THE ARCHITECTURE OF THE WORLD TRADE CENTER

by

Minoru Yamasaki

(The following statement was written by Minoru Yamasaki, shortly after the dedication of The World Trade Center, to explain the thinking behind some of the architectural decisions which resulted in the unusual design of the project.)

We have been working on The World Trade Center project for ten and a half years; and throughout this period we have made many design decisions; as they have been resolved into actual construction I have felt that they have resulted in the kind of buildings which are as I had hoped they would be.

In the middle of the last century Emerson stated principles which might well form the basis of a philosophy of architecture. He said:

> "Beauty rests on necessities. The line of beauty is the result of perfect economy. The cell of the beehive is built at that angle which gives the most strength with the least wax. The bone or the quill of the bird gives the most alar strength with the least weight.
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> "There is not a particle to spare in natural structures. There is a compelling reason in the uses of the plant for every novelty of color or form; and our art saves material by more skillful arrangement; and reaches beauty by taking every superfluous ounce that can be spared from a wall and keeping its strength in the poetry of columns."

He continued,

> "If a man can build a plain cottage with such symmetry as to make all the fine palaces look cheap and vulgar; can take such advantages of nature that all her powers serve him, making use of geometry instead of expense, tapping a mountain for his water jet, causing the sun and moon to seem only the decorations of his estate, this is still the legitimate dominion of beauty."

My work has been affected very much since I read this passage many years ago.

Rather than having enormous exterior and interior columns which interfere with the activities of people on the many floors, we chose to make our exterior wall both load-bearing and the centilever truss which

stiffens the building against the very high winds found at the upper levels, the most difficult structural problem in a high-rise building. The cores in the Trade Center towers contribute nothing to the stiffness of the buildings.

The exterior walls have three columns, 40" on center above, which translate to a single column at the base of the building, giving what has been called a sense of Gothic design. In my view, the concept of the wall, its relationship to the mass of the building and its details are consistent with Emerson's thoughts: "it reaches beauty by taking every superfluous ounce that can be spared...keeping its strength in the poetry of the columns..." I certainly have no shame in this, because the wall is a purely and thoroughly economic way to bring the load down and makes possible sufficient openings at the base for people and materials to easily pass through. This delicate wall, which has been called "dainty", is not only a very beautiful truss, but it carries floors with spans of sixty and thirty-seven feet. These floors are completely column-free, giving maximum freedom in circulation and in office and furniture arrangement. To me, this is one of the gifts of our technology, when we can build 110-story buildings with both human-scale elements and the advantage of long spans.

For me, the day of the all-glass building is finished. The problems which come from lifting and installing enormous panes of glass, which are then shaded by curtains more than half of the day, are almost ridiculous. When glass size is pushed unreasonably, there are structural problems which arise; on several recent occasions in two of our major cities, large panes of glass have been blown out, to the point where buildings had to be barricaded and the pedestrians protected. Large glass, as lovely as it may be,

requires a tremendous consumption of energy for heating and air-conditioning to combat the extremes of temperature. Moreover, glassy buildings tend to be "curtain displays" -- some closed, some half-open, some open -- which adds a more restless quality to an already restless city.

I certainly agree that there should be large glass in observation areas where the prime purpose is just that, to give a panorama of spectacularly beautiful views. In normal working conditions a reasonable amount of glass is of course necessary, so that people may be aware of whether it is beautiful and sunny, or rainy and miserable outdoors, giving them contact with the outside world. It also should be present in sufficient quantities to give relief to the frequently monotonous work which goes on in the normal office. In many all-glass buildings the people who work and live there have a strong sense of acrophobia, which makes their lives uncomfortable.

I must ask myself if we want to design buildings for people to fit some preconceived idea of a glass world. Is this really the future of cities? As for mirror glass, I detest it, because buildings with it look to me as if they have cataracts, showing no life within. On the interior, it produces strange reflections of lights, objects and people which gives me a feeling I can only describe as eerie. As regards the narrow windows, they give me none, if any, sense of acrophobia; and since they are narrow, they cannot bend to the point of blowing out under gale conditions.

Recently the New York Times carried an article about many lower buildings which moved a great deal in sixty to seventy mile winds so that

their upper floors had to be evacuated. These are buildings with much shorter spans, designed for only a little more than one-half the wind force for which the Trade Center buildings are designed. As a matter of fact, the New York Building Code has revised its wind criteria upwards since we designed our buildings, and our standards are still higher. Our buildings are so designed that on the two-to-three decade cycle when winds reach hurricane force, there may be some discomfort, but there will be no oscillation, as experienced in the buildings described.

The land in New York is very expensive; hence, the almost impossible overloading of the Wall Street area with its narrow sidewalks and its great confusion of traffic. Often I feel when I walk there, that I am about to be pushed into the street, to be hit by an automobile. The big building can resolve this, as we have done in the Trade Center, where we have a five-acre plaza where people can enjoy their moments of leisure, the sun and the plants. If you will look closely at the Trade Center, the sidewalks on its perimeter are very wide. They go in and out, without the usual parallel relationship of building to curb, so that people can walk in an uncrowded and comfortable way.

In the limited number of projects on which we are privileged to work, our primary objective is to heighten the quality of experience for those who work or visit or live in the buildings.

Now, imagine the daily experience of the 20,000 or more people who work in each of the towers, who travel on the grim subways (or even on PATH) and land on our concourse. We hope that this fifteen acre retail area will provide both fun and interest on their way to the sudden surprise

of the tower lobbies -- sun-filled spaces seventy feet high -- before they take their elevators to their respective offices. That was planned; it did not just happen. Also, consider the fact that the shuttle/skylobby elevator system -- 55 passenger cars traveling at 1600' per minute, and which we had to plead for -- transports the person easily to the upper floors. These cars stop only once; with doors at both ends, the first passenger on is the first one off; he then transfers, at the skylobbies, to a normal bank of elevators to his ultimate destination. This system eliminates a tremendous number of "dead" elevator shafts and makes a significant addition to the useful and rentable floor area of the tall buildings.

For the 500' x 1000' excavation west of Greenwich Street, the engineers had originally planned to use sheet piling to a depth of only thirty-five feet, using conventional piles for the tower foundations the additional thirty-five feet down to rock. The sheet piling would have meant that a large portion of the Atlantic Ocean would have been in the hole, requiring fantastic pumping during excavation. It took six months for us to convince them that there must be a better way, and the slurry wall which you see in the attached brochure is the result. Now we bear all main columns directly on the rock and we were able to build three floors virtually for free and save millions of dollars by practically eliminating the dewatering. This area houses the new PATH station, refrigeration plant, service trucking, storage and garage areas. Material which came from the seventy-foot-deep excavation made twenty-six acres

of usable land on the Hudson just north of the Trade Center. This I sincerely hope will be turned into housing and recreational areas which are so badly needed in this area of Manhattan.

I am not implying by this statement that these buildings are great. That is perhaps not for any of us to say now, but for the people to decide in the many years during which the buildings will live. I do think that the plan of the Trade Center allows outdoor space for people at ground level -- happy, pleasant space undisturbed by automobiles.

I am happy I was able to design very large buildings which have the scale relationship to man so necessary to him; they are intended to give him a soaring and inspiring feeling, imparting pride and a sense of nobility in his environment. They are set back five-hundred feet from Church Street; their changing quality as one approaches across the plaza is, to me, greatly inspiring. So many tall buildings say nothing at all when you are next to them; or their great beams and columns are gloomy and fearsome from directly below, as they sit so solidly and so closely to the sidewalk and street.

Finally, these advances in building technology allow us to economically compete with lower buildings, giving opportunity to open up our urban centers with spaces, be they green or paved, which are so important to life in the heart of our cities.

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