IMPROVING DURABILITY IN HOUSING

BACKGROUND PAPER

March, 1999

This paper was prepared for the Partnership for Advancing Technology in Housing, National Forum on Durability Research held in Upper Marlboro Maryland on March 31, 1999. Forum was sponsored by the National Institute of Standards and Technology (NIST) and hosted by NAHB Research Center, Inc. This paper was prepared to stimulate the thinking of the forum participants about the current state of durability of housing materials and components and about various approaches to improving durability.

1. The PATH Durability Goal

One of the goals of the public/private "Partnership for Advancing Technology in Housing" (PATH) is to improve housing durability and reduce maintenance costs by 50 percent by the year 2010. Other PATH goals calling for reducing the cost of home ownership, improving energy efficiency and environmental performance of new and existing homes, and reducing housing failures due to natural disasters. Specific research, development and deployment activities to achieve the PATH durability goal will be developed and pursued by industry and government interests over the coming years.

The National Forum on Durability Research is being held to solicit broad-based input in helping to set the PATH durability research agenda and defining priorities across potential activities. Several basic issues and questions should be considered as this agenda comes into existence. This paper has been developed as a stimulus for Forum participants. It discusses durability topics, reviews potential sources of information about durability of homes and building products and identifies complexities inherent in the data, and offers suggestions about different ways to work for durability improvement as part of the overall PATH program.

2. Measuring the Durability of a Product, Material or System

As used in this paper, the term "durability" represents the capability to reliably serve an intended function over a long service life under reasonable conditions of use. This leads to other questions, e.g. what is a "long service life"? The relevant time scales include the life of the building, the lives of other products and materials that are closely coupled with the target product, and the time horizons of the occupants. For many purposes durability is a relative concept, not an absolute, and correspondingly difficult to measure or quantify.

One time-honored approach to defining and pursuing a goal of improved durability appears in a classic poem from New England, "The Wonderful One-Hoss Shay", excerpted APPENDIX A. Under that view, the ideal durable product is one that does not "break down", but rather "wears out," and can be developed most economically by systematically identifying and strengthening each of the weakest links in a system. The goals of preventing breakdown and extending the time until things wear out can and should be pursued together. Measuring or quantifying durability is necessary under both approaches.

Pragmatic quantification. A very practical quantification of durability is based on the expected lifetime of a product or system, from installation to replacement, under real-world conditions of use, exposure and maintenance. Real-world data about frequency of replacement for selected products is summarized in the next section. In addition to a statistically "expected" or average lifetime, there is a range of variability across installations that represents early replacement and may reflect premature failure, whether this results from defects in design or manufacture, faulty installation, lack of necessary maintenance or exposure to extreme environmental conditions.

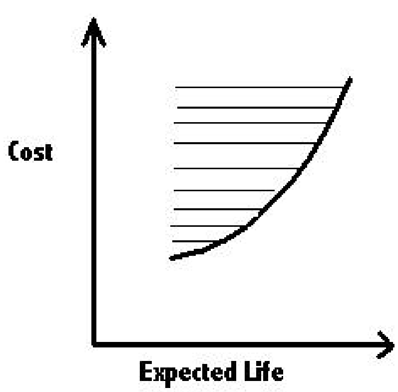
One major shortcoming of using real-world replacement data to determine typical lifetimes and assess durability is that building products can be and frequently are replaced for various reasons other than outright failure or lack of fitness for use. These reasons include functional obsolescence as superior replacement products become available, changing styles, cosmetic or other non-functional deterioration, and changing tastes, needs and wants of owners or occupants. Real-world replacement rates in this sense represent a lower bound on "theoretical" service life.

Scientific quantification. A different, more scientific definition of product durability might relate to the expected service life of a product under standard conditions of use, with standard care. Note that this requires defining standard conditions and standard care, even though use may be under other conditions and care may be lacking. Furthermore, any test-based durability metric requires a correspondingly scientific definition of 'failure', presumably based on real-world failure modes. This is an extensive area of both basic and applied research as well as standards development.

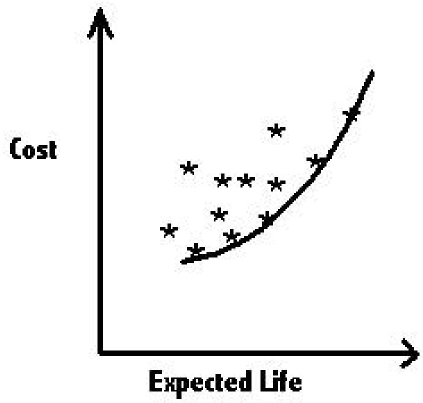
Effects of long-term exposure or usage under quasi-controlled conditions can be studied directly, but for practical reasons durability often is addressed through specialized testing designed to compress the effects of prolonged usage into a short time. As an example, cast polymer plumbing fixtures are tested to ANSI standards using rapid "thermal cycling" of hot and cold water at temperatures designed to simulate actual conditions of use. Other products are subjected to UV irradiation, extremes of temperature and humidity and similar conditions that can be created in the laboratory and are reasonably believed to relate to specific failure modes.

Test-based durability metrics and standards can be implemented in several ways. Some product standards address durability as a simple pass-fail criterion, e.g. successful performance after 500 thermal shock cycles. It is also possible to run this test "to failure" and determine how many cycles a given product can withstand in order to assign a quantitative value to the durability of the product. In principle, where product performance is reasonably consistent the pass-fail classification approach can meaningfully be extended into multiple performance categories or ranks, or even quantitative ratings relating in some idealized way to anticipated service life. Yet conditions in the real world are variable in themselves, and cannot be perfectly addressed in any test program. At the March 31st Forum, Dr. Jonathan Martin of NIST will describe an approach that combines lab measurement and modeling to predict product durability.

Durability Frontier. Most building products and systems are available in a number of alternative forms or have close substitutes that fill the same basic functional requirements. In principle each product could be assessed for its durability with the whole set of results capturing the available durability alternatives at any point in time. A useful way to think about this situation is with a graph showing alternative levels of durability available in the marketplace versus product cost. This abstraction is referred to here as the "durability frontier", and is illustrated here in simplified form for a hypothetical product type such as roofing or siding. The heavy curve is the frontier, representing the maximum durability available for a given cost. Available options in the market permit combinations of cost and performance falling anywhere in the shaded area, but not combinations falling to the right of the curve.



The upward slope to the durability frontier represents an expected trend for more durable products, materials or systems to cost more, other things equal. However, an upward slope may not be present where the products have other dissimilar attributes that affect production cost or demand. Even in this case the durability frontier still is a useful tool for studying durability and durability improvement at a general or conceptual level.



In real life, performance will often fall short of the durability frontier, as illustrated here.

Asterisks in the figure represent individual installations. The asterisks that fall on or very close to the durability frontier are installations that achieve expected performance, while those that lie significantly to the left of the frontier represent early replacement due to premature failure or for other reasons.

3. Baseline Data on Product Lifetimes and Performance Failures

Making sound decisions about how to focus durability-related activities under PATH, and studying the effectiveness of that work over time, requires information about product lives and performance failures. A few sources of relevant information are known, as discussed below. While the available data has several weaknesses, there may be opportunities to improve data collection and better address issues of special concern to PATH.

Consumer Repair and Remodeling Expenditures Survey. NAHB Research Center sponsors an annual survey of consumer repair and remodeling expenditures using a nationwide panel of consumers. The survey data set allows estimating incidence of replacement of various products in a given year, on a national or a regional basis. However, the current survey instrument does not systematically inquire about reasons for replacement so the incidence rates reflect failed products as well as replacement for reasons other than product failure. For example, perfectly functional products are often replaced because their color and/or shape have become unfashionable.

Product lifetimes can, in theory, be estimated from annual incidence of replacement, but this is not straightforward. Where the system can be assumed to be in "equilibrium" or performing in a steady state, the product lifetime equals the reciprocal of the replacement rate, e.g. a 5% annual rate of replacement corresponds to a 20-year average life. Since the housing stock is growing and the mix of products used has changed over time, more complex modeling is needed to determine typical lifetimes from replacement rates.

Data from this survey is currently being analyzed and results will be discussed on March 31st.

American Housing Survey. The American Housing Survey (AHS) is a detailed survey of over 60,000 housing units conducted every 2 years by the Bureau of the Census and sponsored by HUD. The AHS collects information from owner-occupied households about selected major household expenditures for repairs, improvements and alterations carried out in the previous 2 years. For this discussion the most relevant AHS data concerns roof replacement and siding replacement. The study indicates, for example, that about 6.8 million owner-occupied dwelling units out of about 61 million in the U.S. (11%) had total or partial roof replacements costing at least $500 in the previous two years. Similarly, nearly 2 million homes (3%) had at least $500 of siding replaced or added in that time. However, the type of roofing or siding being replaced is not reported in this table, nor is the age of the house, so at best this gives only an overall indication of how long roofing and siding generally last. The AHS data sets for recent years are publicly available, so additional tabulations could readily be constructed.

Expert Opinion. A compilation of expert opinion data from selected industry sources on the useful lives of building products is summarized in a 1993 article by Ahluwalia and Shackford, published in NAHB *Housing Economics* and reproduced in APPENDIX B. This data is notable for its breadth as well as the inclusion of ranges to describe variability in performance. Comments in the article also provide insights into the causes of failure as understood by the experts who provided the data.

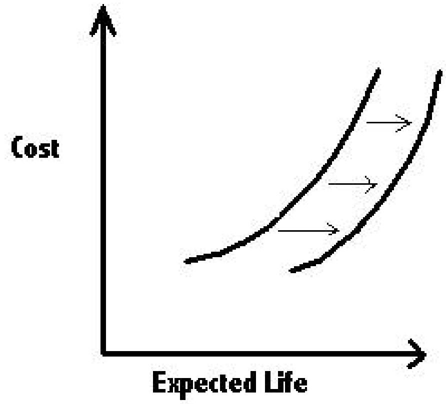
Other Sources of Data. The NAHB Research Center operates a telephone hotline that provides useful information about real-life durability problems in the field. This information is useful for identifying current and emerging durability problems, but is not statistically valid. There are other potential sources of data about product lifetimes and performance failures that should be investigated as part of durability work under PATH. *Home inspectors* are a comprehensive source of information about durability problems in homes of all ages, and some information is available from the American Society of Home Inspectors. *New home warranty insurance companies* have information about claims paid for major structural defects in newer homes, as well as the incidence of other types of failures covered by the insurance. *Property insurance companies* or their trade associations have information about claims relating to building product failures that represent covered risks. Specialized product and material durability studies of many types exist in the technical literature. Finally, the individual manufacturers of products, materials and systems clearly have access to the best information about the frequency with which their products (and often competing products) fail, and the kind of lifetimes that can be reasonably expected, but are reluctant to disclose this information for competitive and legal reasons.

4. Some Basic Strategies for Improving Durability

Several market-oriented strategies are available to improve product durability. These approaches are not mutually exclusive, but rather can act to reinforce one another and PATH should presumably take advantage of multiple strategies over time to maximize impact. Four general strategies with broad potential applicability are identified and briefly discussed below, both to illustrate the range of possibilities and to provide a framework for considering specific durability-related work under PATH. Presumably other strategies exist as well, and should be considered.

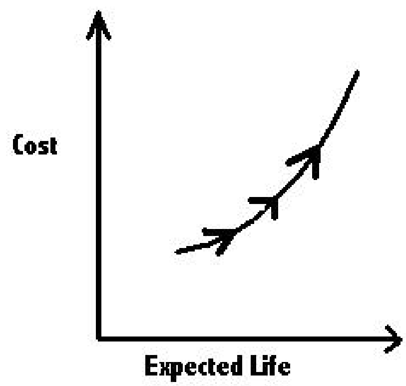
Improve the performance of existing products and materials
Shifts the durability frontier to the right

This approach builds on applied research in materials science and chemistry that can lead to improved product formulations and manufacturing processes. It also can take advantage of empirically validated test methods or test protocols, and analysis of failures in use to identify failure modes and underlying causes of poor product performance. Improving the degree of rapid feedback from users provides information that can stimulate more efficient product redevelopment.



Stimulate selection of more durable products and materials
Shifts the mix of products towards more durable alternatives

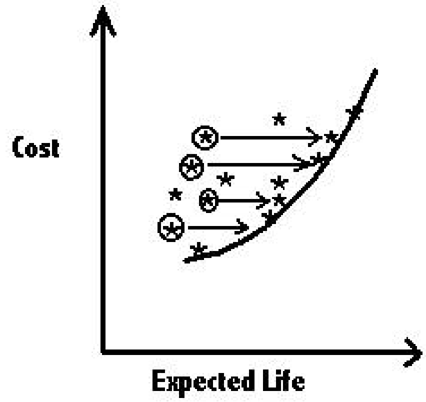
Steps to turn durability into a more marketable competitive attribute can achieve improved durability on a wider scale. This is very difficult in an environment where builders and consumers lack reliable comparative information about the relative durabilities of potential product choices. It could benefit significantly from availability of product durability ratings, even in qualitative form where quantitative metrics are not feasible.



There are relevant examples of product durability classification or rating systems in use. For example, durability ratings are provided today for automobile tires ("tread wear" and "temperature" ratings based on tests using DOT standards). The development and implementation of well-designed standardized durability rating systems for key building products has been given a high priority in earlier work on improving durability in housing, although the most important products and the nature of the rating remain to be defined. Ultimately the selection of durable products would also be stimulated by financial incentives from others that benefit through improved durability, such as property insurance companies or warranty insurance firms, and from recognition in loan appraisal values.

Minimize premature failure due to manufacturing and installation problems
Reduces the frequency of performance inside the durability frontier

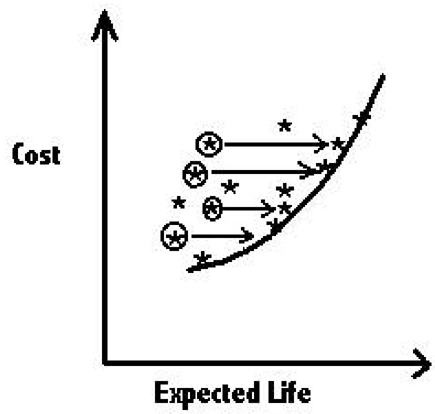
Reducing defects in materials is a quality control issue in manufacturing. Reducing defects due to improper and/or poor workmanship can be achieved through better specifications for product installation and interfacing, coupled with installer training, installer quality control programs and third-party oversight or certification programs.



Creating these programs is complex, but some models exist and others can be developed.

Encourage preventative maintenance and early detection
Reduces the frequency of performance inside the durability frontier

Unlike other buildings, houses have no designated maintenance personnel or facilities manager. Owners and occupants vary widely in their ability and inclination to perform the types of maintenance required by some products, or to inspect homes regularly for signs of impending failure, with costly and unnecessary consequences. Many Building products in newer homes require less maintenance than earlier products, but few can safely be ignored. Unfortunately, analysis of durability often rests on the heroic assumption that products are properly maintained.



Manufacturers provide product instructions and many sources provide guidance about appropriate types and frequency of maintenance for single-family houses, but little of this has any official standing and its impact on building owners is unknown. Obviously it is important to find better ways to reach occupants directly. It may also be that development of formal standards for the periodic inspection and preventative maintenance of single-family houses would support more effective efforts to head off failures and identify specific needs to be addressed. Standards could speed development of an industry that could offer periodic inspection, maintenance or even service or repair contracts covering entire homes. "Managed care" for housing may prove more effective than the current "fee for service" system.

The idea of inspection and maintenance contracts for houses can be seen extension of the service contracts already in wide use covering furnaces or treatment for insect pests, as well as the home inspections often performed at time of property sale. Service providers might be the original builder, home inspectors or other contractors. USAA, a national property insurance company, is already promoting a home inspection service and preventative maintenance program to its policyholders. Home warranty firms might also be interested in this concept.

5. Next Steps

Durability problems range from inexpensive and largely inconsequential to tremendously costly and highly significant. Some sense of prioritization is essential in devising the best approach to achieving improved durability. Inasmuch as the benefits of improved durability are in many respects the mirror image of the costs of product failure, priority attention in the search for remedies should be given to areas where the costs of failure are the highest and/or the costs of preventing failure are the lowest. For example, some product failures are in and of themselves very expensive to repair and therefore good candidates for areas to seek improvement. Examples are structural cracks in foundation walls or significant decay of siding. Other product failures that are good candidates to address are those that initiate a chain of events leading to substantial damage elsewhere in the building. Obvious examples are significant leaks in roofs and walls, which can cause widespread structural, cosmetic and other related damage if left unrepaired, or leaks in plumbing fixtures which may go undetected for long periods of time and cause subfloors and framing to rot. A third category of failures that merit special concern are those which can compromise health and safety of building occupants, such as cracks in furnace heat exchangers or leaky flues for combustion appliances. Leaking heat exchangers introduce carbon monoxide and other toxic gases directly into the indoor environment where they can poison the occupants, while leaking flues can ignite fires in combustible construction.

Another issue that is not systematically discussed in this paper but should not be overlooked is the opportunity to improve durability in existing buildings. This can be achieved incrementally if more durable products are installed as replacements over time, and could also be enhanced through proper regimens of inspection and maintenance to detect problems at early stages while they can be addressed at lower cost. For example, minimizing the incidence of problems in the existing stock of EIFS-clad homes through targeted, early remediation is a timely and potentially very useful way to enhance durability in existing homes, while the development and introduction of less vulnerable EIFS will contribute to improved durability in new homes.

For purposes of initiating work under PATH, it is suggested that work begin by focusing on the subset of durability issues that are inherently costly to repair, even if addressed promptly, and which are also likely to cause further damage if not promptly resolved. Building envelope components and systems (specifically pitched roofs and exterior wall systems) fit these criteria, and those two areas have been tentatively identified as good candidates for early work in discussions between the NIST Building and Fire Laboratory and the NAHB Research Center. Broader input on these choices, and on other recommended ways to ensure that while houses may "wear out" they do not "break down", is welcome as part of the Forum.

APPENDIX A

THE WONDERFUL ONE-HOSS-SHAY by O.W. Holmes Sr. (1858)

Have you heard of the wonderful one-hoss-shay
That was built in such a logical way
It ran a hundred years to a day,
And then, of a sudden it -- ah, but stay
I'll tell you what happened without delay ...

Now in building of chaises, I tell you what,
There is always somewhere *a weakest spot*
In hub, tire, felloe, in spring or thill,
In panel, or crossbar, or floor, or sill,
In screw, bolt, throughbrace, -- lurking still,
Find it somewhere you must and will, --
Above or below, or within or without, --
And that's the reason, beyond a doubt,
A chaise breaks down, *but it doesn't* wear out.

But the Deacon swore (as Deacons do),
With an "I do vow" or an "I tell you"
He would build one shay to beat the town
'n the county 'n all the country round;
It should be so built that it couldn't *break down!*
-- "Fur," said the Deacon, "tis mighty plain
Thut the weakes' place mus' stan' the strain;
'n the way to fix it, uz I maintain,
Is only jest
T' make that place uz strong uz the rest."

[The Deacon builds a one-hoss-shay with
components designed to last for 100 years.
The story continues 100 years later:]

FIRST OF NOVEMBER, the Earthquake-day
There are traces of age in the one-hoss-shay
A general flavor of mild decay
But nothing local, as one may say.
There couldn't be, for the Deacon's art
Had made it so like in every part
That there wasn't a chance for one to start.
For the wheels were just as strong as the thills,
And the floor was just as strong as the sills,
And the panels just as strong as the floor,
And the whippletree neither less nor more,
And the back-crossbar as strong as the fore,
And spring and axle and hub encore,
And yet, as a whole, it is past a doubt
In another hour it will be worn out!

First of November, 'Fifty-five!
This morning the parson takes a drive.
Now, small boys, get out of the way!
Here comes the wonderful one-hoss-shay ...

All at once the horse stood still,
Close by the meeting-house on the hill,
First a shiver, and then a thrill,
Then something decidedly like a spill, --
And the parson was sitting upon a rock,
At half-past nine by the meeting-house clock,
Just the hour of the Earthquake shock!

What do you think the parson found,
When he got up and stared around?
The poor old chaise in a heap or mound,
As if it had been to the mill and ground!
You see, of course, if you're not a dunce
How it went to pieces all at once,
All at once, and nothing first,
Just as bubbles do when they burst.

End of the wonderful one-hoss-shay.
Logic is logic. That's all I say.

Life Expectancy of Housing Components

Gopal Ahluwalia and Angela Shackford

The life expectancies of the components of a home depend on the quality of installation, level of maintenance during use, the weather and climate conditions, and the intensity of use. Some components may remain functional while becoming obsolete because of changing styles and tastes or technological improvements in new products. The average life for some components has increased during the past 20 years because of new products, while the average life of others has declined.

There are more than 100 million homes in the housing stock today, with a median age of 28 years. About 23 percent of the housing stock is more than 50 years old, and some homes are more than 200 years old. The 1940 census reported that there were 37.3 million homes, with a median age of 25 years. The 1990 census found that 18.4 million existing homes were built before 1940, suggesting that nearly half the units that existed 50 years ago are still in use-rather remarkable considering how many of the homes at that time were of poor quality. An old home typically has the original foundation and framing (or concrete block walls). Some even have original doors, windows, and flooring. But most other components have been added or replaced since the home was built.

NAHB conducted a comprehensive survey of manufacturers, trade asso-ciations, and researchers involved in building material products to develop information about the longevity of housing components. Several of the people interviewed qualified their answers, noting variations based on the quality of materials, quality of installation, and whether maintenance has been performed. This article provides a synopsis of the survey results.

The typical life of a *major appliance* is about 15 years. The average refrigerator or kitchen range lasts a bit longer. Washing machines, which tend to take more abuse, have a somewhat shorter lifespan.

The average life expectancy of *bathroom products and materials* varies from 10 to 15 years for fiberglass bathtubs and showers to 50 years for cast iron bathtubs and commodes. Shower doors last about 25 years. The average life expectancy of a toilet is 10 to 15 years, but the longevity of toilet seats has declined with the substitution of plastic for metal bolts. Medicine cabinets and bath vanities are expected to last 20 years; the paint finish in the interior of medicine cabinets usually wears down, causing the metal to rust from moisture in the bathroom.

Kitchens are the focal point of today's homes. Modern cabinetry and appliances are more efficient and need less maintenance than in the past. Plastic laminates and solid *acrylic countertops* are very durable. Traditional countertop materials such as wood, soapstone, or enameled steel have been superseded by modern countertop materials. Countertops made of marble, granite, slate, or wood are very expensive, but most manufacturers of modern plastic laminate and solid acrylics offer products that look similar to these natural materials. Kitchen cabinets are expected to last 15 to 20 years, but are often replaced sooner.

The life expectance of *doors de*pends on the amount of protection it gets from the weather. Interior doors, depending on quality, will last from 30 years to life. Exterior doors that are protected with an overhang are expected to last 80 to 100 years, while exterior doors that are unprotected and exposed average a life of 25 to 30 years. Sliding and folding doors last from 30 years to the life of the home. While garage doors last 20 to 50 years, the expected life of garage door openers is only 10 years.

Flooring made of natural materials lasts a great deal longer than synthetic flooring. Oak and pine flooring lasts as long as the home; marble also usually lasts for the lifetime of the home. Vinyl sheet or vinyl tile flooring lasts an average of 20 to 30 years, which is not bad considering that carpeting lasts only about 11 years, depending on the quality of installation, the amount of traffic, and quality of the fibers.

Poured footings and foundations last about 200 years, while concrete block foundations last about 100 years. Waterproofing with a bituminous coating lasts 10 years, but pargeting with ionite lasts 20 to 30 years.

Heating, ventilation, and air conditioning systems require regular maintenance in order to work efficiently, but even with proper maintenance most components of such systems will not last longer than 15 to 20 years. Central air conditioning units last an average of 15 years, whereas the life expectancy of window units is only 10 years. Humidifiers last only 3 years. Electric water heaters are expected to last 14 years with proper maintenance, which includes flushing the tank, checking the valves, and cleaning electrical con-nections regularly. Heat pumps last an average of *15* years.

Home security appliances have a life expectancy of about 10 years. Intrusion systems (burglar alarms) last about 14 years, smoke detectors last about 12 years, and smoke/fire/intrusion systems last about 1O years.

Most manmade elements *of landscaping* have a life expectancy of 10 to 20 years. Patios (brick or concrete) last 24 years. Wooden decks last about 15 years, depending on the materials and products used (treated yellow pine is guaranteed to last 40 years). Gravel walks last only about 4 years, while asphalt driveways last 10 years. Tennis courts and swimming pools have life expectancies of 10 years and 18 years, respectively.

Masonry can last as long as the home. Chimneys, fireplaces, brick veneer, and mantels are expected to last just as long. Brick and stone walls have an average life of 100 years.

Of *course, millwork* has a much shorter life than masonry. Stairs have an average life expectancy of 50 to 100 years, while rails and disappearing stairs will last 30 to 40 years.

Homes usually need to be painted every 5 to 10 years depending on the content of the paint and its exposure to moisture. Interior wall paint lasts an average of 5 to 10 years, depending on the acrylic content of the paint. Exterior paint on wood, brick, or aluminum lasts about 5 to 10 years.

Most plumbing materials last a long time. Concrete pipes have an average life of 50 to 100 years and cast iron waste pipes last 75 to 100 years. Enameled steel sinks have a life expectancy of only 5 to 10 years, while enameled cast iron sinks last 25 to 30 years. The life expectancy of faucets depends on the finish-a chrome finish lasts much longer than a brass or enamel finish. Low quality faucets last 2 to 5 years less than higher quality faucets, which last 15 to 20 years.

The life of a roof depends on the quality of the *roofing material. Slate* has the longest life expectancy among roofing materials, ranging from 50 to 100 years depending on the grade. Sheet metal has a life expectancy of 20 to 100 years if kept painted, and tiles last for about 50 years. Asphalt shingles, the most commonly used roofing material, last 15 to 30 years.

Basements, floor systems, and exterior and interior framing walls last 100 to 200 years with proper installation and maintenance. A common problem in homes is a leaky basement. Construction technology has made significant improvements in this area by improving the quality of the materials involved in constructing a basement.

The life expectancy *of shutters* depends on the materials used and their exposure to the weather. Exterior wood shutters last only 4 to 5 years, but interior wood shutters usually last for the life of the home. Plastic (vinyl) exterior shutters have a life of 7 to 8 years. Aluminum interior shutters last 35 to 50 years, but aluminum exterior shutters last only 3 to 5 years.

The life expectancy *of siding de*pends largely on the material used. Aluminum lasts 20 to 50 years. Vinyl can last 50 years. Wood/composite wood lasts only 10 years, if it is not properly maintained, but can survive for 200 years if it is kept waterproofed and painted. Brick and stone siding can last for 100 years, but the mortar holding the brick lasts for only 50 years. Gutters and downspouts last about 30 years.

Drywall and plaster are expected to last 30 to 70 years and ceramic tiles for as long as the life of the home.

Windows should last about 20 years before needing replacement. Window glazing is expected to last 20 years. Aluminum and vinyl casement windows should last 20 to 30 years, and wood casement windows have a life expectancy of 20 to 50 years.

Table 1 Life Expectancy of Different Products/Items/Materials in the Home
(This table is a condensed version of the table provided in the original "Life Expectancy of Housing Components)

	Life in Years
APPLIANCES	
Compactors	10
Dishwashers	10
Dryers .	14
Disposal	10
Freezer--Compact Freezer -- Standard	12 16
Microwave Ovens	11
Range--Free standing and built-in electric Range - Free standing and built-in gas Oven--high oven, gas	17 19 14
Refrigerator--compact Refrigerator--standard	14 17
Washers	13
Exhaust fan	20
BATHROOMS	
Cast iron bathtub	50

Table 1 Life Expectancy of Different Products/Items/Materials in the Home (Cont.)
(This table is a condensed version of the table provided in the original "Life Expectancy of Housing Components)

	Life in Years
Fiberglass bathtub and shower	10-15
Shower doors (average quality)	25
Toilet	50
Source: Appliance Statistical Review, April 1990	
CABINETRY	
Kitchen cabinets	15-20
Medicine cabinets/bath vanities -- Inside the cabinet the paint finish usually wears, therefore the metal rusts from the moisture.	20
Sources: Kitchen Cabinet Manufacturers Association; Neil Kelly Designers	
CEILINGS	
Ceiling suspension	Lifetime
Acoustical ceiling	Lifetime
Source: Association of Wall and Ceiling Industries International	
CLOSET SYSTEMS	
Closet shelves	Lifetime
COUNTER TOPS	
Laminate	10-15
Ceramic tile (high-grade installation)	Lifetime
Wood/butcher block	20+
Granite	20+
Sources: AFP Associates of Western Plastics: Ceramic Tile Institute of America	
DOORS	
Screen	25-50
Interior -- Not perfect hollow core Interior -- Solid core wood	<30-life 30-life
Exterior -- Protected overhang, Exterior -- Unprotected and exposed	80-100 25-30
Folding	30-lifetime
Garage doors	20-50
Garage door opener	10
Sources: Wayne Dalton Corporation: National Wood Window and Door Association: Raynor Garage Doors	
ELECTRICAL	
Copper Wiring -Copper plated Copper Wiring - Copper-clad aluminum Copper Wiring --Bare Copper	100+ 100+ 100+
Insulation -- Armored Cable (BX) Insulation -- Conduit	Lifetime Lifetime
Sources: Jesse Aronstein, Engineering Consultant	
	1
FINISHES -- Used for waterproofing	
Paint, plaster, and stucco	3-5
Sealer, silicone, and waxes	1-5
Source: Brick Institute of America	
FLOORS	
Oak or Pine	Lifetime
Slate flagstone	Lifetime
Vinyl sheet or tile	Min 20-30
Terazzo	Lifetime
Carpeting -- Depends on installation, amount of traffic and quality of carpert	11
Marble -- Depends on installation, thickness of marble, and amount of traffic	Lifetime+

Table 1 Life Expectancy of Different Products/Items/Materials in the Home (Cont.)
(This table is a condensed version of the table provided in the original "Life Expectancy of Housing Components)

	Life in Years
Sources: Carpet and Rug Institute: Congoleum Corporation: Hardwood Plywood Manufacturers Association: Marble Institute: National Terazzo and Mosaic Association: National Wood Flooring Association: Resilient Floor Covering Institute	
FOOTINGS AND FOUNDATION	
Poured footings and foundations	200
Concrete Block	100
Cement	*50*
Waterproofing -- Bituminous coating -- If it cracks it is immediately damaged.	10
Waterproofing -- Pargeting with ionite -- It is not typical in a residential setting. Its downfall is when it starts to crack.	***20-30***
Termite proofing -- May have shorter life in damp climates.	5
Baseboard system	20
Sources: Safe Aire Incorporated: WR Grace and Company	
HEATING VENTILATING AND AIR CONDITIONING	
Air conditioning -- Central unit -- Newer units should last longer	15
Air conditioning -- Window unit	10
Air conditioning compressor	15
Humidifier	8
Water heater -- Electric	14
Water heater -- Gas -- Depends on type of water heater lining, whether it is protected and quality of water	11-13
Forced air furnaces -- Heat pumps	15
Duct work -- Plastic	15
Duct work -- Galvanized	30
Rooftop air conditioners	15
Boilers, hot water (steam) -- A lot depends on water quality.	30
Furnaces -- Gas or oil fired	18
Unit heaters -- Gas or electric	13
Radiant heaters -- Electric	10
Radiant heaters -- Hot water or steam	25
Air terminals -- Diffusers, grills, and registers	27
Induction and fan-coil units	20
Dampers	20
Fans -- Centrifugal Fans -- Axial Fans -- Ventilating roof mounted	25 20 20
Coils -- DX, water or steam	20
Coils -- Electric	15
Heat exchangers -- Shell and tube	24
Molded insulation	20
Pumps, sump and well	10
Burners	21
Sources: Air Conditioning and Refrigeration Institute: Air Conditioning, Heating and Refrigeration News: Air Movement and Control Association, American Gas Association: American Society of Gas Engineers: American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.	
HOME SECURITY APPLIANCES	
Intrusion systems	14
Smoke detectors	12
Smoke/fire/intrusion systems	10
INSULATION	
Foundation, roof, ceiling, wall, and floor	Lifetime
Sources: Insulation Contractors Association of America: North American Insulation Manufacturers Association	
LANDSCAPING	

Table 1 Life Expectancy of Different Products/Items/Materials in the Home (Cont.)
(This table is a condensed version of the table provided in the original "Life Expectancy of Housing Components)

	Life in Years
Wooden decks	15
Brick and concrete patios	24
Tennis courts	10
Concrete walks	24
Gravel walks	4
Asphalt driveway	10
Swimming pool	18
Sprinkler systems	12
Fences	12
Sources: Associated Landscape Contractors of America: Irrigation Association	
MASONRY	
Chimney, fireplace and brick veneer	Lifetime
Brick and stone walls	100+
Stucco and mantels	Lifetime
Sources: Architectural Components: National Association of Brick Distributors, National Stone Association	
MATERIALS	
Caulking (for sealer)	8-10
Metal (for coping)	20-40
Mortar (for walls) and plastic (for flashing)	25 or more
Source: Brick Institute of America	
PAINTS AND STAINS	
Exterior paint on wood, brick and aluminum	7-10
Interior -- Wall paint (depends on acrylic content) Interior -- Trim and door Interior -- Wallpaper	5-10 5-10 7
Sources: Finnaren and Haley: Glidden Company: The Wall Paper Institute	
PLUMBING	
Waste pipe -- Concrete Waste pipe -- Cast Iron	50-100 75-100
Sinks -- Enamel Steel Sinks -- Enamel cast iron Sinks -- China	5-10 25-30 25-30
Faucets -- Low quality (Depends mostly on the finish. Chrome lasts much longer than brass or enamel) Faucets -- High quality	13-15 15-20
Sources: American Concrete Pipe Association: Cast Iron Soil and Pipe Institute: Neil Kelly Designers: Thompson House of Kitchens and Baths	
ROOFING	
Asphalt Wood shingles and Shakes	15-30
Tile (Depends on the Quality of tile, thoroughness of the design and the climate)	30
Slate (Depends on the grade)	50-100
Sheet Metal (Depends on the gauge of metal, quality of coating and thoroughness of design and application)	20-50+
Built-up roofing -- Asphalt (Depends on materials and drainage. Coatings will add to lifespan) Built up roofing -- Coal and tar (Depends on materials and drainage. Coatings will add to lifespan)	12-25 12-30
Asphalt composition shingle	15-30
Asphalt overlag	25-35
Source: National Roofing Contractors Association	
ROUGH STRUCTURE	
Basement floor system	Lifetime
Framing (exterior and interior walls)	Lifetime
Source: NAHB Research Foundation	

Table 1 Life Expectancy of Different Products/Items/Materials in the Home (Cont.)
(This table is a condensed version of the table provided in the original "Life Expectancy of Housing Components)

	Life in Years
SHUTTERS	
Wood -- Interior Wood -- Exterior (Depends on weather)	Lifetime 4-5
Plastic - Vinyl exterior (The color starts to fade)	7-8
Aluminum interior Aluminum Exterior	35-50 3-5
Sources: A.C. Shutters, Inc.: Alcoa Building Products:, American Heritage Shutters	
SIDING	
Gutters and downspouts	30
Siding -- Wood (10 yeats if constantly moistened, to 100 years if properly maintained) Siding -- Steel Siding -- Aluminum Siding -- Vinyl	20-50 50-life 20-50 50
Sources: Alcoa Building Products: Alside, Inc.: Vinyl Siding Institute	
WALLS AND WALL TREATMENTS	
Drywall and plaster	30-70
Ceramic tile (high grade installation)	Lifetime
Sources: Association of Wall and Ceiling Industries International: Ceramic Tile Institute of America	
WINDOWS	
Window glazing (Improvement in the unit construction aided in promoting a longer life.)	20
Wood casement Aluminum casement	10-20
Screen	25-50
Sources: Best Built Products: Optimum Window Manufacturing: Safety Glazing Certification Council: Screen Manufacturers Association	