WATERSTREET AT CELEBRATION CONDOMINIUMS:
A CASE STUDY OF HOW TO DESIGN FOR A WET CLIMATE

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Abstract

This case study will present the investigation, evaluation, design, and repair of a 12-building community that had suffered from extensive water intrusion problems since its construction in 1998. The majority of the problems were created by inappropriate design and material selection, which was exacerbated by errors during construction regarding scheduling and work methods. This project is a case study of how to investigate and repair a mixed-use building envelope failure, as well as how designing for a wet, humid climate is quite different than for many other areas of the country.

Speaker


James Ripley has practiced architecture since 1976, providing insight into how buildings are designed and constructed. He has been involved in roof and waterproofing consulting full-time since 1993 at A/R/C Associates, Inc. in Orlando, Florida. The practice in Florida has offered a unique opportunity to observe building performance and deterioration at an accelerated rate in a high-humidity, high-ultraviolet, high-wind environment. A/R/C has observed the long-term performance and failures of numerous structures, as well as their analysis and repair.
INTRODUCTION

The concept that became the town of Celebration was originally envisioned by Walt Disney to be an integral part of his Experimental Prototypical Community of Tomorrow (EPCOT), which was to be a complete working and living city. His vision was to create a living environment for people that would be planned sensibly and executed well, as opposed to the uncontrolled and hectic urban sprawl that he watched occur around Disneyland in California. This led him to secretly acquire enough land in Florida (over 27,200 acres, or 43 square miles) to manage the development of an entire environment. He also negotiated with the state of Florida for Disney World to be granted all of the authority of a city government, including its own building code, utility commission, and improvement district.

Unfortunately, with the death of Walt Disney in 1966, five years prior to the opening of the Magic Kingdom at Disney World in 1971, his guidance was lost and his vision was blurred; when EPCOT opened in 1982, it was merely another theme park. Walt’s original vision was resurrected in the early 1990s when the Disney Development Company established the Celebration Company to develop approximately 4,900 acres of land on the east side of Interstate 4, opposite from the theme parks of Disney World. The town of Celebration was established in 1994 and was developed in a series of self-contained villages to minimize traffic and urban sprawl, and was named “New Community of the Year” in 2001 by the Urban Land Institute.

The community is very walkable and pedestrian-friendly. The buildings that make up this community are a mix of condominiums, single-family houses, shops, restaurants, and small commercial buildings.

The town was designed to be an example of new urbanism, using an early 20th-century, small-town style in collaboration with world-recognized leaders in education, land planning, and design. Contributing architects included Philip Johnson, Michael Graves, Robert Stern, Frank Gehry, Robert Venturi, Denise Scott Brown, Cesar Pelli & Associates, and Graham Gund. Once the landmark designs were completed for the town center and infrastructure, the production of the actual construction documents for much of the remaining buildings in the town was performed by the local architects in California who had worked with Disney Development previously; this is where our story of roofing and waterproofing begins.

Waterstreet

The Waterstreet development (Figure 1) was designed by a Costa Mesa, California, architectural firm and permitted for construction in mid-1997, with sales of condominium units beginning in 1998. The development is a 12-building complex in the center of downtown Celebration. Several buildings are along the main street with retail and offices on the first floor and residential units on the two floors above.

Construction is wood frame with a combination of stucco and fiber-cement siding exterior finishes (Figure 2). Both steep-slope shingles and low-slope modified-bitumen roofing systems have been used.

History

In 2006, an extensive report on the building envelope was performed by an engineering firm and its investigative team as part of the turnover process between the
Figures 3 and 4 – The overall conditions of the roofs throughout the Waterstreet development. The roof design is complex with numerous flashing conditions. Also note algae along the top of the coping cap in Figure 4, below, due to a lack of drainage slope.

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Figure 8 – Minimal tools were needed for this investigation/evaluation.

Figure 7 – During the 2012 investigation/evaluation process, a man-lift was used due to the buildings’ heights and to minimize the time on site.

designed to easily drill through stucco or fiber-cement siding, but performs poorly in wood. Upon drilling through the exterior wall finish, significant resistance would be encountered if the wood sheathing was in good condition, but the drill bit would easily continue through if the sheathing were deteriorated or nonexistent.

This test procedure was minimally destructive, as the holes created by the investigation process were filled with a colored sealant and the results were recorded for later analysis.

The locations of the test holes were selected at the most trouble-prone wall areas based on previous observations, but the number of test locations varied by building because the overall size of the buildings varied. The results were compiled to yield a simple percentage for each building as to the holes with underlying solid sheathing, in relation to the total holes drilled. The lower the percentage, the more damaged sheathing discovered, and the higher the priority of that building for repair.

The results were presented in an interactive digital report (Figure 9), which showed all elevations and where every spot was drilled with extreme accuracy. The owners used this report for their consideration, along with our conclusions and recommendations for repair.

Investigation Conclusions

At locations such as windows, scuppers, gutters, balcony/walkway terminations, dryer vents, and in general any penetration through the exterior cladding, it was revealed that the sheathing had received moisture and was water-damaged (Figures 10 and 11). We also found that in some locations, the sheathing did not appear to be in place at all, which suggested that the material had deteriorated severely and no longer existed.

The fact that water was entering the exterior wall system was compounded by the fact that there was not an effective waterproofing barrier within the wall design and construction. These investigations

<table>
<thead>
<tr>
<th>Building Number &amp; Name</th>
<th>Samples Taken</th>
<th>Sufficient Results</th>
<th>Insufficient Results</th>
<th>Score</th>
<th>Priority Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building 1 The Amherst</td>
<td>204</td>
<td>137</td>
<td>67</td>
<td>67.2%</td>
<td>10</td>
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<tr>
<td>Building 2 The Rosedale</td>
<td>337</td>
<td>259</td>
<td>78</td>
<td>76.9%</td>
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</tr>
<tr>
<td>Building 3 The Chelsea</td>
<td>349</td>
<td>176</td>
<td>173</td>
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<td>3</td>
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<tr>
<td>Building 4 The Davenport</td>
<td>261</td>
<td>141</td>
<td>120</td>
<td>54.0%</td>
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<tr>
<td>Building 5 The Ellsworth</td>
<td>92</td>
<td>40</td>
<td>52</td>
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</tr>
<tr>
<td>Building 6 The Farmington</td>
<td>199</td>
<td>121</td>
<td>78</td>
<td>60.8%</td>
<td>8</td>
</tr>
<tr>
<td>Building 7 The Glenhaven</td>
<td>142</td>
<td>87</td>
<td>55</td>
<td>61.3%</td>
<td>9</td>
</tr>
<tr>
<td>Building 8 The Hampden</td>
<td>459</td>
<td>278</td>
<td>181</td>
<td>60.6%</td>
<td>7</td>
</tr>
<tr>
<td>Building 9 The Idleywe</td>
<td>344</td>
<td>196</td>
<td>148</td>
<td>58.3%</td>
<td>6</td>
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<tr>
<td>Building 10 The Jefferson</td>
<td>312</td>
<td>211</td>
<td>101</td>
<td>67.6%</td>
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<tr>
<td>Building 11 The Kensington</td>
<td>282</td>
<td>181</td>
<td>121</td>
<td>57.1%</td>
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<tr>
<td>Building 12 The Lynbrook</td>
<td>96</td>
<td>39</td>
<td>57</td>
<td>40.6%</td>
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Figure 9 – This chart is an excerpt from the investigative report furnished to the owner to summarize the test findings and to prioritize future repair work.
illustrated that building wrap was an ineffective water barrier; once the water penetrated the horizontal crack in the stucco, it continued through the building wrap and deteriorated the wall sheathing behind.

The existing wall was essentially a barrier wall system that was dependent on sealants and coatings to stop any water at the surface of the wall, but this system had failed due to several contributing factors. This led us to conclude that there were two fundamental problems with all of the buildings in the complex.

The first was that the deficient penetrations and terminations allowed a significant amount of water to enter the exterior walls. The second condition was that the water that entered was not effectively stopped by a proper waterproofing barrier and redirected to the exterior to avoid internal damage. The preceding conditions resulted in the sheathing’s being exposed to water; the OSB material then absorbed it and rapidly deteriorated, which brought the water in contact with the dimensional wood framing. At that point, the structural capabilities of the building were compromised, both in load-bearing capacity of the studs and lateral bracing provided by the sheathing.

### Repair Options and Recommendations

The investigation process led us to believe that any attempt to repair and re-establish the building envelope as a barrier system would be extremely difficult and would impose periodic maintenance demands on the owners’ association that it would be unlikely to fulfill. It was in the best interest of the buildings to convert the exterior envelope to a screen wall system, which assumes that water will find its way into the wall assembly at various locations at some time, at which point it is controlled and directed.

The intent of the design is to establish a waterproofing barrier in the assembly at the correct location and then manage the water by redirecting it to the exterior instead of allowing it to proceed to the interior where damage is created. This conversion would start with the removal of the exterior cladding, exposure of the existing sheathing, and replacement of any damaged or defective materials (Figure 12).

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**Figure 12** – This detail shows the typical repairs defined by A/R/C for the parapet/upper exterior wall with stucco and fiber-cement siding.
We would then install a high-quality waterproofing barrier over the entire exterior vertical surface, followed by reconstructing the exterior cladding so as to establish a drainage plane in the wall and means of escape for water that is received. The various penetrations and terminations that exist, along with the exterior finish, would be designed so as to provide a primary means of defense. The waterproofing barrier, drainage plane, and weep screed would provide the secondary barrier. In this manner, redundancy was introduced into the wall system in terms of waterproofing ability. These design concepts are illustrated in the detail in Figure 13.

Despite the large legal settlement, there were not enough funds to convert all 12 buildings from barrier wall systems to screen wall systems. Therefore, we recommended that repairs be done in three phases of four buildings each, starting with the buildings that exhibited the highest degree of deterioration and, therefore, in the greatest need of repair.

Within each phase, our goal would be to complete the repair of each building before moving on to the next building to minimize the disruption to the building occupants and the complex as a whole. Following the repairs to the first four buildings, we would then reevaluate our recommendations and the repair techniques that had been applied to optimize the repairs as may be appropriate for the level of damage that exists on the remaining buildings.

Both low-sloped and steep-sloped roofs had been in service (with the exception of one building) since the complex was constructed 14 years earlier. From our recent review of the complex, our opinion was that the existing roofs could remain in service with repairs in designated areas for another five years. This would allow us to repair more vertical surfaces and address the most significant needs throughout the complex.

Condominium Politics – Phase One

This is where the reality of condominium politics caught up with us. Based on our scope of work, it was obvious that there was not enough money available to declad and reclad all 12 buildings in the recommended manner. This meant some owners could be left with no repairs being made to their units before all the settlement money was exhausted. The initial response from the governing board was that a less expensive method of repair needed to be considered to allow the repair of all 12 buildings. Although this directive seemed logical, it really could not be achieved and still reliably repair and waterproof the more severely damaged buildings.

The eventual compromise was to perform designated roofing repairs and isolated roof replacement throughout the entire complex prior to starting the first phase of the building refurbishment so that every unit owner received some benefit from the settlement money. We first put together a bid package for the roofing repair phase that would be followed by a separate bid package that would be Phase One for the exterior wall repairs of the first four build-
ings that were the most severely deteriorated. The contracts were structured with base bids for a defined scope of work with numerous unit prices with base-bid allowances for deteriorated material removal and replacement as it was discovered.

**Refurbishment Scope of Work**

The intent of the repairs was to recreate the exterior appearance of the existing elevations. Any changes to the appearance of the elevations were solely to improve the waterproofing performance of the building envelope. The scope of work for the exterior refurbishment of the first four buildings was as follows:

1. All buildings had their exterior finish and trim removed down to the sheathing.
2. All damaged or deteriorated sheathing and wood framing was replaced, with our structural engineer consulted as needed. After the framing and sheathing work was completed, the entire building was wrapped with a self-adhered, modified-bitumen waterproofing barrier.
3. All exterior window units were replaced with new units and properly flashed.
4. Windows, doors, and all other penetrations were flashed to tie into the new waterproof barrier applied to the whole building envelope.
5. New construction was done in sequence to properly tie-in to the waterproofing systems.
6. Concrete balconies and walkways were pressure-washed and treated with an anti-microbial agent.
7. All gutters were replaced and scuppers relocated to correct the drainage issues and discharge into a properly located conductor head.
8. All small roof areas that intersect the new exterior finishes were replaced and reflashed into the new waterproofing system, and all coping caps at these roofs were replaced.
9. In the course of the above work, miscellaneous electrical work included relocation of AC disconnects, reconnecting alarm systems at windows, repulling all circuits through new studs, repairing noncompliant circuits, troubleshooting and testing all alarm systems, and inspecting low/high voltage lines for damage.
10. Miscellaneous mechanical work included extending dryer and exhaust vents and rerouting AC condensation drains.
11. Although plastic “soft” barriers were used to protect the building interiors, the interior finishes were often affected by window or framing replacement and needed to be repaired. Drywall replacement and painting were usually done corner-to-corner, carpets were rolled back, new finish trim was installed and carpets were restretched. Interiors were then cleaned as needed.

**Discovered Conditions**

Much of what was found during construction (Figures 15-17) validated our drastic approach of reskinning the buildings. On one particular building that was shown to be the worst during our investigation, our initial estimates for damaged framing and sheathing was 20%, but ended up being 90%.

Our drill bit testing had shown us that there was water damage in the usual areas of windows, scuppers, and penetrations, but the damage had come down from all of
Figures 18-23 – From upper left, moving across the page to the right, and then from the bottom, again moving to the right, one views a stair tower in full sequence from preconstruction to near completion.

those locations in a “Christmas tree” shape of deterioration.

The water damage was so excessive in the sheathing that it had migrated back into the framing, which also had to be replaced. Many wood structural beams also had to be replaced because of the water intrusion. It was not uncommon to open up a column only to discover there was no more framing within because it had deteriorated from the excessive water intrusion.

Something that was very alarming was how innocent some of the worst areas of water intrusion appeared prior to deconstruction. Seemingly fine walls would have almost no sheathing behind due to the extent of water intrusion.

Figures 18-23 show a stair tower in full sequence from preconstruction to near final completion. One sees a seemingly fine stair tower followed by the discovery of extreme decay. Our design follows to provide a waterproofing system that is appropriate for this climate.

We also found that in many cases, decorative elements worked against the building. Our scope of work to establish a proper waterproofing barrier behind the exterior cladding was validated as we routinely discovered water trapped behind these elements that caused deterioration of the sheathing and framing. The largest problem with many of the decorative features is that they were improperly sloped—either being totally flat, or in some cases, sloping towards the building (Figure 24). This allowed moisture to be absorbed behind the cladding in these locations. Many times a decorative architectural band on a wall would be removed during the construction phase and show an even line of decay of the sheathing below.

This also happened at many column conditions where there was a decorative
Figure 25 – A good example of water being directed to an 8-in. x 8-in. wood column within a decorative element. Note the previously square column is a mess of wet wood fibers that continues down to the damaged spanning beam below.

break in a column that directed water inwards toward a wood structural member within. Luckily, many of these columns were decorative elements and were not actually load-bearing (Figure 25).

The discoveries that were made in the field during deconstruction showed the ugly reality that in Florida, water gets behind almost everything somehow. The screen wall system that we designed corrects this problem by accepting the fact that moisture may enter behind the cladding, establishing an impervious waterproofing system, and providing any moisture with a means of egress.

As we were nearing completion of the refurbishment of the first four buildings of Phase One, the owners elected to add a fifth building to keep the construction pace going before the next phase of construction began, due to an anticipated gap between phases. Condominium law required us to rebid the next phase of work due to the anticipated cost. After the owners saw how expensive it was to reskin the first five buildings under Phase One, they became concerned and decided to merge Phase Two and Phase Three for the remaining seven buildings and bid with an alternate scope of work. This alternate scope and method of repairs was selected by the owner’s representative to target specific areas where the owners suspected the most damage existed. The owners wanted all buildings to receive some level of repair; our stance was that each building should be done in its entirety to establish a complete system before moving on to the next. Although we main-

Condominium Politics – Phase Two

Our stance for the complete scope to be performed was that this problem of water intrusion was a systemic problem of a poorly constructed building envelope and waterproofing system for this climate. Even though it seemed rational to target and fix areas that were suspected to have more damage, it left the waterproofing issues unresolved for areas where the scope was not performed. Our largest concern was that our new repairs would be compromised by adjacent areas where the work was not performed. We tried to explain to the owners that there would be two types of systems in each building if we only did a partial repair scope—both a barrier and screen wall system. Our new screen wall system had the potential to let water in behind the barrier wall system if the two systems were not properly separated.

Regional Design

Although Orlando is considered to be in the southern edge of the humid subtropical region, it experiences a tropical climate for the majority of the year, with the daily high temperature above 90°F and the low temperature rarely below 70°F from mid-April.
Figure 28 – Note the drainage scupper without an escutcheon plate, a metal “ogee” gutter used as a trim molding that is not quite covered with a polyurethane trim board that slopes toward the wall, and the gaps filled with sealant.

through mid-October. During the summer, the heat index due to the humidity can exceed 110°F, and the afternoon thunderstorms can drop more than an inch of rain in less than an hour. The average rainfall exceeds 50 inches, with the design rainfall according to the International Building Code being 4.5 inches per hour. During the winter, the average daily high temperature is in the 70s, with average nighttime lows in the 50s, while the humidity is much lower.

Many of these regional climate demands are virtually ignored by the Florida Building Code, which is an adaptation of the International Building Code written for the entire continental United States. This is especially true in regard to the waterproofing aspects of construction in Florida. For example, the use of a typical polyethylene building wrap on the exterior of the building sheathing is permitted. Building wrap is neither a vapor nor a water barrier, both of which are needed in this type of climate. We believe building wrap actually contributed to the building deterioration that we observed at this facility.

Many of the details we encountered were not appropriate for the Central Florida climate, as illustrated in Figures 26-28.

The selection of materials can also be very important. Exposed wood, regardless of the species used, is very susceptible to attack by moisture and microorganisms. Unfortunately, the design architects specified the use of wood for the decorative columns and bands, as well as trim at windows, louvers, railings, cornices, and various other locations. Many decorative wall panels were simply MDO plywood applied to the exterior walls and painted. Molded polyurethane trim was also used in many locations without being protected or integrated into the wall system in terms of waterproofing and flashing concerns.

We also observed that some waterproofing issues were created by the contractor due to improper sequencing of the various trades. For example, steel pan stair assemblies were installed in an exterior stairwell prior to the stucco application. This allowed the OSB sheathing and building wrap to remain exposed behind the stair stringer. The stucco was then installed above and below the stringers.

Another example may be seen in Figures 29-32, where the sequence of photographs show the drainage scupper through the parapet was installed properly, but before the stucco was applied. Therefore, the escutcheon plate was sealed to the sheathing and building wrap. The stucco was then installed, and sealant applied. When this barrier failed, water entered the wall system and damaged the wood sheathing and framing.

SUMMARY

Our overall design intent for this project was to recreate the buildings with an aesthetic that was similar to what was originally planned. Celebration is a community known for its charm and small-town feel that we did not want to change while correcting the moisture intrusion problems. The process of correcting the problems encountered during this project can be extremely expensive and disruptive to the community and the individual unit owners. The buildings look substantially the same, but the exterior walls now function properly as a waterproof screen wall system for the structure and inhabitants within, at least for the first four buildings that were repaired. The reality of community politics must be considered during a project of this type. Everyone must get something, even if that is not the ideal in terms of design. The final result was the buildings not as they had been, but as they were meant to be.