Chapter 7
D e s i g n : getting it right

"*The ecovillage is not just techniques, but a way of life.*" [Solbyn]

The design of an ecovillage is more than choosing a facade for a group of houses. It must also be the design of a social system. It must be a collaborative endeavor, not the genius of an individual. The resulting design is a product of the creative ideas of individuals working together as a community. The resulting social system will acquire a life of its own. When the social system is mature the people and the collection of buildings become a village. The people may change but the social system remains. Within that social system is a purpose, the purpose of preserving the environment. The initial physical design of the ecovillage can nurture or hinder this social system.

The design and the social system must work in consort to promote environmental protection. The reciprocal relationship between the design and social system will ultimately determine the commitment of the individual and community to its members and to the preservation of the environment. If one element fails the strength of the others is compromised. It is the duty of the designers to create the optimal prerequisites for the preservation of the environment and the social system.

Design for people is design for the environment. A milieu evokes emotions and steers behavior. Design can promote or detract from the sense of community. Designing with people's feelings and behavior in mind is crucial to environmental protection because we, not buildings, cars, or computers, are the ultimate stewards of our behavior and our environment. Certainly, people can overcome bad design, but good design makes it much more likely that people will behave in the intended way.

Good design can promote positive social interaction. A beautiful and well functioning landscape and home can promote a sense of pride and stewardship in its inhabitants. Good design can reduce short and long term monetary costs as well as reducing environmental costs. The bulk of design decisions are made in the planning stage of an ecovillage, but the interaction of the residents with the environment is ongoing. The furtherance of the shared goal to minimize environmental impact must be pursued with vigilance. Individuals and the community can make choices that enhance or undermine the design of the community. With a healthy social system the community will continue to make design choices that reinforce its commitment to environmental protection and the community.

Many books have been written on "how" to build ecologically friendly buildings, but little has been written about the effects of design on the behavior and quality of life for residents. We build houses for people to provide shelter, but it is our relation to these structures that make it a home.

Living ecologically should be a positive experience with; natural materials, natural systems, plenty of light, and beautiful self-perpetuating landscaping. Our built environment should incorporate features that are attractive, simple to understand, visible to the user and user-friendly. Living ecologically should be an opportunity to improve quality of live rather than increase the hassle and sacrifice one endures.

Descriptions in this chapter of technical details of the ecovillages such as: windows or heating systems, provide the background information necessary to

understand people's relation to their built environment. Suggestions for different solutions are based upon observations, research, and consultation with experts in the field of ecological building. The technical descriptions are not intended to be comprehensive. The available techniques and design options are limitless. Features are described via a method of observation which can be applied to any technique or design. The focus of this chapter is on residential housing because that is primarily what the present ecovillages are comprised of. Similar methods of analysis of the interaction of people with their environment could be applied to projects incorporating businesses, schools or other features. Additionally, technical features are described to enable to help the reader understand and envision the ecovillages profiled as case studies. A list of recommended resources for further reading on ecological building techniques can be found at the end of this section. Participants in ecovillage planning are strongly encouraged to learn as much as they possibly can about ecological building techniques. Even if a planning group has a highly experienced architect and builder all the members should be knowledgeable. The needs of groups will vary significantly according to geographic location and the goals of the individuals participating in the project.

The Design chapter is not intended to be a technical reference. The descriptions are not comprehensive. The design experience in the ecovillages varies from fabulous to horrendous. A review of the extremes and other examples can contribute to a more valuable design process in future ecovillage projects and other project which incorporate a consideration of how design effects our and daily lives emotional well-being. The intention is not to single out any one project as "good" or "bad." It is important to note both sides of the story so future projects can learn from previous projects.

The chapter is divided into four sections: ecological design, exterior design, interior design, and systems. The first section, ecological design is an overview of theories of ecological design and key considerations in design. The latter three sections discuss aspects of the ecovillages with the incorporation of research and survey results. The relation of design features to the individual and the community are addressed throughout.

ECOLOGICAL DESIGN

Ecological design is design for the environment. Ecological design is also design for people. It is the art of reducing our negative impact on the environment while preserving; a good quality of life and an ability to function within our culture. Reverting to cave-dwelling and eating roots and berries is not an option within our society.

The appreciation of the needs of individuals in ecological design is relatively new. At the time Tuggelite (1984) and Solbyn (1987) were built ecological design focused on function. Ecological design has evolved to where it has begun to incorporate more intangible aspects such as beauty, emotional well-being, and the physiological effects of details such as electromagnetic radiation. The best ecological feature, explains a resident in Understenshöjden, is "*that ecological housing has been discussed as more than just energy efficiency. It has to do with that which is healthy for the body as well as the soul*".

The success of an ecological design is largely dependent upon its relationship with the user. Good ecological design should not be "*more complicated than it is. Common sense goes a long way.*" [Bålarna] In

an era of increasingly complicated technological advances it may be tempting to employ the latest, greatest, and often, the most complicated techniques. This impulse should be avoided. Simple can be beautiful. "*Try to find technical solutions which minimize labor and complicated mechanisms.*" [Solbyn] In order for ecological design to meet its two main objectives, to preserve the environment and maintain a positive quality of life, ecological design must:

be user-friendly,
be visible,
be simple,
be attractive to see and pleasant to use, and
consider the whole picture.

User-friendly

People are more likely to use or do things which are convenient and hassle-free. A feature which requires a person to do something such as recycling or laundry should be conveniently located and easy for people to understand and use. If regular maintenance of an item is required, such as changing an air filter, the item should be easy to reach and not require any special tools to maintain.

Visible

It is difficult to ignore something in plain sight. People often tend, for example, to take their heating, plumbing for granted because its workings are hidden. Making these systems visible can increase an individual's appreciation and understanding of them. It is easier to maintain and repair items that are visible and accessible. Its physical presence serves as a reminder of the feature's purpose and required maintenance.

Simple

"*Choose simple technical solutions.*" [Tuggelite] Make the building and its systems simple to use, understand, and repair. This can reduce costs to individuals and costs to the environment. Simple tasks are more likely to be done than complicated tasks.

Attractive to see and pleasant to use

We are drawn to beautiful places. When possible, we choose to be in attractive spaces and attend to pleasant tasks. Making the mundane beautiful can increase our inclination to be in a place. A well lit, fresh smelling, clean recycling room can make recycling a decent experience. Whereas, a visit to a dark, smelly, dirty recycling room is bound to discourage people from doing the right thing. A beautiful home with gorgeous flowers and cheerful neighbors might be worth staying in over the summer instead of using a lot of energy and paying a lot of money to travel to a more beautiful place.

"*Full speed ahead on the environment but don't forget beauty.*" [Solbyn] Beauty is an important feature of ecological design. "*It is important to have beautiful homes.*" [Smeden] Thirty-six residents (31%) wrote that the attractive area and homes was a primary motivation for them to move to their ecovillage. Beauty is difficult to quantify, but simple to understand when experienced. An unpleasant appearance is also easy to understand. Seven residents in Solbyn decried the homes appearance as "ghastly" and "without fantasy." "*The worst part about the houses is their tragic appearance. The environment got the upper hand in planning and the beauty of architecture was forgotten.*" [Solbyn]

Beauty enriches our lives. It increases the likelihood that we will stop and "smell the roses." Our appreciation for our immediate surroundings increases our sense of

responsibility for its care. Beautiful homes and features that are pleasant to use enhance residents pride in their own homes as well as their pride in what they have created with their community.

Considering the whole picture

The natural environment is extremely complex. Care for our planet goes beyond careful placement of recycling containers. Everyone, and especially designers[1] , must consider the depth and breadth of their choices. Everything in nature, including our constructed human environment, is part of the larger whole. Like ripples in a pond each action has an origin which fans out to infinite proportions. How we build today has long term and far reaching effects. Each stage of a resources use must be considered.

Every design choice, from choosing a site, to choosing the bathroom tile and considering demolition, requires the designer to consider its ecological impact. Three methods of analysis can help the ecological designer retain a broad view of the environment while making decisions about small details. These methods are: the ecological footprint, life-cycle analysis, and cyclical thinking.

Ecological footprint

A person's "ecological footprint" reflects the impact that person has on the environment. The size of a persons "ecological footprint" reflects the quantity of resources they consume and the pollution produced by the consumption of these resources. For example, Americans use more resources per person than Guatemalans, therefore Americans leave a larger "footprint" on the environment. Americans comprise 5% of the world's population and use 25% of the world's resources. Citizens of Western Europe consume nearly as much as Americans. [Source] The goal of the ecological designer should be to choose designs that will aid the users in reducing their "ecological footprint." A long -term perspective and cyclical thinking can help designers reduce the "ecological footprint" of the community. The Wackernagel website offers a worksheet for calculating your ecological footprint. Source

Long term perspective

Every action and every product has a long-term effect on the environment. The environmental impact of, for example, a cotton shirt, begins in the cotton fields and does end until the shirt has decomposed into dirt many years later. Everything has a story to tell, the shirt has a long history of chemical pollution and energy consumption before it even reaches a shelf in a store. The story continues as its owner transports it home, washes it, and eventually passes it to a new user or sends it to a landfill where it may take years to decompose. Consideration of the whole life of an object can be tiresome at first, but with practice it can transform how you think about the world.

The life of product is often more complicated than it first appears. A Stockholm resident may think a green-house grown tomato from Sweden may be have required less energy to grow and transport than a field grown tomato from Italy. In reality, the production and transport of a kilogram of Italian tomatoes uses about 2 kWh, whereas a kilogram of Swedish tomatoes requires about 19 kWh.[2] Source – Naturvårdsverket… (The Italian tomato will often cost less as well). This particular analysis considers energy consumption. Other considerations such as: pollution, external products such as fertilizer, the water used to wash the tomato, and the energy used to cook the tomato are not incorporated. So many steps are involved in the life of a single product

it is difficult to decide what boundaries to set for analysis. Tools such as Life Cycle Analysis are reaching a point where they can be useful for the designed. Life-cycle analysis (LCA) examines the total environmental impact of a product throughout its life - from "cradle to grave" - from obtaining raw materials, making it in a factory, transporting it for sale, and through its use and disposal. Currently, most LCA programs are restricted to considering the energy and cost of a product. Other methods are being developed which consider concerns such as; the production of green house gases, metals, and hazardous materials.

The Swedish building industry has begun to address the question of the long term environmental effects of products used in building. The trend in Sweden towards positive environmental choices in building, from "cradle to grave" is increasing in response to: European Union standards[3] for environmental responsibility, Swedish building standards, and consumer demand. This trend has facilitated the creation of a environmental data base for building products. The data base contains over 300 building products evaluated according to a *miljövärderingssytem*, an environmental evaluation system. The products are classed as being best, better, acceptable, to avoid, and unacceptable, according to their environmental impact. The evaluation of products includes considerations such as: their chemical composition, their effects on the health and safety of those who install them and the end users, and how well the product can be recycled.

The environmental impact of design decisions is not limited to the LCA of an individual product. Other considerations regarding the durability and use of a feature in relation to its users should be considered. The later ecovillages tended to choose higher quality features, for example, solid wood cabinets rather than particle board cabinets. Solid wood cabinets can withstand many years of use while retaining their beauty. The particle board may be cheaper and have a lower environmental impact,[4] however, if they look terrible and need to be replaced in 7-9 years, while the solid wood looks great for 20-30 years, was the short term gain worthwhile? The maintenance of an item requires long-term consideration as well. For example, plumbing. If a wall of sheet rock/gypsum board must be torn apart to fix the plumbing and then replaced, what was gained by avoiding the installation of an access panel made with metal hinges and a wooden door? "*Think and plan carefully, Don't save money through lower quality. Think long term and chose a little stronger than to discover, for example, the furnace is undersized in relation to the number of persons expected to live in the apartment.*" [Myrstacken]

"*Plan for changes and flexibility.*" [Tuggelite] Long term planning should also include consideration of accommodating changing needs of individual families and the community. As children grow older they may want more privacy. More singles and couples without children, or families with children, may move in. Is there a means to accommodate these changes within the existing structures without major renovations? How will features such as roofs be fixed with the least environmental impact? Are the buildings built to last a hundred years, or fifty? Can the materials in the buildings be reused in new buildings? Can the heating systems be easily modified or replaced if a new and better option is preferred?

Cyclical thinking.

Cyclical systems are another means of reducing our "footprint." The concept of cyclical systems has gained a great deal of popularity in Sweden. The word

"*kretslopp*," is defined as cycle, or circulation, in the Swedish-English dictionary, but "*kretslopp*" has means a lot more in Swedish culture. The American equivalent of "*kretslopp*" is "reduce, reuse, and recycle." Reduce your initial consumption of goods, reuse the goods as much as possible and then recycle them. Cyclical thinking, "*kretslopptänkand*e" goes one step further and includes all resources, water, energy, goods, services, soil, and so forth. Originally "*kretslopp*" was used as a term to describe nutrient cycles in ecology, i.e. carbon, nitrogen, and phosphorous cycles, and the water cycle. The idea was later applied to recycling programs. The word *krestlopp* is now used to promote composting programs, on-site wastewater treatment, biodegradable products, local produce, and much more. This philosophy is also applied in pollution prevention and land use decisions to preserve nutrient cycles from disturbance by new building or industry. Cyclical thinking has been used as an argument by ecovillages to allow on-site wastewater treatment, large gardens and animal husbandry. Planning commissions were reluctant to allow these techniques 10-15 years ago, this growing trend is helping persuade them to allow alternative measures. Returning resources to their respective cycles is an integral goal of ecological design. A cyclical perspective of our environment can help designers make long and short-term decisions to help reduce the communities impact on the environment. Cyclical thinking can also help residents maintain a connection between their actions and the environment in their daily lives. Throwing an apple peel in a trash can becomes much more difficult when you know and have seen first hand how apple peels, and other organic waste, have improved the soil quality in the garden.

The Design Process

The role of the designer is challenging. The addition of social and long term environmental planning complicates the task further. Lofty environmental goals must invariably be balanced with pragmatism. Monetary costs must be considered. Building codes may prohibit unconventional techniques. The designers face a difficult job in determining where and how much to compromise. Although the task is difficult the long term benefits make it worthwhile.

A fortune teller may, at times, appear to be best suited as a designer because long term planning requires making decisions about the unknown. In the thick of it, it may seem easier to delay considering the economic and environmental costs of replacing a tile roof verses a tin roof, however, doing the footwork before hand will save a lot of hassle and resources in the long term. Some aspects can be fine tuned over time, like paint color, other choices, like the heating system, may be extremely difficult and costly to change after the fact. Many aspects of the planning process were discussed in the Planning chapter. The following are points specific to the design choices. Ecological, economic, and social issues are not easily disentangled, however, for the purpose of discussion they are addressed below as separate issues.

Ecological Theoretical tools will prove useful in the initial design stage. The design process is the ideal time to utilize the tools of cyclical thinking, life-cycle analysis and evaluating your collective "ecological footprint." These tools can be used to look at the impacts of construction, material choices, site design, maintenance, and even demolition. Complex ecological relationships must be considered such as: the interrelationship of the buildings and site to the local,

regional and global natural environment; the effect of the chosen materials and design on the physical health of the construction employees, the residents and those who may eventually renovate or dismantle the structures; and the extent to which the design can encourage residents to act with environmental responsibility. More knowledge about environmental building is being gained all the time. The designers will gain a great deal by keeping abreast of the new information.

Economic "*Think about finances before you start to build to avoid 'inexpensive' solutions.*" [Solbyn] It is tempting to choose what costs the least today, however, cheaper is not always better. Replacing an inferior item in a few years may prove far more costly than installing a more expensive, but better quality, item during the initial construction. Items such as solar panels or triple-glazed low-emissivity windows are a large initial cost but the long term savings compensate for the initial investment.

Residents will want to keep costs to a minimum, however, monetary savings may cost the residents a loss of fundamental principles. Strive to "*accept a slightly higher cost instead of compromising too many of the fundamental ideas.*" [Solbyn] Residents in Solbyn continue to pay (in money and in satisfaction) after following the builders recommendation to save money by installing single, rather than double pane glass in the glass room. Compromises will have to be made. The list of standards the resident planning group derives will help retain the features which have the highest priority. Compromises can be made on the less fundamental features. Prices may seem enormous to residents unfamiliar with the figures involved in large building developments, but the costs may not seem so daunting after the costs are divided between residents and payment is extended over many years. A resident recommended to "*choose optimal technical and ecological solutions without too much emphasis on the economic side.*" [Tuggelite] A slightly greater investment in the short term may reap large benefits in the long term.

Social Social interaction is influenced by design, especially site design. It is important to consider how people will interact with the site, with each other, with their homes, and with the systems. The design stage is the time to ensure plans will prove: user-friendly, simple, visible, and attractive to see and pleasant to use. A superior relationship between residents and with their physical environment will facilitate the commitment to community and to the preservation of the environment. Tensions related to the design will undermine the social system. Residents will be more focused on remedying the problems rather than focusing on fostering community. The opposite is also true. An exaggerated focus on social tensions will prevent a focus on an ongoing commitment to preserving and improving site and broader environmental goals. Monetary tensions will also skew the balance between the social and environmental. The maintenance of this balance will continue throughout the life of the ecovillage, however, the better the initial design the easier this balance will be to maintain.

Experience In the effort to strike a balance between social, environmental and economic concerns, designers will find it helpful to draw from others experience rather than rushing to be pioneers. Frequent advice from the residents is "*use established systems and products.*" "*Don't experiment with*

everything all at once." [Understenshöjden]. Experimentation may be tempting, especially because conventional building can be frustratingly anti-environment. Experimentation can be great for a few specific items, but there is a distinct difference between calculated risk and recklessness. If a group wants to try a new product they may want to try to arrange with the supplier free repair or replacement with a proven product if it does not work. Additionally, it is one thing to try a new type of solar panel which can be removed relatively easily from the roof. It is another matter to experiment with a new type of ventilation system on 25 houses where major construction will be necessary to alter it. Common sense and sound research will be invaluable when considering experimentation.

Observation The best way to learn what works and what doesn't, is to see it and talk to people about it. Not only should you insist on proven quality from suppliers, you should also visit sites where these techniques and products have been used and talk to people who live with them every day. You will need details, not just a general idea. What about a product or idea works well, what doesn't. What factors might cause a product or idea to work better or worse?

EXTERIOR

First impressions should not be underestimated. The exterior milieu of the ecovillage can affect the social system. Each encounter with the outdoor and public areas of the ecovillage confront the residents with an emotional response similar to a first impression. If the impression is positive, residents will associate positive feelings with public areas, which are reinforced with each encounter. If their impression is negative, they will learn to avoid this encounter and subsequently, avoiding their neighbors and collective responsibilities.

"It is inappropriate, whatever the budget, to regard landscaping, site layout, play areas, and community facilities as luxury extras. All the evidence suggests that a medium - or high-density family development designed with little concern for these features will be doomed to failure, no matter how much effort and budget were spent on building interiors. One study of private sector housing in London indicates that to most people appearance means landscape and layout first, architecture second (Shankland …, 1969)." [Cooper Marcus 46]

"People get many kinds of messages from each place they encounter."[5] Subtle cues from the experience of exterior spaces determine whether individuals seek to spend their time out and about the ecovillage or scurry to their individual homes without contact with others. Spaces evoke feelings and send messages. Colors, shapes, and textures convey messages in congruence with the emotional and cultural values associated with those sensory experiences. Warm natural colors are perceived as warm, organic, captivating, and inviting. Dark somber colors and poorly lit areas are easily perceived as inhospitable, dreary, cold, and dangerous. The placement and appearance of trees, walkways, and buildings shape the experience of the ecovillage. Mailboxes in an open windy area tell passersby to keep going, whereas the same mailboxes under an awning protected from the elements but open to fresh air compels people to linger and talk with one another. A cramped, out of the way, common house signals a lack of importance, whereas a centrally located, slightly grand common house becomes a focal point and source of pride for residents.

The social system in an ecovillage revolves around

its public areas. The success of the social system depends on positive interaction between residents and between the residents and their surroundings. Residents may go into each others homes occasionally, but the vast majority of their contacts and interactions with each other and the ecovillage as an entity occur in public spaces. Eighty-eight percent of residents said they meet their neighbors "often" (52%) and "most often" (36%) out and around the site, while 60% meet at their neighbors homes "often" (52%) and "most often" (7%). The design of housing developments tends to focus on the interior of the individual home. Exterior space is an afterthought. This denies the inevitable connection between individuals and their community. It encourages residents to focus inwards, focusing on their personal needs rather than their relation to the community and to the outdoors.

The design of the exterior climate begins with the selection of the site for the development. The designer can begin to envision the site plan while choosing the site. The site plan will require consideration of many details. Those discussed in this chapter concern the relative placement of buildings and other features, play areas, the distinction between public and private space, landscaping, areas related to food production - gardens, the root cellar, and pantry, the common house, storage, parking, and the exterior appearance of the homes.

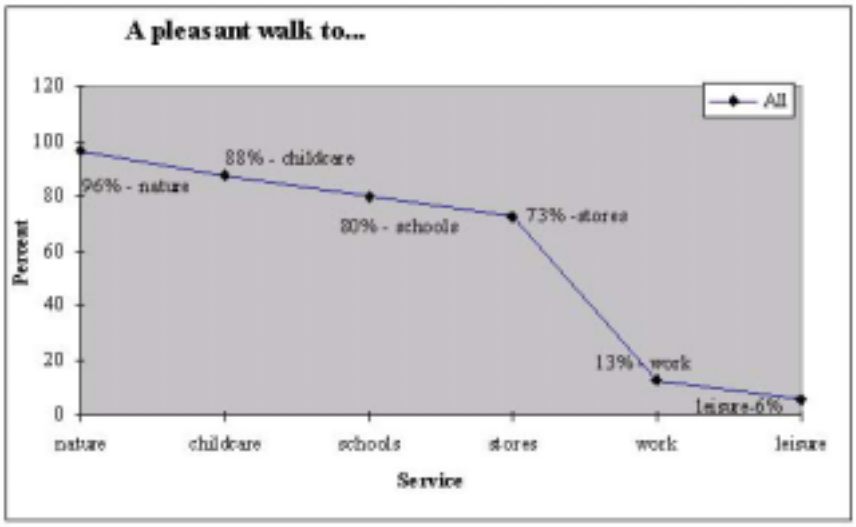
Site Selection

A well chosen site can enhance the overall experience of living in an ecovillage. Trees, good drainage, space for gardening, a location near services; jobs and schools, all contribute to the overall success of the project. A poorly chosen site can potentially undermine the benefits of even the most well designed homes.

It is not always possible to choose the ideal site due to expense and logistical problems with the city planning commission and the existing owner(s) of the land. Compromises between competing interests will have to be made. The importance of different factors will vary according to geographic location and the goals of the planning group. Key considerations in site selection can be divided into two categories, location and existing features.

Location

It is best to locate where residents where can reach a wide variety of services with a minimum hassle and minimum number of automobile trips. Close proximity to nature, shopping, schools, childcare, entertainment, and health care allows residents to reduce the environmental damage from driving an automobile, reduce the costs related to transportation, and reduce the stress related to getting from A to B. The location of Understenshöjden, with respect to services, was so ideal that seven households were able to get rid of their cars after moving in. Driving discourages casual encounters. Location near stores, nature, and entertainment is a ideal extension of the social cohesion of the ecovillage to the wider community. If you can walk or bike to the store you are more likely to run into people you know from the ecovillage and from elsewhere. Seventy-three percent of residents surveyed thought they were located within walking distance of stores. Bus lines and subways are a great way to get to work or reach the theater or movie house, but public transportation is cumbersome to use for running errands.



[Table 7.1]

Which services lie within walking distance?

A popular misconception is that the majority of people's trips, regardless of mode of transportation, are work related. According to the 1990 US Census Personal Transportation Survey, only 22% of trips are work related. Forty-two percent of trips are for personal or family purposes. (Full citation) A survey by the Swedish Environmental Protection Agency showed almost an even distribution for automobile trips for work, visiting family, and shopping, the largest percentage being recreational trips.[6] Of these trips, 27.5 % are less than 1.6 km and 13.7% less than 0.8 km (U.S. Census). A well chosen site for the ecovillage should be able to eliminate automobile use for these shorter trips. If a food store is on the way home, it is easy to carry a bag of groceries every other day or so. If food shopping requires a special trip to a store, which is longer than a kilometer or so away, it is more difficult for older people and parents with children to manage carrying several bags of groceries more than a few blocks. The proximity to public transportation, bike paths, and other safe means of bicycle or pedestrian transportation will influence whether or not residents choose non-automobile forms of transportation.

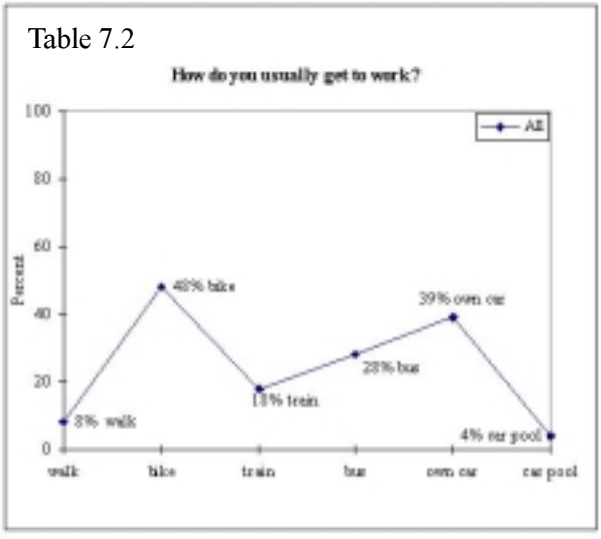
Older children should be able to safely arrive at school by themselves. Their travels to schools, friends', the store, sports and other activities fosters independence and maturity. A nearby daycare reduces the stress on parents to transport their children to daycare. Several parents enjoyed having a daycare on site because their children would come by during the day and then return on their own to day-care. Eighty-eight percent of residents surveyed said their ecovillage was located within walking distance of childcare and eighty percent said they're in walking distance of schools.

A walk in the woods is a great way to recall the splendor of nature. It is good for the spirit and can be good for the environment. Driving somewhere to experience nature seems contradictory and living apart from green spaces can make it difficult to remember why it is important to protect the environment. A walk in the woods looking for berries or mushroom is a great way to spend a Saturday afternoon especially if you can walk there from your front door and meet your neighbors while out and about. Residents might be less inclined to drive to a beautiful spot for recreation if their daily environment is beautiful and relaxing. All of the ecovillages studied are located within walking distance of woods and other beautiful natural areas. Twenty-

seven percent of ecovillage residents sited location near nature as a primary motivation for moving in. However, a site which is today "*so near the woods, it feels like an oasis*" [Mjölnartorpet], may not be so tomorrow. The city should planning department should have an idea of the type of development which might impact a particular site in the future.

Proximity to the resident's jobs is harder to control because places of employment tend to be scattered. Because only 20%, approximately, of all trips are to for work the consideration of job location is not as crucial as it is often portrayed in discussion on transportation. Although, as table 7.2 shows, many ecovillage residents were able to travel to work by means other than their automobiles.[7] The time it takes to reach their places of work ranges from 5 minutes to 1 hour with an average around 20 minutes. Many residents expressed concern about automobile usage. "*We are a long way from downtown and even with the buses there are too many auto trips.*" [Mjölnartorpet]. Many residents wanted to start a car pool. An informal carpool exists in several ecovillages and a formal carpool functions well in Understenshöjden.

Table 7.2



Existing features

Existing features of a site include its natural features, existing structures, nearby development, regulations and city services.

Natural features Natural features to consider include: topography, trees and other vegetation, hydrology and soil quality. Existing topography (hills, valleys, rocky areas, flat open areas) and vegetation on the site can help and hinder plans. Open space will be necessary for gardening. A rocky area may make it difficult to build foundations or place heating or water systems underground. A gentle slope can be helpful for installing an on-site waste water treatment system, but too much variation in height will require creative placement of the houses. Building on a slope can increase costs but it can also allow the buildings to be built closer together while still allowing light infiltration. Existing vegetation, especially trees, can also help in planning for passive solar benefits (see landscaping in the site plan). Saving existing trees can save money by not needing to plant new trees and make the site more attractive. Hydrology is especially important to consider for ecovillages with on-site waste water treatment and also for providing tap water from an on-site well. Ground water located too near the surface can result in mildew damage to the houses. Groups interested in gardening must evaluate the soil quality. Soil quality is also important for choosing the type of foundation for the homes and the waste-water treatment system.

Existing Structures Buildings or other structures on a site can be a great asset to a project. Åkesta was able to fix-up and old root cellar and another building. Using the existing root cellar not only saved them money, they were also confident it would function

well, as it had been keeping vegetables well for years. A ecological renovation project outside of Stockholm, Ekbo, has transformed an old hospital into a series of apartments. Choosing a site with existing structures can be a good way to save money and natural resources as well as a good way to create a link between the past and the future of the site. I strongly encourage incorporating renovation into a project as discussed in the final chapter.

Nearby development As discussed above under location it is important to consider the location of services (schools, stores, public transportation) in relation to a site. The city plan may indicate plans for future development near your site that may make the site more or less appealing, such as designating a nature preserve or permitting light industry. It is important to consider who your neighbors will be and if they will be for or against your project. Vocal neighbors can help or hinder a project. Positive future neighbors may want to collaborate in your project, extending your social, and eco-friendly circle. A nearby farmer or other business may be interested in an exchange of goods or services.

Regulations and city services Hopes for obtaining a dream site can be dashed by realizing the city will not allow you to execute key elements of your project such as wood-burning stoves or on-site waste water treatment. Existing city services, or the lack thereof, can also influence a site selection. Installing new electric, phone, or water lines can be prohibitively expensive and questionable from an environmental standpoint. A city can also offer excellent resources as in the case of Uppsala. Hågaby, outside Uppsala, decided that the most economical and environmentally friendly choice for heating their homes was to connect to the city's superior district heating system.[8]

Site Plan

The location of features in the ecovillage can encourage or discourage behaviors and feelings. A good site plan can greatly enhance the residents' relation to the site and consequently affect their social and ecological behavior. A good site plan can also maximize ecological benefits. It can even provide economic benefits through efficient land use and utilitarian landscaping (i.e. apple trees, berries).

Location of the homes The homes are generally clustered on a small portion of the site. The ecological motivation for this is to leave as much land as possible undisturbed. It saves money because utility lines (water, sewage, electricity, heat) do not have to be run as far. Many of the projects oriented the homes so they could receive maximum sunlight for passive and active solar collection (See Heating section in this chapter). Savings from passive solar heat can be gained with little extra cost. The expense of active solar heat pays for itself over a few years if the system is well designed. Clustered homes are additionally more affordable because of the common wall between row houses or duplexes. The shared wall reduces the number of surfaces exposed to the heat and cold and eliminates the need for two additional finished facades.

The proximity of clustered homes promotes casual social interactions between neighbors who are more likely to meet each other out and around the area than in areas with detached single houses, on the other hand, homes can be too close. A balance between proximity and distance is important. In Åkesta the duplexes arranged in two ovals. The ovals are long and wide which left the duplexes far apart. Residents tend

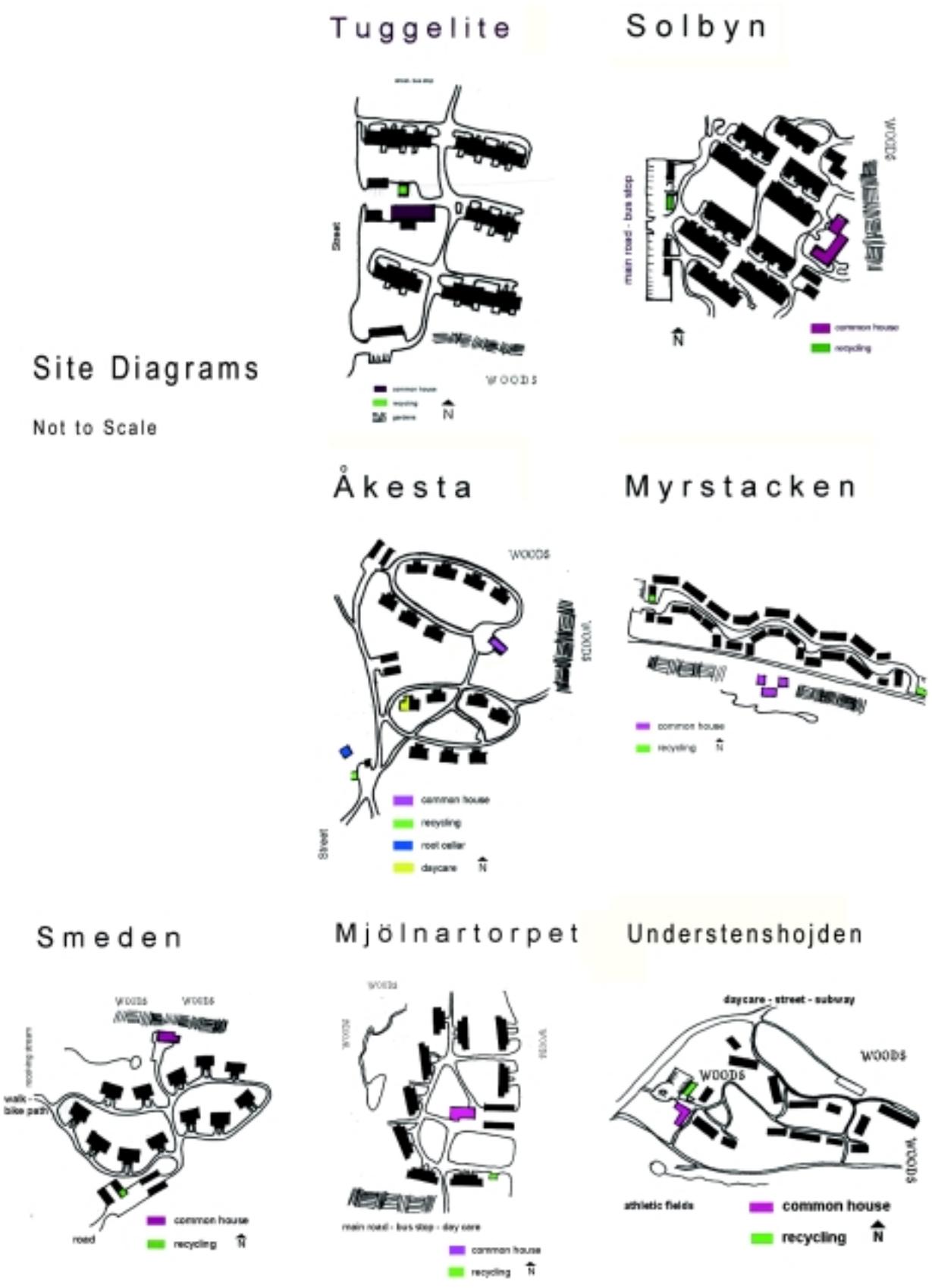


Fig. 1 - Site Diagrams

to socialize almost exclusively with their immediate neighbors and only occasionally those further away. Homes are so far apart in Ruskola that it feels more like a collection of isolated homes rather than a village. This was a conscious design choice which residents appear to be pleased with. As described in the Ruskola case study, the social climate in Ruskola was intended to function differently than all other projects. Each house in Ruskola is located on a large wooded lot. The large lots were chosen to allow expansion over time. The houses are placed on the lot to allow for later subdivisions or the addition of a smaller house for either teenagers or for parents to move into when their children start a family. Solbyn is the opposite extreme. The homes feel so close together that residents complained it is too crowded. It is not the proximity of the houses next to one another in a row which is the problem. It is the distance between the rows which is too short. The front entry of one home looks almost directly into the rear rooms of the next row of homes. The homes in Myrstacken are placed even closer together than in Solbyn along a central "street."

Automobile free

All of the sites, except Ruskola, are free from automobile traffic. The gravel pathways to the houses are wide enough to allow automobiles to reach the houses on occasions when people must move large loads or other emergencies. Automobile traffic is strongly discouraged at all other times. Freedom from automobile traffic creates a calmer atmosphere safe for adults, children and pets.

Walkways

Walkways should be wide enough to stop and talk while others continue by. Well placed walkways can promote a stronger social network. "A greater territorial sense can develop if residents frequently walk through communal spaces on their way to parking, laundries, recreation facilities, and so forth (Cooper, 1970b; Cooper and Marcus, 1971; Newman, 1972). They [the residents] begin to feel comfortable in the space, to greet others, and to perceive it almost as an extension of their dwelling. Thus it is essential that the *shortest* distance to parking, shopping, laundries, and play areas be through or around the common space." [Cooper 120] Residents will create their own walkways by taking shortcuts across the shorter distances. These shortcuts may pass very close to individual windows and could be disturbing to resident's private space. Windows should be situated in relation to the walkways in such a manner that residents in their homes do not feel "intruded" upon by passers by. Private spaces, such as a bedroom, are especially important to shield from a feeling of an invasion of privacy by passers by.

Open areas

Landscaping with a combination of open and wooded areas can create pockets of space for people to gather for large outdoor functions and for more intimate conversations. Two or three people talking may feel exposed in a large vacant area, whereas a large open area is ideal for a larger gathering like a picnic.

Location of different features

Convenience is the most prominent consideration in the placement of services, except for the common house which is influenced by its uses as well as convenience. Central location of services is often ideal. It promotes informal meetings between neighbors and as well as safety through casual surveillance. However, central location of services is not always

possible, therefore special consideration should be given to the movement of people with respect to the site and its surroundings.

Effective placement of services, landscaping, and walkways are possibly one of the greatest contributions the designer can make to strengthen the social system. The placement of services will help determine the extent to which they are user-friendly, visible, attractive and pleasant to use. The location of services can encourage or discourage certain behaviors that strengthen the social system and commitment to the environment.

Visiting The items everyone uses on a frequent basis: mailboxes, parking, laundry facilities, trash/recycling room, common house, play areas, should be located so that residents are able to have casual encounters with their neighbors in public space. A visible and functional location of these items will also encourage residents to use them more often and take pride in their appearance.

Playing Play areas should be located within visual contact of as many windows as possible so many adults can keep an eye on the children while going about other tasks. Children can then be free to go out and play at anytime instead of having to wait until their parents are available to go out and stand watch over them.

Safety and security Windows, doors, and other exterior features: mailboxes, parking, gardens, trash/recycling room, etc. should be visible from many locations. Casual surveillance of public areas by residents promotes safety for the residents and their property.

Recycling The trash and recycling rooms should be conveniently located for as many residents as possible. Residents are more likely to feel positive and act responsibly about recycling if its location is convenient. Convenient location of recycling facilities could be at odds with access for collection. Policies for collection differ between cities and companies. This potential conflict of interest should be investigated.

Resource and energy use Residents are more likely to utilize shared facilities: root cellars, laundry, sauna, workrooms, guest rooms, compost, and gardens, if they are conveniently located. Shared usage of these facilities can reduce the environmental and monetary cost of providing these services to each individual household. Common usage of these features will also increase the opportunity for residents to meet informally.

The ecovillages have had varied success with the location of different facilities. Residents expressed positive feelings about the placement of various services. Residents of some ecovillages expressed a notably higher level of satisfaction with the location of services than others. A comparison of the site plans with survey answers and observations reveals which types of site plans work well. The site drawings indicate where different services are located. Solutions from particular ecovillages are discussed below.

Mailboxes: The placement of mailboxes does not, unto itself, seem to significantly effect social benefits unless there are other factors influencing people's gathering in that place. The mailboxes in Tuggelite are a good place to run into your neighbors because they are located next to the common house where people

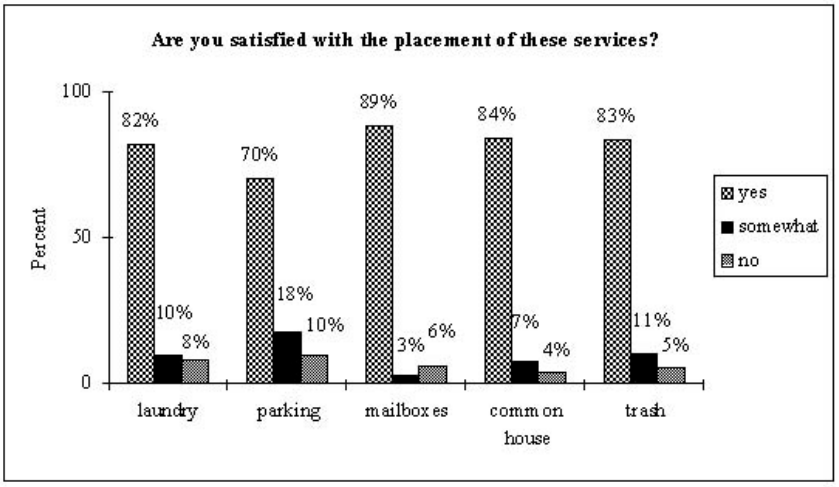


Table 7.3

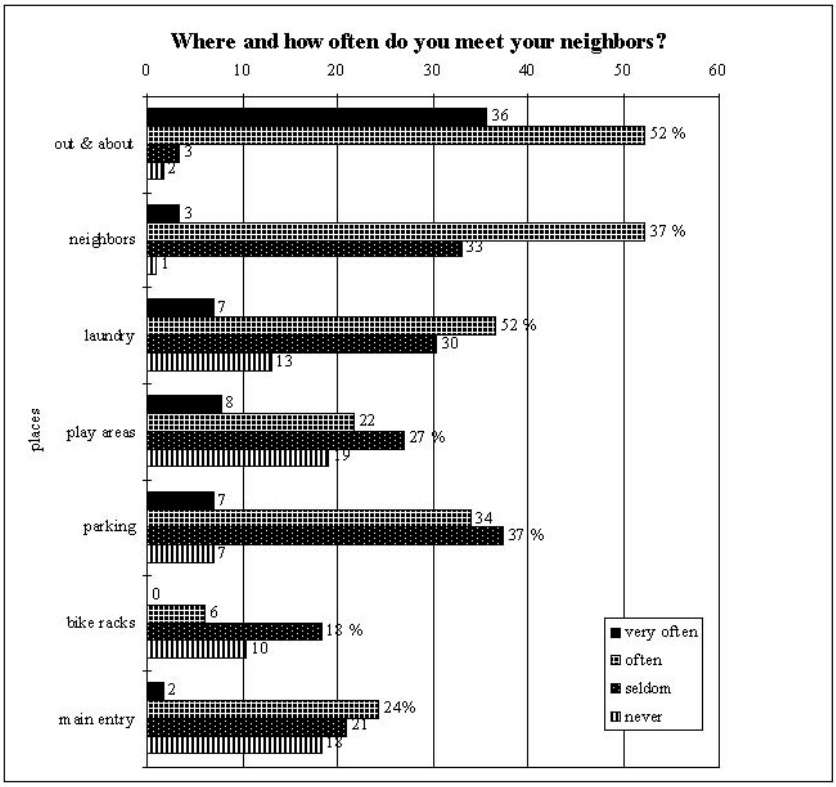


Table 7.4 seldom, as an answer option has negative connotations whereas sometimes does not.

have other reasons to go regularly. The mailboxes at Tuggelite are also covered so residents can stop and talk without being rained or snowed on. The mailboxes at Åkesta are located near the entrance, but away from anything else. In Åkesta, you can drive up to the mailboxes in Åkesta, and therefore missing a social opportunity. Central location of mailboxes is often preferred, if not required by the postal service. If mailboxes are not located in front of peoples' homes then Tuggelite's solution might be a good model to consider.

Recycling and trash: Bringing home packaging is one thing we willingly accept, but disposing of it is usually seen as a chore. These services have been located near the entrance to the projects so residents can drop them off on their way out. They should not be located so far as to make it cumbersome

to carry several bags to the recycling/trash room. The long street design in Myrstacken makes it a "*long ways to recycling room*" [Myrstacken] for residents in the center of the street. Problems can arise when there is more than one exit from the site. Resident's in Understenshöjden and Smeden who do not drive, but instead take the bus or subway (or walk or bike) leave the site through a different exit than the automobiles. The recycling/ trash room in these two sites is next to the parking lot. Those not driving have to make a special trip to the parking area in order to drop off trash and recyclables. Not only is this inconvenient, it also conveys a bias for the automobile over other forms of transportation. The majority of residents in Understenshöjden ride a bicycle or take the subway (75%) and only 14% drive their own car to work. Therefore, the majority of residents do not pass daily by the parking lot where the recycling is. Of the eight residents only somewhat satisfied with the placement of the recycling room, six live far away from the parking area and two live about in the middle. The five residents not satisfied with the location of the recycling room live far away, a distance equivalent to 3-4 blocks.[9]

Parking and other transportation:

Parking is a difficult issue. On the one hand it would be preferable to locate parking along the same path residents take to use any other type of transportation (walking, biking, the bus, or subway). This would provide further opportunities for residents to meet casually while coming and going. On the other hand, it is highly unattractive for the first view of your ecovillage to be a parking lot, as is the case in Solbyn and Myrstacken (if you were to arrive by bus, or rail). Despite the unpleasant first view of Solbyn's parking lot, this space is also the main entrance to the site. Most residents pass by it daily which has made the parking lot a major social center in Solbyn. [Lindén 54] The landscaping section discusses how to make the union of the parking area with the main entry a more attractive experience.

In Myrstacken and Understenshöjden automobile parking is in the opposite direction of the path for other forms of transit. Most residents in Myrstacken drive. Public transportation, schools, and food stores are a little too far for walking to be a the primary mode of transportation. A parking lot is located at either end of a long street. Residents at either end of the area meet each other but there is much less opportunity for interaction between residents at opposite ends. (This is reinforced by low-usage of the common house). Only 45% of Understenshöjden residents surveyed were satisfied with the placement of the parking. The parking lot is open to the street with neither car ports or garages and it is located outside of the view of residents, precluding casual surveillance. Six of eleven Åkesta residents were only somewhat satisfied (one not satisfied) with the location of parking. This might be attributed to two things. First, Åkesta is located sufficiently far from services - stores, schools, the city center - that the majority of residents drive their cars. Although five residents said they take the bus to work, the bus is not a practical means of running errands and other non-work related trips. Second, although there are two parking areas in Åkesta the houses are so spread out on the site that it can be nearly a block and a half for some residents to walk home along a virtually treeless expanse.

The parking lot is a popular place for residents to meet (7% meet their neighbors in the parking lot "very often," 34% "often," and 37% sometimes), whereas meeting while fetching your bike is far less common,

6% of residents said they meet their neighbors "often" by the bicycle parking area (18% "sometimes). Although residents do not appear to socialize near the bicycle parking, 46 % of the residents cited their bicycle as a frequent means of transport to work, whereas, only 37% cited their own automobile. Residents were not surveyed about their means of transportation for non-work related trips, however the frequency of meetings in the parking lot and the paucity of meetings near the bicycle parking would imply residents are still notably dependent upon their automobiles.

Infrastructure for automobiles - carports, garages, and roads, are considered standard in all development. Infrastructure for public transportation and bicycling receives far less attention. Ecovillages with nearby bus stops should take measures to install a bus shelter. The shelter should have lighting for safety purposes. If the ecovillage is not allowed to install the shelter themselves they should insist the city do so.

Some infrastructure does exist for cyclists in Sweden. Paved bicycle paths are more and more common. These paths are often plowed in the winter. However, cyclists are still, more often than not, expected to improvise when it comes to storage. Covered bicycle parking does exist in some pubic areas, but it is infrequent. Most of the ecovillages studied had some type of area for bicycle storage none of the storage areas I saw provided more than minimal coverage. In fact, three residents in Understenshöjden said there is no bicycle storage area, although this is not true, 24% or residents cite meeting neighbors there "often" and 45% "sometimes." Theft is not a great concern in the ecovillages but the owner of a high quality bicycle is not likely to feel comfortable leaving their bike tenuously tied to a weak metal rack. He is also unlikely to want to cram his vehicle under a short overhang where it is just barely out of the rain. Storing a bicycle inside the house is hardly an appealing solution either. A legitimate endorsement of bicycling as a form of transportation will require legitimate bicycle storage. Bicycle garages would be ideal so cyclists can feel safe leaving their helmet and bicycle bags on their vehicle. The second best option would be bicycle parking which is fully sheltered from wind, rain and snow. A sturdy rack for locking a bicycle to should be provided. Each rack space should have ample space on at least one side so the cyclist can reach their vehicle without tripping over five other bicycles. Bicycle storage should be near an exit. Bicycle storage should have adequate lighting. A bicycle path should connect via the shortest route to a city bicycle path or main road. Ample storage space should be allowed near the front entry of the homes for storage of items such as bike bags, rain gear, and a helmet.

Gardens:

No store bought tomato can taste better than home-grown because of the hard work and pride that become a part of that tomato. The gardens are an important part of the residents' connection to the environment. Gardening can also be a great opportunity for residents to meet informally and exchange advice. Nineteen residents (17%) specifically wrote that they meet their neighbors frequently while gardening (gardening was not an option given, these residents wrote in the garden as an extra item). Gardens, shared compost, and root cellars should not be located so far from people's homes that they find it too much of a hassle to carry loads back and forth. Discussions about garden placement should also include social considerations. A good garden requires a sizable time investment. It can be harder to find the motivation to go there if it requires walking in the opposite direction of your daily travels and out of

sight of the houses. In Solbyn, residents' concerns for the placement of the garden area was mainly that is not visible, not because it is a long distance. [Lindén, p.62] A resident of Solbyn described this very well:

"We would like to have had the garden next to the house…You can not go out [to the garden] if you are waiting for a telephone call or something. If it were a regular garden you could go in and out a little in between. You can't sit in a chair and look out [at your garden]. . .I haven't seen anyone have a coffee party in these three years." [Lindén, p. 62].

Most of the homes do have space for a private flower garden, the bulk of the garden space is located away from the houses. This is fine for some vegetables such as carrots, potatoes, and squash are easily harvested in bunches and perhaps stored for several months in a root cellar or pantry. These types of vegetables need a lot of space to grow in, therefore the large garden plots are ideal. Other vegetables are best eaten fresh from the garden. Fresh herbs, for example must be used almost immediately. Lettuce and tomatoes are also best used right away. It can be difficult to muster up the energy to walk a distance to the garden every time you want to cook a meal with these types of vegetables. Designers might want to plan for either greenhouse space or a small utilitarian garden space adjacent to the homes for these types of vegetables.

Fig. 2 Garden at Bålarna

Common House:

Optimum use of the common house is dependent upon location, as well as, the services and events offered in the common house. Tuggelite, Myrstacken, and Åkesta have a centrally located common house, but the most well-used common houses are in Tuggelite and Solbyn. Tuggelite's and Solbyn's common houses are highly valued because of the services available there (see Common House section, located later in this chapter), not necessarily because of their location. Mjölnartorpet has the next most valued common house which is located in the center of the houses "*like a spider watching over its web*." The common house in Myrstacken is not well-used for several reasons. In regards to location, it is located away from the center street where residents most commonly walk. Arriving at the common house requires walking between people's homes, which interferes with privacy. To avoid cutting between houses residents must walk out and around to reach the common house (See site diagram in Figure 1). Understenshöjden may also run into a problem with low usage of its common house due to its location. "*The common house is poorly placed on the edge of the ecovillage…there are natural meeting places for the children but the adults were forgotten.*" [Understenshöjden]. Residents in Understenshöjden place a high value on the common house but the extent of its usage, despite a peripheral location, is yet to be determined because the common house was not finished inside at the time of this research.

Laundry:

Dedicated residents at Understenshöjden carry their laundry from the opposite end of the site, almost, for some this distance is the equivalent of three city blocks or more. It is no surprise that only half the residents surveyed were satisfied with the placement of the common laundry facilities. Two of the residents who live farthest away and go to the common house at least once a week primarily to do their laundry are not satisfied with its placement. Three other residents in the same position were only "somewhat" satisfied with its placement. A common laundry room, as discussed in the Common House section of the Social Chapter, is an important contribution to environmental protection and the social system. It is crucial, in the placement of laundry facilities, to make the distance as short as possible for as many as possible. The prospect of bearing dirty clothes multiple blocks and running back and forth in between is a daunting concept for even the most committed environmentalist.

Play areas:

Play areas should be located far enough from homes as to avoid disturbing residents with noise, but close enough, and central enough so that many residents can keep an eye on them without having to always have someone outside standing watch. The playground for small children in Smeden is located between the houses where adults can supervise them. [Fig. 3] It is also "*near the woods and the common house attracts other children.*" [Smeden] Play areas should be clearly defined to reduce the feeling some residents expressed of being overrun with children, because some children "*do not respect others private space."* [Mjölnartorpet] Play opportunities should be considered for children of all ages, including teenagers.

Automobile free walkways within the ecovillages free parents from worry from automobiles. Encroachment on the automobile free should be avoided because in Myrstacken, "*even though we aren't supposed to drive in the area there are many who do which is not save for kids.*" [Myrstacken] Walkways also provide a hard surface in a safe space for children to bounce balls and learn to ride their bicycles.

Most of the ecovillages initially constructed play areas for young children (0-6) with sandboxes, swings, slides, and the like. Understenshöjden did not initially plan play areas for small children, but parents built sandboxes and put up swings later. A definite play area for children does not however exist in Understenshöjden which has caused some conflict. Some parents feel the area is "*not accommodating for small children.*" The "*area is not small child friendly, i.e. resevoirs, streams.*" [Understenshöjden] On the other hand, some parents feel free form and creative play is better for the children, where they can explore and find entertainment from the natural spaces.

All of the ecovillages with a day care had play equipment for young children installed from the start. The area should be large enough and with enough equipment to hold children's interest. "Housing as If

Fig. 3 - Play area in center of houses at Smeden

People Matter," by Clare Cooper Marcus has an excellent description of the types of equipment and play areas children of different ages are most likely to use.

Older children (7-13) don't necessary want to use swings, slides and sandboxes. They tend to be interested in more active and independent play. Play areas for older children were often added as the need arose. Solbyn made a fun production out of involving children and parents in transforming an open field into a football (soccer) field. Several ecovillages have playing fields for older children. Myrstacken and Ruskola constructed a hockey rink (Myrstacken used asphalt so children can play hockey on roller skates when its warm out). Children in at least three ecovillages had used lumber and other surplus from construction to build tree houses and forts. A father in Understenshöjden noted that the fun was in the making of the fort. Now that it is done they don't use it very often. All of the sites are surrounded by woods which is a great place for older children to explore. A path to the woods should be defined in order to direct foot traffic towards the woods and away from people's private space.

Teenagers don't need play areas, per se. They do, however, need access to areas where they can "hang out" without the watchful eye of their parents. Part of this need can be met through careful site selection. If teens can reach town, school, or community centers on their own they can feel independent and also relieve parents from the need to shuttle their teens everywhere. The common house can be a good get away for children and teens. Ping pong tables are popular. Tuggelite has a loft with a television where children can also hold parties or overnights with their friends. Solbyn put in a soundproof music room for teens in the common house which is used periodically. A room in the common house could serve as a place for teens to escape and hang out. Reports on the satisfaction of teens living in the ecovillages is mixed. One parent said "*... my teenage children who were skeptical really like it (storm trivs).*" [Understenshöjden] Whereas others say it is not a place for teenagers. Obviously it depends a great deal on the teenagers themselves, but measures can be taken to accommodate the balance between teens need for independence and individuality and the responsibilities to their families and the community.

Pets, such as rabbits are popular. Gardening is also a great way for children develop an appreciation for nature and have something to be proud of. Involving children in gardening also a good means to help them learn to respect the garden as a workspace and not a play area.

Public vs. Private:

In a neighborhood where so much is shared it is important to have a little chunk of land to call your own, a space to personalize with your own flowers and outdoor furniture. A corner to grow herbs where can pluck them fresh for dinner. A space where you can sit under a lilac arbor and "*step back from the public current with a good book and a glass of wine."*[Solbyn] "Privacy is more basic and universal need than community or neighborliness. The architectural concern with neighbors and community is commendable, but privacy must be established before people will reach out into the community." [Cooper Marcus 67] "*The collective aspect will grow over time.*" [Bålarna] Residents were asked about their perception of public and private space: was the size of each sufficient, and was the distinction between public and private spaces sufficient?

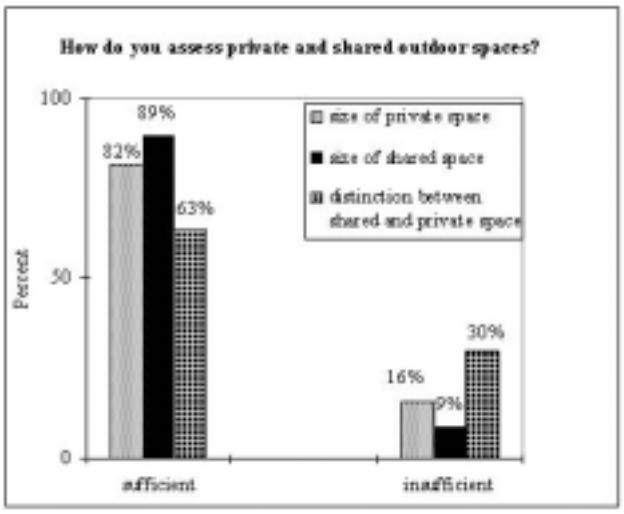


Table 7.5

Size: Most residents were positive about size of public outdoor space and the size of their private outdoor space. Households in Tuggelite, Smeden, Åkesta, and Mjölnartorpet have a large amount of public space with a limited amount of private space. Households in Understenshöjden and Myrstacken have a varying amount of private space. Residents in Solbyn have very little private outdoor space. Aside from their glass rooms Solbyn residents have barely enough private space to plant a small flowerbed. Residents in Solbyn were notably less satisfied with the size of private outdoor space, 42% said they the size of their outdoor private space was insufficient. A smaller percentage of residents in other sites thought their private yards were too small. Possible motivations for these feelings are discussed below.

Distinction: Residents surveyed had mixed feelings about the distinction between public and private space, 63% of those surveyed were satisfied with the distinction of private and public space, and 30% dissatisfied.[10] Judging from resident's comments, the value of distinguishing private and public space depends upon the residents themselves considering: how well they know each other; their values; and what is going on in their lives because people "*must understand that different families have different needs."*[UN].

Private yards in Tuggelite are small, but the public space is large with no distinction between the two. Half of respondents (seven) specifically said there is no physical distinction between public and private, nor is it important. As one resident aptly put it, "W*hat markings? We have nothing like that but one knows anyway."* Smeden, Åkesta and Mjölnartorpet have a similar situation with wide-open spaces and no distinction between public and private. However, some residents in Smeden and Åkesta wished for a larger private space, actually a more distinct private space. I attribute this to the fact that residents in Tuggelite were a close-knit group before moving in, whereas those in Smeden and Åkesta did not know each other well. Therefore, decisions about public and private space should reflect the interests of the residents and not simply copy another projects plan, even if those in the other project are thrilled with their results. Each group has different needs and those needs may change over time. The houses in Åkesta are far apart. There is an abundance of private and public space. Residents were not displeased strongly displeased with the size of the private space, rather they wanted clearer distinctions between public an private space, 73% said the distinctions between spaces are insufficient. This 73%, when contrasted with the 0% of Tuggelite residents who want clearer distinctions implies, not so much a need for clearer distinctions, rather it reflects the social climate of Åkesta. It is a reflection on the residents individual rather than communal focus. It signifies a lower level or respect and trust between neighbors. Distinctions between public and private spaces are not a bad feature, however,

residents should explore their true motivations behind wanting the distinctions.

This conflict of interests was evident from conflicting comments by Mjölnartorpet residents. While one resident was dismayed that fences aren't allowed, another thought it was *"good that it is so open without lots of fences."* [Mjölnartorpet] Most of the back doors of houses in Mjölnartorpet opens onto an open field. This creates a feeling of private space, however six of the homes overlook public space or another backyard. Because "privacy in a dwelling adjacent open space is an important contributor to overall housing satisfaction," [Cooper Marcus 99] those who are deprived of any private outdoor space may feel more exposed than those with private space. The discussion over distinction of space in Mjölnartorpet is not closed, "*some want discrete and open borders while other want high bushes or fences.*" Myrstacken has particular problems with private space. The large bay windows in houses on the north side face the narrow center street. One neighbor expressed his dislike for people being able to walk by and "*see what I'm eating for breakfast."* Houses on the north side have private backyards on a steep hill, whereas the houses on the south side overlook a large field and lead to the shared gardens and common house. Leading to one resident's dismay that "*the area behind our house is used as a throughway by both visitors and neighbors.*"

A handful of residents in Understenshöjden wished distinctions between public and private had been determined even before residents chose which houses they wanted to live in.[11] Understenshöjden is distinct from the other projects because there is comparatively little open space, either public or private. Most of the outdoor space is either wooded or rocky. I felt this was cozy, and intimate, but I do not live with it each day. I can see where some residents feel proprietary about the small amount of open ground they have.

Considerations when discussing public and private space include:

- How well neighbors know one another and the allowance for alterations over time.
- Residents' personal needs and preferences in respect to the groups interests.
- Placement of pathways in respect to peoples' windows and private indoor and outdoor space.
- Establishing a division of private and public space, whether physical or understood.
- Space for pets, vehicles/bicycles, "messy projects", outdoor storage messes, play areas and wood storage.

Landscape

Landscaping creates as much of a first and lasting impression as the color, shape, or size of a home. The "… highest quality architecture can look stark without the softening effects of planting; conversely, a monotonous or repetitive design can be vastly improved by quality landscaping." [Cooper Marcus 46] Landscaping should not be an afterthought. It should receive as much consideration as the appearance and function of the interior. Out-of-door recreation is a "distinct requirement of all human beings, and [should be] appropriately provided for." [Hiss 46] according to American landscape architect Frederick Olmsted.

Good landscaping can make an area an inviting and delightful place for people to meet and live. It can increase environmental benefits. It can save money in the long term through passive solar and microclimate benefits. The cost of a landscape architect can pay for

itself by the avoidance of costly mistakes in site design, drainage, and plant selection.

Function and appearance: Function and appearance are intertwined. An apple tree is functional. It provides shade for people and buildings in the summer and it provides apples in the fall. An apple tree is also beautiful. Its naturally rounded shape, beautiful flowers, and rich foliage make a lovely image throughout the year. The combined value of its function and appearance is greater than either quality separately.

No ecovillage stands out as exceptionally satisfied with either the function or appearance of their outdoor space; 18% of all sites evaluated the appearance of their outdoor space as "very good," and 16% cited the function as "very good." However, if you combine the evaluations of "very good" and "good", the positive ratings jump to 70% for appearance and 75% for function.

Functional landscaping qualities refers to, for example: the appropriate placement of walkways which provide access to different parts of the site, utilitarian plants such as fruit or nut trees,[12] enriched soil for gardening, or adequate drainage for rain and snow. An attractive landscape is more difficult to qualify, but usual standards for an attractive area include a landscape rich with foliage and a balance between shaded and open spaces. A detailed look at the resident evaluations of the sites does not concur with observations. Four of the nine ecovillages employed a landscape architect, Solbyn, Åkesta, Myrstacken, Understenshöjden. The appearance and function of Solbyn and Understenshöjden are very good according to the parameters outlined above. However, Tuggelite and Mjölnartorpet received the highest evaluations for both function and appearance.[13] Observation might indicate a high level of satisfaction with function in these sites because the site design is very effective, however it is not effective in terms of an edible landscape or vegetation that enhances microclimates through shade or wind blocks (see discussion of mircroclimate below). The survey question did not define the parameters of function, therefore residents were probably addressing site design as well as other elements. The appearance rating of Tuggelite and Mjölnartorpet is curious, both sites seemed rather barren despite being bordered by woods. The high rating for appearance is most likely attributable to the fact that the residents in both Tuggelite and Mjölnartorpet were responsible for the landscape design and execution. This sense of personal responsibility and an overall positive evaluation of these ecovillages is the most likely explanation for this. The low evaluations of Solbyn (48% - appearance, 42% - function), despite attractive and functional vegetation, is probably a reflection of the site design and exterior appearance of the houses. Numerous Solbyn residents expressed displeasure with a crowded site and the dark color of the houses.

Bålarna is most probably the best site in terms of function and appearance. The residents would most likely be very positive based upon an interview and the two survey responses. The site has the advantage of being located in an opening in the woods overlooking a lake. "*The site plan is good. Microclimates were considered in the placement of the houses. It relates well with the woods, the lake and the sun.*" The residents have planted many functional plants and continue to develop the site.

Details count: Little details do make a difference, wooden light poles are more attractive and feel more natural than metal poles, [Fig. 4] although

Fig. 4 - Contextual lightpost

both types fulfill the same function. Careful attention to detail makes Understenshöjden delightful to walk through. Rather than remove hills and boulders the landscape architects enhanced these features with, for example, a wooden berm on a hillside which follows the contours of the rock. [Fig. 5]

Welcoming vs. exclusive: Gated communities have been a trend of the 1990's in America. These "communities," clusters of houses, are surrounded by a foreboding two meter wall with one gate through which automobiles can enter upon furnishing the proper access code. Gated communities are not welcoming. They are the antithesis of welcoming. They welcome neither visitors or residents, both who are quizzed upon arrival (via the access) to determine if their kind is "allowed" into the "community." Pedestrians, apparently, are not allowed to cross the threshold without the accompaniment of an automobile.

Ecovillages are already perceived by many as exclusive, in part because it is a close knit community, and in part because they are physically separate because no city street runs through them. Some feel it is the role of the ecovillage to spread its concepts beyond its immediate residents. This requires the creation of a welcoming instead of exclusive first impression. No ecovillage is surrounded by a stone wall, but there are other ways to dissuade visitors and residents from feeling welcome: a poorly defined entrance to the site, inadequate lighting or walkways which intrude upon resident's private space. A welcoming introduction to a site might include: a clearly defined entrance, a sign indicating the name of the site and where the visitor can find a particular house number,[14] a path which passes a discrete distance away from people's private space, and sufficient exterior lighting for navigating in evening hours.

Good landscaping improves residents and visitors overall experience of a site describes landscape architect, Clare Cooper Marcus. "In a highly successful San Francisco co-op residents report that the high-quality landscaping and total visual milieu attracted them to live in the development; few specifically mention the architecture." [Copper Marcus 46] Landscaping details send messages to the residents. A bench or play area exposed regularly to strong winds says "stay away" even if the design is beautiful. The placement of an evergreen tree or bush can make the area more inviting year round. A dark entrance says "danger, back off."

Fig 5 Attention to detail

An awning over the mailbox area tells residents to stop and talk. A wide, exposed area says "keep moving," whereas an area defined by as much as cluster of trees or bushes or as little as a small flower bed can create a break in the landscape where people feel more comfortable stopping to talk.

Middle ground: Landscaping around houses can help establish a transitional space, or middle ground, between private and public space. A middle ground has been shown to enhance the quality of interactions between neighbors. A semi-private space might be defined by a flower garden, low bushes, garden furniture, a deck, patio, or semi-enclosed porch. The front porch seems to "provide for desired solitude without loneliness and social contact without intrusion." Through the provision of a middle ground, the porch has been shown to be a "vehicle to preserve community" in a study by Brown, Burton and Sweaney.[15] This study of the function of front porches in American residential neighborhoods reported that "porches were good places to talk to neighbors, and it was not uncommon for visitors to drop in when one spent time on the porch. Residents also report that they enjoy simply watching what goes on in the neighborhood from their porch." Conversations with ecovillage residents supported the value of this middle ground.

Parking areas: The first view of Solbyn from the street is of the parking lot. [Fig. 6] The only path into the site leads through the middle of the parking lot, a nice welcome for automobiles but not people. Although parking spaces near an entrance are often unavoidable, they do not need to dominate the view. Its appearance can be minimized in two ways. First, by placing the pedestrian walkway on the edge of the parking/garage area instead of through the center of it. Second, by placing trees between it and the pedestrian path. Vines growing on an arbor over the garage or carport can help conceal its appearance. All of the parking lots are finished with fine gravel rather than black asphalt or concrete. The gravel has a softer appearance than concrete. Isolated repairs can be made easily without resurfacing the whole area as is necessary with concrete or asphalt. An apartment house project in Örebro was concerned about allowing oil and other toxic substances runoff into the water supply. Their solution was to place a waterproof barrier under the parking lot. The water and other substances percolate through the surface and run into underground tanks. The liquid in the tanks can then be in the most environmentally safe manner possible. The surface of the parking lot is made of open, lattice-type concrete blocks. The blocks provide a hard driving surface but grass can still grow within the lattice. This solution is not inexpensive, but considering that non-point source run off, such as automotive oil is a significant source of ground water pollution, this solution is a very good choice for the environment.

Fig. 6 - Parking and carports are the first thing one sees at Solbyn

Walkways: The walkways in all of the ecovillages are made of fine gravel. This is a softer look than concrete or asphalt and allows for water infiltration. All of the ecovillages contract with a company to plow the roads, parking lot and walkways in the winter. See the earlier discussion under site design for a discussion of the location of walkways.

Micro-climates and energy conservation: A micro-climate in this context is the climate in a small area. A local hill, a watercourse, or a stand of trees will shift the micro-climate slightly. Harsh winter winds and unforgiving summer sun can make one spot nasty to be in, where just a few meters away can be a wonderful spot to be. Landscape features can influence the climate of small and large spaces. Deciduous trees can shade a home in the summer while letting in the sun from late fall to late spring when it is desired. Plants chosen for their beautiful smell or air filtering capacity can make reading a book in the back porch a delightful experience. A bank of evergreen trees can slow down harsh northern winds in the winter. Not only can shelter from the wind in the winter make the walk to the common house to do the laundry more pleasant, it can also save energy. The architect and landscape architect should ideally consult one another in designing the site. Their cooperation can provide a better overall experience for residents and further reduce the environmental impact of the project. A north facing front entry to a home is likely to be buffeted by harsh winter winds which means an energy loss every time the door is opened. If the front entry must be on the north side the landscape architect can choose vegetation which will mitigate that energy loss.

Lawns: Residents in Åkesta have agree to allow sections of the property to grow freely to encourage the growth of meadow plants. The residents share a push-mower for the parts of the lawn they do mow. [Fig. 7] The solution in Åkesta is worthy of consideration. Green lawns are nice to have, to play on and look out over, but from an ecological standpoint they are not as desirable. Gas powered lawn mowers are incredibly polluting, running a gas mower for on hour produces air pollution equivalent to driving 50 miles. Lawns are usually comprised of a single species of grass which supports a limited ecosystem in comparison to a meadow. A meadow supports a wide variety of wild flower, grasses, insects and other small animals. A meadow is not maintenance free, it will need to be mowed occasionally throughout the season. The appropriate stewardship of a meadow, or other options, should be researched before choosing an alternative to

Fig. 7a - areas left to develop into meadows

Fig. 7b - Residents share a push mower

green lawns.

Soil Quality: It is important to have a soil study done for the site. Soil quality effects: drainage on the site; the choice of foundations for the houses - especially whether a basement or other underground space is to be built; landscaping methods, especially for trees and other large plants; and for food production or gardening. In Tuggelite residents did not allow for the high clay content of the soil when planting trees. Consequently, the trees have grown very little over the years. Only recently did they learn a better method of planting. It is especially important to preserve, or create good quality soil in the garden area. Rocky soil in Solbyn makes gardening difficult.

Drainage: It is important to plan for rain drainage on a site. Smeden's soil has a lot of clay, but that is not the problem they ran into with landscaping. Puddles can be seen around the site for days after a rain. Myrstacken residents complained of the soil being so compacted by construction equipment that water just pools rather than soaking into the soil. Proper drainage and slope are also necessary for a well functioning on-site wastewater treatment system, especially a soil infiltration bed.

Native and climate appropriate plants: Banana trees in Sweden? I did not observe any plant choice as inappropriate as this, but I have seen such examples in the United States. I have seen lush green lawns and tropical rain forest plants grown in the southwest American desert. It is important to choose plants that are appropriate to local climate conditions. Plants that would do well in southwest Sweden would die of thirst and cold further inland. Plants should be chosen that can survive with little water beyond what nature provides. In addition to requiring more maintenance, exotics (non-native plants) can become invasive in an area where it has no natural resistance or predators. Plants otherwise beautiful in their natural environment can become a real nuisance elsewhere.

Edible Landscape: An edible landscape is a great way to provide shade, a windbreak and a supply of delicious fruit, nuts or herbs. See the gardening section for more on an edible landscape.

Long and short term planning: The appearance of the landscape should be considered from season to season, from year to year, and from the time of moving in to three-generations later. Careful short and long term planning can make a beautiful landscape year round, and for multiple generations. Several of the newer ecovillages had quite barren landscapes which is unfortunate. The experience of a landscape does not begin five years after moving in, it begins immediately and never ceases.

A row of closely planted oak trees may appear lovely today, but in twenty years they will be too close and some may consequently die. Plants do grow. It sounds absurdly obvious, but the mistake of planting trees and bushes too close to houses or to each other is far too common.

Plants grow slowly. Again, an obvious point, but all too often a site is cleared of all vegetation before building. A fifty-year old birch tree is a treasure to be preserved, not cut down to make way for a house. Every tree on the Understenshöjden site was accounted for prior to building and the builder was fined for every tree damaged or removed that was not marked for removal. Preserving trees is valuable, however, it is important to account for how the tree was situated prior

to building. A single large tree left in what once was a forest is likely to be blown over in the first large storm. The tree is not accustomed to being exposed to the elements on its own and its root system may not be sufficiently strong to support it in its exposed position. While residents are waiting for trees and bushes are growing into maturity there are many fast growing and colorful plants that can enliven the landscape in the interim.

The seasons change. There is no reason why an area can't be beautiful all year round, but it does require some planning to anticipate which plants will have colorful berries in the winter, or when plants will flower or show their fall colors.

Gardens and other food related concerns

The gardens are an integral part of the ecovillage concept. Gardening creates a closer connection between residents, nature and the food they eat. The gardens are a way to be closer to the food production cycle by removing the middle men of the food stores, and transportation. Other ways of increasing independence from the environmental impact of commercial food production is to buy in bulk, even collective buying from a local farmer. Bulk purchasing and self-production requires more storage room (at a cooler temperature), such as a root cellar.

Gardens and an edible landscape: The ecovillages all have sizable garden space, except for Understenshöjden. (Most households in all sites have a small area for flowers and herbs next to their home). It is understood that organic gardening is the preferred method of gardening although some people may fail to adhere to this on occasion. The garden area should have a source of running water and a clear policy about compost.

Fig. 7 - In Solbyn each household cares for one blackcurrent bush.

The gardens are located towards the edge of the sites. A large area is subdivided with a section for each household. Sections range from 10 to 50 square meters. Tuggelite has an additional shared garden space for plants like potatoes which take a lot of room to have a sizable harvest. Solbyn has an additional garden space for the daycare where the children get the opportunity to learn about where their food comes from. A gentleman in Solbyn related a story about a boy who was astonished when he learned that carrots grew in the dirt with a green top. The boy thought carrots just grew the way they were in the store.

Gardening was a primary motivation for moving in for at least three households in Solbyn, 3 in Åkesta, three in Understenshöjden[16], and one in Smeden. The gardens are well used. A frequent comment from residents was that it is "*hard, but fun.*" The gardens in Åkesta were already showing signs of hearty crops when I visited in May. Lindén found 34 of 40 households in Solbyn use their gardens and 21 of 24 households in Myrstacken use their gardens.[Lindén, 36] Eleven survey respondents from Solbyn wrote that they think the gardens are the most successful ecological feature

of the ecovillage. Solbyn's gardens are unique in several ways. All of the original landscaping was comprised of edible plants (herbs, fruit trees, nuts) which makes the whole area a sort of garden. One black current bush per household was planted in the central courtyard. [Fig. 8](Myrstacken and Åkesta have shared fruit trees as well.) Three residents wrote that they found the edible landscape to be the most successful ecological aspect of the ecovillage. Residents who would like more gardening space can loan plots from others on a yearly basis. Not everyone has time to garden all the time so this is a good solution. The plots in Solbyn different sizes so a larger household has a larger gardening space than smaller households. The Solbyn handbook, "Vi bor i Solbyn" (We live in Solbyn) advises residents to keep their lots free of weeds even if they are not gardening out of respect for other resident's lots. Organic-biological gardening is encouraged. Solbyn buys a large batch of manure for everyone to use each spring.

Poor quality soil is a concern for several ecovillages. Groups may want to consider making an initial investment in soil improvement for the whole gardening area. Over several years enough compost can be generated to significantly improve the soil. Prior to that, there are other ample sources of organic matter as well as a shared investment in renting tilling equipment to initially work the soil.

Understenshöjden has little gardening space due to the rocky wooded terrain of the site. Some residents have dug up their front yards to plant vegetables. When I visited discussions were in progress about how to increase gardening options.

Gardening tools can be a hassle to carry back and forth to the house between uses. A gardening shed or large watertight tool box near the gardens could prove very useful. The community should consider shared ownership of large or infrequently used, but essential gardening tools.

Collective purchasing: Several ecovillages have tried collective purchasing of goods. Collective purchasing is an excellent means of reducing the impact food transportation and consumption places on the environment, especially if residents can arrange purchasing from a local source. Energy savings can be obtained from reduced packaging and transportation. The purchase of organic foods reduces the impact of fertilizers and pesticides on the ecosystem. Collective purchasing often means lower costs for the residents. In the common house at Mjölnartorpet there is a sign up sheet for dry goods like flour, rice or pasta. The order is placed monthly and delivered to the common house where residents can pick up what they have ordered. Some groups have tried to coordinate with a local farmer. Cooperation with a local farmer may limit the variety available, for example three straight weeks sweet peas are the only vegetable available. However, residents do not need to work exclusively with one grower. Each group will be able to find different solutions depending on what is available locally. Two survey respondents from Solbyn specifically wrote that they thought collective purchasing is one of the most successful ecological aspects of the ecovillage.

Pantry: The pantry was nearly forgotten with the advent of the refrigerator but it is making a comeback. A large, energy guzzling, refrigerator is not necessary with a pantry. A smaller, more energy efficient refrigerator model can be installed instead. Many items need to remain cool but not necessarily as cold as a refrigerator, 4° C. Fruits, vegetables, condiments (jams, jellies, pickles, mustard), wine, etc. should remain cooler

than room temperature (20° C), but the refrigerator is unnecessarily cold. Some foods have less flavor when they are too cold, especially wine. The pantry serves as a good intermediate storage place between the root cellar and the dining table. Depending on the design, a small ventilation fan in an insulated pantry is all that is necessary to keep food between 8 °- 11° C. The pantry is cooled by running a pipe underground from several meters away from the house and into the pantry. A fan in the ventilation shaft draws air from outside, underground (where the temperature is a constant temperature of 8 °- 11° C below the frost line), and into the pantry. [Fig. 9] A condensing chamber underground draws excess moisture from the air.

Four of the ecovillages have a pantry in each kitchen, Solbyn, Åkesta, Smeden, and Mjölnartorpet. Survey evaluation of the pantry was insufficient draw any conclusions. The residents I spoke to who have a pantry had only positive things to say. Several residents in Tuggelite use their underground compost room as cool storage for canned goods, sodas and such.

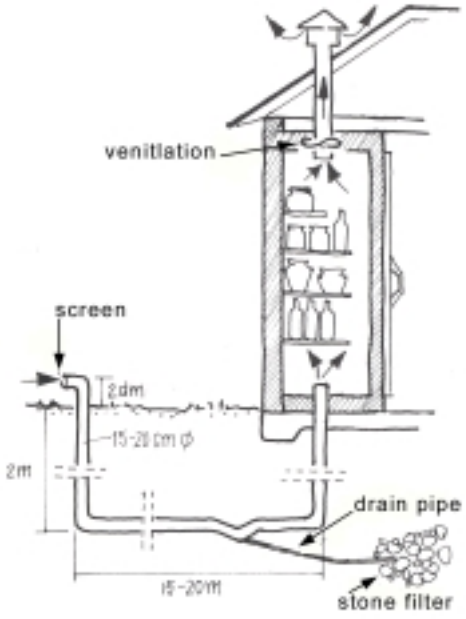


Fig. 9 - Earth chilled pantry, pipe must be below frost line.

Root cellars: Root cellars are a common site in the Swedish countryside. Refrigerators use an enormous amount of energy and are not possibly large enough to store a crop of potatoes, carrots or apples through the winter. A temperature regulated pantry off the kitchen is nice to have but you may not have room for 50 kilograms of potatoes and fifty jars of preserves, nor is the pantry cool enough to preserve these items for months at a times. Potatoes can keep up to a year in a root cellar; apples, up to seven months; carrots and cabbage up to six months. The two biggest dangers in a root cellar are freezing temperatures and humidity. Freezing can be controlled careful insulation. Mold, from excess humidity is more of a problem but it can be regulated with careful ventilation (a lot in the fall and little in winter and spring) and consideration of where different vegetables are best stored in the root cellar. Overheating can be a problem, but in the warmest months of the year there is little need for the root cellar. By the time apples, beets, and potatoes are harvested the weather is beginning to cool down.[17] The root cellar should ideally be built on a north facing hillside where it is shielded from the sun's hottest southern rays and kept cool by northerly winds. Residents unfamiliar with root cellars seemed to expect them to work like a natural refrigerator with constant temperature and humidity and therefore were disappointed. Anticipation of seasonal variation in performance will lead to a much more satisfying experience. Root cellars are also different from refrigerators in that you can't just throw in the food any old way. Apples should ideally be stored in a separate room near a vent as the high levels ethylene gas they give off will damage other items. Cabbage should be hung if possible, and so forth.[18] It takes a

Fig. 10 - Traditional root cellar in Åkesta functions well, but is inconveniently located

Fig. 11 - South facing fiberglass root cellar in Solbyn tends to overheat

little getting used to but the environmental benefits are great. Gardening is more valuable if residents can preserve their produce for a long period of time. Jams, tomato sauce, apple sauce, pickles and the like taste just that much better when canned fresh at home.

Five ecovillages have root cellars: Tuggelite, Solbyn, Åkesta, Bålarna, and Myrstacken. Residents of these assess the function of their root cellar as follows: 3%,very good; 37%, good; 17%, marginal; 24%, poor; and 11%, very poor. Åkesta has, perhaps, the best functioning root cellar. This root cellar had been part of the farm that had been on the site before. It is made in a classic style of stone built into a grassy hill. [Fig. 10] The entrance faces the south but it is shielded from the sun by trees. The Åkesta root cellar is located far enough from the houses as to not be convenient for regular trips, but for large quantities of jams, potatoes and the like it is a good storage option. The residents I spoke to said it functions well but its usage is intermittent as a result of its location. The Bålarna root cellar is concrete covered with earth. It works well except for some problems with overheating in the summer. I was told it is used enough to make it worth having. The Tuggelite root cellars are used very little. Ten of fourteen (71%) Tuggelite households rated the function of their root cellar as poor or very poor. The earth used to cover them was too thin and consists primarily of clay. The combination does not insulate well.

The root cellars in Solbyn and Myrstacken are the same, fiberglass models built into a south facing hill. Their appearance is somewhat space age. [Fig. 11] Walking into a traditional root cellar made of stone or brick evokes a feeling of nostalgia and a bond with the earth. The fiberglass models hardly evoke either of these reactions. Solbyn has had trouble regulating humidity and temperature. Trial and error has improved the results, 31 of 40 households use the root cellars in Solbyn [Lindén, 36] and three survey respondents wrote the root cellars are the best ecological feature of Solbyn. Mrystacken had not solved their problems by the time I visited. They had built stairs over the root cellars to shield them from the southern sun, but humidity was still a big problem. Ten of 24 households said they used the root cellars in Myrstacken. Three Myrstacken residents surveyed had very negative opinions of the root cellar. "*The root cellar has been completely*

worthless. They could never be used. Everything molds there, even the shelves." [Myrstacken]. It is unfortunate that neither the site at Solbyn or Myrstacken offered a good north facing location for the root cellar. A north facing entrance would surely have helped, the cellar would remain cooler and the north winds would help keep humidity down. The old-fashioned earth and stone model over fiberglass because the earth and stone can regulate humidity, fiberglass cannot. Although, stone root cellars also need proper drainage and ventilation to work properly.

Animals: Animals can be a nice addition. The hen houses in Solbyn, Bålarna, Myrstacken, and Understenshöjden are a popular destination, especially for children. The chickens do produce eggs and eat kitchen scraps but it appeared that their primary purpose was for enjoyment. Several residents in Ruskola keep pigs. Bålarna has several horses.

Fig. 12 - Chickens at Myrstacken provide eggs and fertilizer

Compost: The return of organic matter to the earth by composting is a ground principle of the ecovillages. Compost can improve the soil. Composting can reduce the amount of trash and reduce smell associated with trash. All of the ecovillages compost their organic matter to some degree. Methods of composting are discussed further the end of the Systems section of this chapter.

A note about design and the survey: Residents were generally satisfied with the appearance and function of built aspects of their ecovillage. Most answers wound up somewhere in the middle. Very few people cited aspects as "poor" or "very poor". More were inclined to choose the opposite extreme of "very good." By far, the majority of evaluations were good. [see Table xx at end of chapter] It is interesting to note that social evaluations do not correlate with the technical evaluations. In fact, the ecovillage with the poorest technical evaluation, Solbyn, has one of the best social evaluations. The poor technical evaluation is, in fact, justified and not just a reflection of more critical residents. The worst complaints about the technical side of the ecovillages are related to systems problems: heating, waste water, ventilation.

Common House

The services available in the common house are as important as its placement. The benefits of these services were discussed in the Social chapter. The design of the common house can further influence the quality of residents' interactions with this public space. As an extension of the home the common house should be as

welcoming and pleasant to visit as the homes surrounding it. The common house in most of the profiled ecovillages was built in the same style as the houses. The common house was also built to the same ecological standards as the houses; good insulation, windows, or ecological materials. The most frequently used common houses are in Tuggelite, Solbyn and Mjölnartorpet[19]; 85% of Tuggelite residents surveyed visit the common house once or several times a week, 66% in Solbyn, and 77% in Mjölnartorpet. These common houses have plenty of natural light, multiple services, and ample space for meeting. In Åkesta, Myrstacken and Smeden the common house felt drab and cramped. The central meeting room in Myrstacken had plenty of light but it was barren of interior embellishments. There was little furniture or color to delight the eye. It was apparent that this space was under-appreciated, regardless of what residents wrote in their survey. The same was true of the Åkesta. In fact the common house was so much smaller than the homes that it almost appears as an afterthought, not an integral part of the design. No common house gave the impression that its appearance was given adequate attention to make it a more inviting space than the individual homes.

The common house is a representation the community spirit. It is an extension of the home, not a warehouse for occasional required group meetings. Residents should resist the urge to "cut corners" to save money on the common house. If anything, the common house should be somewhat grand. Great care should be taken in its interior and exterior design. The furnishings and interior decorating should be attractive, not just utilitarian. It's design should be user-friendly, attractive and pleasant to use. It should be a beautiful space residents are proud to show off as a symbol of the strength and purpose of their community.

Fig. 13 - Southern exposure of Tuggelite commonhouse with greenhouse and solar panels
need better commonhouse photos

Multi-functional space: The rooms in the common house may need to fulfill multiple functions. The first floor of the Tuggelite common house was dedicated to day care during the day and the residents on evenings and weekends. A conflict occasionally arose between residents and the day care staff because it was difficult to put away everything from the day care everyday. The day care's occupation of the kitchen and large room during the day time in Solbyn greatly limited residents use of the space during weekdays which some residents found difficult to accept. Access to both residents and day care needs should be considered. If the common house is to be a multi-purpose building which enhances daily life for residents it should be available daily to residents in some capacity. (see office and business space below). Adequate storage space must be provided for multiple functions. A Ping Pong table is great to have but it takes up a lot of room. A space for storage of recreational and other types of equipment could help ease the transition between multiple functions of a room. The library in Solbyn is also the weaving studio, and provides space for other crafts. This is fine if the library is only for leaving and retrieving books but a conflict could arise when some

people want to do crafts and others want a quiet reading space. Multiple functions in a room be should be compatible.

Kitchen: The shared kitchen should be sufficiently large to cook for large groups on occasion, and have the corresponding equipment. Separate supplies and storage space should be defined if the kitchen will be used by a day care or for a business. The group may want to purchase special, but infrequently used equipment, such as supplies for canning, or a large electric mixer. A large oven for baking and a large freezer can allow residents to install smaller ovens and freezers in their own homes. A separate space for private dining functions might be considered. Residents can reserve the space for large dinner parties instead of needing to have the extra space, chairs, and tables in their individual home. The kitchen, and other appropriate areas of the common house, should have ample recycling/compost space. The Tuggelite common house has a green house which was used by the day care to grow vegetables and flowers.

Large and small spaces: A large room is good for large group meetings but a smaller, cozy space should be available for smaller group meetings or other small functions or activities. This space could be a separate room or the room could be divided through the placement of furniture or folding screens. If the latter option is chosen it is important to consider how different simultaneous uses might conflict with each other especially in regards to noise. Residents were asked whether or not they regularly met their neighbors while watching television in the common house. Most common houses do not have shared television or television room, 7% said they seldom met their neighbors there, almost all of whom live in Tuggelite. Most households probably have a television, and possibly a video tape player. Although progressive environmentalist may frown on the "mind altering" effects of television and its tendency towards social alienation, most people do occasionally watch television. A television room in the common house could be an opportunity for residents to rid themselves of their own personal set and also present opportunities for viewing quality movies and programs together which could foster discussions which might not otherwise occur one's private home.

Workrooms and projects: The typical home does not allow for large projects or messes. The common house can fill this need. Understenshöjden and Tuggelite have woodworking workshops. Solbyn has a darkroom. A resident in Mjölnartorpet thought their workshop is the one of the best ecological features. A project room with shared tools and machinery not only saves the group from having to own twenty sewing machines, twenty electric saws, and so forth, it also saves the extra space residents would otherwise need in their homes. A project room needs to be large enough for several people to work at once without getting in each others way. The room should have good lighting, proper ventilation and other safety features. It should have counters at a height appropriate for working (this is not the same as a height for reading or eating). It should have storage space for projects in progress and for equipment for the projects. Some projects, such as clay, are easily damaged while in progress, a safe space for storage is especially important for projects such as this. Shared machinery is a large commitment and residents will have to decide how to delegate responsibility for maintenance, repair, and replacements, as applies to all shared resources.

Laundry room: The laundry room, as described in the Social chapter, enhances the social system and reduced the residents overall impact on the

environment. It is of utmost importance to design a functional laundry room which is also attractive and pleasant to use. It should be big enough to allow several people to use it at once. A washer for heavy items such as rugs should be available. There should be ample space for folding, ironing, and line-drying clothes. (An outdoor drying area, set apart by a fence or bushes, can accommodate line-drying on sunny days.) Equipment should be arranged to follow the logical path of a person doing their laundry, for example, the folding table should not be between the washers and dryers as people folding would block the path of those carrying wet clothes to the dryer. The room should not be purely utilitarian. It should have natural lighting and an aesthetic comparable with the rest of the common house. The doors should allow easy entry and exit for those carrying laundry baskets. An automatic door might be best in this situation. An automatic door is not particularly ecological in of itself, however, if it can contribute to making shared laundry a positive experience it will off set the environmental impact that would arise if households installed their own washer and dryer.

Rather than being perceived as a hassle the shared laundry should be promoted as an opportunity for residents to take advantage of other services in the common house. The laundry room should connect to the common house in a manner that allows residents to access the rest of the building without having to go outside. While residents wait for their clothes to wash they can catch up on their reading in a library furnished with comfortable chairs or couches. Or they can work on a project in the workroom; a couple hours a week on a creative project can be an excellent outlet. Or they can catch up with neighbors. The common house can hold a wealth of possibilities.

Office and business space: Office space and businesses are a means of allowing some residents to work closer to home, part of the time or all of the time. They is also an excellent means of breathing life into the ecovillage throughout the day and the week. It is best for the group to decide in the planning stage if they want to allow office or business space in the common house. Rooms can be added later but at a greater cost than in initial construction. Separate and adequate storage space should be included to accommodate these additional needs. Office space for residents should connect to the rest of the common house. It may be a good idea for a business space, such as a retail or classroom space, intended for use by persons from outside the community to have a separate entrance to that space as well as a connection to the common house. The operation of a business should not fully prohibit the residents use of common house facilities during its hours of operation. For example, if classes are to be held in the large meeting room, the sole means of access to other spaces should not be through the large meeting room. Residents should be able to access the kitchen, the laundry, the workshop, without disturbing the class. The desired level of interaction encouraged by the design, i.e. openness to the larger space, should be discussed in depth as this choice will have a significant impact on the social dynamics of the space.

Storage

If storage space isn't provided for residents bulky items public space can become cluttered with peoples belongings. Storage space should be simple, user-friendly, and attractive and pleasant to use. It should have adequate lighting available for use throughout the day and the year. Several ecovillages built storage sheds for each household. Understenshöjden has a separate shed next to each home. Solbyn has a row of storage

Fig. 14 - Each home in Understenshöjden has a storage shed.

rooms on the northeast edge, by the gardens. [Fig. 14] In Smeden what appears to be a third garage structure is actually storage. The remote location of the storage space in Solbyn and Smeden could potentially be very inconvenient, which is good because it might dissuade people from keeping excess items, on the other hand seasonal items, such as gardening equipment should be easily accessible. Each house in Smeden has a small unheated room in the back of the house and some homes have unfinished attic space for storage. Here residents can store outdoor items that can stand extremes in temperature, but not excess water such as: skis, extra bicycles, gardening tools, lawn furniture, etc A storage shed is primarily utilitarian but it should not be an eyesore. Most of the storage areas observed blend in with the other structures.

Ample storage should also be provided for shared equipment. Easy access to shared equipment will increase the likelihood that residents will use it.

Wood storage: Storage space should be designated for wood if the homes are wood heated. The homes Åkesta and Myrstacken were built with the intention of using wood stoves for heating, but no storage space was built, causing haphazard, messy, and sometimes creative, solutions. [Fig. 15] Efficient combustion of wood requires dry wood. Wet wood is also prone to molding and attracting bugs and vermin, therefore adequate wood storage is more than convenient, it is an environmentally sound choice for maximum burning efficiency.

Automobile storage: Six of the ecovillages have garages. Ruskola has garages attached to the houses but the others have free standing rows of garages. A garage may be able to double as outside storage. The garage structure in Bålarna has a small overhead storage area and mini-workroom for each household. Solbyn and Myrstacken have carports. Carports and garages should have electric outlets available for engine heaters. A cold automobile engine produces much more pollution than a warm engine. It is important in a cold climate to keep an engine warm,

Fig. 15 - Neat verses messy storage of wood. Residents find their own solutions when one is not provided.

however, it is a waste of energy to heat the whole garage. These outlets might also be used for recharging an electric vehicle.

Bicycle storage: see the discussion of parking and other transportation in the site design section.

House Exterior

The exterior of the homes contributes to the overall experience of place. The traditional red wood siding with white trim and white framed windows was carefully chosen by four projects with the intention of portraying a link to Swedish building tradition, rather than endorse a public preconception of ecovillages as "different, weird or space age." Traditional designs and locally produced materials fosters a connection between residents and the history of the region. The traditional appearance was carried beyond national tradition to encompass local building traditions. White gingerbread type woodwork typical of Hälsningland graces the entrance to the homes in Bålarna. Rich yellow trim outlines the cooper red wood homes of Smeden in the style of Jönköpingsland. The houses are uniform in color and style, except in Ruskola. This uniformity distinguishes the houses as related to one another and as part of a whole, although some residents would have liked more variation. Choosing to use the same materials on all facades is also an economical choice.

Fig. 16 - Dry secure bicycle storage is a must

Residents were generally pleased with the exterior appearance of their homes, 30% cited "very good" and 46% "good." . Notable exceptions were Smeden where 83% of residents found appearance of the house exterior "very good." No residents in Tugglite and Solbyn found the exterior appearance "very good." In Solbyn 20% cited "poor" and 8% "very poor." The primary complaint in Solbyn is that the black siding and black roof tiles make the houses too dark. [Figures - montage of facades - 1 x 1 close up view of each type of facade with red and white house in center]

The sites which chose other types of facade did not stray far from "traditional" design. Ruskola and Understenshöjden homes are clad with vertical wood siding, the most common type of siding. Those homes in Ruskola are a variety of colors. The homes in Understenshöjden were finished with ferric sulfate, turning the wood a silver gray, and protecting the from rot and other elements. Residents in Understenshöjden have mixed feelings about the gray color, as is discussed further in the Understenshöjden case study. Solbyn and Myrstacken are finished with brick and wood siding (black in Solbyn, red in Myrstacken). The bricks are intended to capture heat from the suns rays during the day and transfer that heat into the home at night.

The rich copper red Swedish paint, known as *Faluröd*, has been used for many generations. Once applied, the paint protects the wood for far longer than any latex or acrylic paint. The pigment and oil penetrate the wood and protect it from water, rot, and insect damage. This environmentally friendly paint is comprised of four basic ingredients: pigment, water, linseed (flax) oil, wheat or rye flour. The red pigment is a by-product of cooper mining, but the same combination of oil, flour,

Fig. 17 - Clay roof tiles are durable and made of local materials

water and pigment can be used to make other colors, known as *slamfärg*, *slam* being a by-product of mining. Faluröd contained lead in the past, new production processes remove nearly all lead from the paint.

Roof: The classic terra cotta tile roof was the choice for most ecovillages. These interlocking red ceramic roof tiles, known as pantile tiles, have been in use in Sweden for centuries. The tiles are made of double fired clay. This process requires a lot of energy in production but they last a long time. High quality pantile tiles can out last the house itself, so long in fact that a market for antique replacement roof tiles has developed. The tiles are laid in rows, the bottom of one row covers the top edge of the one below. The grooves in the tiles combined with a sloped roof easily shed rain and melting snow. [Fig. 17] Broken tiles are easily replaced without having to replace the entire roof.

To cut costs, Smeden and Mjölnartorpet (?) chose to install red cement tiles that are similar in appearance to the ceramic red tiles. Solbyn has black cement tiles in the pantile, interlocking style. The black tile was chosen to attract passive solar heat.

Six ecovillages have roof top solar heating panels (Solbyn and Ruskola do not have any solar panels). Tuggelite and Mjölnartorpet installed all their solar panels on the common house. One household in Åkesta has installed solar panels. If considering solar panels the roofs should be designed with a slope appropriate for solar panels and with proper orientation in relation to the sun's path.

A correctly sized awning, or overhang, will shade a window from the sun when it is high on the horizon in the summer but let in the sun in the winter when the sun is low on the horizon

Drainage of water from rain and snow should be directed away from the foundation of the house to prevent water damage. Rainwater can be collected in a barrel (or some other type of tank) at the bottom of the gutter pipe and later used for watering in the garden. Accommodations should be made for overflow of the tank.

Neatness: Some people are inclined to be messy, other's are inclined to be neat. Rather than attempting to impose neatness on naturally messy people it may be easier to design for inevitable messiness. In Solbyn the apartments are small and interior storage is limited. Outdoor storage spaces are located at the far end of the site near the gardens. The result is that many residents use their glass room as storage space which creates a messy appearance. [Fig. 18] The same type of problem exists in Åkesta where no storage space was provided for wood or other large, exterior items. The result is that the edges of the woods are lined with signs of residents outdoor activities and storage which is not particularly attractive. [Fig. 15] Activities such as composting or chopping wood require space, these activities should be planned for. Ad hoc solutions will invariable lead to conflict and should be avoided by design. Adequate storage space is one part of the solution to messiness. Landscaping is another. Some types of plants require more maintenance than others.

Fig. 18 - The sunrooms do not account for inevitable messiness.

Those who are willing to put in the work to maintain elaborate flower beds can, but those who have less time or less interest in keeping up their personal outdoor space should know about low maintenance options such as vines or other ground covers which shade out weeds and require little extra water or other care. Low-maintenance landscaping could be the theme of a large group meeting and suggestions from this could be published in the newsletter. (see Social Organization in Social chapter for more on theme meetings and newsletters).

INTERIOR

> "So many houses, so big with so little soul. Our suburbs are filled with houses that are bigger than ever. But are bigger houses really better?" [7] "I've discovered living in my own Not So Big House that the quality of my life has improved. I'm surrounded in my home by beautiful forms, lots of daylight, natural materials and the things that I love…My house feeds my spirit." [5] Architect Susan Susanka designs *Not So Big Houses* for experiencing life rather than showing off.

Visible, simple, user-friendly, attractive and ecologically sound design is just as important inside the houses as it is outside. The experience of the individual in relation to their community and the environment is dependent on their experience of public and privabte space. Individuals need space to express their style and family values without interference; a space where they can feel free from pressure to conform to external expectations. Too much emphasis on public space can feel intrusive, whereas too much emphasis on private space can be isolating and counterproductive to the shared goals.

The emphasis on the appearance and function of the interior design of the individual home has increased since Tuggelite and Solbyn, however, the emphasis on common facilities has decreased. It is important to value both features.

Resident satisfaction with the appearance and function of interior spaces reflects the increased focus on these aspects in later ecovillages. Smeden received the most favorable evaluation, 92% of residents cited the interior appearance of their home as "very good," and 75% cited the function as "very good." The

architects in Smeden took great care to make the interior of the homes a beautiful space. In contrast, 28% of Tuggelite residents evaluated the function and appearance of their homes as "mediocre" or worse and 36% of Solbyn residents rated their homes interior appearance as "mediocre" or worse, and 16% for the function.

Material choice

"*Build healthy houses, not just energy efficient such as Solbyn.*" The emphasis on material choice as also expanded over time to include natural and healthy materials as well as energy efficient materials. Nine residents specifically wrote they felt the choice of natural and healthy materials was one of the best ecological aspects of the ecovillages. Twenty-seven residents, nineteen of whom, live in Understenshöjden wrote the general choice of ecologically-friendly materials was one of the best ecological aspects.

Natural materials such as solid wood floors finished with linseed oil, egg tempera paint, ceramic tiles, have gained popularity for their beauty, their ability to age well, and their tendency to have less energy and harmful chemicals used in their production. Healthy materials are gaining national popularity as more and more chemicals and building techniques are being linked to allergies, cancer, and other health problems. For example, particle board - wood chips adhered together to form a sheet or panel - used a formaldehyde based adhesive. Formaldehyde is very effective at preventing rot or insect damage to the wood because its fumes kill the microbes and insects. These same properties have proven harmful to humans exposed to these fumes over time. Particle board in Sweden no longer contains formaldehyde but other countries still use it. Many other examples of "sick building" materials are being regularly discovered. Some building techniques are also being linked to unhealthy consequences. Toilets mounted on the floor tend to trap dirt and microbes because it is difficult to thoroughly clean behind them. This and other sources of microbes are believed to contribute to an increase in allergies. Wall-mounted toilets, which are easier to clean under, are becoming more popular in response.

Some materials are fine once installed but can be hazardous to those doing the construction. The fumes from paints and varnishes are dangerous especially when applied in a small space.

New buildings, but especially renovation projects, will need to consider the possible toxins released from building materials during the eventual demolition of the buildings, or the decomposition of those materials. Additionally, some materials and construction techniques are more easily recycled than others. Although it may be generations before this is an issue is should factor into material choice if the designers want to ensure a "whole picture" perspective on building.

Floor Plan

A floor plan is more than designating square meters to particular uses. The focus should be on quality not quantity. We live in more square meters per person than ever before and yet many of the residents expressed a desire for larger homes. [statistic] This is more likely a reflection of an inefficient use of space rather than an actual lack of space. Careful design of the common house provides an additional means of reducing the total space required in individual homes. The floor plan should reflect the multiple needs of the users for open space, private/cozy space, working space, storage space, natural lighting, and beauty. For economic reasons it is best to make the floor plans of the houses as uniform as

possible. Every deviation from a standard design for the placement of walls and stairwells will cost more, not necessarily in materials, but for the builders labor costs. However there are a wide variety of means to allow for personalization while still having a standard placement of walls, bathrooms, and other fixtures.

The floor plans of most of the houses reflect ecological and privacy considerations. Kitchens and living rooms are generally located on the south side of the houses near the front entrance where there is the most light and most public. In warmer climates the kitchen would be located on the cool side of the house, but in Sweden cooling is not an issue. Bedrooms are generally located on the north side, where it is cooler, there is less light, and they are away from the public view. Many of the ecovillages included a transitional space between public and private needs such as a glass room or deck, see discussion of public and private space in the Exterior section.

There are many other things that are not so obvious which must be considered for a comfortable living area. Several technical considerations form a framework within which the residents' use of space must be contained. Designs for the most resource efficient design for plumbing, lighting, air and heat circulation, sound circulation, and electricity all define parameters for the floor plan. Plumbing should be localized, for example, placing a bathroom sink in the west wall and the kitchen sink on the east wall requires two separate water lines exposed to exterior walls, whereas if both were placed on either side of an inside wall costs and materials would be reduced and the pipes would not be as vulnerable to freezing temperatures. Seasonal and daily changes in wind and sun affect the temperature and amount of light in a space during a day which effects both the experience of the people inside and the amount of energy needed to heat, cool, or light an area. Effective circulation of air and heat can easily be in conflict with the need for sound barriers between spaces. This subject is discussed further in the Systems section on ventilation. The considerations for electricity are similar to the plumbing, but one addition consideration is creating spaces free from electromagnetic energy, this is discussed further in the Systems section on electricity.

Foundation and Frame

Foundation: The majority of the houses have a concrete slab foundation. Different techniques were employed to insulate the foundation and prevent the entrance of moisture: a skirt of insulation, gravel base, cellular plastic under base, insulated crawl space, to name a few. Mjölnartorpet and Smeden installed an insulated crawl space under the foundation. The crawl space provides an air pocket under the house which serves to insulate and keep moisture from the ground floor. The crawl space also provides access to utility lines, especially to the pipes in the floor heaters installed in portions of the houses. Basements are not common in Sweden. Radon gas, moisture problems, and high

Fig. 19 - Homes in Understenshöjden are on stilts in order to minimize the impact on the site

costs, and bedrock are deterrents to installing basements. The projects with composting toilets installed an underground concrete room for the compost containers. (Tuggelite, Solbyn, Åkesta, Bålarna, Myrstacken, Ruskola - in some homes)

Understenshöjden chose to build their homes on "stilts" rather than blast away the stone on the site. They wanted to minimize the footprint of the houses on the natural environment. [Fig. 19]

Care must be taken in providing proper drainage and insulation around the foundation to avoid mildew and other types of moisture damage. Moisture from the ground is the most common source of moisture damage to a home. [Bokalders, vol. 1, p. 131] The repair of moisture damage usually requires extensive work requiring the replacement of damaged areas. This is costly, both environmentally and monetarily. Mildew can also be dangerous to residents' respiratory health.

Frame: Most of homes have wooden frames. Tuggelite and Solbyn used light concrete as a bearing structure as well as in the walls and floor as part of passive solar design. See the *Walls* section for more information.

Insulation

The insulation trend in environmental building is to use cellulose fiber and a paper diffusion layer instead of a plastic vapor barrier. The most popular type of cellulose fiber is Eko-fiber,Ó made from recycled newspaper impregnated with borax (borsalt) against insect and fire damage. Four of ecovillages used mineral wool. From an environmental standpoint, mineral wool is superior to fiberglass or rockwool, but cellulose fiber is still considered the most environmentally desirable. Cellulose fiber is installed on site with a blower whereas mineral wool is installed in sheets. Blown in insulation is more likely to fill every nook and cranny, reducing the chance of cold air passing through, except when it settles, more must be added. Cellulose fiber can also absorb and release a small level of moisture, whereas mineral wool cannot.

Plastic vs. paper barrier. Plastic doesn't allow any transfer of moisture between inner and outer walls causing condensation and mildew. The latter projects used a paper barrier instead of plastic. The cellulose fiber insulation can absorb x% moisture without a negative effect on its insulative properties.

In addition to insulation in the outer walls and roof/ attic, insulation was installed in the floors, foundation and inner walls. Interior insulation helps to reduce sound travel.

All of the projects exceeded the minimum Swedish building standard for insulation (SBN).

Describe what U-value is.

Three Solbyn residents specifically cited good insulation as best eco feature. "Warm in the winter and cool in the summer."

Floors

If monetary cost were not an issue, several groups would have chosen solid wood floors, ceramic tile (clinkers) in the bathrooms, entry, utility room, and kitchen. Wood and clinkers are natural products that feel good on the feet as well as the eyes. Three projects installed floor heaters under the clinkers in the bathrooms, front entry and the option for more. Unfortunately, cost and construction limitations required compromises. Understenshöjden was steadfastly against having plastic flooring in the bathroom. It was the only project able to completely avoid plastic flooring. The earlier projects had parquet and laminate floors in the main areas of the

houses. The later projects tended towards solid wood floors finished with oil. The solid wood floors require more maintenance than the parquet floors but they age well and can last for years. The parquet floors and plastic mats give off fumes. I felt better walking on the wood and tile floors. I felt connected to the natural materials.

The floors in wet areas (bathroom, utility room, kitchen) require special attention to prevent water damage.

Walls

The interior walls are predominantly drywall finished with: wallpaper, spackling, or latex paint. The later ecovillages tended to choose paints made from natural materials that did not emit harmful fumes. Mjölnartorpet and Understenshöjden used egg tempera paint. The color of egg tempera becomes richer over time. It lasts a long time without reapplication. It does not emit harmful fumes during or after application. The walls in Smeden are finished with a beeswax milk paint applied over a microlite weave (to help with adhesion). The beeswax paint has qualities similar to the egg tempera: natural, enhanced color over time, long-lasting, and it has a wonderful smell during application. The cured colors are rich and warm.

Åkesta installed a heart-wall made of brick. The brick wall faces a bank of south facing windows. It absorbs the suns heat and slowly releases it into the room. Solbyn was also supposed to have a heart-wall, but the original plan was so modified (to cut costs) that it does not function in this manner. In Understenshöjden the walls surrounding the downstairs bathroom are made of brick, lined with ceramic tile on the inside. The primary reason for this wall was to drastically reduce the chance of water damage from the bathroom but the thermal mass of the brick can help store heat as well.

Part, or all of the bathroom walls in all of the projects are finished with ceramic tiles. Showers were not in frequent use in Sweden until the 1960's. Bathrooms were lined with wallpaper and were not withstand to withstand the humidity levels or splashing from frequent shower use. The trend in all full bathrooms in Sweden is to install floor to ceiling ceramic tiles in order to prevent water damage. Splash areas above sinks also have ceramic tiles for the same reason as the bathrooms.

The walls in the bathroom of the first floor of Understenshöjden homes are made of two layers of brick. "In the beginning the idea was for the bathroom to have its own foundations, comprised solely of inorganic material. Then one can simply let the water run onto the ground without damage. All the walls are 'genomsläppliga för fukt, so one could let the moisture transfer to and from the bathroom. But now the foundation under the bathroom is of the same construction as the rest of the house. There are wooden beams which can rot under the bathroom floor, therefore we had a vapor barrier installed around the entire bathroom behind the tiles and under the clinkers on the floor. Ideally, the tiles should be put up just with mortar."[20]

TG and SOL…The concrete receives the sun's heat during the day. At night the heat stored in the concrete radiates into the house. Light concrete walls are less sensitive to mildew and can take up and release a small amount of moisture.

Woodwork

Beautiful carpentry is a Swedish tradition. Several of the projects paid special attention to the woodwork. The woodwork in Åkesta, Smeden, Mjölnartorpet and

Understenshöjden is a traditional soaped[21] or oiled pine. The woodwork provides a warm, natural feel to the house. The oil finish improves the visual character of the wood over time. The oil, usually linseed, is from a natural renewable source and does not contain toxic fumes, unlike many petroleum derived finishes.

Windows

Windows shape the experience of a building. Imagine a windowless building with fluorescent lighting. Now, imagine a building with large windows and skylights and the sunlight streaming in. Where would you rather be? Not only does daylight effect our mood, it also effects our electricity bill. Natural light can reduce the need for electric lighting and reduce electricity bills, if the windows are energy efficient.

Despite the many benefits of windows, they are also the greatest source of energy loss in a home. Fortunately, window technology has improved dramatically over the last decade. Now you can have large, attractive, and energy efficient windows. The windows on the North facade in Tuggelite are triple glazed (three layers of glass) and intentionally very small to reduce heat loss. Today, a double paned window with a low emissive coating is nearly as energy efficient as a triple glazed window of a decade ago. Energy efficient need not be ugly.

Accommodating natural light in Sweden and at other extreme latitudes requires extra care due to the extremes in daylight hours. Summer sun can overheat a house. A bank of windows on the south facade may be delightful in the fall, winter, and spring, but agonizing in the summer. In Ruskola (just below the Arctic Circle) east facing windows are far more desirable than south facing windows because the nearly 24-hours of sunlight in the summer is overpowering against south facing

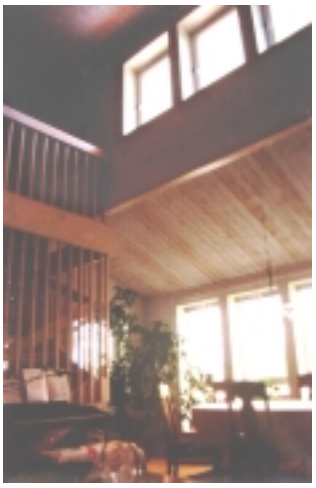


Fig. 20 - Spring sun in living room at Åkesta

windows). Reflective curtains and roof awnings can help deflect some of the summer sun. Reflective Venetian blinds can be installed inside the windows (between glass panes). The blinds are then out of the way and require less repair and maintenance than exterior blinds open to jostling and dust. Residents I spoke to in Åkesta were particularly pleased with the accommodation of seasonal sunlight in their living areas. [Fig. 20]

Heat is lost through the frame of a window and through the glass itself. Multiple panes of glass, low emissive coatings and argon gas or gel filling are methods to reduce heat loss through the glass itself. A standard double glazed window has a U-value of approximately 3.0 $W/m^2°C$, and a triple glazed window, 1.5-2.0. The most energy efficient window, with a vacuum seal and aerogel (transparent insulation) had a U-value of 0.3 [Ekobygg, p. 44]. This technique is still rare, unattractive and expensive. Triple glazed windows with low emissive coating in Solbyn have a U-value of 1.6. Today, similar windows have more attractive frame options and an improve U-value of just under 1.0. The lower the U-value the more energy efficient the window.

Understenshöjden place the more emphasis on choosing their windows than any other ecovillages.

Great care was taken to choose windows that had attractive frames angled on the interior to let in more light. Double-glazed windows were chosen over triple glazed so residents could still hear the birds singing through the windows. Not all residents were pleased with the compromise of energy efficiency for aesthetics. After reading the glowing descriptions of their windows I expected Understenshöjden residents to be unanimously overjoyed with their windows. Surprisingly, it was the residents of Smeden who were most satisfied with the appearance and function of their windows. The windows in Smeden are triple glazed with a low emissive coating and the frame is angled 10° to the inside to let in more light. 92% of Smeden residents surveyed (11 of 12) found the appearance and function of their windows to be very good. Whereas, 69% (20 of 29) of Understenshöjden residents surveyed called the appearance of the windows very good, and 24% (7 of 29) sited the windows function as very good. I found the windows beautiful in both places. Perhaps residents' expectations were too high. Residents did not comment specifically on their windows, expect for one person who said the windows were hard to clean.

Fig. 21 - Tuggelite residents get an early start growing seedlings in their enclosed porch

Not surprisingly, in Solbyn and Tuggelite; where energy efficiency and not appearance was the key consideration in choosing windows, residents surveyed were not notably pleased with the appearance or function of their windows. In Tuggelite 21% (3 of 14) said appearance was very good, 0% in Solbyn. Regarding function, 7% (1 of 14) in Tuggelite marked very good, and 12% (3 of 25) in Solbyn.

Glass rooms and porches

A glassed in porch can fulfill many functions: a green house, a transitional space between outdoors and indoors and public and private, part of a passive solar heating system, an extra room, and a place to extend the enjoyment of the spring and fall. Five of the ecovillages have glassed in rooms. The general feeling about the glass rooms is that they are good, with some comments to either extreme. Solbyn residents were the most disappointed with their glass room. Because the glass in the Solbyn enclosed porch has only on pane it is ineffective in retaining heat and therefore is ineffective as a green house or as a substantial source of passive solar benefits. Some residents have installed unattractive reflective curtains to help even out the temperature other's gave up on using it for growing plants and instead use it for extra, visible, storage. Three Solbyn residents wrote that the glassroom was the most effective ecological feature. However eight wrote negative comments such as: it is hard to clean, they want double paned glass, it is "*Good as a sunning and relaxing*

room but not for heating or growing tomatoes, " and "*the green house is no green house but a glass box.*"

In Solbyn the houses, like Tuggelite, were designed more with energy efficiency in mind than beauty, but many neighbors have spruced up their home with rows of flowers growing outside and inside their glassed in porch.[Fig. 21]

Entry

A vestibule is essential in a cold climate. The vestibule should be large enough so that one door can be closed before the other is opened. The vestibule serves as a buffer preventing cold air from rushing directly into the house. Many residents also use the space for storing boots and coats. Although energy inefficient, several residents expressed a desire for a heater in the vestibule in order to raise the temperature for putting on boots and coats in the vestibule instead of tracking snow and dirt into the house.

Kitchen

We spend a lot of time in our kitchens preparing food, eating, talking, cleaning up. An attractive and well organized kitchen can help make life a little bit easier it can also encourage eating at home over eating out. Sufficient storage space is especially important for families that purchase their food in bulk. A lot of counter space and a large sink is essential to anyone who cooks a lot especially if you grow your own vegetables. Easy access to a compost container is a must. The kitchen in Understenshöjden is probably the most visually pleasing and user-friendly. [Fig. 22]

Fig. 22 - Natural materials and daylight contribute to resident satisfaction with their kitchens in Understenshöjden

SYSTEMS

"*Try to find technical solutions which minimize labor and complicated mechanisms*." [Solbyn]

"*...should be simple and understandable, should function effectively and be easily maintained. People don't always think past their own noses.*" [Mjölnartorpet]

"*Think and plan carefully, Don't save money through lower quality. Think long term and chose a little stronger than to discover, for example, the furnace is undersized in relation to the number of persons expected to live in the house.*" [Myrstacken]

More than anything else, the systems of the home must be visible, simple, and user-friendly. The systems were a source of more discussion and comments than any other design aspect. The residents may have been most critical of the systems' performance because the systems require regular maintenance and are the most easily identified source of environmental performance. Most people are used to staying warm, flushing the toilet, taking a hot shower with the flick of a switch or turn of a faucet. We pay the bills and let a local company deal with any problems that arise. The environmental impact of it is the company's problem, not ours. The tables are turned in the ecovillages. Suddenly, a warm home is a personal matter. You have to monitor the furnace, the accumulator tank, what you put down the sink, or else it comes back to haunt you. The combination of personal responsibility for the maintenance of the systems with high expectations for ecological performance led to a critical evaluation of the systems. The appearance of the houses, the efficiency of the windows; these are fixed, determined at the time of building. Not much can be done to change them. Residents may be more inclined to put a positive spin on them because they are beyond their control. This is not so with the systems. The systems are also more complex and therefore more vulnerable to failures.

As a general rule for all systems; systems should be correctly proportioned for the use they will get. The obvious disadvantage of system that is too small is that it is inadequate. A system that is too large can also be a problem. Most systems have an optimum functioning level. A furnace that is run below its optimum capacity creates more pollution than it does at its optimum level. A discussion of the trials of maintaining these systems is discussed further in the Social chapter.

Heating

A wide variety of heating methods have been tried by the ecovillages. Whatever solution is chosen must be tailored to the project as well as to the commitment of the residents living there to maintain the system. Because summers in Sweden are relatively cool for all but a couple weeks I will not discuss cooling requirements.

General evaluations of the heating systems were varied from excellent to horrible with the majority somewhere in between. Unlike other evaluations where few people cited an aspect as poor, 23% rated their heating system as poor. Expectations of the heating systems were very high and many technical and maintenance problems have arisen over time. Resident's comments are relayed throughout the discussion of the heating systems.

A project can capitalize on the natural advantages

of an area. Bålarna, for example, own 67 acres of woods. Heating with wood was the best choice for them. This is only sustainable because the wood is on-site and can be harvested without exceeding the natural rate of regeneration of the forest.

The heating systems in the ecovillages incorporate multiple heating techniques on an individual or a shared scale. The general types of heating can be divided into 5 categories: conservation, passive solar, active solar, a furnace attached to an accumulator tank, and electricity (natural gas is uncommon in Sweden). Which leads to a discussion of ventilation.

Conservation:

An important part of a heating system is what doesn't need to be heated, or the energy efficiency of a home. Energy conservation, specifically conservation of heat, is primarily dependent on the construction of the homes and the actions of its residents. The most well sealed door in the world is useless when it is left wide open. An extra sweater can allow residents to turn the thermostat down a degree or two. A well insulated home, with energy efficient windows and tight seals around doors, windows and other openings to the outside, requires less energy to heat than a poorly insulated home. A double door entry is an excellent way to reduce the entrance of cold air into the core of the house. A round home would lose the least energy because it has the least surface area, however, since this is not usually practical, a cube design is the next best option. In the case of most of the ecovillages, they chose to build duplexes or row houses so that each home has at least one, if not two shared walls. Although window technology has come a long way, windows are still a large source of heat loss. If bedrooms are placed on the north side they don't need to be kept as warm, nor do they need as much light as other parts of the house so windows on the north side can be slightly smaller or less frequent. Tuggelite and Solbyn took this concept to the extreme, but Understenshöjden went to the opposite extreme of ignoring it, something in the middle is probably best. Individual thermostat control of the radiator in each room can allow residents to heat just the rooms they are in. We spend most of our time in our bedrooms sleeping with blankets over us, there is no need to keep the bedrooms as warm as the kitchen or an office where we spend a lot of time during the day. The ventilation system in a home can also effect its energy efficiency. A heat exchanger can pre-heat cold air coming into the house. This is discussed further under the ventilation section. Energy efficient construction is discussed throughout the Interior Design section.

The combination of conservation measures and passive solar has, in experimental houses, reduced the average need for supplemental heat for a home from 20,000 kw/year to 2,000 kw/year. Super insulated homes even take advantage of the heat people and appliances radiate. Multiply that by ten years and x cents (x crowns) that is x dollars (x crowns) savings in heating costs alone.

Passive Solar:

The basic principle of passive solar heating is to take advantage of free energy from the sun. Passive solar techniques can employ landscaping and/or construction in the home. Landscaping techniques: wind breaks, shade in the summer, light in the winter, etc. are discussed in the Landscape section of the Design chapter. Passive solar design should really be called climate appropriate design. It employs a lot of common sense combined with energy efficient design and a little technology. Design considerations such as the placement of rooms, orientation of the houses, size and number of

windows, and type of shading all reflect seasonal changes in weather and sun exposure. Most of the houses showed sensitivity to basic passive solar principles.

The literature on passive solar design is extensive. Books are recommended at the end of this chapter.

Active solar:

All the ecovillages that instabgvlled an active solar heating system employed a similar method. There are two types of active solar energy collectors; solar panels and photovaltacis. Solar panel systems transfer the sun's heat to a liquid in the panels. The heat from the liquid is used to heat the house. Photovaltaics systems convert the sunlight into electricity. None of the ecovillages have photovaltaics.

Solar panels are mounted on a south facing roof at a 15-22° angle. The orientation of the roof from true south can vary up to 15° without significant loss in efficiency. The panels have a black background over which have a series of pipes run and is covered with glass. A mixture of water and glycol circulates through the pipes. (Glycol is harmful to the environment, an adequate substitute has not yet been found. The glycol raises the boiling point and lowers the freezing point of the water, like antifreeze, thereby making the system less sensitive to extremes in temperature.) The liquid is heated by the sun and runs into an accumulator tank filled with water. The heat from the liquid is transferred to the water in the tank (the dissipation of heat to the water is a law of thermodynamics, that a hot, releases its heat to the system it is contained in until an equilibrium temperature is reached, thereby cooling the liquid in the pipes and heating water in tank.) The heated water can then be used throughout the house in the radiators, shower, sink, etc. The larger the area of solar panels the greater its heating capacity. The system requires electricity to run the pump circulating the liquid. The solar panels provide substantial heat from about March to October. Additional heat can be gained during the rest of the year depending upon the weather. The solar panels could provide heat even on a frigid December day if the sun were shining. The heating system is dependent upon a temperature change between the liquid circulating and the water in the tank, not on the outside temperature. The liquid is always circulating, ……. Because the home is not being heated in the summer, and heat is only needed for washing, the ecovillages have an excess of energy in the summer.

Solbyn, Ruskola, and Åkesta (except for one home) do not have active solar heating. Tuggelite, Mjölnartorpet and Bålarna have shared solar panels. Myrstacken, Smeden and Understenshöjden have solar panels on each home. Residents at those sites with solar panels wrote as one of the most successful ecological measures in the home.

Specific citation of solar panels as a successful ecological measure

TG	MY	SM	BÅ	MJ	UN
3 of 14	3 of 7	5 of 12	2 of 2	1 of 13	11 of 29

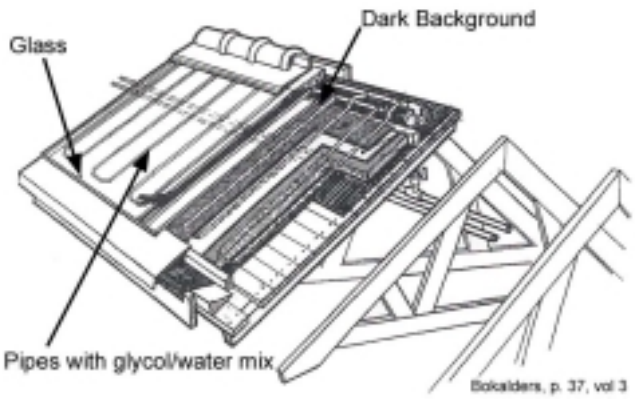


Fig. 23 - Typical solar panel

Concerns about the solar panels were related to the size of the accumulator tank and placement of the panels. Residents in several ecovillages relayed to me that they either had or were considering adding a larger hot water accumulating tank. It is a difficult but important task to determine the ideal dimensions for a system. Hot water is used less from late spring to early fall, but that is when there is the most sun. A larger tank can store the hot water over a longer period, thereby getting residents through occasionally cloudy or cold days without having to resort to electric or wood heat. Everyone I asked said there was an excess of hot water from the solar panels in the summer months. In regards to dimensions, a resident in Mjölnartorpet wished the array of solar panels were larger.

The majority of the solar panels in Myrstacken face due south. The others face nearly due west or east. These households do benefit from the solar panels but not as much as the other households. (See site drawing to see which houses face a different direction.) A resident in Myrstacken felt a shared solar heating system with proper southern exposure would be a better solution. Several residents in Understenshöjden were dissatisfied with the placement of the solar panels, saying they were too low and not getting sufficient exposure to the sun.

Word of the successful use of solar panels has not been lost on the residents in Solbyn where solar panels were not installed due to expense (in 1987 solar panels were more expensive and of lower quality than today). Half of the residents responding to the survey (13 of 25) wrote of their desire for solar panels. Solbyn's heating system is discussed further under electric heating in this section.

Active solar panels are not just an excellent source of free energy (free after the equipment is paid for at least), they are also an excellent method of creating a tangible connection between individuals and their environment. Residents can see and feel the results of choosing an environmentally friendly heat source. Residents with accumulator tanks in their utility room showed off their systems with pride. Explaining in depth how to monitor the amount of heat gained from the solar panels. It is a simple, visible and user-friendly system.

Furnace with accumulator tank:

All of the ecovillages, except Solbyn have some variation on a system where a furnace or stove is attached to an accumulator tank. The basic principle behind this type of system is similar to the active solar system described above. A heat source: a wood burning stove, electric element, or the like, heats a liquid piped next to the heat source. The liquid is pumped into the accumulator tank where it heats the water in the tank. All the systems have an electric heater as a back up source of energy. Hot water from the tank can then be used for washing or be pumped into radiators for heating. Radiators can be along the wall or under spread out under the floor or a combination of the two. The ecovillages have two basic types of systems: a central heat source (district heating), or individual heat sources.

District heating: Tuggelite, Mjölnartorpet, Bålarna and Understenshöjden have district heating where the common house has a large furnace and a large accumulator tank and the hot water is piped to the houses via a network of underground culverts. District heating is a common technique in Sweden, Uppsala, a city of 175,000 is heated almost entirely by a single district heating facility. The advantage of district heating is efficiency. Wood, or any other combustible material,

burns most effectively (producing the most energy with the least amount of emissions) when burned intensely at its maximum temperature. District heating allows a more efficient burn than individual systems. Per person, district heating requires less maintenance than individual systems. It also allows a wider range of fuel to be burned at its maximum capacity. Some fuel burns more efficiently than wood, also some fuel has a lesser impact on the environment than wood logs. The draw backs, compared to individual systems, is that a central furnace must produce a certain amount of energy or else it is very inefficient. This becomes a problem at times when warm days are sporadic and the homes need just a little heat, less than the furnace will provide at optimum burn, but more than the active solar panels provide. Another drawback is ambiance. A wood burning stove creates a cozy feeling in a home. Most importantly, residents have to stoke the stove in an individual themselves thereby being more aware of where there heat comes from and how much wood it is using. A Mjölnartorpet resident described the lack of visibility and simplicity in the shared system with the simple statement, the heating system is "*mystical.*"

Types of fuel: Tuggelite, Mjölnartorpet and Understenshöjden use pellets furnace. The pellets, about the size of rabbit food, are made from compressed sawdust, a "waste" product from the forest industry. The furnaces automatically feed the appropriate amount of pellets to keep the furnace burning at an optimum temperature. Residents regulate the temperature in their homes with individual thermostats on each radiator. Maintenance requires periodic checking of the system (every other day) to ensure there is an adequate supply of pellets and that all systems are working properly. Bålarna uses logs chopped from on their site. They also burn most of their non-organic trash. Stoking of the

Fig. 24 - Hopper for wood pellets at Tuggelite

furnace is done manually. Residents every fifth week each resident has furnace duty.

The gentleman giving me the tour of the furnace room in Tuggelite glowed with pride while explaining the trials of finally acquiring an efficient furnace. Five people on the furnace committee rotate responsibility for monitoring the furnace. The other residents bask in the glow. Energy wise, the district heating system (if well built) has a smaller impact on the environment than individual systems. More heat can be produced with less fuel and there are less emissions. However, I can not say if residents might be more concerned with energy conservation if they must personally perform a physical task (stoking a wood stove) and can personally monitor the temperature in their accumulator tank.

The Tuggelite, Mjölnartorpet, and Bålarna systems are entirely centralized with the furnace and active solar panels both connected to a central accumulator tank. Although, residents did have the option of installing a kakel ugn (see definition in next section), or open fireplace. These are more for ambiance than heating. The furnace in Understenshöjden is central with a central accumulating tank, but each house also has an array of solar panels on their roof connected to an accumulator tank in their front entry.

Four residents in Tuggelite felt their heating system

was a successful ecological measure so efficient that "*two radiators are enough to heat the whole house.*" Two would have chosen a different system which may be a reflection of all the initial technical problems they had with the system. One important concern raised was the lack of individual meters for the heat. Instead of individual meters the heating costs are divided equally between households. I would highly recommend individual meters on a central system, not so much because of equitable costs, but because without some way to monitor how much energy you and your household is using it is hard to determine if you are being stingy or extravagant with your energy use.

Mjölnartorpet had some construction problems with their systems. The culverts carrying the hot water from the central tank to the houses are not well insulated resulting in a large loss in energy. This construction mistake is most unfortunate. It would be expensive to fix and some residents expressed significant disappointment in the system: wrong construction, inefficient, refill of pellets too frequent and increases environmental impact of transport.

Residents in Bålarna seem extremely pleased with their heating system. All the residents actively participate in the heating of their homes: from the big wood collecting day that everyone participates in to their individual turns at stoking the furnace. I am hesitant to endorse heating with wood because it requires cutting trees solely for the purpose of burning them and the air pollution is greater than with other forms of fuel. However, in the case of Bålarna I make an exception. Because the residents cut the wood themselves they can be responsible stewards. They know their woods very well. They can choose which trees to thin out, and which to keep, almost like gardening with trees, whereas a lumber company, or someone harvesting wood for profit, is hard to monitor. They may or may not be careful in selecting trees according to their place in the forest ecosystem.

Understenshöjden has had some problems with their system, especially with balancing the shared system with the individual solar panels. [[some have kakel ugn, but not allowed in all due to proximity to urban area]] Twelve of 29 residents wrote negative comments about it: too complicated, hard to maintain, poorly constructed culverts, etc. Five residents wrote positive comments about it. One resident raised an important point. "*The heating system is unnecessary because we are so close to district heating.*" The group chose to have a local solution instead of connecting with the nearby district heating network for the Stockholm suburb. A system just for the ecovillage makes them more independent and helps residents maintain a closer connection with where their heat comes from. Hågaby, an ecovillage under construction outside of Uppsala, faced a similar quandary. Uppsala Energy, the company that supplies district heating for the city, is one of the most environmentally advanced heating companies in the country and getting better all the time. Hågaby wanted autonomy, but they decided in the end to connect to Uppsala Energy's system because it was the best choice for the environment. Their compromise was to install a large array of active solar panels on a central building. The solar panels will provide hot water for washing for the ecovillage and the surrounding neighborhood. The solar panels offer a way for residents to feel personally connected with where their hot water comes from but without compromising the efficiency available from the city system for heat.

Individual/household systems:

Åkesta, Ruskola, Myrstacken, and Smeden have

a separate heating system for each household.

Smeden and Myrstacken have similar heating systems, but the few comments from Myrstacken were critical whereas the comments from Smeden were very positive. Both systems have accumulator tanks heated with electricity (electric heater runs at night when electricity is cheaper). Wood heated stoves are standard in Myrstacken. The wood stoves are not connected to the accumulator tanks. Judging from the stacks of wood in front of peoples homes, many residents prefer to use the wood stove for heating over electricity. (This may seem more ecological but it is not necessarily so, see the discussion of wood heat below.) There are no floor heaters in Myrstacken which in one residents opinion, was a mistake. " *The floors in the house (clinkers directly on cement) lack heating pipes which leads to and increase heating need in the winter which would have been unnecessary if another method had been used.*" [Myrstacken]. Wood stoves were optional in Smeden, the majority of residents chose to install a kakel ugn. The stoves installed were kakel ugn with a water blanket. Heat is transferred via the blanket to the accumulator tank. Heat also radiates directly from the stove. The only negative comment I heard about the Smeden system was a desire for a larger accumulator tank.

Kakel ugn: Kalel ugn are a special type of ceramic stove or fireplace invented in Scandinavia in the 18th century. …… Modern versions with water blanket attached to accumulator tank. … Expensive, heavy...Heat radiates slowly from ceramic blocks as it circulates through internal channels. [Fig. 25,26]

Each household in Ruskola chose a different system. I am not able to adequately describe their systems.

The Åkesta system uses an electric furnace that heats air blown through a network of ducts. Each kitchen also has a wood stove attached to an accumulator in the utility room the accumulator heats water for washing and for radiators in the bathroom. A few houses have floor heat in the entry. The residents I spoke with use their wood stove as much as possible and avoid using the electric furnace. The designers of the system apparently expected the wood stove to be used infrequently therefore the accumulator tank is too small for it actual use. Every survey respondent wrote something critical about the heating system: three wanted floor heaters, two wanted a larger wood stove and accumulator, and other general comments - not

Fig. 25 - The efficient wood burning kakelugn is common in Swedish homes

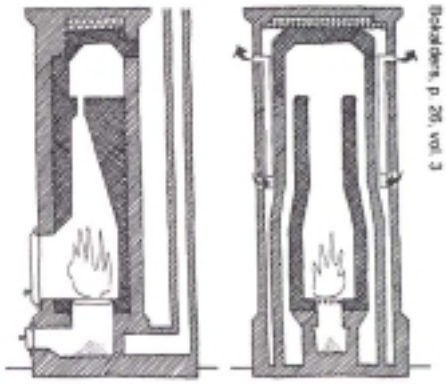


Fig. 26 - Section of the channels in a kakelung

ecologically friendly, complicated, don't like the blown air system.

Wood heat - ecologically friendly or nostalgia?

"*Because this isn't a wooded area probably shouldn't be heating with wood but find some other alternative like a pellets furnace for the whole village.*" [Myrstacken] "*That everyone heats with wood is bad.*" [Myrstacken]

Floor heat vs. Radiators: The ideal method of radiating heat is believed to be low temperature heat over as wide an area as possible for example one that radiates heat evenly from all the walls. Wall heating systems are popular in Germany [Bokalders, v. 2, p.16.] but they are slow to respond to thermostat changes and are prone to leaking. Floor heaters are low temperature and cover a wide area but they can keep your feet too warm if you are standing on the floor for too long. Floor heaters are ideal for a bathroom or an entryway but less desirable for a kitchen. Floor heaters are nice because you do not have to contend with arranging your furniture around the radiators. However, they can be difficult to repair unless service access to the pipes under the floor is part of the design. Heat released near the ceiling is wasted heat. Because heat rises and we do not occupy the top half meter or more of a room.

Electricity: Using electricity to heat a home is likened to washing your car with cashmere. Electricity is high quality energy. Heating is a crude use for energy. …

Ventilation

Ventilation is often taken for granted, that is, until the attic fan starts keeping you up at night, or you have progressively worsening allergy problems and are searching for the cause. Fresh air is a pleasure to inhale. In the absence of it we can feel tired, stuffy, and even get headaches. Fresh air is easy to acquire in the good weather, by opening a window, but in the winter, especially in a well-insulated home, the subject of fresh air becomes complicated. Many of the systems were noisy or introduced cold air. The more successful systems had multiple intakes with heat exchangers. ….

Water

Fresh water:

Most of the ecovillages have their own source of fresh water from an underground well. Solbyn, Tuggelite and Understenshöjden use municipal tap water. Appropriate filters were installed in the ecovillages using well water to make the water suitable for drinking. Residents I spoke with liked having their own water. They felt they were more conscious about how and how much water they used because too much water demand could exceed the well's daily capacity.

Conservation of water:

Most residents are conscious of the importance of conserving water. Water saving faucets and appliances were installed in most ecovillages. The most significant savings were achieved in use of toilets and use in the gardens. Water for the gardens comes either from collected rain water, or from a the reservoir for the waste water treatment system. Although some appliances use remarkably little water, most water use is more dependent on the behavior of the user than the appliances or faucets themselves. My study did not focus on residents personal conservation habits, however, several residents observed that they and their neighbors were more attentive to their water use because overload

or contamination of the systems affects everyone in the community.

Rain water:

Solbyn and Understenshöjden (possibly others?) collect rain water to use on the gardens and flower beds. Collecting rain water is not only a good way to conserve water it is also a good way to direct water away from the foundation of the house to avoid water damage. In Understenshöjden barrels are placed at the base of the gutters off the edge of the house. Overflow runs out through a hose at the top, away from the house.

Wastewater

The subject of wastewater, particularly toilets, is by far the most contentious I encountered. Everyone I spoke to had a strong opinion about the subject. More comments, both positive and negative, were made about wastewater treatment than any other technical aspect. In conjunction with negative cultural attitudes about human wastes we have also developed awkward, unattractive and cloaked approaches to wastewater treatment. Several eco-villages made significant progress towards revealing their wastewater treatment. All the systems are substantially less complicated than city systems. This may be the hardest area to make simple, visible, user-friendly, attractive and pleasant to use.

Wastewater in this context includes the treatment of gray water, black water and dry waste. Gray water is the water we use for washing: the shower, sinks, washing machines, dishwashers and the like. It has organic material, soap, and whatever else a person pours down the drain. Black water is the water from the toilet. Dry waste refers to the solids in a composting toilet.

Wastewater treatment underwent a sort of evolution of its own within the ecovillage movement, especially the toilets. A variety of gray water treatment systems have been tried but they haven't evolved in response to peoples' preferences in the same way toilets have. Figure 2 illustrates the evolution of the toilet systems.

Toilets

Toilets are touchy issue. Many people are reluctant to discuss the subject, Americans more so than Swedes. Typical water-flush toilets are a very inefficient. First, the average flush toilet wastes a lot of water. The average toilet uses an excessive amount drinking quality water (8-25 liters depending on the age of the toilet) to flush a small amount of urine and feces down the toilet. Second, human wastes are a rich nutrient resource typically treated as waste rather than a resource. In a typical Swedish home the source of 70% of the nitrogen and 90% of the phosphorous produced come from black water [fig. 1]. Third, water toilets seem to promote a black hole mentality. People are prone to flushing all sorts of strange things down the toilet. An on-site waste water system discourages the black hole mentality because you sabotage your, and your neighbors' system by doing so. A separate system for the toilets (such as a composting toilet) that residents must personally maintain is an even better way to ensure residents will not be careless in how they use their toilets. A separate system is also a good way to keep the majority of nutrients out of the gray water systems thereby significantly lightening the load on the wastewater treatment system. The capture of nutrients at their source reduces the opportunities for contamination, thereby reducing the

amount of processing required before the nutrients can be used for soil improvement.

Element	Gray water	Urine	Feces	WC total	Total
Solid substance (g)	80.0	60.0	35.0	95.0	175.0
Phosphorous (g)	0.6	1.0	0.5	1.5	2.1
Nitrogen (g)	1.0	11.0	1.5	12.5	13.5
Potassium (g)	0.5	2.5	1.0	3.5	4.0
Liters of wastewater per person per day	150	1.0	0.1	50	200

Composting toilet

The first non-standard toilets were complete composting toilets in which everything is composted in one central container. This composting toilet is completely separate from the plumbing. Feces, urine and toilet paper drop into a container located under the house. The container has a separate fan and ventilation pipe to the outside, drawing air away from the toilet. Tuggelite, Solbyn and Myrstacken installed this type.

People had a variety of experiences with the toilets. One person told me she preferred the compost toilet to any water toilet, "*no smell, no flooding*" [Tuggelite]. Two people in Tuggelite and four in Solbyn felt the compost toilet was one of the most successful ecological aspects of the ecovillage. Whereas other people complained of flies, difficulty with emptying the compost container, and flooding. "*The toilet functions poorly, it leaks. It is life threatening to go down 2.5 meters and up with a sack of compost on your back. Revolting.*" [Solbyn] Eight residents in Solbyn, 11 in Tuggelite, and 2 in Myrstacken wrote negative comments about the specifically about the composting toilets including: the container is too small, the cellar is too crowded, flies (3) flooding and consequent pumping, poor construction, hard to empty (2). Six residents wrote general negative comments about the waste water system. (See the description of the Solbyn system below).

The central problem with this system appears to be the collection system rather than the toilet. The systemic problems begin with the cellar door. The cellar door in Solbyn and Myrstacken is located outside. It is a heavy metal door with a small handle on the ground (bad news for people with back problems). In Tuggelite the cellar door is located inside the front entry. The door is easier to open but the compost must then be carried ¾ of a meter across the floor to reach the exterior door. Entering the cellar is "*life threatening.*" In Solbyn the cellar is so small that the aluminum step-ladder to the basement can not be stored in place. Every time you go into the cellar you must lean down, pull up the ladder, and then descend into this pit on a steep and precariously situated ladder [Fig. 28]. The ladder situation is hardly better in either Tuggelite or Myrstacken. From the start, maintaining this system is neither user-friendly nor pleasant and attractive to use. It gets worse. Then, once you get into the cellar, its walls are bare cement and the space is too small for the activity that follows, emptying the compost container.

I looked at three types of containers: the Snurredas,

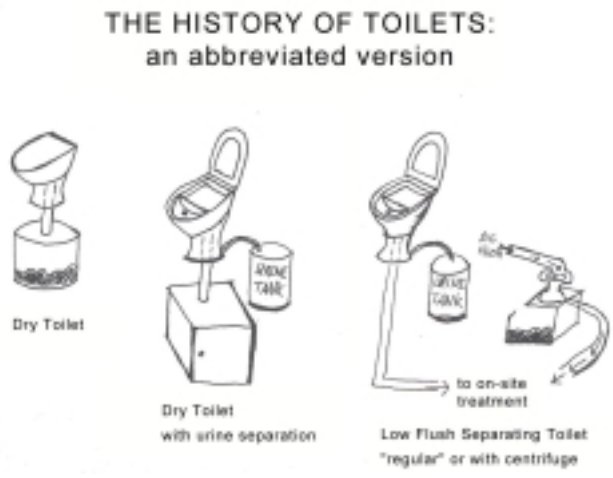


Fig. 27 - The development of alternative toilet systems

Fig. 28 - Precarious ladder

Fig. 29 - Compost bin in cellar is hard to maintain

the Lindén Multrum, and Wolgast (these models have since been modified from the original models observed in this study). The Snurredas and Lindén models are a large container with a small opening 20 cm or so above the floor. At this opening the user must place a dish pan or bucket and scoop the compost from the large container into the small container and then carry the now heavy bucket back up the precarious ladder plus carry it another 100 meters to the after-compost pile near the garden, empty it, and bring it back to the cellar to repeat the process until it is empty. This system is definitely not user-friendly nor pleasant and attractive to use [Fig. 29]. The chamber of the Snurredas is sub-divided into four sections. The idea is to rotate the container periodically so that as one section fills up, the other full ones will continue to compost so that each section will have been sitting for nearly a year before it must be emptied. The problem is the weight of the sections must be balanced for the chamber to rotate. The only way to keep them balanced would be to regularly shovel the compost from one section to another. The containers originally had heating coils under them to speed up the decomposition of the compost, but these soon broke. The containers were too large too maintain an adequate temperature for decomposition. Instead people wrapped the containers in insulation to keep them warm [Fig. 29]. Small households manage quite well with these toilets, but larger families have had problems with too much liquid from the urine. The containers have been known to overflow. To avoid this, a brave adult must go down and pump out the excess liquid. A little sawdust thrown into the toilet after each use cuts down on the build up of liquid and cuts down on the attraction of flies. All the above problems are design problems. The compost toilet has potential, but it must be designed in a manner that minimizes unpleasant maintenance tasks.

The Wolgast system solves several of the above problems. The Wolgast comes with three containers (more containers can be used), essentially rectangular garbage cans made of tough plastic mounted on a rolling base. The whole container is rolled under the toilet, left for three months, and rolled out. You can put a lid on it, leave it in the cellar or take it out to the garden (a sitting period in the container is recommended for initial composting). Flies require just over three months to hatch, therefore the fly problem is eliminated by switching the containers every three months. The rolling bins solve the problem of having to shovel out the compost but the design of the cellar but it is still difficult to carry the containers out of the cellar. Small cellars were built to save on money, but if residents wind up dreading maintaining them and begin dreaming of installing a water based toilet system, the money saved, is really just a delayed cost. The cost is not just monetary either. Each resident who gives up on the composting toilet system in favor of a water toilet is a loss for environmental progress. I believe the composting toilet system is the most ecologically friendly system, but if it fails, all these potential benefits are lost. One solution is

the urine separating composting toilet and a cellar designed to be user friendly, pleasant and attractive to use. A urine separating compost toilet does exist today, but I have yet to see an adequate cellar space.

Hybrid Toilets

The next step in the development of ecologically friendly toilets was to reduce the amount of liquid entering the compost container. The solution was to install two toilets; one for urine and one for everything else. Åkesta, Bålarna and some homes in Ruskola have the double toilet system [Fig. 31]. The urine is flushed with 0.2 liters of water into a large holding tank. Some farmers are interested in using the urine as fertilizer due to its high content of nitrogen and phosphorous. The ecovillages pay to have the urine removed, usually twice a year. Residents in Bålarna spread the urine on their own land. When I asked about this my host said, "*See for yourself. It's green there, but not there. The green is where we spread it last time*." The compost containers and cellars function as before, except with less liquid. (The cellar in Bålarna is just deep enough for the compost container. A hydraulic lift was supposed to be installed, but in its absence the removal of a full container is difficult.) I heard fewer complaints about flies and odor in this system than in the all-in-one compost toilet. Similar concerns about maintenance (emptying the compost) were expressed from Åkesta residents (all compost toilets are Snurredas except one Wolgast). Odor in this case most often results from the urine when the pipes were not adequately sealed. Seven of eleven Åkesta residents cited their toilet system as one of the most successful ecological measures (4 wrote compost, 3 wrote urine separating).

Fig. 30 - Small rolling compost bins [Bokalders 1995]

Urine-separating low-flush toilets

The urine-separating low-flush toilets (USL) are less of a departure from the typical flush toilet than the composting toilets. The urine-separating toilets also require less individual maintenance than the compost toilet. These factors contribute the greater acceptance of the urine-separating toilet than the compost toilet. However, the users understanding and respect for the systems seems to decrease in relation the decrease in their physical and mental contact with it.

The USL toilet has two flushing apparatus, typically a large and a small button [Fig. 32]. The small button flushes the urine collection area with 0.2L of water. The large button flushes both sections of the toilet with 4L. When sitting, humans urinate towards the front of the toilet. The urine collection area of the early WM-toaletten has been enlarged in response to problems encountered in early models [Fig.33]. Too much water from the large flush would spill into the urine collection pipe thereby dilluting the urine and filling up the tank very quickly. The Dubbletten brand of toilet has a children's seat that positions the child appropriately for use of the USL toilet [Fig. 32]. The urine and .2L flows to a collective tank. The urine makes an excellent fertilizer because it is sterile and has a high content of nitrogen and phosphorous. Several ecovillages have contracts with local farmers to collect the urine for use

Fig. 31 - Toilets adapted for urine and compost

as fertilizer. Bålarna spreads it on their own site. The black water from the 4L flush flows to the same tank as the gray water. Experience with the USL toilets has been good. As builders have become more familiar with the installation of USL toilets problems with leaky connections, and subsequent smell have been resolved. The other substantial complaint about the USL toilets is that the urine stains plastic toilets. Porcelain doesn't stain, but it is initially more expensive. The USL toilets have been sufficiently successful that the City of Uppsala and other cities are considering requiring the installation of USL toilets in future renovations of city properties.

Two other variations are the urine separating compost toilet (USC) and the Aquatron. The USC functions similarly to the USL, except there is only a flushing mechanism for the urine portion of the toilet [Fig. 10]. The interest in this variation was twofold: first to capture the nutrients from the urine, second to reduce the amount of liquid in the compost area. The accumulation of liquid had proven especially problematic in families with several children. The Aquatron appears to function just as the USL except that the black water from the large flush first passes through a centrifuge. The feces drop out of the flow into a compost bin and the water travels to the on-site waste treatment tanks [Fig. 14]. Smeden installed the Aquatron. Those interviewed seemed satisfied with it and were pleased have the benefits of the compost without the visual impact of the compost toilet.

Conclusions

The result of the poor design of the compost toilets is disappointment and abandonment of the system. In Solbyn the second toilet in homes with more than one

Fig. 32 - Dubbletten with child seat

Fig. 33 - Urine collection inadequate

Fig. 34 - Urine collection area adequate

Fig. 35 - Urine separating compost toilet

bathroom is a low flush toilet connected to the city sewer system. Many residents have abandoned their composting toilet in favor of the low flush toilet. Myrstacken residents had sufficiently negative experiences with the composting toilets that most households have replaced them with low flush urine separating toilets. Interestingly, in Tuggelite, where only composting toilets were installed, no one has switched to a flush toilet, although it has been discussed. In fact, after a resident showed me her composting toilet and explained the disgusting details of maintenance, she said she wouldn't go back to a flush toilet. For her, and others, the composting toilets are a source of pride. Pride in their commitment to environmental protection. This pride could be much more prevalent if problems encountered by these residents were solved in future projects. All the horror stories from these early ecovillages have scared later planning groups away from the composting toilets and towards the low flush urine separating toilets. I think this is a shame, but perhaps only a temporary situation. Hopefully, another project will be bold enough to try again and prove successful. The low flush urine separating toilet is just a baby step away from what we already have. The composting toilet is a leap. The early projects leaped, and leaped into trouble, we need to keep taking baby steps to get back to where they leaped to,

Fig. 37 - All that is visible of the soil infiltration bed in Akesta

Fig. 38 - Only the tops of the tanks show in Understenshojden's system

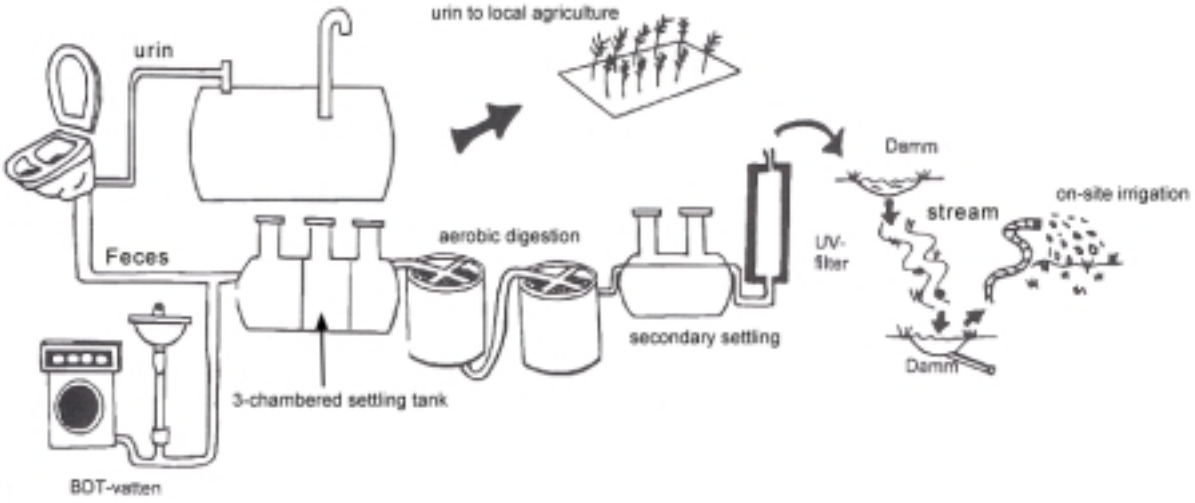


Fig. 36 - Understenshojden's wastewater treatment system is similar in configuration to others'

but this time, equipped with the knowledge gained from the pioneers experiences.

Waste water treatment

The water and waste water treatment systems in all but Understenshöjden are self-contained. The systems vary, but the basic approach is similar whether treating just gray water, or treating gray and black water. The main difference between the treatment of black and gray verses just gray water is maintenance. The black water systems require much closer maintenance.

The Association of Swedish Water and Sewage did a study of the systems. No one system was determined to be significantly better than the others.

See images of systems on previous page. Expand discussion.

Electricity

Electricity is to energy as gold is to jewelry. It is the highest quality of energy, not to be squandered on mundane tasks such as heating a home. Electricity can also be dangerous. Studies have proven a link between cancer and long term exposure to high voltage, such as living under power lines.

Contrary to a popular misconception, electricity is not clean energy. Electric power is in Sweden is generated primarily by nuclear, coal, oil and in small part hydro. All of these methods have harmful effects on the environment. A group of Solbyn residents have purchased shares in a wind farm. …. Seven residents wrote that they feel wind power is Solbyn's most successful ecological feature.

The use of electricity for heating is discussed above under heating.

Low -energy appliances were installed in most ecovillages, but quality or size was not sacrificed in the pursuit of appliances with the lowest energy use. For example a refrigerator exits which only uses xxx kilowatts, but it is costly and smaller than equivalent sized name brand refrigerators. In the interest of cost and reliability the "best" appliances were not always chosen. Low energy lightbulbs, movement sensors and other energy saving measures were also used. Sixteen residents wrote that energy consumption was too high.

Residents in Understenshöjden were greatly concerned about the long term effects of electric current on the body. Residents could choose to have a shut of switch in the upstairs bedroom to shut off all electric current to the room. Electric cables have extra insulation.

Trash/Recycling/Compost

Disposing of waste is probably one of the least favored chores in any household. It was not so bad for apartment dwellers who could toss everything in a trash chute where it would magically disappear. Recycling and compost have made it all far more complicated. However, it was not too many years ago that people had to recycle and compost. There was no curbside trash pick-up or magical trash chute. The oldest and youngest generations understand the concept of recycling and compost, but all the generations in between are products of decades of a throw away society. These intermediate generations are those for whom waste disposal design must appeal to.

A dark, smelly, out-of-the-way, "recycling cottage" with heavy locked doors is not a good enticement for recycling. Plastic buckets, large enough to hold five soup cans, stuffed under the sink or hung precariously from the cabinet door, do not encourage users to fill them. The prospect of rinsing out a putrid compost bucket lined with fruit fly eggs is hardly compelling. It is

impressive that anyone manages to recycle or compost.

First, one man's trash is another man's treasure. As long as our discarded items are given the dirty treatment instead of the royal treatment it is difficult to regard them as "treasure" or resources instead of waste. This is not to imply the use of a mahogany cabinet for discarded bottles, but it should mean an end to dark, smelly rooms.

Ten residents wrote that they thought recycling was one of the best ecological features and 21 wrote the same of compost. Many residents faithfully recycle and compost, however not without complaint. Concerns were voiced about the quantity and quality of residents recycling and composting performance. Good design choices can make these tasks more bearable.

Inside recycling

Adequate space for recycling should be built into homes. There is not enough space under the sink for cleaning products, trash, compost, and four recycling fractions. A Myrstacken family had devised a system in their bathroom. They built four shelves above the toilet. On each shelf sat a container, big enough to hold a weeks worth of paper, glass or cans from a family of four.

Not over yet - just because the houses are built does not mean that the design phase is over, just significantly slowed.

"*Important to keep up with nw knowledge and developments.*" [Tuggelite]

Expand conclusions

"*A practical test of interesting systems from an ecological perspective. Even if we have had problems the next ecovillage will have it easier because they can learn from our experiences.*" [Understenshöjden]

"*Think long term. Avoid expensive, complicated, untried systems.*" [Bålarna]

"*We aren't sure how our systems are good from a long term perspective.*" [Mjölnartorpet]

"*Double and triple check design and function of design systems, especially heating and sewage.*" [Mjölnartorpet]

1 Designers in this chapter refers to the residents and the professionals involved in the design process.
2 Figure 2.17, *Att äta för en bättre milö* (Eating for a better environment). Naturvårdsverket, Rapport 4830, 1997.
3 The International Standarization Organization (ISO 14000) and the Environmental Management and Audit Scheme (EMAS) are the most significant standards in the European Union.
4 This is an assumption for the purpose of example, it is not necessarily factual, the production of plywood and oriented strand board has many negative environmental effects.
5 Hiss, Tony. *The experience of place.* p. 26.
6 The US survey counted number of trips. The Swedish study looked at distance driven for different purposes. *Biff och Bil,* rapport 4542, page 21.
7 I asked residents how they usually traveled to work. Some people gave more than one answer. I included multiple answers in the statistics. If someone checked two means of transportation, i.e. bus and automobile, the survey did not reveal how often they chose one or the other means of transportation.
8 Uppsala Energy is firmly committed to using renewable sources of energy and reducing air emissions to almost undetectable levels.
9 All the residents in Smeden are satisfied with the location of the trash room, however, due to the location of Smeden in relation to the city, public transportation, and the food store, there appears to be a higher dependence on the automobile than in Understenshöjden.
10 Some respondents interpreted this question as total public and private space, not just outdoor space. Therefore the results are not completely representative.
11 Residents in Understenshöjden chose which house they would live in very early in the design process, before distinctions of space were made clear.
12 Solbyn and Åkesta paid special attention to the use of

functional/edible plants in landscaping.

13 Function: “very good” and “good” combined, TG - 93%, MJ - 92%. Appearance: “very good” and “good” combined, TG - 79%, MJ - 93%. Understenshöjden had 83% for appearance and 79% for function, slightly lower than TG and MJ. No other ecovillage came close to these high evaluations.

14 Little is more frustrating than spending twenty minutes wandering about in search of a house number, especially in the dark.

15 Brown, Burton, Sweaney. *Neighborhoods, households and front porches: New Urbanist community tool or mere nostalgia?* Environment and Behavior, vol 30, No. 5, September 1998, pp. 579-600.

16 Although gardening opportunities are more limited in Understenshöjden than in other ecovillages, the space available for gardening there is still more than a lot of residents had when living in an urban apartment building.

17 This holds true for Sweden. I did not look into other climate conditions.

18 See ———book

19 Bålarna has a business (computer company) in their common house, but not a central meeting room. I would say it is well used because there are people working there five days a week, but not in quite the same sense as the others. Ruskola does not have a common house.

20 Lanne, Lotta. “Björkhagens Ekoby Är Klar,” (Björkhagens ecovillage is finished) *Kretslopp,* December 11, 1995, pp. 12,14,16-17.

21 Soaped pine keeps a bleached appearance over time, whereas oiled pine becomes a deeper yellow over time. The pine is bleached with lye.