From homes to docks to public walkways, the emergence of composite boards more than 20 years ago transformed and shifted the decking industry. Composites started out with a single digit share of the market when compared to wood, increasing from 2% in 1999 to 24% in 2010. However, one factor in the deck assembly did not see a change: the framing. So while architects and builders specified or installed composites that would not twist, splinter or get eaten by termites, most frames were being built with the same old wood. While deck substructures are a $1.9 billion market that remains primarily composed of pressure-treated lumber, the status quo is starting to shift as steel framing enters the mainstream market.

If you think about it, the substructure of a deck is the heart of a deck’s durability, the basis for its aesthetics. You could say the old way, the wood way, is putting a high-performance decking on top of a low-performing foundation. As with any innovation, questions arise.

- What is this product?
- Why does an architect choose to specify it?
- How does a builder install it?

This education unit will answer those questions. Let’s begin with the benefits and features of steel deck framing.

**Benefits of Steel Deck Framing**

The benefits of steel deck framing become evident when contrasted with the shortcomings of wood framing. With deterioration from weather, moisture, time and pests, wood framing can twist and warp, flaws which transmit to the surface decking. No matter the high quality of the decking boards, the overall appearance and functionality will become compromised. With the stability of steel, this new type of framing eliminates those problems.

In an article in Professional Deck Builder, Robert Shaw, who owns Colorado Deck and Framing in Colorado Springs, wrote that while decking material has come a long way in recent years, “I don’t think the quality of framing materials has kept up, and it seems...
Silly to put decking with a 20-year (or longer) warranty onto a wood frame that I doubt will last that long. Because of this, I've begun building decks using steel joists that allow me to offer customers a frame that will last as long as the decking I put on it,” (Professional Deck Builder, March/April 2011).

**Additional Benefits of Steel Deck Framing**

**Consistently Flat** — Steel framing equals a refined and consistently flat foundation on which to install deck boards. This eliminates that familiar yet tiresome exercise of shuffling through stacks of lumber for uncompromised boards.

**During installation, there is no worry about which way to turn a crowning board.**

**Remains Stable** — Query any deck builder and they will share myriad stories of composite decking boards that became wavy and uneven over time because of the instability of the wood framing underneath. When wood framing twists and warps, those impacts show up on the surface of the decking. In contrast, steel framing won’t twist and warp over time, so the deck boards remain in place, resulting in fewer callbacks and sullied reputations. Straight steel beams and joists below mean level decking above.

**Longer Spans** — Because of the strength of lightweight steel beams, longer spans between posts are possible. This gives the architect more flexibility in post placement, preserving views where desirable.

**Design Flexibility** — Curved decks, popular with owners and designers alike, are simple to create with a steel framing system. The process involves notching the flanges of a C-shaped header to allow it to bend. As most deck builders know, it’s as difficult as it is time-consuming to bend wood. A curved deck topped by a corresponding curved railing or pergola makes a stunning design statement. Other designs made easy with steel framing include expanded cantilevers and angled corners.

**Easy to Install** — While the term steel framing might conjure up visions of heavy iron and blow torches, lightweight steel deck framing requires no special tools and cuts and installs as easy as wood, if not easier. If someone can work with wood, they can work with steel framing. According to the professional deck builder referenced earlier, moving steel deck framing components is much easier than moving around pressure-treated lumber.

**Nationally Available** — Steel deck framing is available on a national scale and is not a specialty item. This lessens the potential for delays during construction and keeps the job moving along.

**Non-Combustible** — Steel deck framing qualifies for extreme wildfire building codes under the International Code Council (ICC) – Wild Land Urban Interface (WUI) building material requirements. That makes it a good choice for areas of high-density housing and frequent wildfires, eliminating one more combustible item on a home’s exterior.

**Termite/Insect Repellent** — While extreme measures are taken to dissuade insects from eating fibers in wood used for decking boards, those measures are not necessary with steel framing. Insects...
**Case Study: College Campus Walkway**

*The Challenge:* To create a serene walking path on a busy private college campus in the Western United States that would prove to be wear-resistant, protect the fragile surrounding environment, and provide a lovely spot for student and alumni gatherings. Because of the pond and wildlife in the area, it was a popular place where students and nearby residents socialized. But the activity took a toll on the root system of the fragile Cyprus trees and on the banks of the pond, which were eroding.

College officials sought to build a 2,200-square-foot boardwalk-type walkway around the pond that would not rot or decay over time due to its proximity to water, the chemicals in the water, or from insect or termite damage. They wanted a product that was stable and strong enough to withstand the thousands of weekly visitors while, at the same time, would protect the environment.

*The Solution:* Upon learning about a steel deck framing option offered by the same company that manufactured the selected composite decking boards, university officials decided to use this product to gain the stability, durability and flat, straight surface that couldn’t be achieved with wood. They also were impressed with the 25-year warranty that accompanied the steel deck framing. The product proved easy to install and, as importantly, was compatible with the helical piers that the builders chose to use instead of concrete footers in order to provide extra protection to the tree roots. There is a high level of satisfaction with the results.

<table>
<thead>
<tr>
<th>SUSTAINABLE FEATURES OF STEEL DECK FRAMING</th>
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<tbody>
<tr>
<td><strong>Long Lasting</strong> — Galvanized, dual-coated steel lasts longer than pressure-treated lumber, eliminating callbacks and the cost of replacing or repairing wood framing.</td>
</tr>
<tr>
<td><strong>Recycled Content</strong> — Steel framing components may contain 25% recycled content which could contribute toward LEED points.</td>
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<tr>
<td><strong>Recyclable</strong> — Check with the framing manufacturer, but steel framing waste may be 100% recyclable. And in the event that the deck project is eventually torn down, the steel substructure can be returned to the recycle stream and possibly repurposed.</td>
</tr>
<tr>
<td><strong>Chemical Free</strong> — Unlike pressure-treated lumber, which is infused with volatile chemicals to protect it from pests, steel is chemical free. Even without LEED points, or points from other green building rating systems, a chemical-free building material will appeal to clients trying to minimize chemicals in and around the home.</td>
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**DESIGNING AND PLANNING STEEL DECK FRAMING**

Not all designs will be as large or complex as a rooftop pool surround, but before one designs or builds a deck, it’s...
helpful to review design options and considerations. While an all-wood deck may deteriorate and require replacement in just a few years, as was the case at the apartment complex, a deck on a steel frame will last much longer. Therefore, more care should be given to the design.

Here’s what to think about:

**Design and Build to the Space**

In a smaller space, designing a multi-level deck to make use of vertical space should be considered. Double-check local building codes about setback requirements first. The space under a deck can be used as well, as a patio or storage area (however grills should not be used under decking areas due to ventilation and fire hazards). In a large backyard, the possibilities are limitless — multiple levels, pergolas, gazebos, and sweeping curves are all possible. Distinct activity areas could include a garden, grilling station, or a pool. Irregular spaces can benefit from the flexibility of curved decking space, which is easily attainable with steel.

In terms of size, some common rules of thumb for deck designers and builders include:

1. A deck should be no larger than 20% of the house to which it is attached.
2. No single section of deck should be larger than the largest room in the house. This is where different deck sections and heights are most compatible with a smaller house.
3. A deck area that includes a dining space will most likely be the largest portion of a multi-section deck. The recommended space for a table and chairs should be at least 12’ x 12’.

Finally, with such a large investment being made in the pool deck itself, opting to use steel will extend the lifespan of the installation well beyond what could be expected of wood, further protecting the $1.3M investment. In the event that the deck is torn down, the steel framing can be recycled back into the product stream. This showcase project, built on top of the building that houses the flagship Manhattan Mercedes dealership at 11th Ave. and 53rd St., incorporates more than 2,000 curved 8-foot deck planks that were custom bent to conform to the circular pool deck and bench surround. It is the visual focal point of this rooftop wonder.

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**Case Study: The Mercedes House Rooftop Deck**

*The Challenge:* Two Trees Management Company, a multi-billion dollar residential developer in New York City, sought a product that would meet required fire codes in the construction of an elevated deck project on the fourth-floor set-back roof terrace of an 850-unit luxury condominium and rental complex on the Upper West Side. Fire codes would not allow the company to use pressure-treated wood for the entire 36,000-square-foot terrace, so they elected to incorporate steel deck framing to support the 80’ diameter outdoor wading pool deck.

*The Solution:* Lightweight steel deck framing offers several benefits. It is a highly stable material that provides a uniform grid onto which the curved deck plants can be fastened. The complex deck design has an outboard circular edge that was easily framed by using the C-channel style track material. The steel deck framing also contributed to the building’s LEED points for recycled content and local sourcing of the steel framing.

This article continues on www.hanleywooduniversity.com. Go online to read the rest of the article and complete the corresponding quiz for credit.
To bring attention to the dining area, it can be elevated, multiple colors of deck boards can be used or the direction of the boards can be alternated.

Consider Sun and Shade. When shade is required or desired, there are two basic ways to achieve that: trees or a structure. The location of the deck may correspond with the position of existing shade trees, or a pergola or gazebo can be considered. You may wish to design a multi-section deck that provides both sunny and shady spaces for user preference. Often overlooked is the space beneath a higher deck. This space can be used for storage or can be finished to provide outdoor space during rainy days.

Plan Entrances and Exits. Often, a deck is connected to a home. But decks can actually go anywhere, such as a problem muddy area near a pool or pond. In this case, the metal deck framing will not rot and deteriorate. A raised deck, and/or one with a railing, can have single or multiple access points. Multiple staircases work well with two-story decks. With raised decks, particularly on contemporary homes, the sleek aesthetic of steel deck framing adds a nice touch. For a smaller deck, perhaps off a bedroom, wide stairs can make the deck feel more expansive.

Include Places to Lean or Sit. Railings not only give the deck a finished look, but also protect children and pets. In some cases, railing is required by code. Matching built-in bench seating adds more functionality to the deck and encourages people to sit down and relax. Think about traffic flow and how people will use the deck and move across it when adding railing or seating.

Components of a Steel Frame
While these decking ideas seem complex, the frame is not. In fact, there are only three components to a steel frame: the track (or ledger), beams, and joists. The track attaches to the structure and the ends of the joists. Beams support the joists and joists support the decking boards. Each piece can be cut and assembled like wood, and is available in standard lengths: 12, 16 and 20 feet.

Building with Steel Deck Framing
The same tools are needed to assemble both steel and wood frames. Include:

- Corded 7-1/4” circular saw and a 7-1/4” ferrous metal cutting blade
- An impact driver with a hex head 5/16” attachment
- A drill and a step drill bit
- Tape measure
- Permanent felt marker
- C-channel vice grips

Hardware and connectors needed include:
- Galvanized self-drilling steel framing screws #10 x ¾”
- Galvanized 7” “L” brackets
- Galvanized post brackets

The strength of the deck framing depends on four critical connections:
1. Post to pier (Refer to local building codes for proper installation methods).
2. Support post to beam
3. Track/ledger to structure
4. Rail post to frame

Steel deck framing cuts easily with a circular saw and a ferrous metal blade. Each steel component is galvanized and coated with a specially formulated exterior finish. To prevent rust when scratched, paint any exposed steel with the manufacturer-suggested touch-up paint. Tip: Do this after cutting a large number of components in order to speed the process.

The installation process will involve five steps:

1. Installing the Track
   Before installing the track, mark the track where each joist will be positioned. Joist spacing and associated span capabilities are referenced in the manufacturer’s span tables. Also,
check with the decking manufacturer and local building code for required maximum spans of the deck boards. Pre-drill holes for lag bolts using a step bit while the track is on sawhorses. Secure the track to the structure using approved methods of attachment, consulting a structural engineer or local building code official.

2. Installing the Beams
There are four scenarios for installing beams. Let’s take a look at each one:

Single Drop-Beam Scenario 1 — For a single drop beam on a 4” x 4” post, set the beam on top of the 4” x 4” and secure it with the specified post-to-beam connection hardware and metal-to-metal screws and wood fasteners (follow the manufacturers’ installation guide).

Single Drop-Beam Scenario 2 — For a single drop beam scenario on a 6” x 6” post, attach the beam to each notched post using ½” bolts. Using a drop beam requires the track to be used as a front plate to secure joist ends.

Flush Beam Scenario — For a flush beam scenario on a 6” x 6” post, attach angle brackets to the beam where the joists will be joined. Use C-channel vice grips to clamp the brackets into place. Attach the beam to the post using the recommended post bracket and #10 or ¾” hex head galvanized self-drilling screws.

Double Drop-Beam Scenario — This applies only to 6” x 6” posts. Set the beam on top the post and secure it with the recommended post-to-beam connection hardware, metal-to-metal screws, and wood fasteners (follow the manufacturer’s installation guide).

3. Installing the Rim Joists
Take the outer joist and fit it into the track, inside the top and bottom flange. Use #10 x ¾” self-tapping, dual-hardened galvanized screws and screw through top flange into the joist, then through bottom flange into the joist. Fill all holes in the 7” galvanized L-bracket with the same hardware, attaching the joist to the ledger plate. Make sure the rim joist is level, then install temporary dunnage, screwing through the joist, to make sure the rim joist can support the beams in either a flush or drop-beam scenario.

4. Installing Joists
Use a 7” galvanized L-bracket, with the longer side flat down against the joist. Use a C vice clamp to hold the bracket in place. Using an impact driver or drill, fill all holes in the bracket with #10 x ¾” dual-hardened, galvanized self-tapping screws. Screws are attached using a 5/16” head driver. Lay out your joists, using either 12” or 16” on-center layout, as previously determined. Slide the joist with the hanger attached into the top and bottom flanges of the track, and screw the top flange to the joist. Repeat the process on the bottom. Then, fill the holes from the L-bracket into the track. Repeat the process to set joists into the flush beam. Turn the C-channels of the joists so they are facing each other in every other bay. This will make blocking easier.

Add blocking to every other bay of joists, over the beam. This creates a web-stiffener over the beam. This is for a dropped beam installation. Attach the cut piece of joist material to each side joist with L-brackets. Secure blocking through the joist flange into the dry beam with two #10x3/4” self-tapping screws.

5. Installing Front Track
L-brackets have been installed on the ends of the joists. They will attach to the front track. The top and bottom flanges of the front track go over the ends of the joists. Push the track into place, placing a screw on the top flange into each joist, and through the bottom flange into each joist.

For a front track that curves, make relief cuts through top and bottom flanges every two to four inches.
Surfacings and Railing
While installing a steel deck frame is key to the long-term longevity and enjoyment of the deck for years or decades to come, the most creatively satisfying part is what comes next: the finishing touches. This includes deck boards, fasteners and railing.

While straightforward and common, horizontal decking in addition to decking laid at right angles, is routine, but there are other decking patterns to consider:

**Diagonal Decking** — Diagonal decking is the technique of installing decking at a 45-degree angle across the joists. Diagonal decking is sometimes installed using deck boards to picture frame the diagonal pattern. A double joist, back-to-back, is required to secure the diagonal boards and the picture frame board.

**Breaker Boards** — A breaker board is a perpendicular decking board used to pattern, as well as section off areas of the deck where parallel deck boards end uniformly. When installing a breaker board, you will need to install two joists spaced the width of the decking minus ½”. Keep the flat part of the joists facing each other. Attach two joists to the bottom of the breaker board with the flat part of the joists facing away from each other. Install the joists ¼” away from the edge of the decking board.

**Fasteners** — There are two options for fastening deck boards to metal deck framing. They are traditional top-down screws and hidden fasteners. Traditional top down recessed screws can be covered with plugs color-matched to the decking boards. The screws also can be color-matched to the decking boards. Hidden fasteners are the same nylon clips used to attach decking to a wood frame, except with a self-tapping, stainless screw.

**Tip:** In order to keep the fastener straight and secure, cut a piece of scrap groove board and use it as an aid to help hold the hidden fastener down before screwing it in. This will make sure the fastener stays fully straight for the remaining boards to be attached. Hold the scrap board in place and align the screw hole to the fastener with the center of the joist. Secure the fastener and continue along the length of the board at every joist.

**Railing** — Install rail posts to the inside of the deck framing prior to installing the deck boards. To create a flat surface on which to position the post, cut a piece of joist and snug it inside of the track the full width of the bay where you want the post. Drill the holes for the ½” carriage bolts to penetrate the steel members using the step bit, and cut a blocking piece of joist with L-brackets attached on each end. This will sandwich the post between sturdy steel members for solid installation. After drilling holes through the wood post, hammer through the carriage bolts, put the washers on and tighten the nuts. Finally, screw the L-brackets to the side joists, pinning them in place.

**Maintenance** — Corrosion is a naturally occurring phenomenon. However, with proper corrosion management, the life of metal deck framing can be extended. During construction, inspect all components of the framing for exposed steel and cover any exposed area with manufacturer-approved touch-up paint.
This helps the aesthetics as well as the durability. Understand that atmospheric and environmental conditions, such as air-borne pollutants, can affect steel deck framing. Integrity is inspected by tapping along the surface area of the components with a metal tool, such as a screwdriver. If flaking of the exterior coat occurs or discrepancies of sound are heard, that calls for action. The first inspection should happen within six years for residential framing and four years for commercial framing. After that, inspection should happen every two to five years for residential and every two years for commercial structures.

So what needs to happen if corrosion is detected? Sand any affected areas to twice the size of the corroded area with 80-grit sandpaper, and then reapply manufacturer-approved touch-up paint to that area.

As you have seen, designing and building with steel deck framing is as easy, and oftentimes easier than using wood. Its ease of use and many benefits make it a superior choice for a deck substructure. Steel framing lasts much longer than wood while maintaining a stable, refined, and straight appearance for decades. Because the deck will last a long time, intelligent and elegant design is possible.

In this education unit, you have learned the benefits and features of steel deck framing and reviewed the basic design considerations for decking. You learned how to install steel deck framing and how to finish it off with deck boards and railings, as well as simple maintenance recommendations.

**SUMMARY & RESOURCES**

When you make the shift to Trex Elevations Steel Deck Framing, you get high-performance, low-maintenance, dual-coated galvanized steel that won’t rot, warp or leave you hanging like traditional pressure-treated wood substructures. Visit http://www.trex.com/plan/products/deckframingdrainage/trexelevations/index.htm for more information about Specification, Components, Installation Instructions and Videos, a Photo Gallery and other Resources.

**Customer Service:**

hwuniversity@hanleywood.com

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**About Trex**

Trex Company is the world’s largest manufacturer of high performance wood-alternative decking and railing, with more than 20 years of product experience. Stocked in more than 6,000 retail locations worldwide, Trex outdoor living products offer a wide range of style options with fewer ongoing maintenance requirements than wood, as well as a truly environmentally responsible choice. For more information, visit trex.com You can also follow Trex on Twitter (@Trex_Company) or Pinterest (trexcompany), “like” Trex on Facebook, or view product and demonstration videos on the brand’s YouTube channel (TheTrexCo.).

Contact Trex directly with any questions related to the information in this article.