For we are God's fellow workers; you are God's field, God's building. By the grace God has given me, I laid a foundation as an expert builder, and someone else is building on it. But each one should be careful how he builds. For no one can lay any foundation other than the one already laid, which is Jesus Christ.

- 1 Corinthians 3:9-11
community by design

Developing Community Through Sustainable Design :: Rethinking Scheidler Apartments
God has provided the means and motivation for me to make it through the past four and a half years. Without Him I would be laboring in vain.

Thank you to my beautiful wife Britney and to Morgan and Meredith for supporting me and sacrificing so much to allow me to pursue a dream. I love you.

Thank you to Caleb and Jevon for encouragement, motivation, and friendship.

Thanks to Bob Fisher, Bob Koester, and Jeff Culp for keeping me on track through thesis.

Unless the LORD builds the house, its builders labor in vain.
- Psalm 127:1
This thesis investigated two major issues that played out through a design project. The first issue was developing strategies that promote community through design. The second issue was that of sustainable development and building methods.

The project consists of the design and development of an apartment complex that incorporates the issues of community and sustainability. Three different building scales were investigated: the unit, the cluster, and the site.
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The project I used to study these principles of sustainability and community was the redevelopment of Ball State’s student married housing: Scheidler Apartments. These apartments currently occupy a large and spacious property at the northeast corner of Tillotson Avenue and McGalliard Road.

Having lived in Scheidler Apartments the past year and other apartment complexes previously, I was inspired to study how, as communities, they can be improved, both at the individual level as the resident, but also at a broader level, bringing a sense of unity to the entire complex.

This thesis assumed a scenario in which the current apartments do not exist. I used the current property to redevelop an improved community. The redesign includes the development of the resident apartment units as well as the masterplan of the entire community.

**Program:**

- Apartment Unit
  - Living Room
  - Dining Room
  - Kitchen
  - Bedrooms
  - Bathroom
  - Storage
  - Personal Outdoor Space
  - Shared Outdoor Space

- Masterplan
  - Apartment Office
  - Laundry
  - Maintenance Office & Storage
  - Green Space - specific &
    general uses
  - Community Room
SUSTAINABLE DEVELOPMENT:

For society to continue developing in the way it has in the past, we need to pay more attention to our environment. How this is best achieved is often a matter of opinion rather than fact, dependent upon different perspectives of the environment and views of nature. Recently, a concept has emerged that has attempted to bring together the best aspects of these different viewpoints, and to harmonize the development of mankind with the protection of nature. This is the concept of "Sustainable Development".

Sustainable development involves maintaining our current rate of development whilst leaving suitable resources behind for later generations to continue to develop. In this context then, environmental problems must be tackled by considering their relationship with the state of the economy and the well-being of society. In fact, the environment, the economy and society taken together, include everything that we need to consider for a healthy, prosperous and stable life.

Although sustainable development is about integrating the environment, society and economy, the economy, and in turn society exist within the wider context of the environment. The economy exists entirely within society, because all parts of the human economy require interaction among people. However, society is much more than just the economy. Happiness, pleasure and well-being do not stem solely from financial growth. Friends and families, culture, religion and ethics are important elements of society that are not primarily based on exchanging goods and services, but contribute to the overall quality of life. Society, in turn, exists entirely within the environment. Our basic requirements, air, food and water, come from the environment, as do the energy and natural resources for housing, transportation and the products we depend on. Protection of the environment, therefore, resides at the core of Sustainable Development.

In the 1980s, increasing concern about the effects of economic development on health, natural resources and the environment led the United Nations to release the Bruntland Report. This defines sustainable development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs."
COMMUNITY BY DESIGN ::

Healthy and prosperous communities do not just happen. The quality and nature of a community are determined by the choices people make over a number of generations. Ideally, the choices a community makes are knowledgeable and deliberate. But that is not always the case.

One of the first things we learn about communities is that everything and everyone is linked in one way or another as part of a living system. Like nature, communities are held together by a network of relationships, some of which extend beyond the community. The more communities understand these interactions, the better informed their choices will be.

Sustainable community development is a process and a capacity to make decisions that consider the long-term economy, ecology and equity of all communities. The goal of sustainable community development is to build sustainable communities: communities with the ability to remain healthy and successful over the long term.

One dynamic of the community, is the pattern of relationships between living things and their environment. By consuming natural resources and producing waste, every community leaves an ecological mark. Nearly every decision a community makes affects the environment in some way. Understanding our relationship with the environment involves a close look at how our actions affect it. Communities that desire long-term prosperity consider which actions will protect and develop natural resources for future generations.

Ideally everyone in a community shares in its interests. If the community is successful, they benefit; if it is not, they suffer. Equity is the fairness of relationships between people, groups of people and generations of people. Where there is equity, decisions are based on equality and everyone (regardless of race, income, sex, age or disability) has opportunity and is treated with dignity. Equitable communities provide opportunities for everyone to participate in all activities, benefits and decisions. They consider not only how their choices affect current residents but also how they will affect the choices available to future generations.
**Physical Context:**

The property on which Ball State’s Scheidler Apartments currently reside is located at the northeast corner of Tillotson Avenue and McGalliard Road in Muncie, Indiana.

The property is bounded by residential housing to the east, the football arena and parking to the south, commercial open space to the west, and elementary school property to the north.

The property is strongly separated from the main campus by McGalliard Road as well as Bethel Avenue. I believe these are the larger deterrents to pedestrian traffic to campus than the one-mile distance.

The property currently houses approximately 450 apartments arranged around nine courtyards.

**Cultural Context:**

The cultural context for the apartments is primarily based in the diversity of the residents. Although all residents have a student status in common, the population is primarily comprised of non-traditional students -- graduate students, married students, students with children, international students, and other upper level undergraduate students.

The best thing that can be said for the existing apartments is that they are relatively inexpensive, but, they are extremely impersonal inside and out. How can the needs of this diverse student culture be integrated into a design that fulfills multiple needs?

The property is far enough away from the main campus that a feeling of disconnectedness is easily adopted. This can be perceived positively in that it can be an escape from the pressures of classes and a hectic schedule. It also creates a need to provide some specific amenities for the residents.
Dunsmuir Flats
Los Angeles, California

The four attached apartment flats were designed by Gregory Ain in 1937. Ain's architecture is characterized by a complete absence of ornament and by forms in which effects of mass and weight are minimized for the sake of an effect of pure volume.

By staggering the four row houses on his difficult 49-foot inside lot, the architect has gained extraordinary advantages. Major rooms have three exposures and each house obtains a well screened garden court, each bedroom a secluded balcony. The houses open to their gardens on the south, but windows on street and entrance sides are kept high for privacy.

"The building is as consequent in structure and form as it is in plan. Instead of the usual stud frame, widely spaced 4-by-4 wood posts are the basis of an extremely regular design. Glass is set directly between the posts, forming continuous bands almost flush with the smooth walls. Emphasis is on the enclosed volume rather than on the walls which define it.

Seaside
Florida

The cottages had deep roof overhangs, ample windows and cross ventilation in all rooms. They were built of wood and other time-tested materials and with reasonable maintenance, could last several generations. When Robert Davis asked Miami architects Andres Duany and Elizabeth Plater-Zyberk to help him plan a community which could combine the traditions which had produced these buildings, it was soon clear that considerable research needed to be done. No one knew how to revive a building tradition. So a number of journeys were made through the South, and especially through Florida, with cameras and sketch pads and tape measures, until the architects and developer felt confident that the basic rules for making these buildings were understood. Most of the buildings were studied in the context of small towns, and gradually the idea evolved that the small town was the appropriate model to use in thinking about laying out streets and squares and locating the various elements of the community.
BedZED
Beddington, England

BedZED, the Beddington Zero Energy Development, is an environmentally-friendly, energy-efficient mix of housing and work space in Beddington, Sutton.

Unique is an over-used word, but BedZED deserves it. There are a number of small, one-off projects based on sound environmental principles. However, to our knowledge, BedZED is the first to incorporate up-to-the-minute thinking on sustainable development into every aspect of the scheme, from the energy-efficient design to the way the houses are heated.

BedZED will only use energy from renewable sources generated on site. It is the first large-scale ‘carbon neutral’ community -- i.e., the first not to add to the amount of carbon dioxide in the atmosphere. BedZED shows how housing can be built without degrading the environment.

Marzahn Low-Energy Apartments
Berlin, Germany

As pilot project for energy-saving house building in Marzahn, a building concept was to be developed, under adherence to the tight cost framework for social housing construction.

For the maximum utilization of the sunlight, a disk-shaped, laterally chamfered solarium was developed and oriented as north south type. While the thermal insulated north front is to a large extent closed, the south façade was implemented wide in coated warm glass and rounded for the enlargement of the transparent surface convex.

The cold areas are accordingly, stairways, development corridors in the zoning of the sketches, and baths to the north to work like a heat buffer for the warm areas aligned south, which are connected by sliding panels, so that sunlight falls also with lateral idea into the depth of the area. Continuous balconies, which make the beam of light possible unhindered during the winter months with low standing sun, protect in the summer months before the high-standing sun.
For every house is built by someone, but God is the builder of everything.

- Hebrews 3:4
The final design solution was derived from the idea that community can be encouraged through design and planning but never forced.

The design was developed at three distinct, but inter-related scales. At the private level, the unit was developed to give the resident an efficient space with a feeling of private ownership. The cluster was developed to encourage community by giving small groups of residents a shared space to interact in a sheltered environment. At the site level, issues of walkability, shared community spaces, and environmental concerns drove the layout.
From the beginning I knew the idea of community would be implemented in the joining of the apartment units. Questions began to arise: How many people make a community? Can there be too many people to make community effective? What brings people together in comfortable situations in which they can interact?
The issue of sustainability and building in an environmentally responsible way was also a concern from the start. I investigated issues of daylighting, passive heating and cooling, ventilation, shading, and wind protection.
The plan is efficient and uses a utility core to free up exterior walls for windows and daylighting. Concrete or tile would be used as finished flooring on the southern half of the apartment to take advantage of their thermal mass properties.
The floor plan is designed to be mirrored to take advantage of southern sun exposure. The entry is always located on the outside wall of the apartment but decks and large windows are oriented to the south.

This second floor has two bedrooms with double height spaces above the dining room and office spaces. This layout can be rearranged as a three or even four bedroom apartment by reclaiming the open spaces.
Ecological decisions about materials choices have tended, until recently, to be driven by isolated, hot-button issues: avoid wood from old-growth forests, use recycled materials, use local materials. These issues are important, but they sometimes drive choices that are short-sighted. While some sources of wood should be avoided, wood in general is a relatively low-impact material to use, so avoiding wood entirely tends to increase overall environmental impacts. There is a clear need for methods and tools that make it feasible for building professionals to look at the issues holistically, but for the most part these tools are still in their infancy.

Over the past decade or so, an increasing number of public and private waste management operations have begun to reduce construction debris volumes by recycling and reusing these materials.

**Bamboo Flooring**

Bamboo is an affordable, attractive, eco-friendly, and durable alternative to traditional hardwood flooring. Because it is a harvested grass that continually regenerates, bamboo is considered a renewable and sustainable resource. Typically harvested within five years of sprouting, making it a truly renewable resource. It is also attractive as a building material because it is very hard - 30-50 per cent harder than oak. It is also 2.5 times more dimensionally stable than most hardwoods.

**Window Efficiency**

Glazings in both windows and glass doors can have dramatic effects on the energy performance of a house. A wide variety of coatings and configurations are now available to achieve a range of goals. In addition to a glazing's U-value, the other important factors are the daylight transmittance (the amount of visible light the window lets in) and the solar heat gain coefficient (the amount of heat the glazing lets in — glazings with low solar heat gain coefficients allow less heat in).

**Fly Ash Concrete**

Fly ash is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. U.S. power plants produce millions of tons of fly ash annually, which is usually dumped in landfills. Fly ash is an inexpensive replacement for portland cement used in concrete, while it actually improves strength, segregation, and ease of pumping of the concrete. Fly ash is also used as an ingredient in brick, block, paving, and structural fills.
Building Lumber

Wood and lumber products used in the building are Forest Stewardship Council (FSC) certified. FSC is a nonprofit organization that encourages responsible management of the world’s forests. It accredits independent organizations to assess the forest management practices of landowners and companies to determine if its environmental, social, and economic standards have been met. FSC-certified wood is derived from forests that are conscientiously thinned, not permanently depleted. Non-FSC-certified woods in the building would be either reclaimed from deconstructed buildings or fast-growing, abundant hardwood and softwood species, such as maple and poplar.

Insulation

Insulation used throughout the building consists of over 25 percent recycled glass, with an acrylic binder that eliminates binder-related formaldehyde emissions during manufacturing. After installation, it emits no formaldehyde.

Recycled Gypsum Drywall

Fiberock Aqua Tough Interior Panels, used throughout the building, are a type of drywall made of 95 percent recycled materials, such as newspaper and gypsum from titanium dioxide production, and such post-industrial sources as power plant desulfurization equipment. The panels are moisture-, mold-, and fire-resistant and designed for high traffic areas.

Appliances

If you live in a typical U.S. home, the appliances in your home are responsible for about 20% of your energy bills. Refrigerators, freezers, clothes washers, dryers, dishwashers, and ranges and ovens are the primary energy-using appliances in most households (hot water heaters are discussed in the Saving Water and Heating It Efficiently section). Taking steps to save energy while using these appliances, and replacing old inefficient appliances with modern ones, can save you money.
green roof

The Benefits of a Green Roof:
- Reduce stormwater runoff, helping to prevent raw sewage from overflowing into surface waters during large rains
- Enhance roof life
- Improve energy performance of buildings, reducing heating and cooling requirements
- Reduce noise
- Improve air quality
- Create a healthier environment

Two Types of Garden Roof Assemblies:
The type of roof assembly is determined by the depth of their growing medium and species of plants.

EXTENSIVE:
Extensive green roof systems have a very shallow growing medium (2-6") that supports only hardy, low growing vegetation. This system is lightweight, ranging from 15 to 35 lbs/ft² and requires very little maintenance and irrigation.

INTENSIVE:
Intensive systems contain a deeper growing medium allowing for a wide variety of plants and even small trees. Compared to the extensive system, this system is more garden-like. Regular maintenance and irrigation is generally required with the intensive system.
Heat Storage

Thermal mass, or materials used to store heat, is an integral part of most passive solar design. Materials such as concrete, masonry, wallboard, and even water absorb heat during sunlight days and slowly release it as temperatures drop. This dampens the effects of outside air temperature changes and moderates indoor temperatures. Although even overcast skies provide solar heating, long periods of little sunshine often require a back-up heat source. Optimum mass-to-glass ratios, depending on climate, may be used to prevent overheating and minimize energy consumption. Avoid coverings such as carpet that inhibit thermal mass absorption and transfer.

Suntempering

In cold climates, a strategy termed "suntempering" orients most of the home's glazing toward the south—a glazing area of up to 7 percent of the building floor area. Additional south-facing glazing may be included if more thermal mass is built in. Such a shift in window location is a great strategy for cold climates and costs nothing beyond good planning. Many passive solar homes are merely suntempered.

Thermal Mass in the Heating Season

10:00 am to 5:00 pm
Sunlight enters south-facing windows and strikes the thermal mass inside the home. The sunlight is converted to heat energy, which heats both the air and thermal mass materials. On most sunny days, solar heat maintains comfort during the mid-morning to late afternoon periods.

5:00 pm to 11:00 pm
As the sun sets, it stops supplying heat to the home. However, a substantial amount of heat has been stored in the thermal mass. These materials release the heat slowly into the passive solar rooms, keeping them comfortable on most winter evenings. If temperatures fall below the comfort level, supplemental heat is needed.

11:00 pm to 6:30 am
The homeowner sets the thermostat back at night, so only minimal back-up heating is needed. Energy-efficient features in the home minimize heat losses to the outside.

6:30 am to 10:00 am
The cool early morning hours are the most difficult for passive solar heating systems to provide comfort. The thermal mass has usually given up most of its heat, and the sun has not risen enough to begin heating the home. During this period, the homeowner may have to rely on supplemental heat. Energy-efficient features in the home minimize the need for supplemental heating.
The cluster serves two purposes, first, to promote community, and second, to provide environmental solutions. The units can be organized in groups of four, six, or eight. These clusters share a covered space that could have different uses such as children’s play area or community gardening. These courtyards give the resident’s a space that is shared but typically limited to the adjacent units unlike the larger green spaces that are much more public.
Shading is the prevention of solar gain through radiation and conduction into the building.

**How it works:**
- Three kinds of shading: exterior, interior, and by glazing
- Use double roofs, wall screens, vertical louvers, broad overhangs, verandas, or trees.
- For the east and west shading use dense trees, vertical louvers and egg-crate louvers.
- Desirable overhang $W=H/SLF$.
- Louvered overhangs allow hot air to escape.
- Interior shades are roller shades, drapes, blinds, and skylight battles.

Each unit has specific forces acting on it such as sunlight, winter winds, summer breezes, adjacencies, etc. Each of these forces would be considered and have a design response, creating modified units based on their unique location and surrounding characteristics. Items such as shading devices, glazing sizes, and tree placement could be used to meet each unit's individual need.

**NORTHWEST**
- Highly shaded
- Afternoon light in summer
- Direct winter winds

**SOUTHWEST**
- Direct afternoon sunlight
- Cool summer breezes

**NORTHEAST**
- Highly shaded
- Morning light in summer

**SOUTHEAST**
- Direct morning sunlight
- Afternoon shade
**Summer Sun:** Louvers, overhangs, and trees provide shading in the summer months.

**Winter Sun:** Large glazing on the southern face of the apartment takes advantage of the low sun angle in the winter months providing deep sun penetration into each unit.
**Stack Effect :: Solar Chimney**

Hot air rising from lower adjacent spaces to taller spaces where it can be vented out of the building.

**How it works:**
- Place inlets low on the high-pressure side, and outlets high on the negative pressure side.
- Create adjacent lower spaces feeding the taller thermal chimney.
- The sun will heat the mass of the chimney.
- The warm air will be displaced and will rise where it can be vented out of the building.
- Ridge vents will draw hot air from attic spaces.
- Do not place attic vents near inlets, because you will draw the exhaust air back into the building.
- The stack effect increases linearly with the height difference between openings.
- It also increases linearly with the difference in temperature between inside and out. This creates potential for internal airflow even under breezeless outdoor conditions.

**Ventilation ::**

Natural Ventilation includes promoting airflow through openings such as windows, doors, skylights, and roof ventilators.

**How it works:**
- Use operable windows to help control air flow.
- Casement windows catch wind at parallel angles to walls.
- Awning windows catch wind at right angles to walls.
- Passive cooling of people requires an unobstructed path to maximize air speed.
- For cooling buildings requires directing the air along the wall and ceiling.
- Avoid rooms with only one window and no outlet, because air will not enter the space.
- Projections perpendicular to the building and downwind of inlets will funnel winds.
- Wing walls should be as long as the window is wide.
- Open plans aid the flow of air through the building.
Summer :: ventilation

In the warm summer months the courtyard ventilation stack would be opened and warm air could escape and also help draw cooler breezes through the apartment's open windows.

Winter :: passive heating

In the winter the courtyard space could act as a greenhouse, heating up and allowing warm air to be pulled back into the apartments to supplement some of the heating costs.
The concept for the site is shown in the graphic to the right. It is the idea of centralizing the most public places to allow the easiest access for the largest number of people. This would contain the apartment office and other amenities shared by the entire community. Each pod creates a shared space that becomes more and more private as it gets smaller down to the individual unit which is the most private space.
principles of new urbanism ::

The principles of New Urbanism can be applied increasingly to projects at the full range of scales from a single building to an entire community.

1. Walkability
   - Most things within a 10-minute walk of home and work
   - Pedestrian friendly street design (buildings close to street; porches, windows & doors; tree-lined streets; on street parking; hidden parking lots; garages in rear lane; narrow, slow speed streets)
   - Pedestrian streets free of cars in special cases

2. Connectivity
   - Interconnected street grid network disperses traffic & eases walking
   - A hierarchy of narrow streets, boulevards, and alleys
   - High quality pedestrian network and public realm makes walking pleasurable

3. Mixed-Use & Diversity
   - A mix of shops, offices, apartments, and homes on site.
     Mixed-use within neighborhoods, within blocks, and within buildings
   - Diversity of people - of ages, income levels, cultures, and races

4. Mixed Housing
   - A range of types, sizes and prices in closer proximity

5. Quality Architecture & Urban Design
   - Emphasis on beauty, aesthetics, human comfort, and creating a sense of place; Special placement of civic uses and sites within community. Human scale architecture & beautiful surroundings nourish the human spirit

6. Traditional Neighborhood Structure
   - Discernable center and edge
   - Public space at center
   - Importance of quality public realm; public open space designed as civic art
   - Contains a range of uses and densities within 10-minute walk

7. Increased Density
   - More buildings, residences, shops, and services closer together for ease of walking, to enable a more efficient use of services and resources, and to create a more convenient, enjoyable place to live.
   - New Urbanism design principles are applied at the full range of densities from small towns, to large cities

8. Smart Transportation
   - A network of high-quality trains connecting cities, towns, and neighborhoods together
   - Pedestrian-friendly design that encourages a greater use of bicycles, rollerblades, scooters, and walking as daily transportation

9. Sustainability
   - Minimal environmental impact of development and its operations
   - Eco-friendly technologies, respect for ecology and value of natural systems
   - Energy efficiency
   - Less use of finite fuels
   - More local production
   - More walking, less driving

10. Quality of Life
    - Taken together these add up to a high quality of life well worth living, and create places that enrich, uplift, and inspire the human spirit.
Retaining Ponds:

A retention pond is a body of water that is used to collect storm water runoff for the purpose of controlling the release of this runoff. Retention ponds have no outlets or streams, creek ditches, etc. Water collects and then is released through atmospheric phenomenon such as evaporation or infiltration.
reflection

My main goal entering into this thesis project was to obtain a better understanding of “green” building design. It seemed to be an overused buzz-word that I wanted to make tangible. What does it mean to have environmentally responsible design? Is sustainability a passing trend or a future certainty in architectural design? I feel that this thesis allowed me to investigate these issues and play them out through this design project.

I am excited to begin the next chapter of my life as a professional designer. On one hand it feels like I have been in school forever and on the other it seems that it was just yesterday that the program began.

Thesis, and the CAP program in general, have prepared me to begin a career in architecture as a critical thinker, a passionate designer, and a responsible member of my community.

Thanks.
selected sources ::


www.eere.energy.gov/buildings/
www.designadvisor.org/
www.greenerbuildings.com/
www.nahb.org/
www.newurbanism.org/
www.usgbc.org/
Whatever you do, work at it with all your heart, as working for the Lord, not for men, since you know that you will receive an inheritance from the Lord as a reward. It is the Lord Christ you are serving.

- Colossians 3:23-24