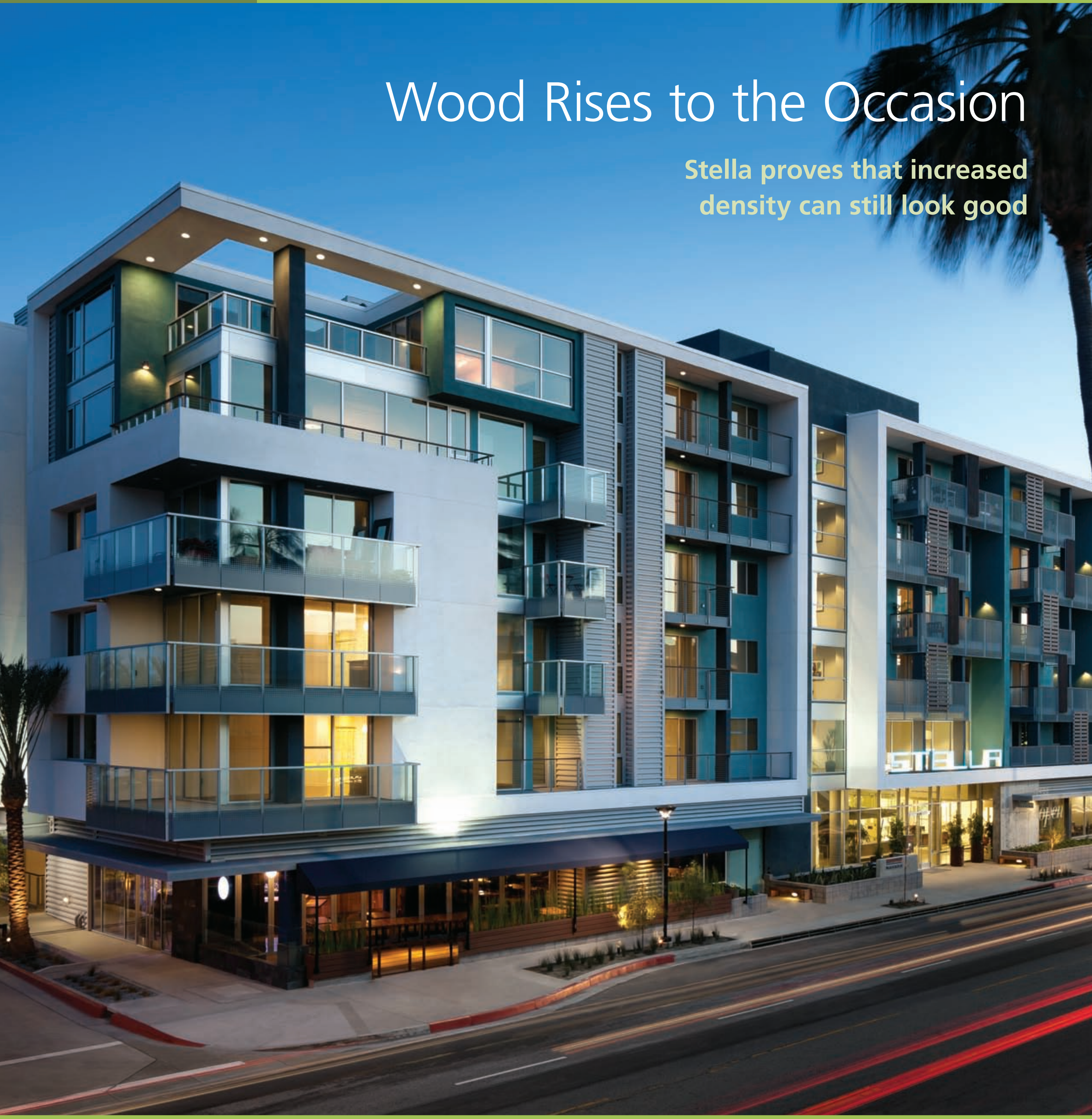
CASE STUDY

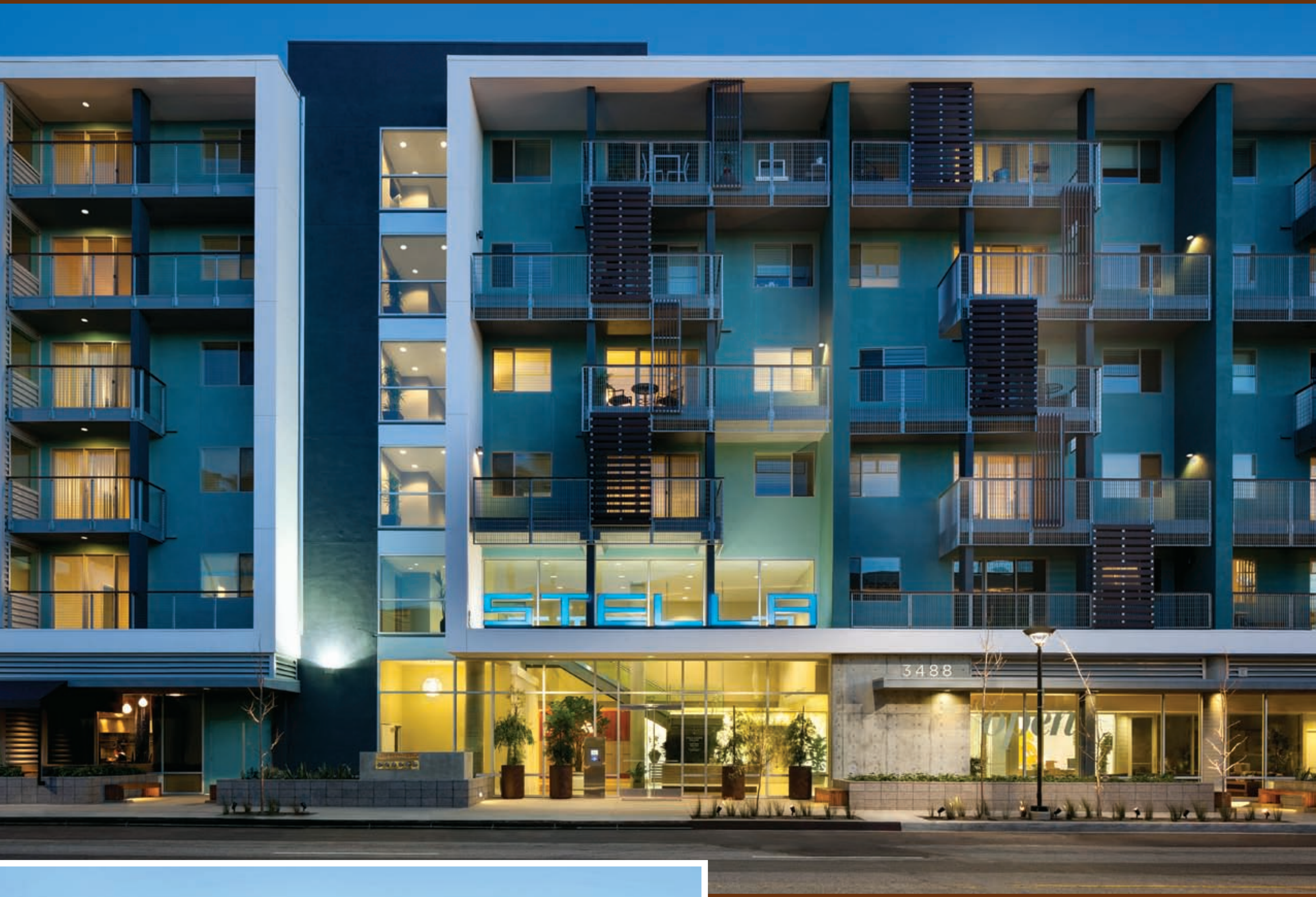
STELLA

# Wood Rises to the Occasion

## Stella proves that increased density can still look good




WoodWorks




If the building market in southern California is any indication of things to come for the rest of the country, wood-frame construction is literally looking up.

"It seems that all of the newer projects here in southern California are going taller, and they're all being built in wood," said Tony Ditteaux, partner and vice president for GLJ Partners, developer and general contractor of Stella, a new mixed-use, multi-family project in Marina del Rey.

"Everyone now is doing '4 over 2' or '5 over 2' podiums, pushing the densities and going taller. As developers, we're trying to maximize our height and the number of units we can get on a site. Wood allows us to do that quickly and affordably."

Stella's sleek, contemporary exterior gives little indication that it holds practical wood framing inside. "We did a quick cost analysis on a Type I building but found that wood was much more cost effective," added Ditteaux. "With a 5 over 1 podium configuration on the one building, we took advantage of every inch. It was an easy decision to use wood."

Two factors made Stella's construction unique: the use of both Type III-A and V-A construction on one podium and the use of prefabrication to speed the building process.

## Making the Most of an Urban Infill Site

The Stella story began in 2008, when GLJ Partners took over a piece of land with an existing entitlement from the height of the building boom. "The entitled project had 244 condo units, and, exemplifying the philosophy at that time, they were pretty bloated with not much open space," said Sean Finn, project architect with DesignARC. "The original developer was basically trying to increase the saleable square footage at the expense of the community. Our task was to redesign the project within the existing entitlement, so keeping the unit count and keeping the retail square footage but reducing the footprint of the structure to make room for more amenities."

The site was uninspired—it was two old restaurant pads bisected by a driveway to a nearby hotel, adjacent to a gas station, freeway and existing retail centers. "One of our challenges was how to create a place in the middle of this parking lot where people would want to live," said Finn. "The previous design had two buildings, each four stories on a one-story concrete podium. We kept the project at 244 units, but reduced the unit size slightly and turned one of the buildings into a five-story structure. We then used the area allowed by the extra story to add better amenities and create more open space. In other words, we leveraged the reduction in the footprint of the private space to increase the community footprint."

To attract residents, DesignArc used the extra space to add resort-style amenities more typically found in luxury projects. The Stella complex includes a heated saltwater pool with hot tub and large sand beach, state-of-the-art fitness center, resident lounges and a catering kitchen, business center and conference room, private movie screening room, yoga studio and spa room, rooftop deck and other high-end features.

### Stella

**LOCATION:** Marina del Rey, CA

**OWNER:** Merlone Geier Partners • San Diego, CA

**DEVELOPER/GENERAL CONTRACTOR:** GLJ Partners • Carlsbad, CA

**ARCHITECT:** DesignARC • Los Angeles, CA

**STRUCTURAL ENGINEER:** Taylor & Syfan Consulting Engineers • Pasadena, CA

**FRAMER:** Larrabure Framing • Chatsworth, CA

**TWO BUILDINGS:** 650,466 square feet total

**NUMBER OF UNITS:** 244

**CONSTRUCTION COST:** approximately $65 million

**COMPLETION:** 2013

## Pacific Modern Appeal, Practical Wood Structure

A huge part of Stella's appeal is its sleek exterior—Finn calls it 'Pacific modern.' But behind the finishes, its structure is highly practical. The development consists of two nested wood-framed L-shaped structures, oriented for maximum access to light and views. The two buildings are set on top of a concrete podium housing 9,000 square feet of ground floor retail space and 578 parking stalls. Of the two L-shaped buildings, one is five stories of wood (Type III-A construction) and the other is four stories (Type V-A). The one-story concrete podium is Type I-A.

The wood-framed portion of Stella consists of Douglas-fir dimension lumber along with parallel strand lumber (PSL), laminated veneer lumber (LVL), glued laminated timber (glulam) beams and engineered wood I-joists for the floor and roof structures. The project used both plywood and oriented strand board (OSB) structural wood sheathing.

Finn said they were deliberate in their decision to use the right building component in the right application. "Each wood component had its place in Stella. Most of the floor assemblies were 11-$^{7}/_{8}$-inch I-joists; we used exposed glulam beams in the public spaces, and we used LVL where we had higher load concentrations. We specified fire-retardant-treated (FRT) wood components for the exterior walls of the Type III-A structure, and non-treated dimension wood everywhere else."

## Mixed Construction Types

The *International Building Code* (IBC) classifies buildings into five types of construction. Type III permits non-combustible exterior walls and combustible materials everywhere else, while Type V allows combustible building materials for all structural elements. Each construction type is further subdivided into protected (A) and unprotected (B), which relates to the level of fire-resistance rating required. Because multi-family projects tend to use drywall on walls and ceilings anyway, it is common to utilize this protection to achieve a Type A classification.

The fact that Stella has two structures, one Type III-A and the other Type V-A, on the same podium, was unique. Type V construction allows untreated wood building components throughout, while Type III allows the use of untreated dimension lumber and engineered wood products for interior elements of the structure but requires FRT wood for exterior wall framing. To meet this requirement, Stella's design team specified FRT studs, rim boards and plywood for the exterior walls of the five-story structure.

According to Finn, the desire for a modern aesthetic with amenities flowing throughout the building also added complexity. "We positioned many of the units on top of large amenity spaces that needed to be more open. In those situations we used steel, not as moment frames but to transfer the bearing wall loads. We also had a lot of non-stacking situations, which complicated the design."

The code allows both a prescriptive and a calculated path for analyzing a building diaphragm as either rigid or flexible. In Stella's case, the project could have been considered either. "We ran both a rigid and a flexible analysis and opted to present a rigid solution to the city," said Garrett Mills of Taylor & Syfan Consulting Engineers. "We anticipated that the long interior corridor walls would enhance the performance of the building." Because rigid diaphragm action was very likely in this configuration, additional strength was added to the corridor walls based on the analysis.

## Structural Solutions for Open Architecture

Finn said he and his design team coordinated closely with the team from Taylor & Syfan to provide structural solutions that met the *California Building Code* (CBC) 2007 requirements.

"Most of the exterior walls were between patio doors leading out to the balconies," said Mills. "So the narrow panels are really full-height segmented shear walls at the exterior. Where we did have shear walls with windows, we used a 'force transfer around openings' detail, which worked well." Force transfer around openings offers a way to accommodate wall segments that don't meet the aspect ratio requirements of 2:1 or 3.5:1 on their own. By blocking and strapping above and below the window opening, the engineer creates shear piers the height of the window, changing the height for the aspect ratio. The blocking and strapping also creates continuity around the opening, allowing for fewer overturning restraints at the ends of the shear walls.

Working together, Mills and Finn also avoided the need for moment frames. "We made sure we had five-foot shear wall segments at regular intervals along the exterior wall, and we worked hard to come up with a design that did not need moment frames," said Finn. "This was a big deal for us, because you would think a building that looks like Stella would require moment frames, but it did not."

Utilizing different materials can create the need for special detailing to accommodate differential shrinkage. By avoiding steel moment frames in the exterior walls, this was not an issue. Mills said they also worked to carefully manage cumulative shrinkage. "Shrinkage effects could have led to excessive drift in our shear wall system, especially for stacked shear walls in a structure that is five stories tall," he explained. "But we managed that by using engineered wood joists, which have very little shrinkage, in the floor envelope." Where other projects may have used semi-balloon frame detailing, dry or engineered plates, or other means to reduce shrinkage, the floors for both structures were platform framed throughout, even at the exterior bearing walls. Because the project was framed in a low moisture environment and also prefabricated, the framing material had ample opportunity to dry, reducing the post-construction shrinkage that can cause issues if not accommodated. The team also used a continuous rod tie-down system to resist overturning and a shrinkage compensation device to limit deflection under wind and seismic forces.

To achieve the open architecture that makes Stella's design so appealing, the design team felt comfortable with fewer highly loaded walls at the exterior of the structure because of the redundancy provided by the corridor walls and demising walls under a rigid analysis. "In addition, many of the common areas were located under residential units above," said Finn. "For example, we have a gym and a lounge underneath units, and because we have all those bearing walls above, we came down on steel beams and then transferred the loads to steel columns. But we only had to use steel in a few situations."

As a project utilizing prefabricated walls, variations in framing mattered. For example, there is one corner of the complex with four different types of units stacking on top of each other, each with different layouts. Most of the project has conventionally-framed and stacked units.

## Using OSB vs. Plywood to Manage Story Drift

Many building professionals consider OSB and plywood to be relatively interchangeable as sheathing products. But Stella's design team took advantage of a nuance between the two different engineered wood panels.

Stella's open, airy exterior meant there were limited exterior walls. Where these walls could be used as shear walls on the five-story Type III-A building, the design team specified plywood, which could be fire-retardant-treated. (FRT OSB was not readily available.) They specified OSB everywhere else, because OSB has advantages with respect to story drift.

Shear walls rely on the apparent stiffness, $G_a$, of the sheathing, which is a product of nail slip and shear deformation. $G_a$ is considerably larger for OSB than plywood, yielding less lateral deflection. The exterior wall assemblies in the Type III-A building required FRT sheathing for the exterior walls, but the majority of the lateral resistance is supplied by the non-treated interior corridor walls. Therefore, Taylor & Syfan specified OSB sheathing for the interior walls to take advantage of the extra stiffness OSB provided, and specified the less rigid plywood sheathing for the exterior walls, which needed to be FRT.

## FRT Considerations for Exterior Walls

All FRT products are required to meet performance criteria set forth by the American Wood Preservers Association, but each treatment formulation is proprietary. Because of this, structural properties for FRT components vary by manufacturer, yielding different structural design values—which meant Stella's design team had to be very deliberate in their specifications. They used larger lumber sizes for the FRT headers in the exterior walls than would have otherwise been needed to accommodate the reduction in shear and flexural capacity related to the fire-retardant treatment.

"FRT manufacturers have slightly different recommendations for reduction in load capacity that would apply to shear walls or bending strength in the rims or balcony members," said Mills. "Essentially we had to pick one manufacturer and specify those products, and then the contractor had to ensure availability from that manufacturer. We had the added benefit that the contractor was also the developer, so GLJ Partners was involved in the design process with us. It was helpful to be able to go to the City with specifications we knew the developer was comfortable with instead of having to get re-approved with a different manufacturer later through plan check."

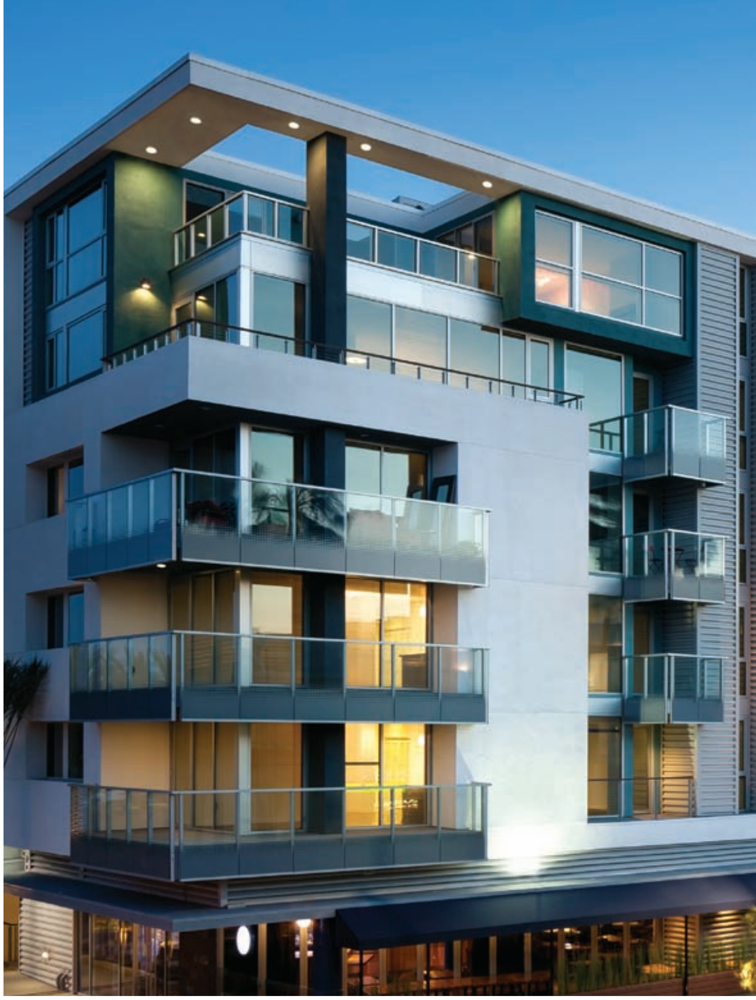
DJ Hammond is director of construction with Larrabure Framing, the framing contractor for Stella. "FRT lumber has a six- to eight-week delivery lead time; it's important to get your design done early so you can order materials. But given enough time, it's certainly doable. We were fortunate to have been involved in this project early; having eight months to coordinate was key to being able to do what we did with Stella."

## Stylish Balconies Add to Stella's Resort-Style Appeal

Among Stella's attractive design features are the balconies which cantilever off the building. The use of balconies helped the design team achieve an open and airy feel, but in turn limited the amount of exterior shear walls. In both of the nested wood-framed L-shaped structures, corridor walls provide the majority of the lateral resistance longitudinally (similar to a hotel) and long party walls between units provide the resistance in the transverse direction.

"Our design was a little unusual in that we didn't cantilever the floor framing out over the exterior wall for the balconies," said Finn. "We used I-joists inside, and then used dimension lumber on the exterior for the balcony framing. Much of the framing actually ran parallel to the exterior wall, but we used ledgers on both sides, which allowed us to maintain continuity of the exterior wall."

The balconies themselves did not have to be constructed of FRT lumber. The code allows balconies of Type III-A structures to be of combustible material and requires them to be 1-hour rated because balcony framing is considered an extension of the floor construction. As such, they are required to have the same fire-resistance rating as the floor construction with a few exceptions. If the balcony is framed in FRT wood, or qualifies as heavy



timber (Type IV) construction, or if automatic sprinklers are used, the balcony may not need to be protected. To avoid fire rating requirements, Stella's balconies were protected with automatic sprinklers.

## Narrow Exterior Shear Walls Challenged Seismic Design

California's seismic requirements added some complication for Stella's structure (which needed to meet Seismic Category D), but the architect and engineer developed a number of design solutions.

They took advantage of Stella's L-shape configuration by adding 6-inch seismic joints at the intersection of each of those L's, which, in a seismic event, will act independently of one another. The seismic joint was essentially a gap large enough to avoid damaging contact under the building's total seismic deflection. "We were mindful of the fact that L shapes create re-entrant corners and stress concentrations, so we decided to break it up," said Finn.

Mills added that, although they opted for a rigid diaphragm analysis, it was a challenge to have limited shear walls on the exterior. "We worked closely with the architect to get certain lengths of wall on the exterior where they would have otherwise wanted it to be entirely open for aesthetics. And we also coordinated the location of the 5-foot-wide stacked shear walls along the perimeter." he said. "We took advantage of being able to drag forces from one end of the building to the other so we didn't need to have shear walls at every single unit, for example. Our biggest challenge was at the lowest floors, especially on the five-story building. Where we had two-sided shear walls, we specified FRT plywood sheathing on the exterior with very tight nailing."

Mills said another challenge that wasn't immediately obvious until they started construction had to do with end posts. "When you have fairly narrow panels at the exterior and you have a five-story building, you end up with fairly large end posts for the shear wall compression forces. Therefore, when you have a 5-foot-long shear wall and the ends of your wall must accommodate a continuous rod tie-down system with close to 18 inches of end wall system on either end, things can get crowded."

For example, in some places they needed a pair of 6 x 6 posts with a 6-inch gap between for the tie-down rod, which took 18 inches on each side. "This left only a few feet in between, so we ended up with not a lot of sill plate left where we could physically get an anchor bolt into the podium deck," Mills said. "It really became a challenge to lay out our anchor bolts, which are needed to transfer the shear to the podium from the wood structure. Even when we only needed four or five bolts, it was tight."

## Panelization Saved Hundreds of Thousands of Dollars

One of the keys to Stella's success was the coordination, facilitated in part by the fact that the general contractor was also the developer. "Construction-wise, it was a very complicated project with a lot of moving parts," said Ditteaux. "We had contaminated soil and groundwater, the site was next to a highway, and we had no room to work or store materials. We hired Larrabure Framing about eight months before we began construction, which gave us a huge advantage."

Ditteaux said Larrabure panelized the project off site. "Every day, we'd get three to four truckloads of wall panels, and we'd just stand them up. We easily saved one to two months of construction time because of the panelization. From a general contractor/developer standpoint, that time savings is a big deal; we saved a few hundred thousand dollars just in general conditions and supervision."

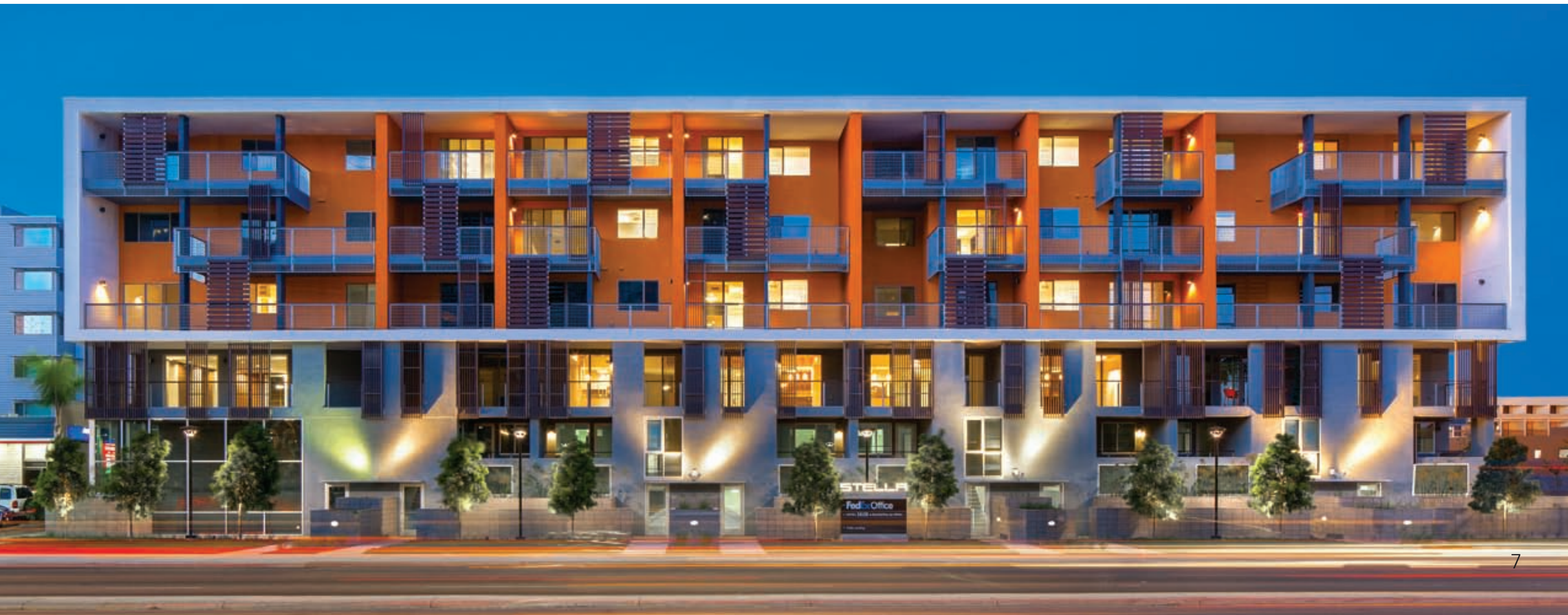
Larrabure's Hammond said they've panelized 100 percent of their projects for the last four years. "If there's not enough time to panelize a project, we'll typically pass on the bid and go to the next one. Panelization typically takes 10 to 15 percent off the timeline compared to traditional site-built construction, saving enough time, money and materials to make it worthwhile for all of our projects. If there hadn't been some delays with the podium on Stella, we could have framed this project in 20 weeks, which is fast for a building of this size and level of complexity. Otherwise this was a fairly typical installation for this type of structure, so there was no huge challenge."

While panelization is most often used for structures with similar unit types, Larrabure panelized walls for the entire project, even though Stella had some unusual unit types. "The walls, which are typically 9 feet tall and 12 feet long, were not sheathed," said Hammond. "We've found they become too heavy and difficult to work with; it's easier to lift them into place unsheathed, and then do final field adjustments if needed."

Floors and roofs were not panelized but were pre-cut and packaged into units with all the blocking, I-joists and beams required; the packaging reduced waste and saved space on site. The package was craned into place, which Hammond said reduced confusion at the job site while also speeding construction. "The average unit was 1,000 square feet and each unit had two joist packs that got dropped into place. One would typically have the I-joists and the other would have the beams and blocking. We handle it the same way for all projects, regardless of whether the job is three, four or five stories tall."

## Stella: A Hint of What's to Come

GLJ Partners has a number of similar projects in planning and under construction. "Stella is a continuation of what we've been doing and what we will continue to do," said Ditteaux. "Most of the new projects we're involved with are urban infill, Type III, 5 over 1 or 5 over 2 podium construction. Using wood for Type III versus a Type V building is no big deal for us, but the density we get in additional units easily pays for the little bit of extra construction costs. Being able to go higher allows us to make more money from the site, and wood's affordability and ease of construction made Stella even more successful."



## Carbon Benefits

Wood lowers a building's carbon footprint in two ways. It continues to store carbon absorbed by the tree while growing, keeping it out of the atmosphere for the lifetime of the building—longer if the wood is reclaimed and reused or manufactured into other products. When used in place of fossil fuel-intensive materials such as steel and concrete, it also results in 'avoided' greenhouse gas emissions.

Use the carbon calculator to estimate the carbon benefits of wood buildings. Visit **woodworks.org**.

**Volume of wood:**
2.3 million board feet (equivalent)

**U.S. and Canadian forests grow this much wood in:**
16 minutes

**Carbon stored in the wood:**
4,495 metric tons of $CO_2$

**Avoided greenhouse gas emissions:**
9,554 metric tons of $CO_2$

**TOTAL POTENTIAL CARBON BENEFIT:**
14,049 metric tons of $CO_2$

*EQUIVALENT TO:*

**2,683 cars off the road for a year**

**Energy to operate a home for 1,194 years**

*Source: US EPA*

*Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations. Note: $CO_2$ on this chart refers to $CO_2$ equivalent.*

*WoodWorks is an initiative of the Wood Products Council*

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