After an absence of some years, anyone who returns to an American city is inevitably surprised by the radical change that has occurred in its skyline. Indeed, the skyline of every major American city, with the exception of Washington, D.C., and Philadelphia, has been completely changed over the last 20 years by the construction of large numbers of high-rise office buildings. In addition, a number of very tall buildings (50 floors and up) have appeared in many of these cities. In Houston, several buildings of more than 50 stories have been built and an 82-story building with a projection approaching 100 stories in height is in the site-preparation stage. Wind-tunnel tests have been completed on a 160-plus-story building for Chicago. Other very tall structures are being proposed for Denver and New York. As it appears that the American city of the future is going to be characterized by large concentrations of tall buildings, it might be prudent to consider just what the long-term impact of these structures will be and what the consequences for the future of the city might be.

Long-Term Urban Impact

In 1978 the Chrysler Building was declared a National Historic Landmark. This is significant because it suggests that tall buildings have existed as a building type long enough to draw conclusions about their long-term life and their impact on the urban environment.

New York has the greatest concentration of high-rise buildings in the world. This concentration has existed for some time. It also has three of the tallest buildings in the world—the Empire State and the twin World Trade Center towers. Though Houston is a very different sort of urban environment, we might expect some of the general long-term effects of tall building observed in the New York example.

There is very little information available about the long-term economic life of tall buildings. From the relatively recent interest in rehabilitating commercial structures, it appears that buildings can have lives significantly longer than their first economic life. In New York, significant renovation in both commercial and residential structures has been taking place for some time. The bulk of the buildings being renovated predate the 1920s and are relatively small in size, which is related to the economics of renovation. Newer buildings have not generally been renovated but demolished. Most recently, preservation advocates have achieved landmark status for Lever House (Skidmore, Owings and Merrill, architects, 1952) to prevent demolition. Not only is this building only 32 years old, it has received world-wide recognition as one of the earliest and best examples of the modern slab office building. A similar fate awaited the Chrysler Building. After 1960 the owners of the Chrysler Building, Goldman-Diloreto Interests, could only service the huge mortgage on the building by effectively eliminating any maintenance on the property. This led to, among other things, the accumulation of 1,200 cubic yards of trash in the basement, numerous leaks, and other serious problems which drove tenants away and doomed the structure to certain demolition. It was saved from this fate only by a takeover by the principal mortgage holder, the Massachusetts Mutual Insurance Company, and the investment tax credit that landmark status made possible.

There are many reasons that a relatively new structure of unquestioned architectural historic value such as Lever House might be demolished, not the least of which is the continued extremely high value of land in Manhattan. However, it is ironic that Lever House could not be renovated at less overall cost than constructing a completely new structure. Indeed, this is true for most high-rise buildings and if this condition is exacerbated by the height of the building, a serious future problem is created wherever there are concentrations of these buildings. In the case of the Chrysler Building the maintenance service was reduced and as a result many tenants decided to move. While the area around the building did not seriously decline in value, the building enjoyed a very negative reputation. Would anyone have imagined this possible when the building was completed in 1929?

Another serious question regarding the impact of tall buildings is related to their effect on the surrounding urban environment. We all have observed the phenomena of crowds gathered early in the morning and late in the afternoon but devoid of life at other times. The concentration of population in very tall buildings means that the street level must be allocated almost completely to circulation space. The little commercial space that remains is too expensive for small-scale retail operations that used to inhabit the street level. As tall buildings are constructed in larger and larger numbers, the surrounding streets become less populated and therefore less able to support small-scale commercial activity. In other words, a vicious circle is initiated in which fewer and fewer people have any direct interest in the public space. The street becomes an unused, and potentially dangerous, area.

Beginning in the 1950s a number of critics of urban planning—perhaps the best known of which was Jane Jacobs, author of The Life and Death of Great American Cities—warned of this disturbing development in the "modern city." They argued that the seemingly chaotic network of small businesses and mixed use that characterized the streets of the traditional city was an important social mechanism. Besides providing a stimulating environment, rich in random associations, the businesses had a vested interest in the safety of the street and supervised it as such. More recently, such observers of urban crime patterns as John Q. Wilson of Harvard University, have recognized a relationship between intermittent use, lack of supervision, and random violence.

The purpose of this argument is not to suggest that high-rise building is responsible for street crime. However, it does appear that this type of building contributes to a pattern having negative consequences. In recognition of this, New York zoning laws were changed in 1979 to mandate retail space on the street level of commercial structures. Other cities have adopted "bonus" programs to stimulate redevelopment of the downtown street area.

Planning and Development Patterns

The tall building has become a component of the planning of American cities, especially those developing like Houston. In such localities as Dallas or Denver this phenomenon happened under the watchful eyes of a planning agency, while in such others as Houston, the same phenomenon occurred exclusive of public controls.

In the 1930s and '40s planners began to realize that the flight to the suburbs would exert serious consequences on existing downtown areas. Urban design theory strongly supported the redevelopment of downtown areas in conformance with modernist planning ideals on the model of many European cities rebuilt after World War II. In the 1950s, the United States government supported this goal by instituting the Urban Renewal Program that made possible the public condemnation and clearing of large tracts of downtown property. This laid the groundwork for the eventual commercial revitalization.
There are many reasons why tall buildings consume so much energy. The elevators and pumps required to service the upper floors attach an energy-use premium to building height of about 10 percent. Another source of energy consumption is related to the size of the structural framework of the buildings. While it is true that large-scale mechanical systems have some inherent efficiencies, they have difficulty handling variable-sized loads. That is to say, the machinery is efficient when operating at 100 percent capacity but cannot operate efficiently when only a few floors or single offices require air-conditioning. During a typical year, the majority of operating time is in such a partial demand mode.

The largest environmental premium paid for very tall buildings, however, is a product of the scale and inflexibility of the floor plan. The greatest single consumer of electricity, and the greatest single source of heat that the air-conditioning system must overcome, is the lighting system. Almost half (about 40 percent) of the air-conditioning tonnage in high-rise buildings is provided to offset the heat generated by lighting systems. Consequently, air-conditioning may be required 12 months of the year, even in Chicago and New York. Many very tall buildings become larger at the base; other, slab-type buildings may maintain the same shape for their entire length. In either case, the sheer size of floor and depth of lease space virtually eliminates any possibility of using increased exposure to natural light to offset artificial lighting requirements. Consequently, the building form tends to "lock-in" the inefficiency of large buildings and prohibit increased efficiency at a future date.

In view of serious consequences in the future, why are these buildings still built? Many people assume that they are the inevitable product of the balance sheet and the real estate development process. There appears to be, however, a considerable body of evidence that suggests that high-rise buildings, especially very tall ones, are surprisingly subjective products, built as much for symbolic as for financial opportunity.

Building Costs

There is no question that tall buildings are inherently more expensive than equivalent space in other height configurations. It is difficult to state how much more expensive, because developers and clients are generally secretive about the ultimate cost of these projects. Preliminary cost information was available on the following Houston projects. It is generally accepted that the actual cost exceeds this amount by, in some cases, a considerable percentage.

Available information would place the cost of a structure roughly comparable in quality and below ten floors at approximately $70/sf. Therefore the very tall building represents an approximate 20 percent premium building cost over lower building configurations.

The major component of this increment is the cost of the structural system. There have been a number of significant changes in the engineering of tall buildings that have led to a dramatic reduction in the amount of steel in very tall structures. The Empire State Building (1929-1931) used an average of 50 pounds of steel/ft. of building, while the Sears Tower in Chicago (1973-1974) used less than 15 pounds of steel/sf of building area. Much of this reduction is related to the use of engineers like the late Fazlur Khan of the Chicago office of Skidmore, Owings and Merrill. 'Khan observed that the primary forces in tall buildings were induced by wind loading rather than gravity, and he developed the framed-tube system of wind bracing that is now utilized almost universally in high-rise buildings above 40 floors. Even at the theoretical optimum, however, Khan observed that the amount of structural steel would increase dramatically in response to building height. For example, a 60-story structure must utilize about 30 percent more steel/sf than a 20-story structure of comparable floor area.

Vertical circulation systems are another major cost generated by increased height. Mechanical systems in excess of 40 floors use a dual elevator system incorporating low-rise and high-rise elevator banks. The low-rise elevators are in an atrium and the lower half of the building. Faster and more sophisticated than the service elevators, they serve the higher stories. Generally, high-rise tall buildings may utilize three sets of elevators through a sky lobby. Conventional elevators serve the building's lower floors and serve the highest ones from the sky lobby.
lobby. A third class of very specialized elevator travels directly from the ground floor to this intermediate lobby. This class of elevator is the largest, fastest and most expensive, averaging as much as $500,000 per unit as compared to an approximate $100,000 per unit for the conventional type. The building utilizes six of these elevators, adding a premium of several million dollars to the construction cost, a cost directly related to building height.

A new premium for high-rise buildings in the Houston area has been generated by the new high-rise building code requiring sprinklers in buildings above nine floors. The nine-floor height is determined by the maximum access of fire department water supply. This regulation has been much publicized the fire danger inherent in very tall, scaled buildings. This in itself constitutes a serious criticism of very tall structures. While the sprinkler system cannot guarantee safety (cf. smoke-related casualty), it has been accepted for the time being as a sufficient fire-suppression device. The cost of a sprinkler system may add as much as $200 to the cost of a structure and, this, is a direct cost of building height. Even with the provision of sprinklers there is significant evidence that fire safety still presents a serious problem in tall buildings. In all high-rise fires to date the highest proportion of loss of lives has occurred due to smoke inhalation, and smoke generation will not always activate a sprinkler system.

These major expense areas, in addition to a number of other factors, are a limiting factor in the profit potential of high-rise buildings. The other factors that are inherent more expensive than lower-scale buildings of comparable quality. The premium seems to be justified in return to land, a 200-story building, as an example, is ten times the height above approximately 10 floors. A 70-floor building, however, is more than two times the cost of a building under 10 floors of comparable floor area.

Highest and Best Use

The high-rise building has become a symbol of commercial success and the land-development process. As such these buildings seem to represent the "highest and best use" of real estate and the most profitable building investment.

The profitability of very tall structures also requires

reexamination. It seems ludicrous to suggest that these buildings are unprofitable, but this may in fact be the case in a number of projects. Their profitability depends on a delicate balance between the prestige of the building and the rental market. In many cases the buildings cannot be leased as quickly as expected or inducements must be offered to encourage leasing in such markets as the present one. In the opinion of many real estate developers, this is the situation in a majority of Houston projects built in the last ten years.

Such factors as these should discourage the proliferation of tall buildings in a free-market economy. Ironically, however, the tax system allows the loss of the buildings to be deducted as an economic loss from a tax liability. The loss may actually be "sold." The reasoning behind this provision is somewhat complicated, the mechanism is intended to stimulate the building economy, functioning like the mechanism of depreciation. Once again this suggests that these very tall buildings are not the inevitable product of the real estate economy but are surprisingly subjective ventures, unwitting in institutionalized by, among other things, the tax system.

Other Issues

There are a number of issues that relate to personal aspects of the buildings we have discussed. Perhaps the most important of these is the question of whether office workers experience psychological dislocation in a tall building. A large number of studies that indicate that people may become disoriented in high-rise buildings. They cannot easily distinguish from floor or even a side of the building they are on. Tinted glass tends to make it difficult to read outside weather conditions and, even more, the peace and quiet of the streets below.

While productivity has not been tied directly to this, studies indicate that workers choose, in overwhelming numbers, to work in lower buildings after working in high-rises. So at the very least, there is a question about the fitness of high-rise building for the workplace that must be considered.

The Density Argument

One of the most often expressed arguments for tall buildings is that they are necessary to achieve density, and that the alternative is uncontrolled urban sprawl. This argument contains two implicit assumptions: that high density cannot be achieved with mid- and low-rise buildings and that the alternative to the concentric city is uncontrolled and counterproductive urban sprawl.

The density argument depends first on establishing standards of acceptability. For this reason it is useful to compare the densities of existing cities. The densities of the core areas of Tokyo, Hong Kong, Peking, and Shanghai are all productively that we slightly in excess of New York (800 persons per acre). Paris, London, and Rome have densities only marginally less than New York. Tokyo and Hong Kong have a high preponderance of tall buildings. Peking and Shanghai are somewhat comparable with these tall buildings and very high densities are achieved. In the United States, Washington, D.C. and Philadelphia have densities slightly higher than New York. Of course, there are tremendous differences in land patterns and space standards between Asian and European cities and between American and European cities. However, it is clear that high density can be achieved with a high level of amenities without tall or very tall building.

The concentric density argument is inherently more complex. According to this view, a city requires a core of center of appreciably higher density that its surrounds.

Conclusion

When patterns of development and building, then, might be a more realistic approach to tall buildings? In terms of the city, a more dispersed planning strategy emphasizing suburbs as opposed to a single center should be considered. The concept of providing for a network of allowing unrestricted utility connections in the down-town area.