Chapter 3: New Construction

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3.1 Introduction

"Chapman University prides itself on providing students with state-of-the-art facilities and top-notch equipment" (Chapman University, Upcoming Projects). With a student population that is expanding each year and intentions to develop the university further, new construction is a critical component of the environmental impact of the university regarding water usage and landscaping. Chapman believes that new construction should not only add to the "already stunning campus beauty", but also "improve learning experiences and community involvement" (Chapman University, Upcoming Projects). The 2013 Environmental Audit did discuss new construction efforts at Chapman, but the primary focus was on Leadership in Energy and Environmental Design (LEED) and the general expansion of Chapman's facilities. LEED certification will be addressed again, as it relates to site sustainability, but this chapter focuses on the actual construction phase, specifically:

Figure 3.1. *Construction of the Musco Center for the Arts building on main campus.*

- The types and frequency of dust mitigation efforts on Chapman construction sites
- Concrete manufacturing choices for Chapman's existing construction projects
- Current, future, and potential green landscaping alternatives that must be instituted during the construction phase

3.1.1 Dust Mitigation

When land is cleared of previous structures and vegetation as the construction process beings, the soil is disturbed and soil particles often become airborne, adding to the ever-growing issue of air pollution. Air pollution is controlled by the Air Quality Management District (AQMD), which requires Chapman to make efforts to control airborne particulate matter resulting from "any activity or man-made condition capable of generating fugitive dust" (Rule 403, AQMD). The full list of site qualifications and requirements can be found here: http://www.aqmd.gov/rules/reg/reg04/r403.pdf. Dust mitigation efforts are required by the AQMD, and only 22% of Chapman University faculty and staff and 23% of students surveyed felt that there was an issue with both dust and noise pollution as a result of current construction efforts on main campus (2014 Chapman Environmental Audit Survey: Water and Landscaping). Even though Chapman's current efforts comply with the AQMD standards, alternative forms of dust mitigation can be explored in an effort to limit water and chemical usage.

3.1.2 Concrete

In all new construction projects on Chapman's main campus, concrete is the primary building material. Concrete has an extremely long life, is sturdy, and is quite affordable compared to most other building materials. There are three primary negative environmental effects associated with the use of concrete:

- The binding agent used in the manufacturing of concrete is cement, most often Portland cement. Worldwide, the production of Portland Cement alone accounts for about 5% of human-generated carbon dioxide (CO_2) (The Cement Sustainability Initiative, 2002).

- Unless the construction site is remote and has a concrete manufacturing facility on site, many trucks must transport the concrete from a manufacturing facility to the construction site. Through the transportation of materials, additional greenhouse gases are emitted as a result of the combustion of fossil fuels, further contributing to climate change.
- A ratio 1:4, water to concrete, is the standard for cement pouring. Additionally, water is used to clean the trucks after each pour. Because of the increasing scarcity of fresh water, water conservation is a particular concern. While there is no suitable substitute for concrete, there are many sustainable alternatives to a traditional concrete lifecycle.

3.1.3 Leadership in Energy and Environmental Design

Leadership in Energy and Environmental Design (LEED) is a point based certification program, overseen by the United States Green Building Council, which rewards environmentally conscious building strategies and practices. While LEED is primarily focused on the efficiency and impact of the building itself, the efficiency and impact of the building site also contributes to LEED certification. Results from the 2014 Environmental Audit Survey show that 74% of faculty, staff and students (n=1419) feel that LEED certification is an important aspect of new construction. LEED projects must satisfy a combination of credit categories to earn points. One such category is Sustainable Sites, which “encourage strategies that minimize the impact on ecosystems and water resources” (LEED).

3.2 History of New Construction at Chapman

3.2.1 Overview

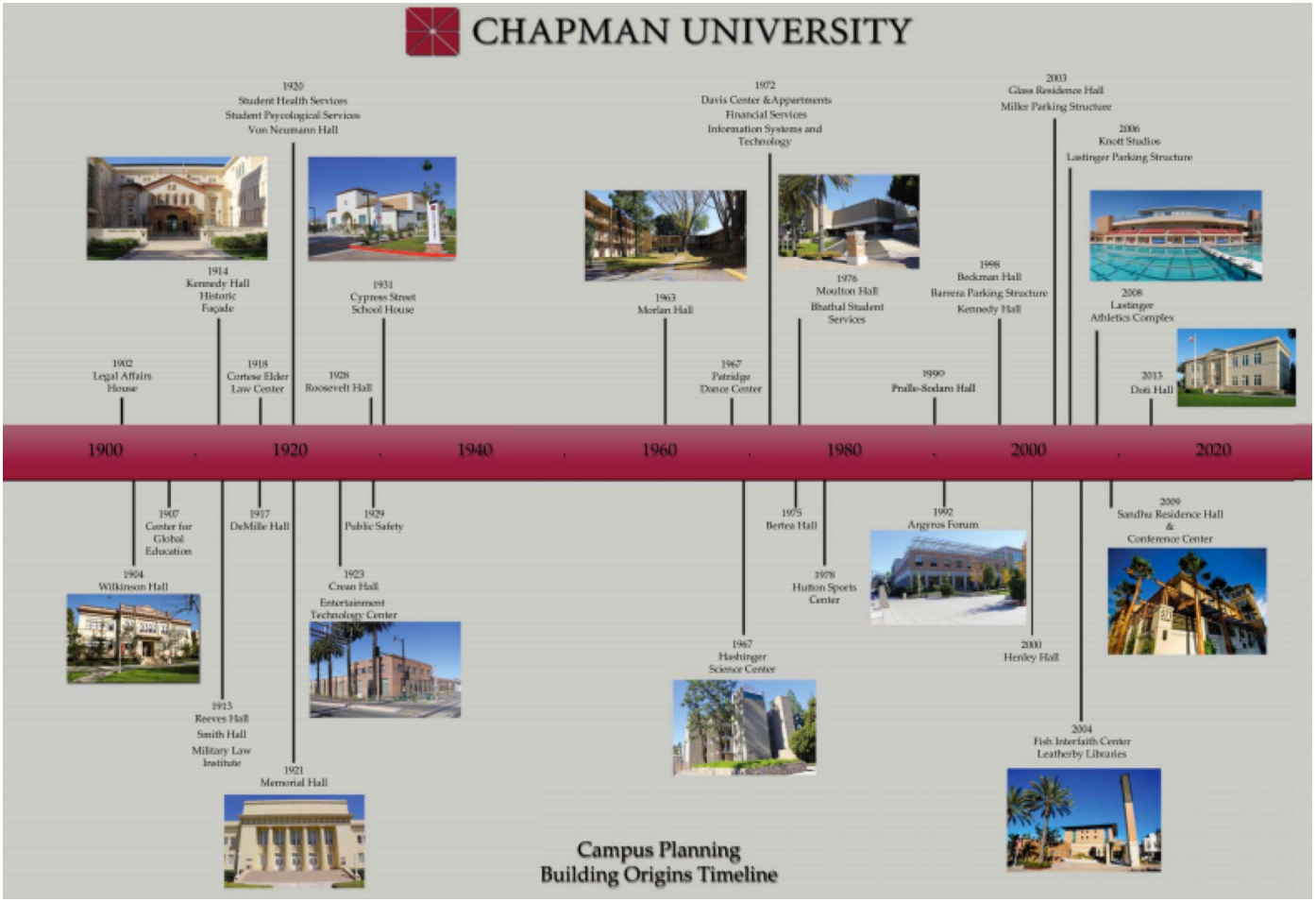

Figure 3.2. *Timeline of building construction on Chapman University campus.*

Project	Estimated Completion	Construction	Design	Planning
Health Science Campus	Fall 2014	✔		
Digital Media Arts Building	2015	✔		
Musco Center for the Arts	2015	✔		
Tennis Center	2015		✔	
Center for Science and Technology	2015		✔	
Historic Packing House Adaptive Reuse	N/A			✔
West Residential Village	N/A			✔

Table 3.1. *Phases and estimated completion dates of the nine existing construction projects on the main Chapman campus.*

Since 2000, Chapman has completed nine new construction projects. The University has an additional three in construction, two in the design phase, and two in planning. As seen in Figure 3.3, projects currently under construction include the Musco Center for the Arts, the Digital Media Arts Complex, and the Harry and Diane Rinker Health Science Campus. The Center for Science and Technology, the Tennis Center, the West Residential Village, and the Historic Packing House Adaptive Reuse are currently in design and planning.

Chapman has recently achieved its first LEED certified building and has focused on LEED equivalency for future projects. The Cypress Street Schoolhouse is LEED Gold and Doti Hall is LEED equivalent (Silver), introducing great potential to reduce future energy and water needs. When California declared a drought emergency on January 17, 2014, reducing water consumption became a particular concern regarding current and future construction efforts. While many of Chapman's future buildings are already in the design and construction phases and are unlikely to change, looking at the effects of new construction, related to water consumption, is important in understanding the impact of new construction.

3.2.2 Past accomplishments

Chapter 1, Building Construction, in the 2013 Campus Sustainability Audit, thoroughly covered Chapman's current sustainability efforts in the retrofitting of existing buildings and the construction of new buildings on Chapman's campus. With a total energy bill of $1.9 million dollars during the 2010/2011 fiscal years, energy efficiency is one of the campus' primary utility concerns. In 2012, many buildings were retrofitted with energy efficient lighting. This included the replacement of T12 fluorescent lights with T8 fluorescent lights that will lead to "improved efficiency, higher intensity, and potentially longer life due to reduced degradation in light input over time" (SBA, 2012). These changes reduced the required light bulb wattage from 32-36 watts to 28 watts, therefore reducing energy consumption. Additionally, low or zero-chemical indoor sealants, paints, and cleaning products replaced previously used products, improving the air quality that students, faculty, and staff are exposed to regularly. Regarding new construction, Chapman has no existing plans to submit future projects to LEED certification, but many of the buildings are state-of-the-art facilities that include a range of green building practices (Ken Murai).

3.3 Current Status of New Construction at Chapman

3.3.1 Dust Mitigation

As required by the AQMD, dust mitigation efforts must limit the effects that a construction site has on the surrounding air quality. At Chapman, the site contractor controls these dust mitigation efforts. The contractor typically sprays water from a truck to moisten the dirt and control dust. Recently, a binding agent called Soil-Sement was used on the Digital Media Arts Center because the site was bare and left untouched for a period greater than one year. Soil Sement is an environmentally friendly dust suppressant that has been certified by both The California Environmental Technology Certification Program (CalCert) and the California Air Resource Board (CARB). Soil-Sement does not contain detectable levels of polynuclear organic matter which includes polynuclear aromatic hydrocarbons as defined by the Federal Clean Act section 112 (b); nor does Soil-Sement contain detectable levels of fluorinated or brominated compounds that could be expected to contribute to ozone depletion or global warming." Soil-Sement is the most environmentally and economically conscious binding agent on the market and remains effective for more than a year.

While water and binding agents are often the most effective ways to mitigate dust, there are viable alternatives that are considered to be more sustainable. The use of mulch is one alternative that settles dust, particularly in areas with high vehicle traffic. A thin layer of mulch on top of exposed dirt contains the dust particles, especially when the area becomes compacted. The primary issue with the use of mulch for dust mitigation is its removal when the area is ready to be developed. This is a tedious process that takes time and manpower.

Another viable alternative is tilling. Dust most commonly becomes an issue when the exposed soil becomes compacted from vehicle traffic. As the temperature and humidity dry the compacted dirt, a thin layer of dust develops on the surface and is easily disturbed by wind and/or human traffic (both vehicle and foot). By tilling the dirt, the process of compaction is constantly disturbed and it is more difficult for dust particles to form. Tilling is effective if both wind and vehicle travel are limited; it is not ideal for Chapman University, however, because most of Chapman's sites typically have high vehicle traffic and the region experiences Santa Ana winds on a regular basis.

3.3.2 Concrete Usage

Concrete is the primary building material used for all new construction projects. For Chapman's projects, the structural engineer provides the general contractor with a list of approved types of concrete. This list is based on soil stability and building size. The general contractor then chooses the concrete supplier, presumably based on cost. While there is no viable alternative to the use of concrete, there are concrete suppliers who promote and practice sustainability. Robertson's Concrete and CEMEX Concrete are the suppliers for the Digital Media Arts Center and the Musco Center for the Arts, respectively. Both of these companies mix the concrete at a ready mix facility and then truck the pre-mixed concrete to Chapman's campus. Both companies have mixing facilities within six miles of campus, limiting transportation emissions. Additionally, both companies maintain commitments to sustainability wherever applicable.

Robertson's Concrete, which is being used in the Digital Media Arts Center, prides itself on green building projects. The primary focus of Robertson's Concrete is pervious concrete that allows water to percolate through the concrete to underlying surfaces. This eliminates the need for traditional storm water management systems and allows structures to be used for storm water retention. Additionally, Robertson's Concrete has a fleet of low emissions vehicles and uses recycled materials as often as possible. (Robertson's Ready Mix, 2011).

CEMEX Concrete, the supplier for the Musco Center for the Arts, has faced environmental controversy in past years, but has recently become committed to a more sustainable future. In 2004 the company received the Wharton Infosys Business Transformation Award for the development of a

platform that allows them to "determine the exact mix for a specific customer order at each plant, ensuring consistent quality, less waste, and greater client savings" (Infosys, 2004). A much larger company than Robertson's Concrete, CEMEX has facilities worldwide and has developed a commitment to improve and standardize water measurement and management throughout the company. These efforts are intended to minimize the water footprint and increase water efficiency. While most concrete suppliers are making efforts to be more sustainable, cement is a widely used product that has many environmental consequences, which cannot be solved with one solution. (CEMEX, 2014).

US Cement, a California based company, has developed EF Technology which uses fly ash to substitute up to 50% of the Portland cement used. Fly ash has equal or even greater binding abilities than Portland cement and is a coal combustion waste product. Fly ash is typically disposed of in landfills or ash ponds so using it in combination with Portland cement not only decreases the use of cement, but also reduces waste generated from coal plants. In addition to the sustainable recycling and use of fly ash, US Cement has a return concrete recycling program that reuses cement that was not used as well as a water management and washout systems program. These programs focus on minimizing water use, collecting water used to wash trucks, and reusing it when possible. Overall there is clearly an industry-wide commitment to becoming increasingly more environmentally friendly and with future development plans, Chapman has the opportunity to be on the leading edge of sustainable concrete choices.

3.3.3 Green Landscaping

As mentioned earlier, LEED is a point-based system that credits green design practices. For financial reasons, obtaining LEED certification is not always practical, but LEED practices should still be encouraged for sustainability purposes. The per building price of certification is based on square footage, but starts at $2,750 and would likely be greater than $5,000 for many of the buildings under construction at Chapman. Sustainable Sites is a LEED category that is designed to "encourage strategies that minimize the impact on ecosystems and water resources" (LEED). If sustainable site practices were implemented during the construction phase, that would be the most cost-efficient way to maximize the water saving potential of a specific building. Actions such as reducing irrigation by more than 50% are awarded points towards LEED certification, but more importantly, these practices reduce water usage, which is of particular concern given California's current drought conditions.

The recent construction of the Cypress Street Parking Lot has surrounding landscaping with drought resistant plants and a water filtration system. According to new construction code, all water entering the sewer system must be filtered/cleansed beforehand. Because of this requirement, both the Digital Media Arts Building and the Musco Performing Arts Center have plans for underground reservoirs that will collect, filter, and cleanse water before it enters the sewer system. Additionally, the new science center has plans for a bio-filtration system for roof rainwater that will be collected, filtered, and used for landscaping before it enters the sewer system. While many of these systems are LEED credited, they are also part of new building codes. According to Ken Murai, the Director of Campus design, by 2030, buildings will all be net zero, meaning that the total energy collected on the site will be equal to, or greater than the total energy consumed, and LEED

Figure 3.3. *Green landscaping recently developed by the Cypress Street Parking Lot.*

certification will become obsolete. While the Southern California climate is not conducive to net zero water consumption, many projects will significantly offset their water needs by using recycled water.

One of the biggest issues with existing green building efforts is financial feasibility. While green design adds value to a structure, it is not always included in the budget set by developers and is expensive. Additionally, while green design saves money in the long run, the initial expenses are greater. Because developers put up the initial investment, but Chapman pays utilities and maintenance, green design is often installed after the initial construction. While green design is ingrained in architects through basic concepts like orientation and ventilation, developers are primarily focused on the capital investment and not the long term value and sustainability of a project.

3.4 Concluding Assessment

3.4.1 Areas of progress

With the recent construction of one LEED-Silver equivalent building and the remodel of another that is LEED-Gold certified, Chapman University has begun to put an emphasis on green building design and construction. While Chapman has made substantial efforts to expand the size of its campus and student body, its most sustainably minded initiative is, as stated on Chapman's sustainability website, "the greenest building is the one already built". By retrofitting existing buildings, Chapman is utilizing its existing resources in an effort to minimize its long-term consumption. Most recently, Chapman has implemented green landscaping next to the recently completed West Campus Parking Structure. This site has drought-resistant plants, artificial turf, and recessed channels for water collection purposes. However, while sustainability and green design have become considerations for all future construction efforts, there is room for improvement.

3.4.2 Areas in which to improve

One of Chapman's largest areas for improvement is an increased commitment to LEED equivalency. While the substantial financial component associated with LEED certification may not be feasible for the university, Chapman does not have an existing commitment to green design. Many similar institutions in Southern California have developed a LEED certification commitment, which strengthens their commitment to sustainability. One comparative example of an institution with a commitment to LEED certification is University of Southern California. As stated on the USC Green Buildings page, "In January, 2010, USC's Board of Trustees passed a resolution stating that the campus strive to achieve LEED standards for all buildings on campus". There is no need for Chapman to develop a similar commitment to LEED certification, but a commitment to green design/LEED equivalency would strengthen the University's commitment to sustainability. Another way in which Chapman can improve its sustainability efforts is by requiring the use of sustainably treated and manufactured building materials such as concrete, paints, carpets, etc. Many of the building materials used in existing projects are often chosen at the discretion of the contractor. By requiring the use of sustainably treated building materials, Chapman can be assured that new construction efforts are increasingly environmentally conscious. While campus beauty and aesthetics are among Chapman's primary selling points, sustainable landscaping practices often suffer for visual appeal. By also emphasizing the development of sustainable site use during the

Sustainable Sites		**14 Possible Points**
Prereq 1	**Construction Activity Pollution Prevention**	Required
Credit 1	**Site Selection**	1
Credit 2	**Development Density & Community Connectivity**	1
Credit 3	**Brownfield Redevelopment**	1
Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	**Alternative Transportation**, Parking Capacity	1
Credit 5.1	**Site Development**, Protect or Restore Habitat	1
Credit 5.2	**Site Development**, Maximize Open Space	1
Credit 6.1	**Stormwater Design**, Quantity Control	1
Credit 6.2	**Stormwater Design**, Quality Control	1
Credit 7.1	**Heat Island Effect**, Non-Roof	1
Credit 7.2	**Heat Island Effect**, Roof	1
Credit 8	**Light Pollution Reduction**	1

Figure 3.4. *LEED credit options for Sustainable Sites.*

construction phase, Chapman can substantially increase its water efficiency while maintaining a high level of aesthetic beauty.

Often viewed as unrelated to New Construction, increased education on sustainability is important and can have an immediate influence on the campus' impact. Regardless of what students study, the concepts and practices associated with sustainability are part of nearly all businesses these days and should be emphasized as part of Chapman's curriculum. As seen in the Chapman University 2013 Environmental Audit Survey data, only 21 percent of students had learned about sustainability in one of their classes, 67 percent had not learned about sustainability, and 12 percent of people did not answer. As Chapman continues to expand and develop, education regarding sustainability is critical to the development of a complete student.

3.4.3 Existing gaps in knowledge

With a variety of parties involved in new construction at Chapman, many issues and decisions are delegated to teams hired by Chapman with little or no interaction with Chapman staff. Although Chapman hires these companies and personnel to make educated decisions on the behalf of the University and conduct the services they offer, there seems to be a disconnect between the University and these hired parties. It is inevitable that Chapman must delegate many of the duties associated with new construction, but it seems that many sustainability decisions are left in the hands of contractors and project managers who have less of a commitment to sustainability and a smaller investment in Chapman's future. This disconnect made accessing pertinent information very difficult throughout the research process of this audit. Much of the information and data that would have helped support many of the claims made in this chapter was unavailable to students.

Another significant gap in knowledge is the relative effectiveness of different dust mitigation efforts. While these efforts are required by the AQMD to keep air quality below 20% opacity and invisible beyond the property line of the emission source, it is difficult to determine the exact amount of existing dust that is directly caused by construction. Gathering better air quality data would allow crews to minimize their dust mitigation efforts to the required levels, consequently limiting water chemical usage.

3.5 Recommendations

3.5.1 Low cost/effort

- Reduce dust mitigation efforts to the minimum required by the AQMD.

This is at the discretion of the general contractor and would require more frequent monitoring of air quality. Increased air quality data would allow the contractor to focus dust mitigation efforts when air quality is poor and reduce efforts when the air quality is less of an issue.

3.5.2 Moderate cost/effort

- Develop a campus based LEED equivalent rating system that encourages the installment of green landscaping practices for all future projects.

Ken Murai, Director of Campus Design and a LEED-Accredited Professional, is qualified to aid in the development of a similar rating system to LEED that would emphasize Chapman's commitment to sustainability without the financial costs associated with the existing LEED certification process.

- Write a policy that requires the use of the LEED equivalent rating system for all new construction and renovations.

3.5.3 High cost/effort

- Establish a commitment from contractors to use the most sustainably manufactured and transported cement distributor for all future projects.

Currently, the structural engineer provides the general contractor with the structural/strength requirements that must be used to determine the provider of cement. As long as the minimum structural/strength requirements are met, the choice of concrete manufacturer is up to the general contractor. By requiring a commitment to the most sustainable concrete company, given the requirements of the structural engineer, the university can assure that its concrete choices have the minimum impact on the environment.

- Hire an environmental engineer to work alongside designers and project managers to seamlessly install green building practices into the design, planning, and construction phases of new development.

While Ken Murai is LEED-AP accredited, an environmental engineer would bridge the gap between the university and the companies in charge of many construction decisions. This professional could work under Mackenzie Crigger, the Campus Sustainability Manager, and focus solely on new construction.

3.5.4 Future areas of research

The next step in research regarding new construction on Chapman's campus would be a lifecycle analysis of all building materials. The 2013 and 2014 Audits have compiled information about the fixtures and appliances in new buildings, as well as an understanding of LEED certification, both building and site specific. They also provide an understanding of the environmental effects of the most commonly used building material, concrete. Conducting lifecycle analyses of all building materials will allow designers, planners, and contractors to make sustainable choices regarding the selection of future building materials.

3.6 Contacts

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