



FACT SHEET

COMPONENTS: FLOORING

Description

Finish flooring is applied on top of a structural subfloor (usually OSB or plywood). It is most often selected based on comfort, attractiveness, durability, and functionality including issues maintenance, acoustic or insulation properties, ease of cleaning, and resistance to stains and water. Each type of finish flooring typically comes in a range of finishes, colors, and prices. The following analysis examines the relative economic, energy, and environmental impacts of the following 7 types of finish flooring: wood flooring, laminate flooring, vinyl flooring, linoleum, ceramic tile, cork, and carpet.

Recommendations

Based on economic and environmental impacts, ceramic tile and linoleum are recommended. Economically a higher first cost is incurred, however when durability and life time cost is considered, these products stand out. When considering carpet, look for high recycled content and products that are recyclable. New carpet tile systems are relatively inexpensive, easy to maintain and durable.

- Consider durability, maintenance requirements, and ease of cleaning when selecting flooring.
- Choose flooring that will be serviceable through the end of the first mortgage term, usually 30 years.
- Products that contain PVC have serious impacts on the environment and human health. When possible, look for alternatives to using PVC products, such as linoleum or ceramic tile.

Flooring Alternatives

alternative	cost/sq. ft. (materials & labor)	IAQ	expected product life (years)	life cycle thinking	practice
wood flooring	7.75	no significant effects	25-100	good, if solid products	standard
laminate flooring	7-11**	no significant effects	15-30	typical	standard
vinyl flooring, marbelized 12" x 12"	1.48	off-gassing during installation and maintenance	10-25	typical	standard
linoleum	1.11-1.67*	off-gassing during installation and maintenance	40	good	standard
ceramic tile, thin set 8" x 8" tiles	4.85	no significant effects	25-100	very good	standard
cork flooring, standard finish 1/8"	4.37	off-gassing during installation and maintenance	30-40	good	standard
carpet, nylon	2.73	off-gassing during installation and maintenance	8-11	typical	standard
carpet, wool	9-15***	off-gassing during installation and maintenance	25-30	typical	standard

Except where noted with a *, cost data is taken from RS Means CostWorks, figuring materials and labor costs, without overhead and profit.

** Price dependent on number of square feet installed, and grade of laminate flooring.

*** Price dependent on grade of carpet and pad.

Criteria Summaries

Cost: Flooring cost varies widely by material type, and within a given material. In general, cost is associated with durability within a given material type. For example, a \$1 per square foot sheet good is generally less durable than a \$2 option. A low initial cost will typically cost more over time if early replacement is considered. Vinyl flooring has the lowest first cost, typically between \$1.50-6 per square foot installed. Linoleum costs \$1 to \$2 per square foot installed. Carpet can cost as little as \$2-6 per square foot installed, and increase from there. Cork flooring ranges between \$1.50-5.00 per square foot installed. Ceramic tile can range from \$5-15 per square foot installed, laminate floors will cost about \$8-10 installed, and hardwood floors run about \$6-12 per square foot installed.

IAQ: Durable finishes such as tiles, which require less chemical application for cleaning or maintaining finish surfaces, produce the least amount of indoor environmental impacts. Finishes which can be cleaned with water and light detergents and need no additional coatings or waxes (tiles, some laminates and solid woods and bamboos) produce less harmful emissions to the air within a residence. These flooring materials also tend to be hard surface, making them easier to clean of dust and exterior particles which are tracked in, reducing accumulation of allergens within the indoor environment. Flooring materials which require resurfacing (woods, cork, linoleum, vinyls) emit Volatile Organic Compounds during the resurfacing process, and require adequate ventilation to remove those during application and curing periods. Carpets have the greatest negative impacts on indoor air quality because they accumulate dirt, dust and allergens, and because they off-gas both from their materials and from the adhesives and accessories used in their installation.

Expected Product Life: Hardwood flooring has the longest potential life - if properly maintained it can achieve more than a 100 years of serviceable life. Proper maintenance includes refinishing of the sealer as it wears, and not oversanding during refinishing, which will shorten the useful life of the boards. Ceramic tile has a very long useful life if the grout joints are well maintained. Linoleum products have long been known as a 40-year floor. Cork flooring will also last about 40 years, longer with proper maintenance. Carpets typically last the shortest amount of time, with an average life expectancy of 8-11 years for nylon fibers and 25-30 years for wool fibers. Vinyl flooring lasts from 10-25 years, again depending on level of quality and intensity of use. Laminate flooring needs to be replaced after about 25 years.

Lifecycle Thinking:

- Energy consumption (non-renewable, fossil fuel energy): Vinyls, petroleum-based carpets and tiles use the most energy during extraction, manufacturing, transportation and use/disposal. Cork, even though it is produced in Europe and North Africa, requires little energy over its life cycle.
- Pollutants generated in production: Vinyls produce toxins throughout their extraction, manufacturing, use and disposal cycle. They should be avoided, if possible, even though they are usually the most inexpensive initially. Carpets, including wools, produce more pollutants in general than other floorings. Tile also creates higher percentages of air pollutants during its manufacturing process.
- Potential for off-gassing in the building: Carpets have the greatest negative impacts on indoor air quality because they accumulate dirt, dust and allergens, and because they off-gas both from their materials and from the adhesives and accessories used in their installation. If they are not directly glued-down, but installed using carpet pad and mechanical fasteners, they still produce off-gassing from the pad and the carpet itself. It is best to have the product off-gas in a well-ventilated location for a minimum of 10 days prior to installation, where it will not pick up any other emissions from other products. Avoid carpet backings of styrene butadiene rubber (SBR) latex for healthy environments. Some recent tests indicate linoleums may off-gas significant amounts of Volatile Organic Compounds (VOCs) which may prove to be a problem. However, manufacturers are now providing a factory-applied coating which eliminates the off-gassing. Wood, engineered wood products, and laminates should be sealed to prevent off-gassing formaldehyde and other VOCs. Cork has no attributable problems from off-gassing.
- Durability of the product: Ceramic tile, if properly installed and maintained, will last for decades, as will solid wood flooring. Solid wood floorings and those engineered products using wood veneers can be refinished over time, prolonging their life cycle; although, wood veneers can only be refinished once at most, while solid flooring can be refinished several times.
- Potential for future recycling: Currently, carpets have the best potential for recycling, because they can be removed in the largest pieces and shipped most easily. However, their weight is a drawback because it increases embodied energy required to transport to recycling facilities, mostly located in the southeastern US. Cork can be ground up and reused or composted; ceramic tile can be ground up and used for fill, and linoleum is biodegradable, as is wool. Additives and finishes added to any of these products may minimize or prevent recycling or composting efforts.

Hardwood flooring

Wood flooring has a high aesthetic value for residences. It also has a long life cycle and is relatively easy to maintain over time. Most wood flooring is derived from hardwood trees, which can come from local/regional or sustainable and certified forests. Reclaimed or salvaged wood flooring saves materials and can come from species or grain types or sizes of trees no longer available, which increases their aesthetic value. From an environmental standpoint, this approach saves materials from the waste stream and does not impact living trees. Use water-based and low-VOC floor coatings, finishes and cleaners to further minimize environmental impacts.

Laminate flooring

This type of flooring uses engineered wood products as a substrate, reducing use of prime wood fibers; however, most laminates include petroleum-based resins and have high embodied energy due to the pressure-treatments required for laminations. They may off-gas formaldehyde and require some recoating to preserve their finish. Not recommended for high-traffic areas because when they wear out they cannot be refinished and must be landfilled or burned, causing additional pollution. Some laminates use thin wood veneers on engineered substrates, which allow for refinishing at least once during lifecycle and prolong use. Use low-VOC adhesives, cleaners, or finish coatings, or mechanically fasten.

Linoleum

Linoleum flooring is made from organic and renewable resources; the cork used comes from harvests off trees which renew yearly. There are some concerns about certain VOCs emitted, which also provide the bactericidal properties which make linoleum an excellent choice for kitchen areas. These emissions can be controlled by factory-applied coatings now provided as standard by manufacturers. Linoleum requires minimal maintenance and cleans with water in most cases. Use low-VOC adhesives, cleaners, or finish coatings.

Ceramic tile

Recycled-content tile can be made using waste glass from light bulbs, bottles, or auto windshields. Also, tile can use a byproduct of feldspar mining for content. Tile can be ground up and used for base or fill at the end of its life cycle. Choice of aesthetically flexible patterns and colors prolongs the life cycle of products. Appropriate installation methods ensure longer life cycle. Maintenance impacts are lower because of product durability. Use low-VOC additives, mortars, grouts, and sealers.

Vinyl flooring

Whether as sheet goods or tile, solid vinyl or vinyl composition products are made from petroleum-based materials and chlorides, some of the most toxic pollutants which have significant impacts throughout their manufacture, product life and disposal. Additives required to increase durability, flexibility and color produce off-gassing, and may flake off lead, cadmium and organotins - and phthalate plasticizers. The products also pose a fire hazard, as they release gases, such as hydrogen chloride which turns to hydrochloric acid when inhaled. As it burns, whether accidentally or in waste incineration, it releases yet more toxic dioxins. (Healthy Building Network) Vinyl products require adhesives, surface coatings and a higher level of maintenance coatings over their life cycle than other resilient flooring products. Use low-VOC adhesives, cleaners, or finish coatings to reduce impacts.

Cork

Cork comes from a renewable resource but must be shipped from Europe and Northern Africa, increasing embodied energy. Shipping via sea routes tends to be less energy intensive than shipping by truck, but the material must still be shipped across country to national distributors. Cork flooring requires minimal maintenance, produces minimal off-gassing, and is very durable if used appropriately. Select low-VOC adhesives, cleaners, and finish coatings.

Carpet

Natural carpets made from wool, grasses, or cotton have reduced impacts over petroleum-based products. They off-gas less harmful emissions, require less toxic chemicals to clean and maintain, and are biodegradable upon disposal. Carpets made from Nylon 6 or 6.6 fibers are very durable and can be recycled (either laterally or down-cycled), prolonging their life and keeping them out of landfills. Carpets with recycled-content made from recycled PET derived primarily from post-consumer plastic soft drink containers reduce the amount of virgin material required, but have a higher embodied energy because of shipping related to recycling efforts and the process of recycling the material itself. Their primary benefit is to keep material out of landfills. Carpet pads are either made from recycled carpet pad or recycled carpet fibers and reduce the amount of material sent to landfills.

Practice: All of the flooring selections examined here are common finish flooring materials and use standard installation methods.