizations by state.</td>
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<tr>
<td>National Consumer Law Center</td>
<td>Provides education and advocate support to economically disadvantaged homeowners.</td>
<td><a href="http://www.nclc.org/">www.nclc.org/</a></td>
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<tr>
<td>Home Energy magazine</td>
<td>Provides information regarding residential energy management.</td>
<td>Home Energy 2124 Kittredge St., #95 Berkeley, CA 94704 (510) 524-5405 <a href="mailto:contact@homeenergy.org">contact@homeenergy.org</a></td>
</tr>
<tr>
<td>Southwest Energy Efficiency Project (SWEEP)</td>
<td>Resource for energy efficient construction in the Southwest.</td>
<td>SWEEP 2260 Baseline Rd. Suite 200, Boulder, CO 80302 (303) 447-0078 <a href="mailto:info@swenergy.org">info@swenergy.org</a></td>
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<tr>
<td>HomeASTA</td>
<td>Provides technical assistance to recipients of HUD grants. Step-by-step recommendations on how to build a more energy efficient home.</td>
<td>HomeASTA (866) 367-6228 <a href="mailto:info@homeasta.org">info@homeasta.org</a></td>
</tr>
<tr>
<td>National Low Income Housing Coalition</td>
<td>Non-profit developer dedicated to solving affordable housing issues.</td>
<td>NLIHC 1012 14th Street, NW, Ste. 610 Washington, DC 20005 (202) 662-1530</td>
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<tr>
<td>Good Neighbors</td>
<td>Online list of affordable housing organizations by state.</td>
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Resources for Energy Efficient Mortgage Information
Información sobre hipotecas para uso eficiente de la energía

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<tr>
<td>Alliance to Save Energy</td>
<td>Resource for on energy-efficient financing.</td>
<td>Alliance to Save Energy 1200 18th Street, NW, Ste. 900 Washington, DC 20036 (202) 857-0666</td>
<td><a href="http://www.ase.org">www.ase.org</a></td>
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<tr>
<td>Veterans Administration</td>
<td>Resource for VA EEMs.</td>
<td>(800) 827-1000</td>
<td><a href="http://www.homeloans.va.gov/handbook.htm">www.homeloans.va.gov/handbook.htm</a></td>
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<td></td>
<td>Hipotecas para uso eficiente de la energía, de la Asociación de Veteranos.</td>
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<td>Información sobre las políticas actuales relacionadas con las hipotecas para uso eficiente de la energía.</td>
<td>P.O. Box 4561, Oceanside, CA 92052-4561</td>
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<td>(760) 806-3448</td>
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<td><a href="mailto:info@erha.com">info@erha.com</a></td>
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<td>Hipotecas para uso eficiente de la energía, de la Asociación de Veteranos.</td>
<td>P.O. Box 4561, Oceanside, CA 92052-4561</td>
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<td>(760) 806-3448</td>
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<td><a href="mailto:info@natresnet.org">info@natresnet.org</a></td>
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<tr>
<td>FannieMae</td>
<td>Lending service with a focus on affordable housing, rural housing and EEMs.</td>
<td>FannieMae</td>
<td><a href="http://www.efanniemae.com/hcd/ahc/aff_mort_prods.jhtml">www.efanniemae.com/hcd/ahc/aff_mort_prods.jhtml</a></td>
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<tr>
<td></td>
<td>Servicio de préstamos con énfasis en vivienda asequible, vivienda rural e hipotecas para uso eficiente de la energía.</td>
<td>(800) 7FANNIE</td>
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<td>or for EEMs only</td>
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<td>(202) 752-4041</td>
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<tr>
<td>Federal Citizens Information Center</td>
<td>Resource for consumer energy efficiency programs.</td>
<td>FCIC</td>
<td><a href="http://www.pueblo.gsa.gov/ctic_text/housing/energy_mort/energy-mortgage.htm">www.pueblo.gsa.gov/ctic_text/housing/energy_mort/energy-mortgage.htm</a></td>
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<td>Programas para el consumidor sobre uso eficiente de la energía.</td>
<td><a href="mailto:catalog.pueblo@gsa.gov">catalog.pueblo@gsa.gov</a></td>
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<td>Federal Home Loan Bank</td>
<td>Offices across the US</td>
<td><a href="http://www.fhlbanks.com">www.fhlbanks.com</a></td>
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<td>Funding agency for community renewal groups. Agencia de financiamiento de grupos para la remodelación de comunidades.</td>
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<tr>
<td>Freddie Mac</td>
<td>Freddie Mac 8200 Jones Branch Drive McLean, VA 22102-3107 (800) FREDDIE</td>
<td><a href="http://www.freddiemac.com/">www.freddiemac.com</a></td>
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<tr>
<td>Lending agency with a focus on affordable housing. Agencia prestamista con énfasis en vivienda asequible.</td>
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<tr>
<td>Federal Housing Administration (FHA)</td>
<td>U.S. Department of Housing and Urban Development 451 7th Street S.W., Washington, DC 20410 (202) 708-1112</td>
<td><a href="http://www.federalhousingauthority.com/">www.federalhousingauthority.com</a></td>
<td></td>
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<tr>
<td>Provides programs that help to insure approval of low-interest loans. Ofrece programas que ayudan a obtener la aprobación de préstamos con bajos intereses.</td>
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<tr>
<td>National Home Energy &amp; Resources Organization</td>
<td>4005 Poplar Grove Road Midlothian VA 23112 (800) 373-2416 <a href="mailto:n-hero@ix.netcom.com">mailto:n-hero@ix.netcom.com</a> <a href="mailto:n-hero@ix.netcom.com">n-hero@ix.netcom.com</a></td>
<td><a href="http://www.national-hero.com/">http://www.national-hero.com</a></td>
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<tr>
<td>Provides state-by-state listings of the energy raters it trains and certifies. Listado de los calificadores energéticos que treinta y certifica en cada estado.</td>
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<td>Project Development Process Desarrollo de proyectos</td>
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<tr>
<td>A home building industry’s technical online information resource. Datos técnicos sobre la industria de la construcción de vivienda, publicados en línea.</td>
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<tr>
<td>RESOURCE</td>
<td>DESCRIPTION/TITLE</td>
<td>CONTACT</td>
<td>WEBSITE</td>
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<tr>
<td>The Housing Community Development Knowledgeplex powered by Fannie Mae</td>
<td>A web-based resource for affordable housing and community development.</td>
<td>4000 Wisconsin Ave., NW North Tower, Suite One Washington, DC 20016-2804 (877) 363-PLEX</td>
<td><a href="http://www.knowledgeplex.org">www.knowledgeplex.org</a></td>
</tr>
<tr>
<td>Inspection Checklists for Trade Contractors</td>
<td>A home building industry’s technical online information resource. NAHB/RC</td>
<td>400 Prince Georges Blvd Upper Marlboro, MD 20774 (301) 249-4000</td>
<td><a href="http://www.toolbase.org/tertiaryT.asp?TrackID=&amp;CategoryID=674&amp;DocumentID=737">www.toolbase.org/tertiaryT.asp?TrackID=&amp;CategoryID=674&amp;DocumentID=737</a></td>
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