# THE LATEST IN GREENHOUSE CONSTRUCTION AND ENVIRONMENTAL CONTROLS

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Nine out of ten greenhouse construction projects that I have seen in the last 5 years in California have serious problems, and it is from a lack of proper planning. To give you an instance that happened about 2 years ago, a very well-respected foliage grower decided he wanted to build a 200 x 600 ft. addition to his greenhouse, so he called up three greenhouse manufacturers, saying he wanted a 200 x 600 greenhouse addition, with a glass covering, with 50% shade, (which he had used in his original house), what is your bid, and how soon can you build it? A week later he let the contract out, the following day he is all over the contractor to get it completed in a hurry. This sounds like a familiar scenario. After completion he puts his foliage plants in it. Three weeks later they all burn up. Obviously it seems to be fault of the greenhouse construction company. The glass was wrong. The shade wasn't right. What happened was his old 18 year old house had an acrylic covering, which had darkened over the years. If he had paid $39.95 for a light meter to compare the light inside and outside his old house, he would have found that he needed 85% shade. A simple thing, but an expensive problem, arose from a lack of planning.

How many of you know what the "kiss" principle is? A few. This was drilled into me by my dad. It is, "keep it simple, son." The simpler you can make things the better they are going to work for you. Yes, this is "high tech" today, but high tech does not have to be complex.

Secondly, you have the "4P" theorem—"prior planning precipitates performance," or the corollary, "poor planning precipitates problems." We have all been through that. Keep these two things in mind, please. If you are going to expand, or have the opportunity to build—it may be a once in a lifetime situation. You want to do it right. You want it to be profitable, and you want it to work the way it should. I guarantee you it will not work without proper planning.

The steps that we have followed are:

Firstly, know your needs and your wants. Differentiate between what you need (must have) and what you want (would like to have). What is important to you? For us, working with roses, it is light, ventilation, nutrition, temperature, and humidity. You have to

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separate things out and prioritize them. If you can first meet your needs, then you can consider your wants.

Secondly, after you have clearly defined your needs, figure out how far you can compromise those needs, if you have to. After you find your ideal, you still may not be able to reach it entirely, so know what your limits of compromise are. Question everything.

We moved from Pleasanton to Watsonville, California; the Watsonville-Salinas area has 40% of the U.S. cut flower rose production. It is very concentrated. So you would assume that everything is going to be great, no problems, for rose cut flowers. Such is not the case. Question everything that you have done in your own operation. Know why you are doing what you do.

Travel—get out and travel. Go to Holland, a lot of the new innovative ideas and equipment are coming out of Holland. They are ahead of us—new ideas are coming from there. See what is going on elsewhere, then pick and choose.

Use some common sense when you design your ideal greenhouse. There are a lot of manufacturers out there and they may tell you that you have your choice of greenhouse A, B, C, or D. They may try to sell you that way, but make them come up with a design for what you need and what you want in a greenhouse.

The same goes for the equipment you are going to put into the greenhouse. There will be times you are going to be better off buying the component parts of the equipment and putting it together yourself. Just remember, you are paying for this equipment. You should be able to get what you want.

Set up a master plan for your entire project. Sometimes this is difficult. A long-term planning horizon for us just now is 5 years. This is due to the international situation. A substantial number of roses are now being imported into the U.S. Ten years ago, it was 2% of the market—today 45% of the blooms are coming in from off-shore, from Mexico and from South America. But when we put in our new greenhouse we had a master plan for our entire 52 acres. We are now only using just 7 of those 52. But by doing that we could plan for our underground pipes for the remainder of the acreage without having pipes running under any greenhouses in our phase two or three.

Another thing, don't piece-meal what you are going to do today. Don't start a greenhouse with manufacturer X, then half-way through construction decide to add five more pieces of equipment. Plan the entire phase before you start construction. Again, limit your compromises. Your needs are out there. Just keep looking until you find them.

Try to have one piece of equipment do multiple tasks. An example with us is our mist system. We use it for mist but it can also spray pesticides early in the morning before people come to work. We also

use the same tank and pump to spray down the isles with hoses. We have a $7000 savings by using the same equipment for two operations. So try to get multiple uses out of the same equipment.

Do not be afraid to act as your own general contractor. There are some things you will not consider doing, such as building and putting up the greenhouse itself—but there are several things you can do yourself, probably better and cheaper than a lot of the contractors out there. But again, it takes planning, research, and perseverance to do it. One thing that really bit us was the time-frame. Give yourself plenty of time. We thought we would be done by the middle of July, but now we see it is going to be the end of October. Figure out your time frame, then add 50% to it to be safe.

One other part of this planning process—if you are going to move to a different region, as opposed to expanding in your present location, even though there are many other greenhouses in your new location, check out the climate, the soil, and water. But also think about transportation, the markets, customer accessibility—if this is important to you. Think about local regulations, codes, the local master plan, zoning, and neighbors.

What was important to Devor Nurseries and our rose production? First, light, ventilation, nutrition, temperature and humidity, soil and water, customer accessibility, all wrapped around economics of operation. Now, with all the other greenhouses in the Watsonville area, we find that there are numerous microclimates. There are greenhouses that literally hang onto the cliffs near the ocean, while others are up against the mountains; and within a 5-mile radius, it is not uncommon to have a 30° to 40°F temperature differential. Out on the Pajaro plan there is salt water intrusion. We are told by chemists analyzing our well water, that must add several elements for plant nutrition as our water alone is too pure for plant growth.

How do you get all this information? Start with data from any nearby U.S. Weather Service installation, look at other crops growing around you, look at USDA soil maps, get a back-hoe out and go down 10 or 12 ft. all over the parcel and see what you have underground. Take soil samples to your lab for analyses for minerals and pathogens, such as phytophthora and oak root fungus. Check wells on neighbors' property for amounts of water they can pump and for minerals in the water. Don't blow your whole enterprise for a $200 lab bill.

For the greenhouse structure itself, we wanted something that is wide and high. It is important to have a very stable, constant environment for roses. So our greenhouses are 276 ft. long and 50 ft. wide. The high peak on the roof gives us a constant environment down where the plants are. Changes occur slowly, and above the plant canopy.

Make sure your structure is strong. I guarantee you will add three times the iron on the structure that you thought you would need. So make sure your walls and your posts are ample. Doors, make sure you have enough and they are big. Our main doors will admit a one-ton truck. Aisles should be wide—yes, you will lose production space but if you are going to use carts crossing in the aisles, they must have room to do it.

The greenhouse covering, or ''skin'' is important. We put a lot of thought into it. We selected the Solatex, low iron, safety glass. Solatex glass was developed for solar hot water heaters you see on the roofs of houses. The advantage is that it lets in 6% more light at noon and 12% late or early in the day at a low sun angle, as compared to ordinary glass. And light is our No. 1 factor in growing roses. The low iron content gives a glass that diffuses light so we don't have strong shadows.

The other decision we made was to use safety glass, chiefly as a safeguard against earthquake tremors, that could cause ordinary glass to come down in sheets, injuring our workers. Safety glass just breaks into fine particles.

Our vent system is somewhat unique among rose growers. Mostly, large ranges of greenhouses will have houses side by side with top vents only. You really need side vents also, set up high to allow replacement air for hot air going out the top vents, giving a chimney effect.

We use shade curtains. We ordered a special curtain, using strips of reflective material, then an open strip. This allows hot air to escape through the open strips. When the shade curtains are closed it is often cooler in the greenhouse than outside.

To heat the greenhouse we are using a hot water system. The boilers work at 14 p.s.i. We selected it to give uniform heat throughout the greenhouse, as compared to steam heat. There are economic benefits, too—a 10% less installation cost and 10% less operating costs. We are using 3-way mixing valves, which gives us greater heating efficiency too.

Our mist system has intermediate size nozzles, so we can cool the plant leaf itself—not the air, yet we want to be able to spray with it from time to time, at 4:00 in the morning, set off by a computer. The advantage to this is that your crew does not have to be out of the greenhouse while spraying is going on, a labor savings practice.

Our fertilizer injectors—this is one of the examples of the ''kiss'' principle (keep it simple, son)—we looked at injector systems that cost from $4100 to $41,000 that basically do the same thing. We selected the first because it is a simple, positive, water-driven meter that has an injector stroke every time 4 gallons goes by the meter. The meter will work at a flow rate of 4 to 350 gallons per minute. It will be connected to the computer which will tell it when to come

on and for how long to be on. It has a high level EC (electrical conductivity) cut-out. We don't want the EC to climb up and burn the plants. The computer will also record the EC so we will know if the EC of the nutrient solution is climbing.

We have a drain system under each bed. Roses need to be leached occasionally. The solution is recirculated onto the landscape outside. We hope we never have a spill but if we do we want to be able to contain it.

In putting this altogether, it is going to be a computer-driven environment. Things we looked at in selecting a computer are: capability, flexibility, expandability, service to be expected, and the stability of the vendor. There have been many environmental computer companies lately that have not been able to stay in the market, because all this is very competitive and the technology is changing rapidly. Another thing to look at is scientific curiosity. The company we selected—Hoppman—has a sales rep. who excels in this.

Our packing shed is attached to the greenhouse so the product does not go outside. Ours is a rose hybridizing environment, so no plant material is ever exposed to unfavorable conditions. Our packing shed is designed for accessibility, 75 x 150 ft. but has seven outside doors.

Sanitation is very important. All concrete floors should be hosed down daily. Think about sanitation constantly.

Remember when you build or expand, you are doing it for yourself. Do it for economics and do it based on your needs, and do it so you can say, "this is my one opportunity and I have done it right."