Cost-Efficient Design and Construction of Affordable Housing

Walsh Construction Co.

For more than 50 years Walsh Construction Co. has partnered with public housing agencies, non-profit community development organizations and various for-profit entities across the Pacific Northwest to deliver more than 75,000 units of affordable housing to our communities. Each of those units is still standing today and serving as affordable housing. We have learned a few things along the way about how to design and build affordable housing in the most cost-efficient manner. We do not believe design quality and cost-efficiency are mutually exclusive. Rather, we believe it is a matter of including cost-efficiency as a valid constraint in the design of affordable housing and doing the best to give simpler, "leaner" designs a sense of place, character and distinction, while maintaining essential functionality and durability. We also believe that cost-efficiency – when pursued by project teams in a highly disciplined manner – creates an opportunity to incorporate a variety of value-adding measures and amenities into projects, providing a path towards truly high-performance affordable housing. To start the conversation with project teams, WALSH has developed the following list of important considerations for cost-efficient development, design and construction.

Project Approach / Concept / Scale

- Strive at all times for simplicity. Applying a discipline to "keep it simple" will go a long way towards helping to reduce costs so that important architectural and performance features can be included in the project, even when working with limited budgets. Excessive form articulation, not stacking units, cantilevers, or mixing steel with wood framing are just a few examples of common design moves that inherently introduce complexity and increase cost. These should be avoided wherever possible.
- Consider developing a larger project. All things being equal, larger projects are more cost-efficient. There are roughly the same number of components to design, specify and construct in a 20-unit building as in a 200-unit building. On larger projects, the overall development costs - including the cost of design services and construction management - can be spread over a greater number of units and thus the cost per unit can be reduced significantly.

Site Selection / Site Development

- Choose the site carefully. It is important to exercise sufficient due diligence during site selection and attempt to identify sites that are inherently more cost-efficient to develop. Be aware of sites where local jurisdictions may impose costly requirements such as the dedication of significant portions of the site to public rights of way, half street improvements, etc.
- Look for sites with little to no slope as these are generally more cost-efficient to develop than sloped sites.
- Identify sites without contaminated soils or high radon levels.
- Identify sites with good soil bearing pressure to minimize footing size and avoid the need for piles.
- Look for sites with good drainage characteristics to allow for lower cost stormwater management solutions.
- Site design should be simple and laid out in relation to topography and features. Buildings and paths should be laid out in relation to site grades to minimize the need for regrading, retaining walls and stepping of building pads/foundations.
- Consider stormwater management when developing the site plan, making best use of existing topography to integrate features such as stormwater planters and bioswales.
- Minimize the area dedicated to parking and maximize the area dedicated to landscaping.

- Simplify the landscape design. Use native, drought-tolerant species for groundcover generally and selectively use higher cost paving and planting materials.
- If irrigation is to be provided, concentrate planting areas that require irrigation in limited zones that can be served efficiently with a minimum of piping and equipment.

Building Design & Layout

- Cost-efficiency begins with the most efficient building layout that fits a particular site.
- Develop building plans that minimize the area dedicated to circulation. This generally suggests the use of double-loaded corridor schemes at larger buildings wherever possible, although at narrower sites it may only be possible to use a single-loaded corridor scheme.
- Where local codes will allow, the use of single stair buildings may provide a more efficient overall layout by minimizing circulation area, particularly at smaller footprint buildings.
- The use of unit plans with a narrow-deep "aspect ratio" will result in a more efficient overall building form and reduce the total area that must be dedicated to circulation and building enclosure. This single step can deliver a high degree of efficiency to every design.
- Laying out unit plans and building plans on two-foot modules will help to rationalize work on the building during both design and construction, and will optimize material use, reduce waste and increase productivity with framing, drywall and other trades.
- Incorporate advanced framing measures (i.e. wall studs and floor joists spaced at 24" o.c.) whenever possible. Not only will this reduce cost and improve productivity, it will result in considerably higher thermal performance at exterior walls. (Note: stay with double top plates at walls, as single top plates have more disadvantages than advantages).
- It is generally advantageous to orient floor framing with joists spanning across the unit from party wall to party wall, running parallel to the exterior wall. With windows stacked at the exterior wall this allows for dramatically reducing the amount of header framing at the exterior walls, reducing cost and improving thermal performance. Consider laying out unit plans such that bearing walls are spaced apart 14 feet or less, as this may to allow the use of 9 ½" deep floor joists.
- At the typical residential levels of the building, reduce the floor-to-floor height to the minimum practical dimension as this will result in cost savings due to quantity reduction of materials and systems. This may have additional positive benefits on projects that are subject to height limitations, by allowing for designs with an additional story.
- Set the floor-to-floor height of buildings to net out ceiling height of 8 feet at unit interiors as this will optimize drywall installation, using 48" wide x 96" long sheets. If higher ceilings are desired, work with 8'-6" or nine-foot heights as this will be possible using full width (uncut) 54" wide drywall sheets. This optimization reduces waste and improves productivity, leading to cost reduction. When optimized floor to floor height is combined with use of 9 ½" deep floor joists, further optimization is possible, using full length (uncut) structural sheathing panels at the walls.
- Develop/configure each unit plan layout to optimize for material reduction while maintaining the essential livability and flexibility of the unit. Minimize the quantity of walls, doors, and closets.
- Locate windows on modular stud layout at exterior walls to minimize framing, optimize sheathing utilization and reduce thermal bridging associated with wall framing (i.e. framing factor).

- Locate plumbing walls in close proximity to one another, to shorten piping runs and allow collective servicing of units. “Back to back” arrangement of fixtures along a shared wall is the most ideal.
- Develop bathroom layouts that allow plumbing to be placed in walls that are not at the unit perimeter (i.e. party walls, corridor walls, exterior walls). This will minimize the need for double framed walls and help avoid conflicts between plumbing and the structural components of shear walls, the enclosure components of exterior walls, and minimize the complex and costly detailing at piping required to meet fire and sound ratings.
- Where a modular construction approach is to be explored, unit plans and party walls should be aligned across corridor to facilitate the use of full building width “volumes” (i.e. unit + corridor + unit).

Vertical Stacking / Structural Framing

- Stack walls and unit plans as much as possible and align openings within walls from floor to floor. This will provide continuous structural load paths to the foundation, reducing structural complexity and cost. It will also reduce complexity and cost in associated plumbing, wiring and duct runs.
- When planning large common spaces at the lower levels of the building, be mindful to design these spaces to keep structural spans as minimal as possible. Locate walls, columns and beams as best as possible to pick up loads from above. Seek out solutions that can be accomplished with wood members and related connection hardware rather than structural steel. Avoid steel whenever possible as it typically has a high relative cost and often creates significant constructability and construction management issues in large wood frame multi-residential buildings.
- Where structural steel is required at lower levels of the building, coordinate the location of structural members with the layout of plumbing and other systems. For example, placing floor beams directly below party walls can cause severe conflicts with plumbing risers.
- Avoid structural cantilevers in wood framing if at all possible. Cantilevers create structural complexity and will likely increase construction costs significantly.

Building Massing & Articulation

- Keep building massing as simple and compact as possible. Minimize stepping in the exterior wall plane and the roof plane. Steps create formal and structural complexity and reduce performance by increasing thermal bridging and making it more difficult to achieve building airtightness.
- Whenever possible, building orientation should run east to west to facilitate better energy performance and reduce the number of west-facing units (which can be prone to overheating).
- Arrange windows to provide good daylighting and natural ventilation, while preventing overheating (15-25% window-to-wall ratio is a good target range for performance and cost effectiveness).
- Use a steep slope roof form (with asphalt shingle roofing and a vented attic) whenever possible in lieu of a low slope roof form as this is generally the lowest cost roof form.
- Avoid contiguous gable end designs, where steep slope roof areas pitch directly toward each other. Such designs increase the quantity of wall area and roof area, create water management difficulties, and significantly increase the chance of long-term durability problems.
- Where low slope roofs are required, use an exterior drainage approach (through wall scuppers and external downspouts) in lieu of internal drainage.

- Minimize the quantity of canopies, trellises, balconies and other exterior form elements. Where these elements occur, provide simplified, constructable designs, with a focus on detailing to enhance durability.

Amenities

- Consider shared amenities located in common areas, rather than individual amenities within each unit. For example, provide common laundry facilities in lieu of a washer and dryer in individual units. Provide common balconies in lieu of balconies at individual units.

Standardization & Repetition

- Strive at all times to standardize unit plans and building sub-components and use as repetitively as possible**.** Think in terms of what we call the "80/20 Rule": attempting to standardize and optimize 80% of the building design, while saving 20% of the design for customization to address the unique site and program of each project (see more below). Standardization and repetition offer significant potential to reduce costs by allowing for the optimization of systems and components, and on larger projects additional cost benefits can be derived from an economy of scale.
- To the maximum extent possible, use the same plans for dwelling units and use the same layout for kitchens and bathrooms within those units.
- The use of repetitive components such as windows, doors, cabinets, appliances, plumbing & lighting fixtures has potential to lead to greater economies of scale in purchasing, resulting in better pricing.
- Utilize standardized enclosure and MEP systems with a reliable track record. Too often, a "reinvent the wheel" approach has been taken to the integration of systems with affordable housing designs, leading to the use of relatively expensive systems that in many cases have had in service performance problems, or led to long term maintenance issues for building owners and/or residents. The focus should be on developing and utilizing standardized and reliable systems that are functional and durable yet cost-effective, and that do not change dramatically from project to project. High levels of energy efficiency, comfort and indoor air quality can be achieved with such an approach, while helping to manage costs and ensure reliability.

Coordination

- Coordinate the location, size and configuration of enclosure, mechanical and electrical system components with structural framing members to optimize the layout of those members and components while avoiding undue costs related to conflict resolution.

Prefabrication

- Prefabrication of units or components has the potential to reduce costs, shorten schedules, and improve quality.
- Components such as windows and cabinets are typically already prefabricated. Investigate other opportunities for prefabrication such as with wall and floor panels, piping runs, ductwork, kitchens and bathrooms.
- Modular construction – where entire dwelling units are factory built and shipped to the site for assembly into a building – may provide a cost-effective solution at certain projects depending on site and schedule dynamics.

The 80/20 Idea

It's apparent from surveying the industry that nearly every affordable housing project is designed from scratch and the result is unique, customized to its site and program. This tendency to build 100% prototype projects is a significant factor that contributes to rapidly increasing costs in construction and a relative lack of productivity growth in the industry. As part of our CEDC approach, we've developed the 80/20 Idea: roughly 80% of the elements that constitute an affordable housing design can be the same or highly similar. These are elements that for the most part are hidden or buried behind other elements; for example, structure, insulation, mechanical and electrical systems, drywall, firestopping and acoustic detailing. If the project team can optimize the design of those elements and begin to use them more widely as standardized elements, we have the opportunity to bring costs down significantly, through reduced material use, improved constructability and productivity, and, more generally, a reduction in complexity and uncertainty for the trades involved. The achieved savings can then be used for the inclusion of more of those visible elements that strongly contribute to architectural quality and building performance: the other 20%. This refers to the form, articulation and exterior expression of the building, the exterior cladding materials and interior finishes, daylighting and natural ventilation, or amenities such as balconies and roof decks.

Standardize / Optimize

80%

- Typical unit plans
- Corridors
- Exit stairways
- Foundation system
- Structural system
- Enclosure system
- Typical windows and doors
- MEP systems
- Typical interior finishes
- Cabinets
- Appliances
- Lighting
- Elevator(s)
- Laundry facilities

Customize

20%

- Response to the site
- Interface with the street
- The space between buildings
- Building plan / layout
- Building form / massing
- Façade design / expression
- Building entry / lobby
- Common rooms and spaces
- Public stairway
- Select common area finishes
- A few select unit plans
- A few select windows
- Balconies
- Roof deck amenity