ENCROACHMENTS IN THE PUBLIC RIGHT-OF-WAY

TECHNICAL APPENDIX

BUREAU OF PLANNING
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CITY-WIDE POLICY

ENCROACHMENTS IN THE PUBLIC RIGHT-OF-WAY

TECHNICAL APPENDIX

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CITY COUNCIL MEMBERS:

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Margaret Strachan, Commissioner

PREPARED BY:

Portland Bureau of Planning

Terry Sandblast, Planning Director
Steve Dotterrer, Chief Transportation Planner
Stephen Iwata, City Planner
Holly Johnson, Word Processor
Donna Beck, Secretarial Clerk
Emily Wied, Graphics
Jones & Jones, Illustrations

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INTRODUCTION

The public rights-of-way are of many types with varying functions and characteristics. As a system, they accommodate the movement of people and goods and unify the various districts in the City. They provide avenues of vistas and open spaces for natural lighting and air. The rights-of-way establish a visual pattern for orienting city residents, emphasizing city centers, neighborhoods and natural features.

The utility of the space within the public right-of-way can be impacted by a structural encroachment below, at, or above street level. An encroachment can disrupt the public use of the right-of-way by restricting pedestrian and traffic passage, dislocating underground utilities, or blocking vistas and natural lighting. Encroachment may, however, be necessary to improve development opportunities in the city or to provide alternative pedestrian access across congested city streets via skywalk or underground pedestrianway.

The following is an analysis of the functions and impacts of encroachments in the public right-of-way that led to the development of the policy. Included in this analysis are the impacts of encroachments on street-level activities, urban design, the microclimate, and public use and safety. This analysis also examines encroachment policies of other cities and examined existing city codes and procedures as they relate to encroachments in the public right-of-way.

SECTION I

INVENTORY

Existing Above-Grade Structures

Twenty-three above-grade structures span streets in the city of Portland (Figures 1 and 2). Of these, 12 are skywalks, four are skybuildings, and seven are "other structures." The latter category consists of five skystructures used in manufacturing or warehousing and two motor vehicle ramps that are part of the delivery access system at the Lloyd Center. All of the skystructures have been built since 1950. Seventeen of the 23 are located downtown.

The inventory of skystructures contained in Appendix I demonstrates that:

- o Most are covered or enclosed;
- o Most are viewed as providing weather protection and convenience in moving from one building to another;
- o Most, though not all, owners characterize the use of their skystructures as "heavy;"
- o Most are high enough off the street to avoid problems;

- All enclosed skywalks and some of the covered skywalks are equipped with fire doors and interior sprinklers; and

- The skystructures in Portland cause their owners few problems.

Additionally, there are other skywalks and structures in the city that do not span the public right-of-way. Besides the four structures at Portland State University listed in Appendix I, five others span vacated streets on the University campus. One is a skybuilding which serves as a student lounge as well as a pedestrian connection. The city granted a conditional use permit to Good Samaritan Hospital to construct a skywalk over a vacated portion of N.W. Marshall Street in May, 1980. At about the same time, it issued a conditional use permit to the University of Oregon that embraced two skywalks at the medical school. At Providence Hospital, the Hearings Officer granted a conditional use permit for a skywalk over NE 49th Avenue. At a later date, NE 49th Avenue was vacated.

There are also numerous minor above-grade building projections in the City. Those were not inventoried for this study and consist of marquees, awnings, canopies over loading docks, balconies, and the like. The only major above-grade guilding projection is at the city's Morrison West Parking Garage, where the building protrudes seven feet over the sidewalk on the north and south sides.

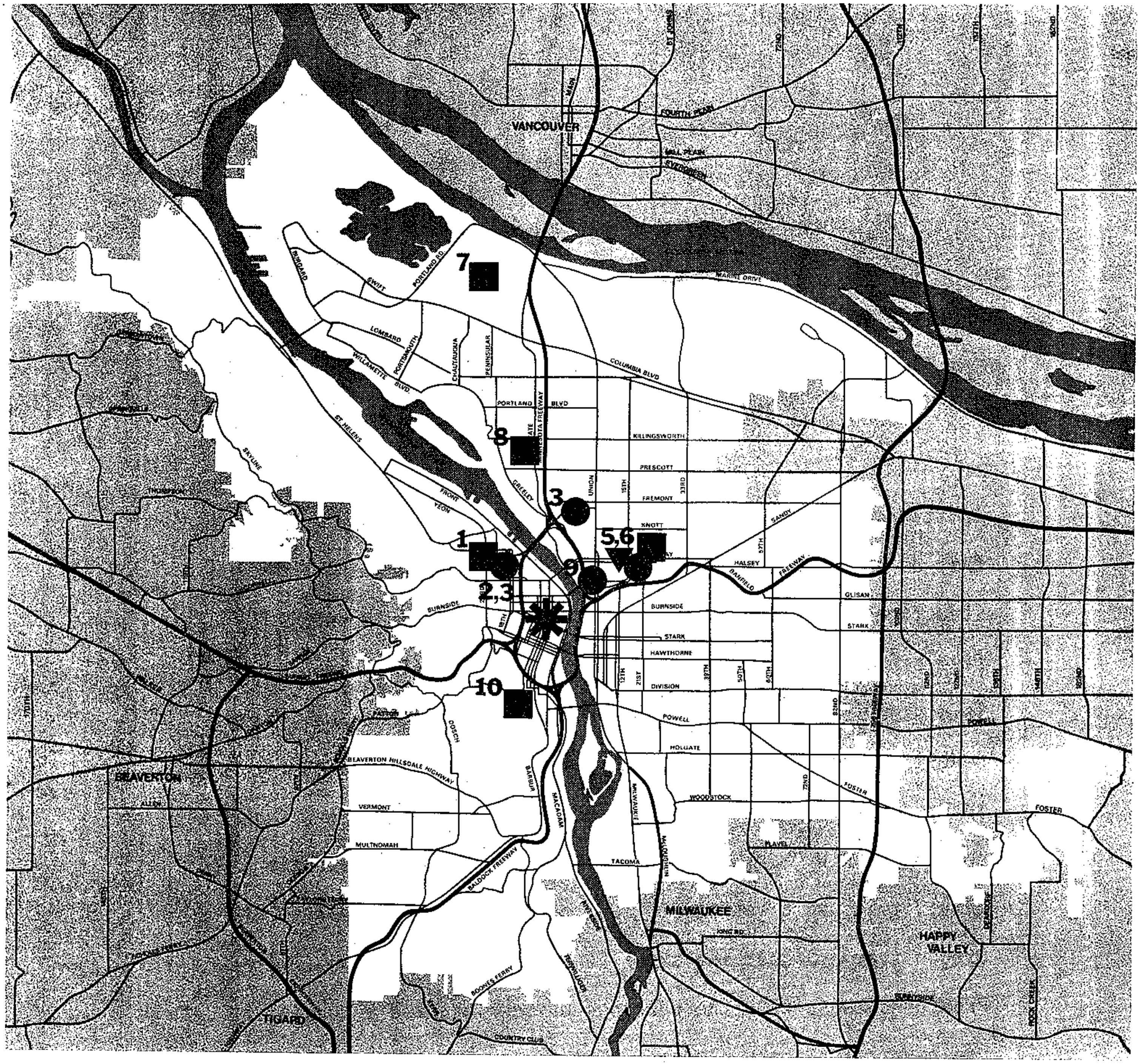

FIG. 1
MAJOR RIGHT-OF-WAY PROJECTIONS (excluding CBD)

Map key:

- ■ Skybridge
- ● Tunnel
- ▲ Vault
- ✱ See Fig. 2

APPLICANT-OWNER		TYPE OF PROJECTION
1.	Good Samaritan Hospital	Skybridge Network
2.	Good Samaritan Hospital	Tunnel
3.	Emanuel Hospital	Tunnel
4.	Physicians & Surgeons Hospital	Tunnel
5,6.	Lloyd Corp., Ltd.	Tunnel, Vaults, Bridges
7.	The Nicolai Co.	Skybridge
8.	Kaiser Foundation	Skybridge
9.	Holladay Park Hospital	Tunnel
10.	University of Oregon Health Sciences Center	Skybridge/Building

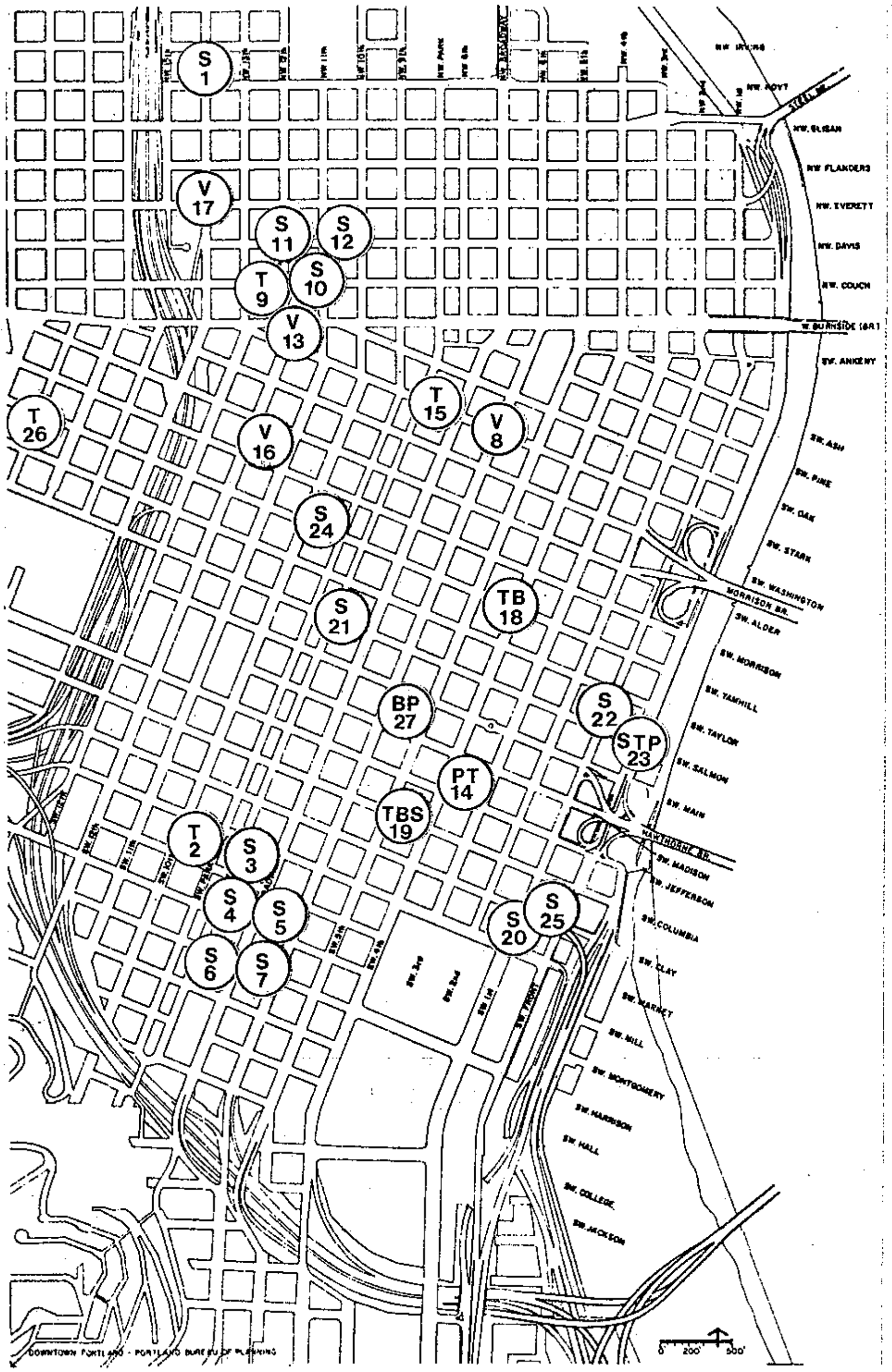

FIG. 2
MAJOR RIGHT-OF-WAY PROJECTIONS: CBD

	APPLICANT-OWNER	TYPE OF PROJECTION
1.	Meier & Frank	Skybridge
2.	State of Oregon Board of Higher Education	
3- 7.	State of Oregon Board of Higher Education	Skybridge Network
8.	First Nat'l. Bank of Oregon	Vault
9.	Blitz-Weinhard Brewing Co.	Tunnels
10-12.	Blitz-Weinhard Brewing Co.	Skybridge Network
13.	Blitz-Weinhard Brewing Co.	Vault
14.	United States Government	Sub-surface parking/Tunnels
15.	Bank of California	Tunnel
16.	Multnomah College	Vault
17.	Meier & Frank	Vault
18.	Georgia Pacific Co.	Tunnel/Building Projection
19.	First Nat'l. Bank of Oregon	Tunnel/Building Projection/ Skybridge
20.	Melvin Mark Properties	Skybuilding/Skybridge
21.	Hauser-Jenson Investment	Skybridge
22.	Portland General Electric	Skybridge
23.	Portland General Electric	Skybridge/Tunnel/Sub-surface parking
24.	Direct Imports	Skybridge
25.	Moran Construction Co./ Mariott Hotels	Skybridge
26.	Republican Co.	Tunnel
27.	Standard Insurance Co.	Building projection/Sub-surface parking

Map key:

S Skybridge
T Tunnel
V Vault
P Sub-surface Parking
B Building Projection

Existing Below-Grade Structures

There are 13 below-grade structures in Portland that fall within the scope of this report and are not building vaults (Figs. 1 and 2). Of the 13, six are underground pedestrianways. Three of the pedestrianways connect hospital buildings and three connect buildings to parking. Two buildings, the Willamette Center and the First National Bank Tower, have underground parking that extends across the street. Willamette Center also has an underground motor vehicle tunnel. The Lloyd Center has a merchandise delivery system including two motor vehicle tunnels and underground parking that extends under Halsey Street.

In addition to the structures included in Appendix I, several building vaults extend beyond the curbline and thus require a revocable permit. Most of these originally extended no further than the curbline and were allowed without a permit until the city subsequently widened the street. An exception is a 40-foot long vault underneath S.W. Broadway between S.W. Morrison and S.W. Yamhill Streets, extending 27 feet from the east right-of-way boundary abutting the Pioneer Square block. This vault housed boilers for the old Portland Hotel which occupied the Pioneer Square block until its demolition. The city later issued the Meier and Frank Company a permit to retain the vault for automobile servicing when the hotel was replaced by a parking structure. The original plans for the Pioneer Square would use the vault area as a gallery and food service.

Existing At-Grade Structures

Four street encroachments within the study's scope were identified:

1. Ordinance 113433 granted a revocable permit for parking level access ramps where the sidewalk would normally be on S.W. Main and Madison Streets bewteen S.W. Fifth and Sixth Avenues at the Standard Plaza building. Pedestrian walkways on private property replace the sidewalks, pursuant to the ordinance. Both walkways are below the grade of the street and connect to the sidewalk along Sixth AVenue by steps on Madison and a ramp on Main. A two-foot sidewalk was maintained on S.W. Main and Madison Streets for curb parking access.

2. Ordinance 124416 granted a permit to construct a building access structure and a concrete ramp extending into the right-of-way at the Riviera Motors building on S.W. First Avenue near S.W. Market Street. First Avenue's right-of-way is unusually wide at this location, and 15 feet, including a seven-foot sidewalk, remains between the structure and the curb. The permit also allowed the construction of concrete steps on S.W. Market, between SW First and Front Avenues.

3. Ordinance 129903 granted a permit for parking level access ramps where the sidewalk would normally be on S.W. Jefferson and Columbia Streets between S.W. Fourth and Fifth Avenues at the First National Bank Tower. As with the encroachment, eight-foot pedestrian walks on private property replace the sidewalks.

4. Ordinance 150255 granted a permit for a retaining wall with integral, raised landscaped plaza areas and staircases extending 11 feet into the right-of-way along S.W. Third Avenue between Main and Madison Streets at the Multnomah County Justice Center, now under construction. Inside the property line, a building arcade will provide additional walkway space for pedestrians. The approved perimeter of the building plan leaves 12 feet of sidewalk for through pedestrian circulation, provides handicapped access on Third Avenue, and allows for an at-grade entrance to the Central Precinct police facility on SW Second Avenue and a permanent outdoor cafeteria space.

In addition to the above, a parking-level access ramp occupies what would normally be the sidewalk area at the corner of S.W. Fourth Avenue and S.W. Jefferson Street (Terry Shrunk Plaza) for parking associated with the Federal Building across S.W. Fourth Avenue to the east. This would constitute an encroachment within the scope of this report had the city not vacated and conveyed to the U.S. Government the sidewalks along S.W. Fourth Avenue and S.W. Jefferson Street bordering Terry Shrunk Plaza.

FUNCTION

Encroachments in the public right-of-way can serve a number of functions. Functions here mean the benefits a person may seek in using or building a structure in the right-of-way, or setting policy on them. The following is a discussion on the functions, or benefits, structures in the right-of-way can have.

Walkways

An underground walkway or a skywalk can provide an alternative way of crossing a city street, and this way serves four basic functions. By separating the pedestrian from motor vehicle traffic, grade separated walkways can avoid the hazard and stress of crossing the street. Underground walkways and covered or enclosed skywalks provide weather protection for the pedestrian during inclement weather. By utilizing the grade separated walkways, the pedestrian can improve travel time walking between buildings, avoiding the delays at the sidewalk. Lastly, having an underground walkway or skywalk may sometimes offer greater personal safety than using the street, or at least making the pedestrian feel safer in areas with low levels of street activity, particularly at night.

In multi-block developments, the construction of a grade separated walkway can benefit the owners by improving interoffice communication, or the building's image, or improving retailing opportunities, or improving multi-block development opportunities. For individual businesses in a multi-block setting, grade-separated walkways can improve productivity and inter-departmental communications by reducing the walking times between one department and another. They can help attract tenants by making the workplace more convenient or pleasant. Corporate employers may see skywalks and/or skybuildings as contributing to the image they wish to project through the architecture of their office buildings. Underground walkways have no visual function in the urban landscape. Skystructures and underground facilities used in industry can improve efficiency by enabling more rapid movement of goods within a multi-block complex. They can also help a business adapt expanding operations to a multi-block setting as an alternative to moving to larger land parcels.

On very expensive land, construction of skybuildings and underground facilities may be necessary to achieve sufficient economies of scale in construction and operation to make a project feasible. It may also be that use of right-of-way reduces costs relative to revenue because the street right-of-way is often free (developers sometimes do not have to buy the space or rent it as they do private property). This is because, without the land cost, the added cost of a square foot of leasable space in street right-of-way (i.e., the marginal cost), will be lower than the added cost of a square foot of space on private property, but added revenue will be about the same. In some cases this may reduce average per square foot costs of a project sufficiently to make a feasible project. In others, it may simply increase the developer's profit. Below-grade construction is higher than above-grade construction and for underground facilities to lower development cost, land cost must be higher than the skybuilding.

Skywalks can provide institutions like hospitals and schools the same benefits they afford employers: improved efficiency, interdepartmental communications and convenience. In addition, institutions may have special needs. At Portland State University, for example, skywalks can move a large number of students between classes in short periods of time and avoid delays caused by crossing streets and ascending and descending stairs. Convenient, protected passages between hospital buildings is another example. In non-downtown settings, when arterial street traffic volumes and speeds are high, and night-time street activity is low, personal safety can be enhanced by skywalks.

Network

A network of skywalk or underground pedestrianways linking peripheral parking structures with the retail core can attract people to downtown and make it more accessible. Several cities in the United States have used grade-separated networks to keep their downtown more compact as retail and office square footage grows over time. A skywalk network can do this by intensifying retailing above or below the ground floor.

Such a network can become a positive attraction for downtown. With increasing competition from suburban, environmentally-controlled shopping centers, a grade-separated walkway network can provide for convenient reduction between shops, increasing retailing opportunities above or below the ground level. Such a network can also provide for weather protection during inclement weather conditions, particularly during the peak Christmas shopping period.

In cities with subways, underground walkways and malls serve the added function of providing direct linkage between stations and nearby buildings.

Generally speaking, retail stores that sell "comparison goods," i.e., goods that people tend to shop around for, do better when there are other like stores nearby. The concentration of stores offers shoppers convenience in comparing prices and selection. In addition, a shopper heading for one store may patronize another store the shopper passes on the way. Through this grouping effect, department stores benefit small shops, and vice versa. Historically, a downtown core provided the best location for most comparison shopping, although some neighborhood centers were able to offer a sufficient "critical mass" of shops for almost all types of purchases. "Critical mass," applied to retailing, is the amount and combination of retailing in close proximity to a particular location that will, through the grouping effect, attract sufficient sales volume to provide a profit for retail outlets. A major advantage of the shopping malls developed since World War II is that this critical mass can be provided within a single structure. In a downtown setting, a skybuilding or building projection simply adds to the number and size of stores that can be put in one location, increasing revenues throughout the project. Skywalks can have a similar effect by linking a retail development to other existing stores nearby, thus adding to the number of stores in proximity to one another.

At-Grade Encroachments

The functions an at-grade street encroachment can serve are illustrated by the Justice Center plans and the Riviera Motor building. At the Justice Center, the encroachment provided for a design solution to the County and architect to allow for more convenient public access into the building. The designed flexibility enabled the County to provide for an at-grade building entrance on 2nd Avenue and handicapped access on 3rd Avenue. The pubic benefit to the encroachment not only permitted more convenient pedestrian access into the building, but also improved the pedestrian environment, including a covered arcade for rain protection, an outdoor cafeteria and landscaped planter. The Riviera Motors encroachment similarly permitted the building owner and the public more convenient access into the building. In both cases, the encroachment provided for design flexibility unavailable if right-of-way boundaries were rigidly enforced.

To the motorist, the function parking beneath the street serves no different use than parking within a building. For a building developer or owner, however, it can serve to functions parking within a building does not serve. As with skybuildings and underground malls, it can reduce development costs compared to the alternative of added land acquisition, if land costs are high enough. At the same time, it can free space within a building for other, more profitable, uses. The other uses can increase profits either by generating higher net revenues per square foot than parking would, or, in the case of retail developments, through the grouping effect.

Street encroachments can serve to accommodate access and egress ramps for basement parking, as demonstrated by Standard Plaza and First National Bank Tower. By directing pedestrians around the ramps, they reduce pedestrian-vehicle conflicts where the ramps connect with the right-of-way. From a building developer or owner standpoint, they can either reduce ramp grade or the space required for the ramp within the building, or both. Reducing the space required for the ramp within the building frees space for other uses.

SECTION III

STREET LEVEL ACTIVITIES

Aside from the function they serve, encroachments in the public rights-of-way also have impacts on street level activities. Here, impacts mean an adverse effect that is detrimental to people other than those who enjoy the skystructure or underground structure benefits, most often the general public. Removing people from the sidewalk is one of the functions a skywalk can serve. It can also be viewed as an impact. The removal of people from the street can impact desired street level activities, including retailing.

The emphasis of downtown planning and development has been oriented toward the enhancement of the street level, pedestrian environment. This is to provide the pedestrian with an array of pleasurable interactions with the Portland character and would include people, retail activities and street vendors, and the diversity of man-made and natural amenities. Skywalks or underground walkways are intended to take people off the street. This may be a desirable objective where existing pedestrian volumes exceed the capacity of the sidewalk, and the resulting congestion impacts the desired street level pedestrians experience. On the other hand, fewer number of pedestrians on the street may make some people feel threatened and vulnerable and avoid using the street. At-grade encroachments can impede pedestrian movement by reducing the sidewalk width.

Policy Setting

The Downtown Plan establishes a policy framework to humanize downtown Portland by encouraging pedestrian amenities, a mix of densities, activities and lead uses, and improved transportation access. The following are the policies and guidelines in the Downtown Plan that affect this policy study.

In the pedestrian circulation section the skywalk is described as follows:

a. Between Fifth and Sixth north-south from Meier and Frank through the U.S. National Bank Building to possible parking facilities.

b. Between Alder and Morrison east-west from possible peripheral parking facilities to the center of the Retail Core. Extend this skyway to the waterfront.

c. In the Government Center* and the Auditorium Renewal** areas connecting buildings over major streets and to the waterfront.

d. Connecting convention hotels together in the Hotel/Entertainment District.*

e. In the Portland State University area connecting education buildings and parking facilities.

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*Roughly bounded by Jefferson and Salmon Streets and Second and Fifth Avenue.
**Roughly bounded by Market and Jefferson Streets and Front and Fifth Avenues.

The Plan addresses skywalks in several other places, as well. In the section on commerce, a planning guideline is to "Develop concentrated retailing along major ground-level and second-level pedestrianways."[2] A planning guideline in the section on building density reads:

> Consider granting incentives -- permitting maximum densities or other economic benefits -- in order to implement planning objectives: such as more downtown housing, preservation of historic buildings, provision of arcades or covered sidewalks, additions to the skyway system and usable rooftop open space (emphasis added).[3]

The section on visual image contains the guideline to "promote coordinated design for all skyway system."[4]

The concept of the downtown skywalk network is tied in with the plan's vision of the retail core, which it defines as the area roughly bounded by Stark and Yamhill Streets and Third and Eleventh Avenues. A goal the plan states is to "maintain a compact retail core."[5] But the planning guideline is to "encourage expansion of the retail core in the direction of the waterfront by development of tourist-oriented retailing there."[6] At the same time, the plan stresses street level activity and pedestrian movement. A commercial development goal is to "encourage retail use of ground-level space, including shops and restaurants on first floors of office buildings..."[7]

Another is to promote a system of pedestrianways which:

1. Connect the retail core with the waterfront, offices,

residential areas, and parking facilities.

2. Create a pleasant shopping environment in the retail core, utilizing widened and covered sidewalks and/or malls, special lighting and landscaping.8

In the same vein, a transportation goal is to "give maximum accommodation to walking in the core."[9] The plan further states that "in recognition of Portland's rainy weather, covered walkways, malls and other appropriate pedestrianways should be developed to serve the entire core area and to link open spaces and parks,"[10] and calls for limiting or restricting auto traffic in the retail core in deference to pedestrians.[11]

Network Impacts

How much reduction in street level pedestrian volumes a skywalk or underground walkway causes depends on the type of structure, time of day, and time of year. A skywalk or underground network open to the public and linking ten or twelve blocks in a downtown can reduce street level volumes substantially because it offers an alternative downtown circulation system. If the skywalks or underground walkways in the network connect to one another via through-building arcades or underground malls lined with stores, banks, etc., the reduction may be less because the shops could be associated with increased numbers of people in the downtown, although this assumes that the arcade shops have not displaced street level shops, i.e., that there has been growth in market demand and more people are visiting downtown. In contrast to a network, a single above- or below-grade structure connecting an office building with a subsidiary structure and accessible only to employees, like the one at the First National Bank Tower, will have less of an effect. In addition, the skywalk of this type or underground walk will not reduce pedestrian volumes at night, when most employees have gone home. This would not be the case with a network, which may stay open until late evening hours. Above- or below-grade walkway use, and consequently the effect on street-level pedestrian volumes, will have a seasonal effect, depending on weather conditions.

The reduction in street-level pedestrian volumes skywalks or underground pedestrianways can cause is not well-documented, but the effect can be significant. Minneapolis has the most extensive downtown skywalk network in the nation. It is a second level system with through-building arcades and it connects into several, well-known developments, including the IDA Center and Nicollet Mall. A 1976 Urban Land article concluded that a skywalk system could be expected to attract from 30 to 75 percent of total interblock pedestrian flow, depending on how extensive the system is, how favorable at-grade pedestrian conditions are, and upon the weather.*[12] The article also reports the results of "before and after" studies of two skywalks added to Minneapolis's system. In both cases, pedestrian flow on the streets the skywalks

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*The 75 percent figure applies to "freezing conditions, which in Minneapolis are more frequent and more severe than in Portland.

crossed dropped by approximately 60 percent. The article notes, however, that sidewalk volumes began to rise again over the following year.[13] This supports the contention that skywalk networks work through-building retailing arcades may be tied to growth in downtown visits, so that total pedestrian traffic grows, even though some of it uses the skywalk system.

Toronto, in contrast to Minneapolis, has a total of approximately two miles of underground malls, tied into large retail development associated with office buildings and into the subway system. The city in the '60s and '70s encouraged the construction of underground pedestrianways. But Toronto has changed its policy, based on the inclusion that underground pedestrianways adversely affect activity at the street level. Toronto is changing its emphasis from underground pedestrianways to promoting the sidewalks for pedestrians.

Reducing the number of people on the street where there are few in the first place may make an area forbidding, handicapping its chances of becoming a more popular place. If a street is crowded, especially at night, it can promote a sense of personal safety and encourage activities for retailing or entertainment.

Street-Level Retailing Impacts

Skywalks or underground pedestrianways can seriously affect street level retailing by reducing sidewalk pedestrian volumes and modifying an area's pedestrian circulation system. To a large extent, a store's sales depends on the market for the goods it sells (how much money people in the area spend on them), how much competition it has, and how accessible and visible the store is relative to its competition. Pedestrian movement past a store acquaints people with its existence and what it offers. By rerouting pedestrian flow and reducing pedestrian volumes, a skywalk can make a store less accessible and less visible. In economic terms, it increases the cost of the goods the store sells by the extra effort needed to get to it and interferes with the information system that makes the market for the goods work. This is especially important to specialty stores who are dependent on the passerby type of sales. If the effect goes too far, it can drive a store out of business or require it to move elsewhere.

This type of effect has implications for the area that the store is located in. The storefront may remain empty. Another possibility is that the storefront will remain empty for a while, the rent will drop, and a store of some other type will move in. If the storefront remains vacant or if the new store differs in type or character, the area will lose some of the benefit it obtains from a grouping of like stores. Aggregated over a block or a larger area, this can become a cycle of deterioration.

The extent of a skywalk's effects are difficult to quantify or predicate. They will depend on how sensitive to pedestrian volumes and accessibility the street level stores are, the degree of access between the street and the skywalk level, and whether or not the skywalk or skywalk network is associated with growth in pedestrian visits to the area. Rents at the street level provide an index because they reflect retail sales volume. In Minneapolis, no study has ever systematically examined street level rents, although it reported that the consensus of downtown businessmen there is that the skywalk network did not reduce street level rents.[14, 15] However, this fails to tell whether rents would have been higher without the skywalks and whether sales volumes kept pace with rising costs.

It may be possible to develop a skywalk network in a retail area and avoid these impacts on street level activities. This could be done by tying the network to the intensification of the area's retail growth. Retail growth occurring at second and third levels, rather in a horizontal expansion throughout the area. The network would need to provide visible linkages between the skywalk level and the street level, and taking measures to ensure that street level can attract an adequate share of the pedestrian flow. Such measures might include sidewalk widenings, establishing auto-free zones, providing improved rain protection, and encouraging sidewalk activities, such as setting aside space for musicians, vendors, etc.

Policy Analysis

It has been eight years since the Downtown Plan advocated the skywalks network, and the plan poses an obvious question: What happened to the retail core skywalk network? Of the more than ten interblock connections the plan envisions, only the skywalk linking the West Morrison Parking Garage with the Galleria has been constructed and it is on the third instead of the second floor. The U.S. National Bank Plaza building was designed to accommodate a skywalk link through it. The only other skywalk proposal fitting into the retail core network was another third-level connection between Penney's and Meier and Frank. It was abandoned when Cadillac Fairview withdrew its proposal for the Morrison Street Project. For all practical purposes, the Downtown Plan's skywalk network concept has not achieved its objective in the eight years since the plan's adoption.

A basic objective of a skywalk network would be to intensify retailing to above-the-ground-level. It appears that the demand for new retail square footage in the retail core has been insufficient to warrant the construction of the network. Increasing competition from regional shopping malls, e.g., Washington Square and the Clackamas Shopping Center, have cut into the market share the downtown may have garnered. This may be possibly due to an insufficiently aggressive program on the part of both the business community and the City to attract new downtown businesses. Improving downtown rain protection, for example, could serve as an incentive to attract new businesses. The Downtown Plan's policies to encourage ground level retailing in office buildings outside the core provides an ample supply of first-level space away from the core. This has diverted the core's ability to intensify retailing activities.

Another reason the skywalk network has not been built, which partly reflects this lack of demand, is deep skepticism among some members of the downtown business community, and concern about the side effects a network might have.

The skepticism arises partly from the expense of skywalks when connected into existing buildings and design, construction, and operation difficulties they pose.* More importantly, it comes from familiarity with the importance of pedestrian volumes to downtown retailing and concern about the reduction in street level volumes a skywalk network would cause. The feeling is that not enough people are visiting downtown to retain adequate volumes on two levels. A skywalk network might severely hurt street-level retailers, which would hurt the major retailers.

The Downtown Plan fails to resolve the objectives for maintaining a compact retail core and the expansion of the core towards the waterfront. The construction of the skywalk network can be used to achieve either objective, in the short run, but not both. There are tradeoffs between vertical expansion within the retail core and the horizontal expanse toward the waterfront.

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*Skystructures between buildings under separate ownership when part of a network raise for the owners difficult issues of maintenance responsibility, security, business hour coordination, liability, financing, and public access.

A strategy for achieving and maintaining a healthy retail environment has not been developed. Such a strategy should seek to balance the retail activities in the Downtown with it as a whole, and to maintain a healthy link of retail within the Downtown itself.[16] Such a strategy should be developed to identify the role of a skywalk network in the overall strategy for retailing in Downtown.

Each of these reasons notwithstanding, a good part of the network the Downtown Plan envisions, or something akin to it, would be in place within the next few years had Cadillac Fairview's Morrison Street Development project proceeded. Two of the downtown's major retailers, Meier and Frank and Penney's, lost little time arranging to link into the project with skywalks. Frederick and Nelson might have, too (via Meier and Frank), but planned instead to move into the project itself. This bespeaks the perception that tying in would be important. Some retailers have expressed concern regarding a network on small street-level retailers. What they would consider as the necessity of tying into a Cadillac Fairview-type development would overshadow their misgivings on the network's effects.

This analysis leads to the conclusion that the skywalk network the Downtown Plan envisions will not be developed until either a) downtown retail expansion exhausts other, more attractive options, such as expansion toward the waterfront, or b) a major, inward-oriented downtown project with a direct link to parking, like Cadillac Fairview's proposal, gets built.

The analysis here leads to the conclusion that a skywalk and skystructure network built to tie into a Cadillac Fairview-type development could have a serious adverse impact on street-level retailing and the downtown retail core in general. This would happen unless the downtown's retail market (i.e., the dollars spent there) had grown to a point where they could support the new project, the added above-grade retailing along the network's through-building arcades, and street level retailing, and the new project and the skywalk network were designed to adequately interconnect with the street level. The downtown retail market growth could come from either gradual growth over time, from growth stimulated by the project, or from a combination of the two.

Skywalks in The Government Center and the Hotel/Entertainment Districts do not pose the same tradeoffs as they would in the retail core. In fewer instances would they be associated with through-building retailing arcades, and street level retailing is not as prevalent or important in these areas as in the retail core. Nonetheless, skywalks in these areas will reduce street level pedestrian movement, undermining efforts to enliven the downtown, especially the Auditorium and Hotel/Entertainment areas. They will also have at least some adverse effect on street level retailing. The extent and seriousness of these effects will depend mainly on the nature of the buildings connected, the degree of public access to the skywalks, and how much pedestrian movement there is in the first place, as discussed in the section on skystructure impacts on street-level pedestrian activity.

At-Grade Encroachment

Encroachment at the sidewalk levels can impede movement of pedestrians. With access parking ramps displacing sidewalks, the space-saving to the owner of the building and other benefits they afford accrues to them at the expense of pedestrians. Encroachments can cause substantial pedestrian inconvenience. The detour at Terry Shrunk Plaza is minor, but the encroachment along Main Street at the Standard Plaza requires pedestrians to use stairs, excluding handicapped use of the public right-of-way. Also, the narrow sidewalk maintained at Standard Plaza, along Madison, places the pedestrian uncomfortably close to the traffic. Such a situation does not adequately or safely separate the pedestrian from the moving vehicular traffic and should not be repeated elsewhere. Street encroachment should not require pedestrians to detour and should preserve adequate sidewalk width. How much width is adequate depends on pedestrian volumes, what abuts the sidewalk (retail stores require wider sidewalks to accommodate "window shopping"), and obstruction in the form of trees, signs and the like.

URBAN DESIGN

> Portland is a product of both its natural setting and the actions of generations of people who have buit in that setting. It is the combination of these two forces that make the City a unique place. It is an intimate place made up of many closely spaced intersections with views to the surrounding hills, mountains, and the Willamette. Historical links with the past exist in groups of buildings as well as individual structures, street character and furnishings. Portland has a diversity composed of a wide variety of activities, styles of architecture, special features and parks. This identity can be supported or denied by new development.17

Preserving Portland's identity is an important consideration in determining the acceptability of any new building or structure, especially within the downtown area. The issue this section is concerned with is the relationship between encroachments and Portland's identity. Specifically, the discussion centers on the City's views, urban design, and aesthetic considerations of skystructures within Portland's urban landscape.

An important part of Portland's identity are the 200-foot block, and the frequent streets which provide for greater open space, light, air, and more direct pedestrian travel than is typically available in city centers. The small city blocks are an important part of the City's design concepts to preserve its views and create a pleasant pedestrian environment in downtown.

Views

Skystructures built over the street can block the view down a street, both of what is along the street itself, and of what is at the end of the street, terminal view, (e.g., hills or mountains or a landmark). The extent and nature of the effect depends on a number of variables. These variables include:

1. The distance from the viewer to the view subject;

2. The width of the street;

3. The elevation of the view subject (e.g., the hills or landmarks relative to viewer's elevation;

4. The grade of the streets;

5. The distance between the skystructure and the viewer;

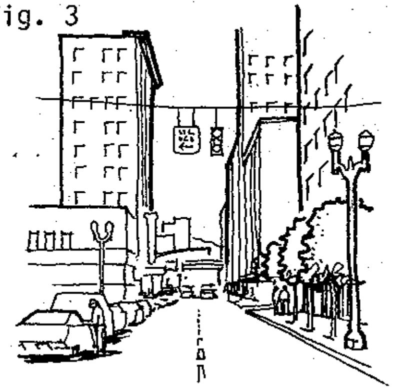
6. The skystructure's clearance for the street;

7. The skystructure's height; and

8. The skystructure's width.

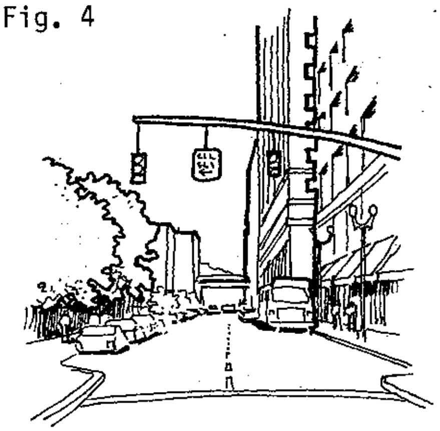
The first four factors affect how much view there is in the first place and its elevation from the viewer's perspective. The amount a viewer can see declines with distance because the lines defined by the buildings along the street converge (Figure 3). The narrower the street, the sharper the convergence. The apparent elevation from the viewer's perspective will also decline with distance. The view

Fig. 3



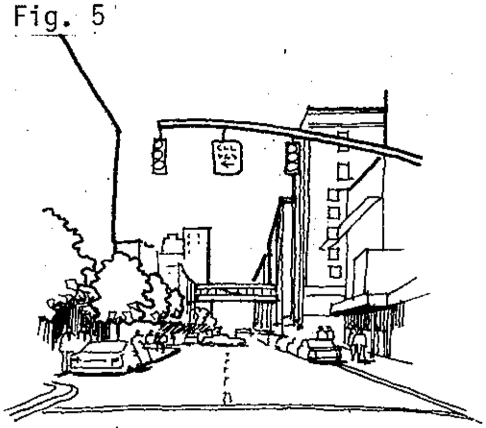
SEVEN BLOCKS AWAY

Fig. 4



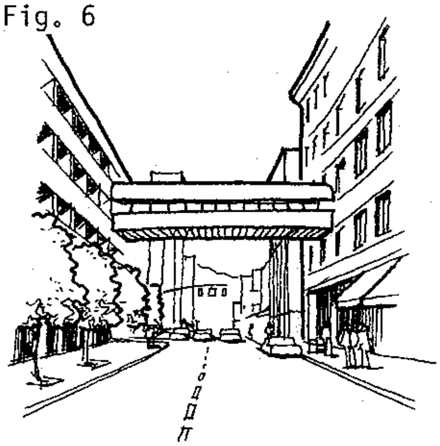
FIVE BLOCKS AWAY

Fig. 5



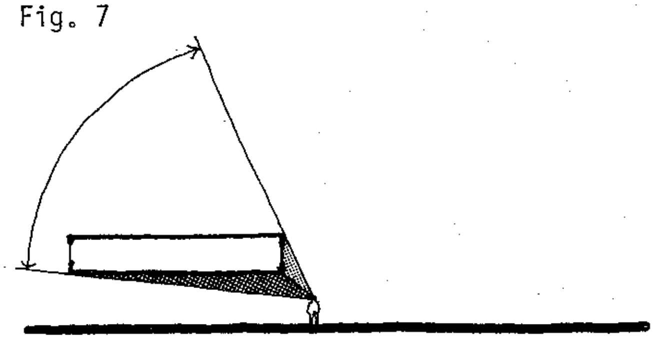
THREE BLOCKS AWAY

Fig. 6

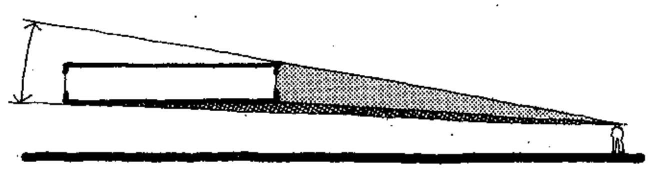


ONE BLOCK AWAY

Fig. 7



VIEW BLOCKAGE - CLOSE VIEW



VIEW BLOCKAGE - DISTANT VIEW

Fig. 8

subject's actual elevation (e.g., low hills versus mountains) will affect this as well. A downgrade will open more to view, an upgrade less.

The third through eighth factors determine how much a skystructure blocks the view. Generally speaking, the greater the distance from skystructure to viewer, the less the view blockage, although the view from close to the structure, say, one block, may not be blocked at all because the viewer can look under the structure (Figures 3-6). Both clearance from the street and greater skystructure width increase the amount of view blockage for the viewer standing near the structure, but have less effect on the amount of blockage at a greater distance (Figures 7-8).

Clearance from the street also affects the apparent elevation of the view subject to the skystructure blocks. At one block, for example, a third story skystructure might block the view of low hills several <u>miles</u> distance (Figures 9-10). Differences in street grade, however, could reverse this.

Skystructure height makes a big difference. Increased height from a multi-story skystructure not only increases the amount of a view the structure blocks, but also increases the distance from viewer to structure over which it effectively blocks the <u>entire</u> view (Figure 11).

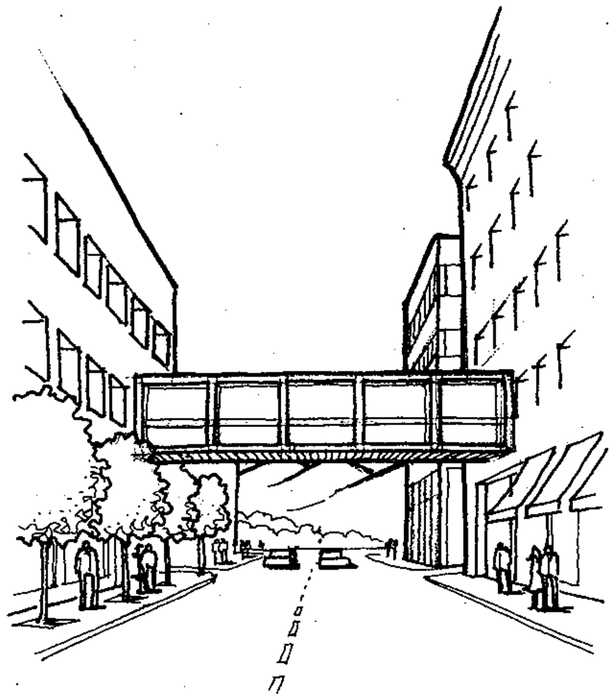


Fig. 9

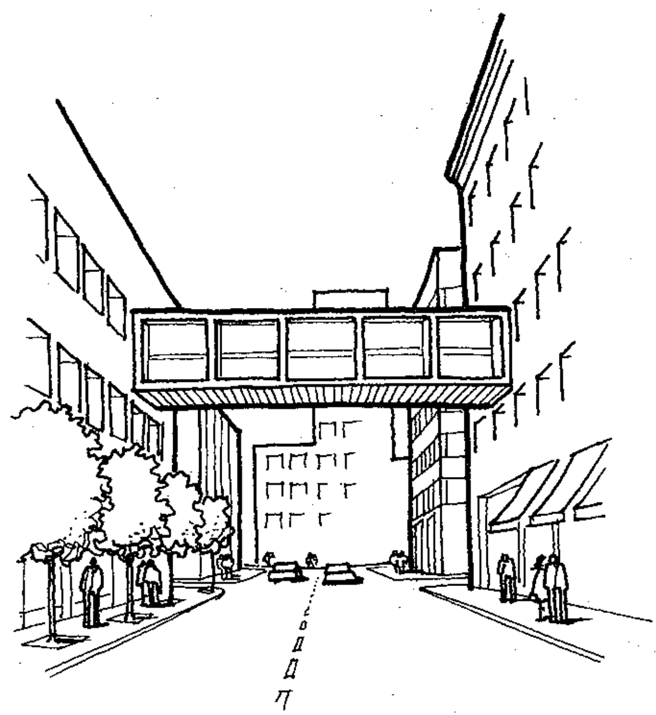
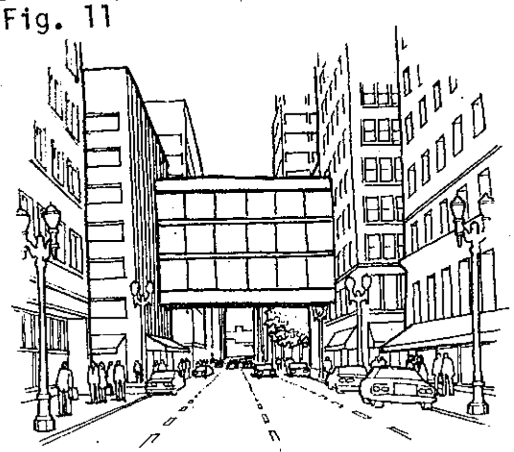


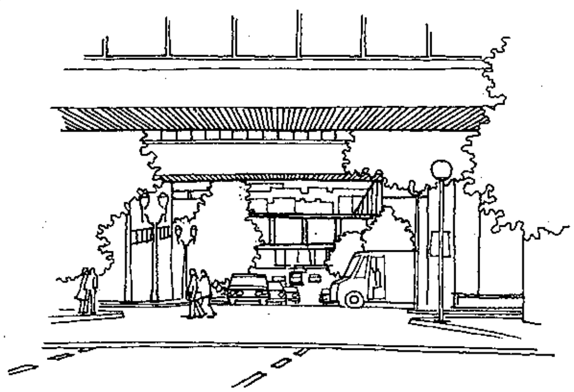
Fig. 10

Fig. 11



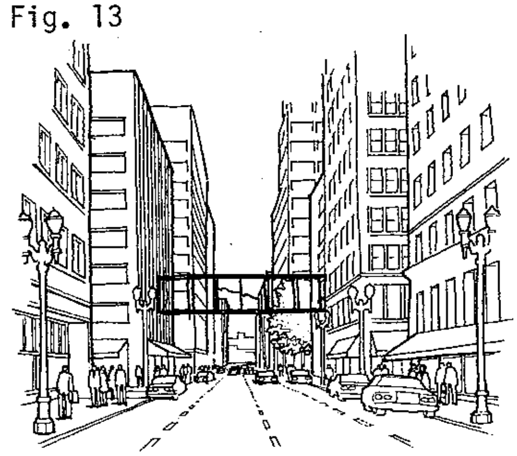
VIEW BLOCKAGE CREATED
BY HIGH SKYSTRUCTURE

Fig. 12



STACKING EFFECT OF
MULTIPLE SKYSTRUCTURES

Fig. 13



VIEW ALLOWED BY
TRANSPARENT SKYSTRUCTURE

Other factors also make a difference. More than one skystructure on a block can have the same view blockage effect of one wide structure (Figure 12). Multiple skystructures on one street can have an additive effect, blocking a view over a greater range of viewer locations. Use of transparent materials sometimes reduces the view blockage a skystructure causes (Figure 13). However, the view through transparent materials will always be filtered, and often they will not be transparent at all because of reflections.

View Categorization

In downtown Portland the views of the hills, distant mountains, Willamette River, at the end of downtown Portland's streets set it apart from other cities' downtowns. These views, especially of the West Hills, river, and elevation gain on the East Side, impart a sense of scale to the downtown and help people orient themselves. Not all downtown streets have these views, but most do (Figures 14, 15). Some streets also have features along them, like architecturally or historically distinct buildings and landmarks, that contribute to a street view's value (Figure 16). Consideration of skystructure proposals should take into account how the affected street view compares with other street views. It should also focus on the structure's view blockage impact at the most critical viewer locations. These locations should be based on where the most viewers will be and viewer locations that should be protected, e.g., parks and fountains.

The four view categories are:

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Critical View to a Natural Feature
(Major Potential Visual Intrusion)
Examples include views chiefly to the west and south towards the West Hills and east to the Willamette River.

View to a Major Man-Made Feature
(Moderate Potential Visual Intrusion)
Examples include the Elk Fountain on Southwest Main and Union Station at the end of Northwest Sixth.

Minimal Views
(Moderate Potential Visual Intrusion)
Although the view north along Broadway in the downtown has no natural or manmade focus, the retention of the existing character of this major downtown street is a recurring concern voiced by citizens. Views along Park Avenue, an unique narrow street, and to areas of Portland east of the Willamette River, are similarly categorized because of citizens' concerns that the existing character of these corridors be maintained.

Minimal Views
(Low Potential Visual Intrusion)
Examples include views that have no visual focal point or prime cultural significance, and can therefore most easily absorb the impact of a skystructure.

(THE ABOVE ARE KEYED TO THE NEXT TWO SHEETS)

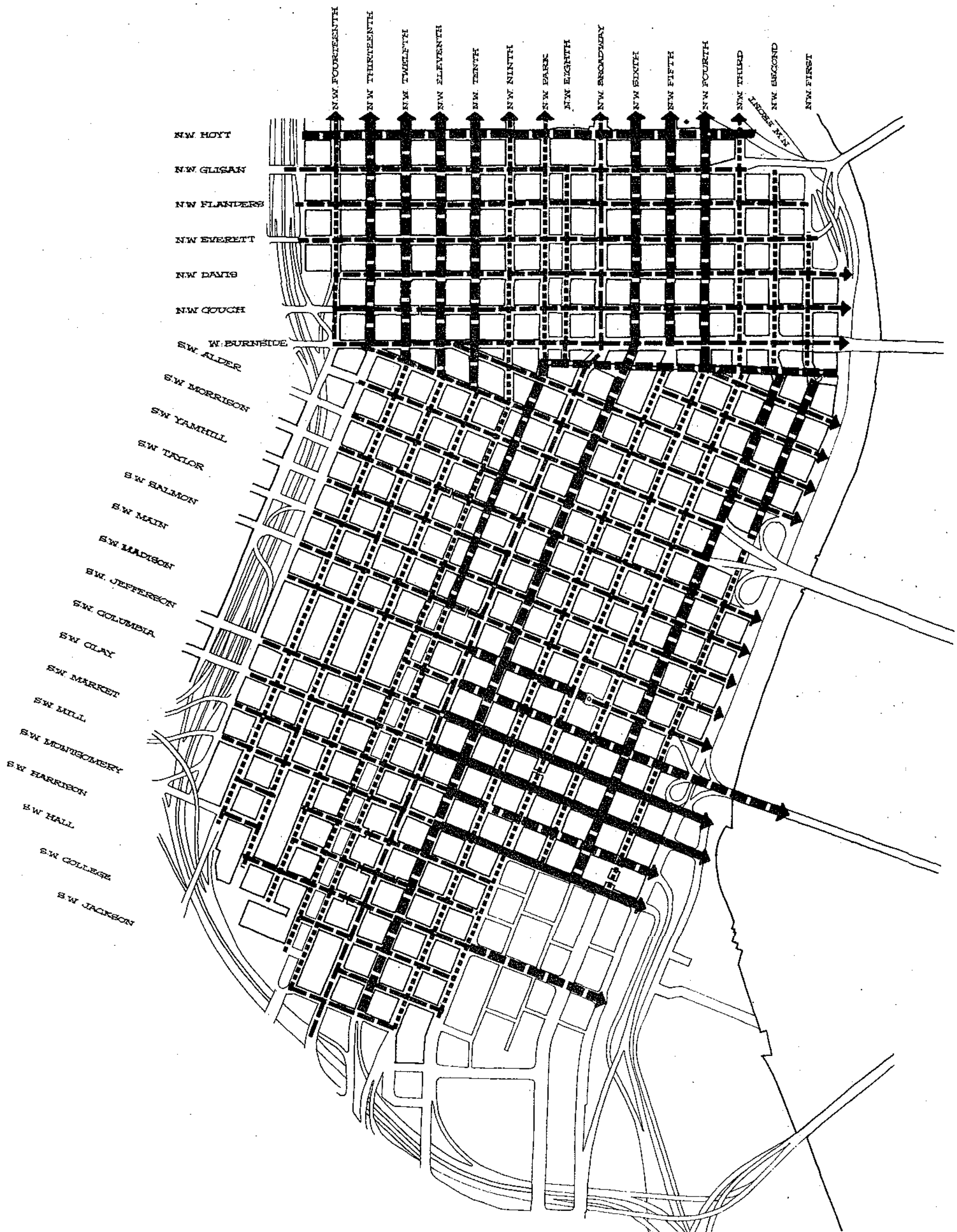


Fig. 14
VIEW CATEGORIES
NORTH & EAST VIEWS

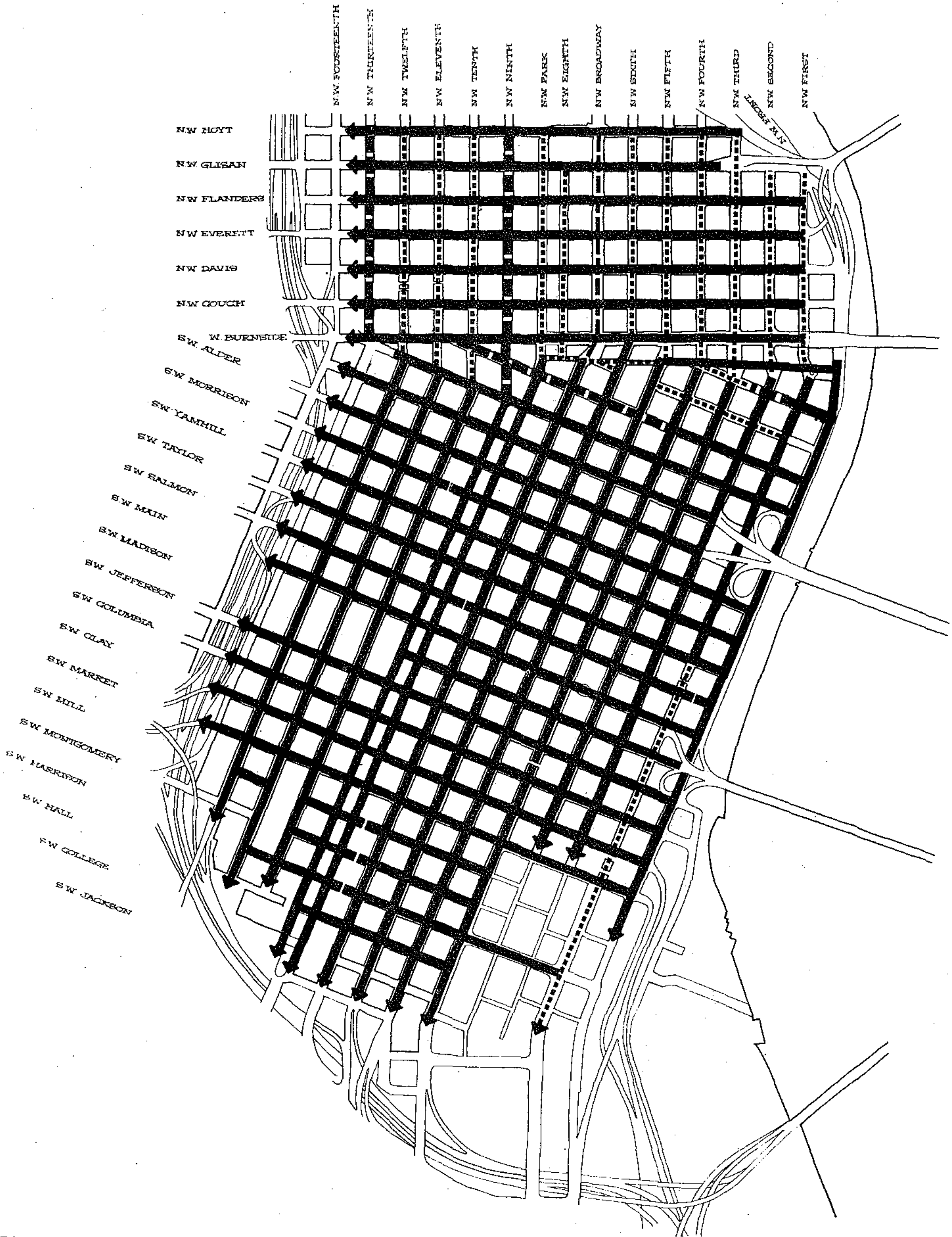


Fig. 15
VIEW CATEGORIES
SOUTH & WEST VIEWS

Architectural and Historical Features

Figure 16 indicates some of the major areas, landmarks, buildings, and districts commonly cited as "significant" architectural and historic features. Skystructures would, in many cases, alter the character of and have a detrimental effect on many of these features. This list is partial, and skystructure proposers should refer to national and local registers, agencies, and societies for other landmarks and structures of value.

<u>Key</u> to map on the following page:

1. Skidmore/Old Town Historic District
2. Yamhill Historic District
3. Pioneer Courthouse
4. Pioneer Square
5. Chapman Lownsdale Square
6. South Park Blocks
7. North Park Blocks
8. City Hall
9. Multnomah Library
10. "Jesus Saves" sign
11. Jackson Tower
12. Terra Cotta District
13. Lovejoy Fountain
14. Ira Keller Fountain
15. Calvary Presbyterian Church
16. Portland Art Museum
17. First Unitarian Church
18. U.S. Customs House
19. Railway Exchange Building
20. Concord Building
21. Hamilton and Dekum Building
22. Equitable Building
23. University Club
24. U.S. National Bank
25. Paramount Theater

7a

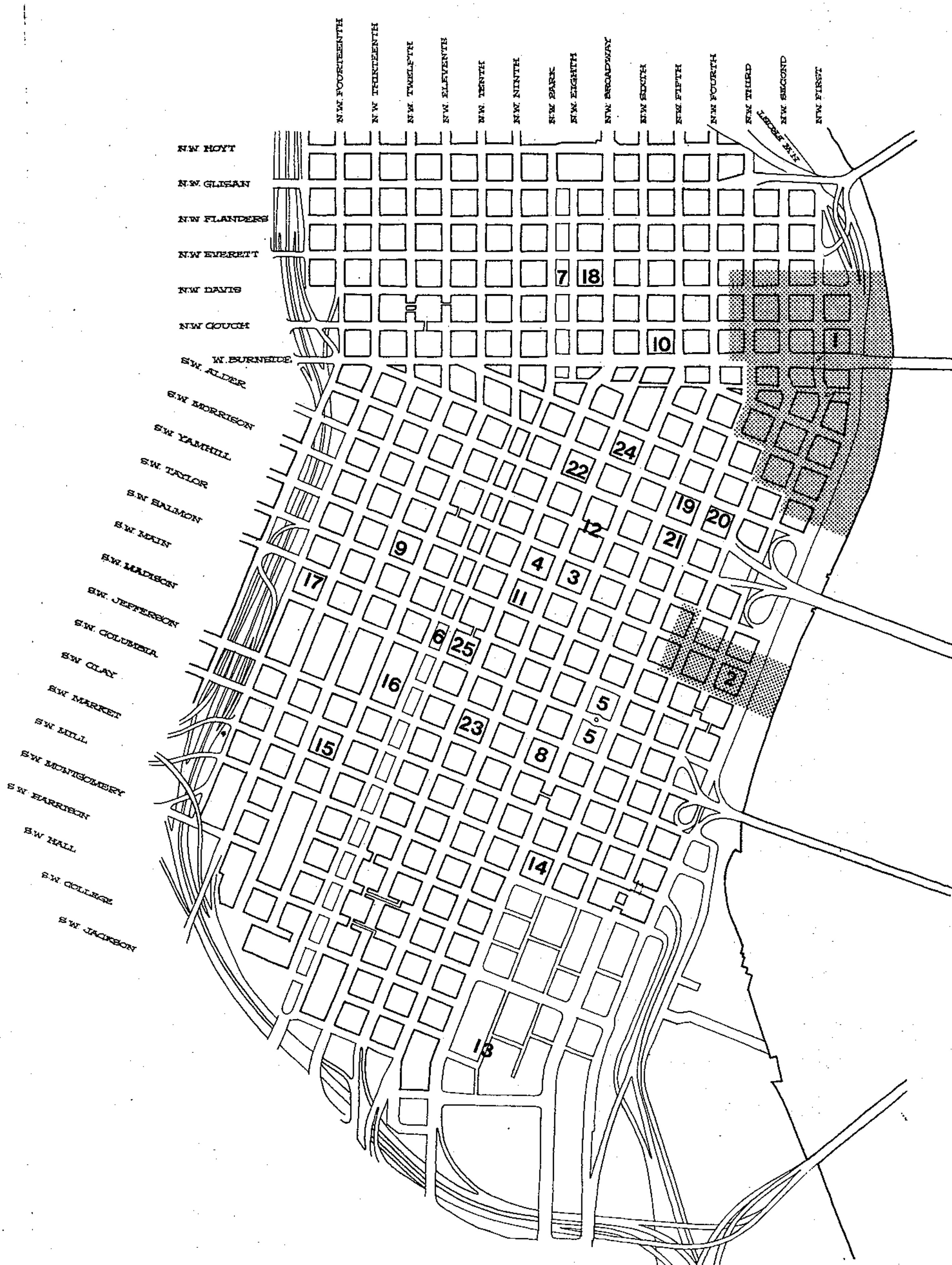


Fig. 16
ARCHITECTURAL &
HISTORICAL FEATURES

An unfortunate result of the oreintation of downtown streets south of Burnside is that it generally does not permit views of Mt. Hood or Mt. St.Helens from the street level.

The maps on the two accompanying pages depict the four broad classifications of view categories that have been used to characterize the major street views. It is intended that the map be used to determine the visual compatibility of pedestrian views with potential skystructures.

Views outside downtown vary more. Consideration of skystructure proposals should take into account physiographic elements like mountains, hills, and rivers; vegetated areas like parks; and man-made features including distinctive cityscapes such as merging patterns in street geometry.

Design and Aesthetics

The aesthetic value of a skywalk and at-grade encroachments is dependent upon an individual's values and taste; one person's "gateway" or exciting "visual element" is another's "eyesore." The following is a discussion of various factors that can be considered in evaluating the design of a skystructure.

The skystructure can serve a definitive function within the urban landscape, apart from what transpires within them. By virtue of their size, shape, color, and placement, skystructures become memorable and identifiable landmarks. Thus, skystructures can acquire positive values as landmarks apart from their usefulness as circulation links. Skystructures can serve as:

<u>Landmarks</u> - skystructures help people orient themselves when entering the sidewalk from a building, for example, or driving down a street. Distinctive size, color, and design help in this regard. Landmarks also contribute to a person's image of a place.

<u>Gateways</u> - skystructures can establish a gateway or portal effect at entrances to a district.

<u>A Unifying Element</u> - a network of skywalks connecting all or some of the buildings in an area could help set it apart. A uniform design or color would reinforce this effect. St. Paul has taken this approach in its downtown.

<u>Visual Linkages</u> - on a smaller scale, skystructures can provide a visual as well as pedestrian linkage between buildings that make up one complex. The skywalks at Willamette Center and Portland State University are examples.

Edges - skystructures can reinforce the edge or boundary between one type of land use and another, such as between highly urbanized land and open space.

To provide a guide to the design of skystructures and at-grade encroachment in downtown, the Downtown Design Standards adopted by the Design Committee establish standards to guide development in downtown. The following are standards from the document that can guide a skystructure design.[18]

1. THE 200-FOOT BLOCK STRUCTURE

Preserve the present grid pattern typical of downtown Portland's right-of-way and the ratio of open space to buildings that it produces.

2. PROTECT THE PATHWAY SYSTEM

Where a right-of-way contains mixed modes of travel, protect and reinforce the sidewalk environment through maintenance of the City's pattern of strongly separating pedestrian and motor-vehicle movement.

3. MAINTAIN THE STREET WALLS

Maintain a recognizable enclosure of space in downtown rights-of-way.

4. UNIFYING ELEMENTS

Strengthen the special identity of sub-areas of the downtown by respecting existing layers of similarity or adding new layers that enrich and expand an area's character.

5. CONTINUITY AND COMPATIBILITY

Maintain compatibility with design features of surrounding building which give continuity to the area.

6. CORNERS THAT BUILD INTERSECTIONS

When designing building corners give special attention to the role such elements as openings and awnings play in reinforcing the intersection as an activity area.

7. THE STAGE AND THE ACTION

When planning new buildings, develop the ground level with as much public use space as possible and with frequent views and access into internal activity spaces from adjacent sidewalks.

8. STRUCTURES OVER THE RIGHT-OF-WAY

When placing structures over the public right-of-way, preserving significant views, pedestrian pathways and public access to light, and air, and provide active pedestrian spaces below.

This study concludes that a large above-grade skystructure in downtown Portland would ill-fit its existing character. This is due to difference in scale such a structure would represent, its inconsistency with the core's small single block pattern of development, and the tunnel effect on the street.

Signs, Posters and Banners

Except when the City code specifically allows them (e.g., store signs on buildings) private signs in street right-of-way require a permit from the City in the same way that a skystructure does. Signs, posters and banners as distinct uses of street right-of-way are subject to separate approval by the City Engineer.

Location on Block

Past policy recommendations have supported locating skywalks at mid-block. One consideration is to preserve the uniform appearance of each of an intersection's legs as a matter of urban design. Another is to maintain intersections as a series of focal points on which an area's visual organization rests. Location on a block is most likely to become an issue where an existing building's interior layout is such that the point of entry has a significant effect on skystructure cost or feasibility. In such instances it may require connections with street intersections.

Angled Skystructures

Most of the time the floors in buildings connected by skystructures are at different elevations, raising the possibility of vertically angled skystructures. Proposals for horizontally-angled skystructures are also possible. Angled appearance should be avoided, i.e., that skystructures should be designed to disguise level changes and should be at symmetrical angles from the buildings they connect. This may not be as important in industrial areas.

SECTION V

MICROCLIMATE

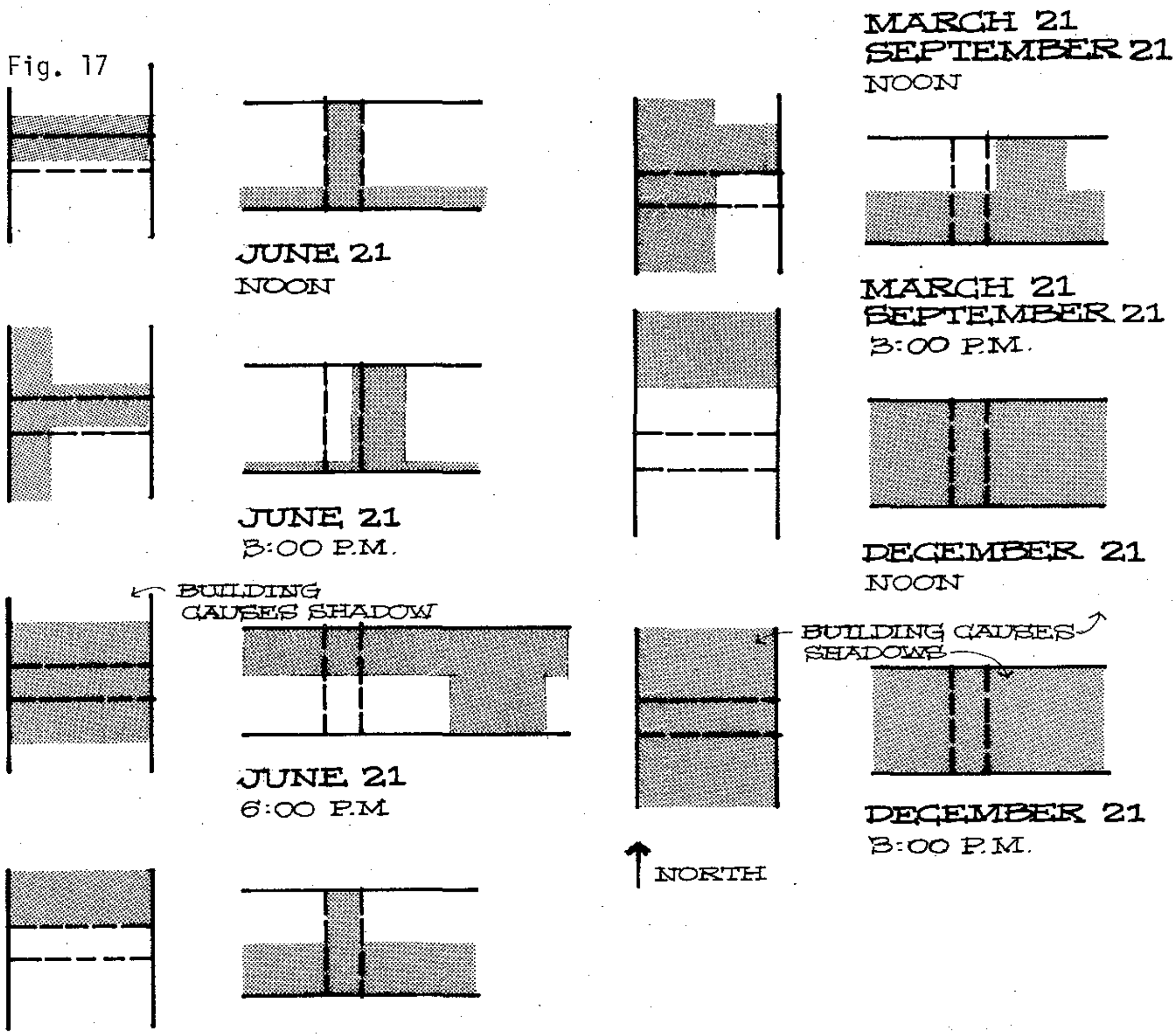
The 200-foot blocks define a character in downtown by providing for frequent intersection, high ratio of open space to building area, preserving views, and frequent open and airy sidewalks. The grid network promotes sunny avenues to enhance the pedestrian's environment. This section discusses the possible impacts a skystructure may have on the microclimate in downtown and its effect on street level.

Various factors contribute to climatic variations between city blocks. These factors, including building heights, traffic volumes, wind velocities and direction, topography, land uses, street right-of-way, and seasonal changes in the sun's declination can contribute to differing climates between city blocks. Differences in climate would manifest itself in terms of variation of light and shade, wind velocities, noise levels and air quality.

Shadows

The shadows a skystructure casts will depend on the time of day and year, the orientation of the street it crosses, and surrounding buildings. Figure 17 shows the shadows a skystructure would throw at different times of the day on the summer and winter solstices (June 21 and December 21) and vernal and autumnal equinoxes (March 21 and September 21). The structure is ten feet high, 20 feet wide, and 20 feet off the street. The buildings connected are as high as the top of the skystructure. The north-south street is 80 feet wide and the east-west street 60 feet wide, as is typical in downtown Portland. If morning shadows were shown, they would be the symmetrical opposites of the afternoon shadows shown working in three hour intervals from noon. Figure 17 shows how the sun's angle affects the skystructure's shadow, and that the sum of area within the shadow would be shadowed even without the structure. This effect would be even greater with higher buildings.

Fig. 17



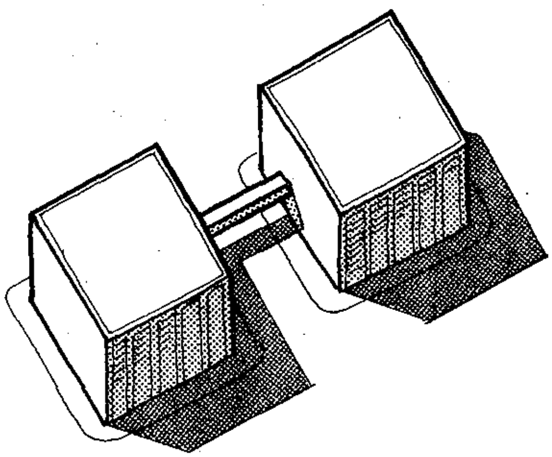
More importantly, a skystructure's size also affects how far beyond the structure it throws a shadow. The structure's height from top to bottom makes the biggest difference (Fig. 17 and 18). As Figure 17 shows, the shadow's impact of structures crossing north-south streets generally exceeds the shadow impact on east-west streets. If high enough, from top to bottom, i.e., over one level, a skystructure over a north-south street can eliminate what little direct sunlight there is at mid-winter over a substantial segment of the street beyond the area directly beneath the structure. This may prolong snow and ice conditions during the winter months on City sidewalks and streets.

How much direct sunlight Portland gets should be kept in mind in considering shadow impacts. As a mean, there are about 70 clear days and 70 partly cloudy days in Portland every year. The clear and partly cloudy days are distributed to month in Table I.

TABLE 1 : Average Clear and Partly Cloudy Days

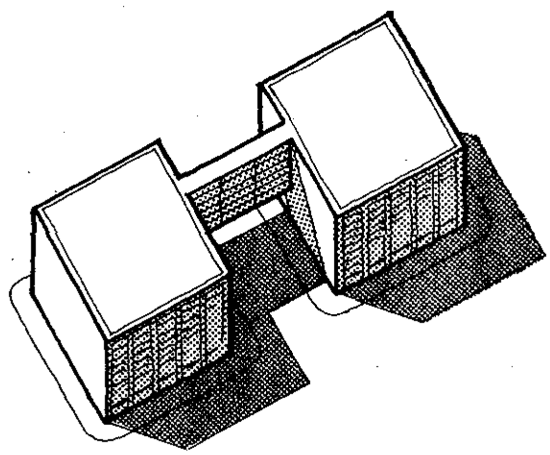
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Clear	3	3	3	4	5	6	13	11	10	6	3	2
Partly Cloudy	3	3	4	5	7	8	9	10	8	6	4	2

Fig. 18

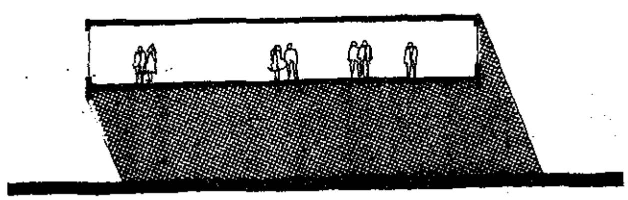


SHADOW CAST BY LOW SKYSTRUCTURE

Fig. 19

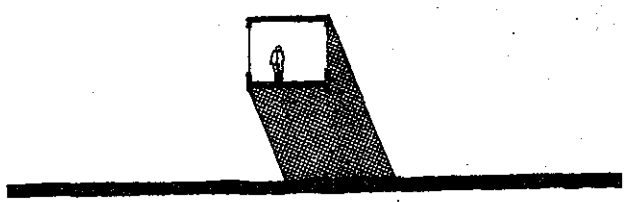


SHADOW CAST BY HIGH SKYSTRUCTURE



SHADOW EFFECT
WIDE SKYSTRUCTURE

Fig. 20



SHADOW EFFECT
NARROW SKYSTRUCTURE

Fig. 21

Light Levels

The concern here is with light levels beneath a skystructure during the day. (See Fig. 20 and 21).

Unfortunately, defining the effect of skystructure height and width on light levels underneath exceeded this study's time and resources. The subject is highly complex. Light level impacts depend not only on time of day and year, weather conditions, surrounding buildings, and skystructure size and design, but also on what color everything is. Use of architectural models, or even computer simulation, is possible, but generalizations are difficult to make. The subjective nature of light level perceptions is also troublesome.

One important concern is the psychological effect that such a structure would have on persons walking beneath it. A large structure tends to create a ceiling over the pedestrians which will change the way they perceive their surroundings. Great care must be taken not to create a dark tunnel or cave.

Dark areas not only create fear and apprehension, they also invite crime. An area that is too dark could create problems with traffic and pedestrian safety. When a vehicle travels from natural sunlight, (approximately 7000 foot candles), into a substantially darker area similar to a tunnel, (approximately 10 foot candles, which should be regarded as an absolute minimum for roadways), the human eye does not have sufficient time to adjust to the reduced light level. There is a moment of partial blindness which could easily create an accident. Design of lighting systems for modern tunnels always takes this into consideration, and this should be done for skystructures too, where necessary.

Portland's existing skystructures permit a few generalization, however. All else being equal, the wider and lower a skystructure is, the lower will be daytime light levels beneath it. Narrow skystructures, in the range of ten to 30 feet, seem to have little effect, even at the first story. Nearly all of Portland's existing skystructures fall into this category, including a 32-foot wide second level skystructure over vacated Montgomery Street at Portland State University. Portland's widest skystructure, the second level skybuilding over First Avenue at the Crown Plaza, however, seems to be at the borderline between little or no noticable effect, and a noticable, possibly excessive, light level reduction. It is 60 feet wide and has a 16-foot clearance from the street. Proposals for second-level skystructures this wide or wider call for special consideration of daytime light levels beneath them. Lighting beneath wide skystructures is especially critical where there will be pedestrians and storefronts.

Lighting should be used to mitigate the tunnel-like effect wide skystructures can have on the street. Light wells along a skystructure's longest axis have the greatest potential. Light wells more closely approximate the sun's intensity than artificial lighting, although this study can offer no guidance on their effectiveness in particular cases. With artificial lighting, overall flooding is one approach, but may mean more light than is needed in some areas, and may be energy inefficient. Washing the building walls on either side of the street with light is more energy efficient, and can give the impression that the area is lighter than it actually is. Windows opening into visually interesting activities, etc., inside the buildings will also increase perceived light levels, and inside lighting will help light the street and sidewalk outside.

It is desirable to avoid the energy daytime artificial lighting would consume, and more importantly, artificial lighting is not the same as natural lighting. Cutting down on daylight level is a disadvantage of wide skystructures, and should be avoided where pedestrian activities are encouraged.

Wind

A skystructure can increase wind velocities over and under it because air flows that would otherwise flow by must instead flow around the structure. At a given wind speed, the effect depends on several factors, including clearance below the structure, the height of the structure, the width of the structure, surrounding building heights, topography, etc. The channeling of the wind would decrease with increasing distance, i.e., the increased velocity will be greater at the structure's lower edge than at 15 to 20 feet below. Low clearance and/or narrow street width would increase this effect by reducing the size of the passage beneath the structure. Buildings have a similar effect, with winds directed around their sides. Normally this is not a problem except with large, high-rise buildings. The combination of a skystructure and the effect of two buildings it connects, however, can combine into a funneling of wind beneath the structure. The potential impact is greatest when a skystructure extends to the buildings' corners.

The occasional strong winds in Portland can make walking uncomfortable, and when wind storms do occur, a skystructure's effect could be serious. None of Portland's existing skystructures seem to pose a problem; the buildings they connect are not especially large, and although most are at the second story, they are more than one story high. Multi-story skystructures with low clearances from the street and connecting large buildings could well have undesirable wind tunneling effects at the street level. This could represent a threat to pedestrian comfort and safety. Wind funneling can also break windows and remove building claddings.

Air Quality

Portions of downtown Portland are currently projected to be in violation of the 10mg/m eight-hour average carbon monoxide (CO) standard. Appendix II indicates the areas in downtown that are and projected to be in violation of the standard. The City has committed itself to achieve the standards by 1982. If the 1982 deadline cannot be met an extension request to 1987 may be necessary. This is despite declining motor emission, increased transit ridership and various measures implemented to improve air quality.

Skystructures may impact the air quality situation depending on the height, width and location. The structure over a right-of-way can reduce the dispersion of air pollutants, and could cause a violation or delay attainment of the standard.

The air quality impact of a skystructure was exaimined and the results are indicated in Table II.

Two locations were examined for maximum eight-hour average CO level, one a north-south street, SW Broadway between Morrison and Alder, and one an east-west street, Jefferson between Broadway and Park. The projection for CO and attainment years were made for ten skystructure configurations combining heights of 18 feet and 28 feet with width of 20, 40, 60, 80 and 100 feet.

Table II

Predicted Maximum 8-hour Average Carbon Monoxide Levels Under Various Skystructure Configurations

		Skystructure Width (ft.)						
Receptor	Skystructure Heights	0	20	40	60	80	100	Traffic Volume ADT
407	18 ft.							
	-1982 CO level (mg/m^3)	11.3	11.83	12.35	12.87	13.40	13.93	13,000
(Broadway Ave. between Morrison & Alder)	-Structure Impact*	0	.53	1.05	1.57	2.10	2.63	
	-1987 CO level (mg/m^3)	7.0	7.39	7.78	8.16	8.55	8.94	16,200
	-Structure Impact	0	.39	.78	1.16	1.55	1.94	
	28 ft.							
	-1982 CO level (mg/m^3)	11.3	11.64	11.98	12.31	12.65	12.99	13,000
	-Structure Impact	0	.34	.68	1.01	1.35	1.69	
	-1987 CO level (mg/m^3)	7.0	7.25	7.50	7.75	8.00	8.25	16,200
	-Structure Impact	0	.25	.50	.75	1.00	1.25	
305	18 ft.							
	-1982 CO level (mg/m^3)	7.4	7.74	8.07	8.40	8.74	9.07	8,000
(Jefferson St. between Broadway & Park)	-Structure Impact	0	.34	.67	1.00	1.34	1.67	
	-1987 CO level (mg/m^3)	4.7	4.91	5.13	5.34	5.55	5.77	8,400
	-Structure Impact	0	.21	.43	.64	.85	1.07	
	28 ft.							
	-1982 CO level (mg/m^3)	7.4	7.62	7.83	8.04	8.26	8.48	8,000
	-Structure Impact	0	.22	.43	.64	.86	1.08	
	-1987 CO level (mg/m^3)	4.7	4.84	4.98	5.11	5.25	5.39	8,400
	-Structure Impact	0	.14	.28	.41	.55	.69	

* Structure Impact = CO level for given width - CO level without (mg/m^3)

The Broadway test site is located in an area projected to be in violation of the eight-hour average standard in 1982 and in compliance by 1984. Under the 18 ft. height scenario, only the 20 ft. width skystructure will not delay attainment. The 40 to 80 ft. structures will delay attainment to 1985 and the 100 ft. to 1986.

For structure 28 feet above the surface, compliance for 20 to 40 feet wide structure, compliance will occur in 1984, while being delayed to 1985 for the 60 to 100 foot range. As a general guide, DEQ considers projects with over a 0.5 mg/m^3 increase in CO levels as having significant impact if standards will be violated.

Estimated CO concentrations at Jefferson Street site are not projected to be in violation in 1982 or 1987 under any alternative configuration. However, if no-build 1982 air quality levels are close to 8.5 to 9.0 mg/m^3 skystructure impacts may contribute to CO violations in 1982.

In general the following conclusion can be made regarding this analysis:

1. Special attention should be given to skystructures located in the violation areas identified in the Downtown Parking and Circulation Study. Limits to a 20 ft. skystructure width and/or auxiliary ventilation may be appropriate.

2. In areas with projected no-build case CO levels of 8.5 mg/m^3 or greater or with traffic above 8000 ADT, careful attention should be given to skystructures over 60 feet wide.

3. The higher and narrower skystructures have lower CO impacts.

4. Offices located under a skystructure should have ventilation intakes above the skystructure and preferably above the street canyon.

5. Location of pedestrian rest areas, bus stops, sidewalk cafes, etc. beneath skystructures should be avoided in high traffic areas.

Noise

Noise levels* beneath a skystructure can increase due to the tunneling effects.

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*As a criterion for judging sidewalk noise, this study uses a daytime L_{eq} of 60 dBA. L_{eq} is a measure of energy average sound level, which has been equated with L_{10} levels. A L_{10} is the noise level in dBA that noise exceeds ten percent of the time over a given period. A noise level of 60 dBA has been found to be the threshold for speech interference at two meters outdoors. Thus, a daytime L_{10} of 60 dBA means that noise levels are high enough to interfere with speech ten percent of the time during the day, and a L_{eq} of 60 dBA represents approximately the same. Daytime here means 7:00 a.m. to 10:00 p.m. HUD noise criteria for evaluating proposed (re)development sites for housing do not permit such housing projects at sites which exceed the value of 70 dBA Ldn. Thus, the increment given by a skystructure may tie the balance between the acceptance or rejection of a site.

A recent survey indicated that noise levels in downtown are relatively high, see Figure 22. At no location where measurements taken for the study, were noise levels below the L_{eq} of 60, and at many locations noise levels were far higher. An increase of 10 dBA is usually perceived as a doubling in noise.

The presence of a skystructure would increase noise levels below the structure. Increases may range to a practical limit of about +10dBA*, although the theoretical limit is greater. When the width of the structure exceeds that of the street (at right angles) below it, a tunnel may be considered to be formed. Noise increases are at their greatest at the center of the tunnel, decreases with distance from the center, and may be considered to extend beyond both ends of the tunnel to an effective distance equal to the width of the skystructure. Beyond those points, the effects may be considered negligible. The critical dimension is the width of the skyway, relative to the width of the street it crosses; when this factor exceeds 1.0, propagation beyond the cover can be anticipated. This may, therefore, have implications for the selection of streets for such skystructures, since downtown north-south streets are approximately 20 feet wider than those running east-west.

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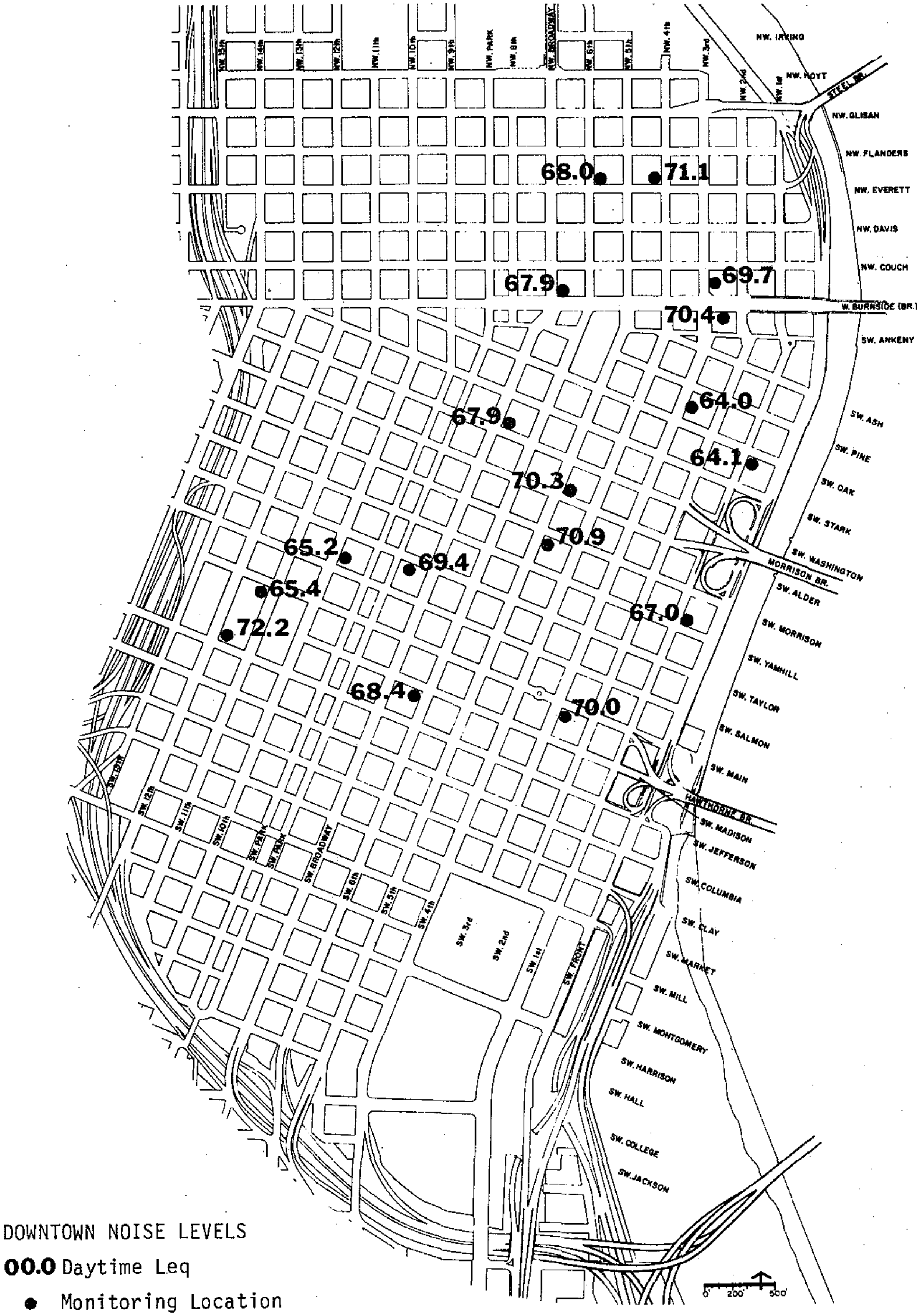
*This statement is based on considerations of the range of probable dimensions of both streets and covers.



Source: Wyle Research, Compilation of Measurement Data for the City of Portland Urban Noise Survey, March, 1979

Fig. 22

Appendix III describes a simple method for determining approximate noise increases under all covers, regardless of width. The method has been developed by Dr. James D. Chalupnik of EPA's Region X Technical Assistance Center, Dept. of Mechanical Engineering at the University of Washington. The following assumptions have been used:

a. Materials used in typical construction of such skystructures have fairly uniform acoustic properties.

b. Only the acoustic properties of octave bands between 500 Hz and 4 KHz have been considered, as those that would have the greatest impact on the listener.

c. Acoustical absorbtion characteristics within these bands are similar.

Given these assumptions, it is necessary to know only the width of the street (distance between buildings), the height of the bottom of the skyway above the street (the "ceiling"), and the width (breadth) of the skyway. These quantities are entered into two simple equations; resulting values are then entered on a nomogram, and the anticipated increase is read directly.

A separate and similar procedure is included for determining the effects of acoustical treatment that might be incorporated into the skyway to reduce the noise impact.

Attention should be given to the placement of skystructures in relation to the long range plans for downtown housing, as well as the location of existing skystructures. Formal eligibility for federal monies may be dependent on noise impacts of skystructures.

SECTION VI

PUBLIC USE AND SAFETY

The establishment of a public right-of-way entrust onto the City the responsibility of protecting the public's right for the use and safety of the street.

The areas of concern for this section are the vertical clearance of a skystructure, use of columns to support skystructures, fire safety of skystructures, and personal safety of the individual.

Street Clearance

Aside from avoiding adverse effects on the street level environment, skystructures should be high enough off the street to avoid being struck by motor vehicles or excessively interfering with utility construction or maintenance vehicles. In general, uniformity among jurisdictions with responsibilities regarding structure clearances is also desirable, and special weight should be given state standards because of the state's primary responsibility for matters of this nature. This study found that:

- o State law permits motor vehicle heights up to 14 feet;[19]

- The Oregon Department of Transportation's standard for vertical clearance over state highways, and the standard the Department encourages for other highways, is 17 feet with allowance for future resurfacing.[20]

- The Federal Highway Administration (FHWA) has adopted for bridges over federal routes the standards of the American Association of State Highway and Transportation Officials (AASHTO).[21] The AASHTO standards specify a minimum clearance of 14 feet with an allowance for resurfacing, except for state trunk highways and federal interstate system highways. For trunk highways and interstate system highways in urban areas, they specify a 16-foot clearance unless the area is "highly developed" and a 16-foot clearclearance is "unreasonably expensive" or unneeded for "defense requirements." FHWA generally allows from six inches to one foot for resurfacing.

- Low clearance structures in the City, including over Columbia Boulevard (16 feet), Front Avenue (15 feet), Bybee Boulevard (13 feet, 8 inches), and the Banfield Freeway (14 feet, 9 inches), have been struck by vehicles, some frequently.

- When the City of Portland designs a structure spanning a street it now aims for a clearance of at least 17 feet.

- Maintenance Bureau hydraulic backhoes used for repairing deep sewers require a minimum of 18 feet of clearance for unimpaired operation.

- Sight clearance to provide adequate safe stopping distances at intersections with traffic signals is not a constraint in most instances, (i.e., the minimum height to afford a safe stopping distance is lower than the figures quoted above). An exception where a skystructure is located in close proximity to an intersection on a downhill grade. In that case, the extent of the constraint will depend on the height of the signal, the steepness of the grade, the distance from the signal to the near side of the skystructure, traffic speed, and whether trucks or buses normally use the street (truck and bus drivers sit higher off the pavement than automobile drivers).*

- Fifteen feet provides adequate clearance for light rail vehicles.

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*Appendix IV contains a formula for computing minimum clearance to preserve safe stopping sight distance.

- The lowest of the skystructures in the City for which dimensions were obtained, the skybuilding over First Avenue at the Crown Plaza Building, is approximately 16 feet off the pavement.** Although it has never been struck by a motor vehicle, the structure has interfered with installing an electrical transformer in the building.

- Portland Fire Bureau apparatus require a minimum clearance of 13 feet. Fire Bureau officials are satisfied with the 16-foot clearance requirement an inter-bureau committee recommended for downtown skywalks in 1977 (mentioned in the introduction).

These findings show that the City should normally disallow clearance below 17 feet and that a clearance of 17 feet, six inches (the state standard with six inches for resurfacing) is normally desirable.

**The skybuilding over Sam Jackson Parkway at the University of Oregon Health Sciences Center is probably lower, but the exact dimension is not known at that time. The structure was constructed before jurisdiction over the Sam Jackson Parkway passed from the County to the City. Whether it has ever been struck by a vehicle is also unclear.

Street Trees

The public right-of-way provides an area for public amenities, including street trees. The Downtown Plan establishes as a goal for visual image to give careful consideration to the design of street furniture, planting, signing and lighting. As a planning guideline the plan calls for the street tree planting program.[39] Structures in the right-of-way can restrict the City's opportunity to plant trees.

Structures below the sidewalk, especially building vaults, can preclude tree planting. Suspended treepots are sometimes included over a vault, but there have been instances where the treepot cannot accommodate the growth of the tree put in there.

Above grade structures, including skystructures, building projections and awnings can limit the location and selection of street trees. If street trees are to be planted, the city and building owner needs to consider the requirements for tree planting.

The City has a City Forester and a City Street Tree Advisory Committee. The City Forester cited the need for coordination for new buildings. This would enable the City Forester to advise the architect on street tree planting needs and requrements.

Columns

Designers sometimes use columns to support skywalks or sidewalk arcade structures. There are four problems with columns when placed in street right-of-way:

- o Trucks can sideswipe them if they are too close to the curb because most street surfaces are rounded for drainage; trucks at the curb lean outward. The City requires two feet of clearance between the curb face and light standards to avoid sideswiping.

- o Columns can obscure pedestrians about to enter the street from passing motorists, increasing the chance of pedestrian accidents. This is not the case if the columns are small in diameter (about six inches or less).

- o Columns can obstruct sign distances at intersections if located too close to the street. This is mainly a concern at intersections without traffic signals. If column diameters are small, this is not a problem unless the columns are spaced closely together.

- o Columns can interfere with pedestrian movement along the sidewalk, depending on size, location and sidewalk width.

This study concludes that columns for skystructures should be prohibited and discouraged for building projections and only be permitted if it can be shown they do not interfere with the public use and safety of the right-of-way.

Personal Safety

Skystructures and underground pedestrianways pose a number of concerns regarding personal safety. As mentioned in the section on street level pedestrian activity, by taking people off the street, they can reduce the deterrent effect people on the street have on crime. They can also provide opportunities for crime within them. In general, design should aim to provide as much visibility of the street and of the structure's interior as possible. As much as possible, the entire passageway should be visible from one portal to the next. Designs should also avoid alcoves or other recesses that can be used as hiding places. Stairwells should be open or glazed, and elevators should be glazed. Lighting is important. There may also be a need for special security patrolling or monitoring, depending on the degree of public access and use. Positive public attitudes toward a place deters crime; a person who is confident and comfortable is less vulnerable to be victimized. This could be reinforced through lighting and directional signs. The section on skywalk networks identifies additional considerations.

The absence of visual connection between the sidewalk and underground pedestrian walkways can mean a greater potential threat to the personal safety of pedestrians within the structure. The greater feeling of isolation can make a person feel more vulnerable and less likely to use the facility. Such underground facilities should be designed with crime prevention in mind. Security measures should be included, but it should be recognized that public policy is very difficult.

Fire Control

There are several Fire Bureau concerns that the fire and building codes do not address. The first is that there is no requirement that an enclosed pedestrianway, either a skywalk or underground walkway, be kept completely clear of combustible materials. The second is that the building code does not require sprinklers on the undersides of skystructures to suppress fires on the street. Steel, commonly used for skystructures, is relatively rapid to give way under heat. The third is that skystructures can interfere with fire fighting, e.g., by blocking the use of ladder trucks. Normally they are not a problem unless they combine with some other local condition. The problem is especially serious when an unsprinklered building is involved, because sprinklers often obviate fire fighter access through a building's exterior wall openings. The Fire Marshal indicates that each of these concerns would be considered in reviewing skystructure proposals. Existing building and fire code provisions address most of the Fire Bureau's concerns regarding skystructures. They:

- Require fire doors where skystructures at below grade facilities connect into buildings. If the doors are left open, they must be equipped with automatic self-closing devices activated by temperature or smoke.[24]

- Require sprinklers in skystructures and below grade structures. They are considered building exit corridors, and thus are subject to the requirement that exit corridors be sprinklered.[25]

- Require that skystructures be designed to preserve minimum exterior wall opening requirements for unsprinklered buildings. For buildings where the distance from one wall to the opposite wall is less than 75 feet, the skystructure must preserve "at least 20 square feet of opening entirely above the adjoining ground level in each 50 lineal feet or fraction thereof of exterior in every story" on at least one side of the building. For buildings where the distance from one wall to the opposite wall exceeds 75 feet, the skystructure must preserve this access standard on at least two sides of the building.*[26]

- Require ventillation for smoke removal.[27]

- Require use of fire-resistive materials in construction.[28]

District-wide Networks

District-wide skywalk or underground pedestrianways networks raise issues of public interest and safety not raised by a single skystructure. With a single skywalk, for example, the code requirements are in place to ensure that the structure will serve its intended function. A network, on the other hand, poses problems not posed by a single skywalk, like deciding who is responsible for maintenance. It will also be used by the general public. With a network, it is more likely that owners will turn to the City for help if problems arise, such as the need for security patrols. Finally, failure of a network to work well will have greater implications for the public good than the failure of a single skystructure.

A network of underground pedestrianways in Portland is less likely than a network of skywalks, but is still possible, particularly if a transit subway were to be constructed downtown. All the considerations regarding public access and interior design in the analysis of above grade structures also apply to underground pedestrianway networks.

With privately developed networks, some issues can be addressed through agreement among building owners, possibly through some form of association. Maintenance and coordinating business hours are examples. For other issues, it is appropriate to establish policy guidelines. These issues have to do with public access to the network, interior design, and security:

Public access - the issues are how frequently along a network should access points be located, where they are located, the means of access offered (stairs, ramps, escalators, elevators), and the visual linkage with the street level they afford. A related issue is when they are open. Access will influence the impact a network would have on street level activity; all else equal, the better the access the less the reduction in street level activity. Access planning must be coordinated with other planning considerations. How much of the day a network is open affects design. If open 24 hours, it may be possible to separate the through building passages from the rest of the building. Even if open less than 24 hours per day, some business along the through building passages may wish to close earlier than others. They would have to be separated.

Signing - signing is an issue both at access points and within a network. Signing can improve the street/network linkage. It can also affect how well a network works, in general. Spokane and St. Paul have uniform directional signing schemes. Minneapolis leaves signing up to individual building owners.

Ceiling height - the standard ceiling figure is a minimum of eight feet. Long eight foot high passages can seem like tunnels. Increasing height in longer passages would avoid this.

Interior width - the standard in other cities is generally in the range of 12 to 14 feet, with more width in heavy use. Generally speaking, through building passages should be wider because of window shopping. In any case, width should reflect pedestrian volumes, taking into account flow peaks*.

Level changes - floors across streets and between buildings on the same block usually do not line up, posing the issue of how to handle interior level changes. The building code requires that for interior level changes are a maximum of 1 to 8; and if used as a required access, the maximum grade is 1 to 10.

Weather protection - the issue is whether skywalks should be open, covered or enclosed. Open and covered skywalks raise concerns about things being dropped onto the street, although this has not been a problem at Portland's existing skywalks. Given Portland's temperate but rainy climate, covered skywalks would serve the weather protection function adequately most of the time. It may be, however, that a compeletely enclosed, heated and air conditioned network would be more successful. Compared to other cities with skywalk networks, such as Cincinatti, Toronto and Minneapolis, they generally have more severe weather conditions

*Earlier pedestrian planning studies in Portland have covered this ground and can be referred to.

that warrant the need for such a system. These cities have generally more severe winters and hot, humid summers that make street level pedestrian activities unpleasant during these months. The network is an important weather protection system in the city center for these cities.

Restrooms, etc. - restrooms and amenities like places to sit, drinking fountains, and vendors can also affect how well a skywalk network works. The public objective would be to ensure that normal architectural standards are met.

Vandalism - if interior design is vandal-resistent, a network will stay in better condition. Combined with monitoring and security to prevent vandalism, this can help preserve a network's attractiveness, and thus its use. This connection is the basis of strict vandalism control measures in other similar public places. Washington D.C.'s subway is an example.

Lighting - the concern here is mainly with crime prevention. The avoidance of dark pockets is one consideration. As discussed in the section on personal safety, positive public attitudes toward a place deters crime. Lighting can also help by reinforcing this. Architects consider 15 to 30 foot candle light levels a minimum.

Security - the issues are the need for and adequacy of patrolling and monitoring, assigning responsibility for these functions, design for crime prevention, and police access. Reserved parking spaces for police vehicles is advisable, for example, to provide for foot patrolling by the Police Bureau. Retailing within through building arcades and public access increase the crime potential in both the numbers and types of crime, compared to single skywalks with limited public access. Keeping a network open 24 hours a day increases security problems further. Visibility into the skybridge network would enhance security monitoring by police vehicles and pedestrians on the street.

Building Vaults

Building vaults are technically outside this report's scope because the City Code permits them outright; no special permit is required. The study found no compelling reason to change this. Building vaults appear to present only two difficulties. One is that the installation of light standards, parking meters, and the like sometimes causes building vault damage or leakage, exposing the City to liability and generating tension between the City and the building owner. This could be avoided by requiring that building vaults, when constructed, meet standards design specifications providing for the future installation of light standards, et.c. The second problem is that sometimes building vaults fail to adequate provide the landscaping installed over them. This problem could be avoided by City Forester review of vault plans. Both solutions can be accommodated within the framework of building permit procedures.

SECTION VII

POLICIES IN OTHER CITIES

Portland can learn from other cities. This section reviews the skystructure policies of eight cities.* These cities fall into two categories, those that encourage skywalks in their downtown core areas, and those that do not. The first category includes Cincinnati, St. Paul, Minneapolis, Spokane, and Buffalo. In addition to providing examples of how a city can approach the development of downtown skywalk systems, several of these cities have accumulated vast experience in addressing the variety of issues that skywalk systems raise. The cities of San Francisco, Seattle, and Toronto comprise the second group where each is generally reluctant to approve them when proposed, although skystructures are not absolutely prohibited. These cities have considerable experience in addressing skystructure issues.

Cities That Support Skystructures

With the exception of Buffalo, the cities in the first category all have extensive downtown skywalk networks, all at the second level. Three of the cities, Cincinnati, St. Paul, and Spokane, have developed detailed skystructure policies. Minneapolis takes a different approach, and Buffalo is in the process of defining its policies.

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*The section is based on telephone interviews with local officials in each city, the documents cited in the section, and other documents sent by the cities and in the study file.

Cincinnati

Cincinnati has an extensive second-level walkways system initiated by an urban renewal project. There are now 12 street crossings linking a total of 12 blocks in the core area. Downtown Cincinnati is very compact with many narrow streets, measuring 40 feet curb-to-curb, with 13-foot sidewalks, and 66-foot right-of-ways. The downtown skywalk area is relatively flat, allowing the walkways to be constructed on a second level without elevation changes. The skywalk network was conceived to reduce the street level conflicts between the traffic and pedestrians.

The walkways have expanded Cincinnati's CBD commercial activities vertically rather than horizontally to reinforce their pedestrian-oriented downtown. The second level retail businesses are linked to street-level stores by escalators, elevators, and stairs at various important nodes on the walkways system. An important part of the success of the skywalk network is that it was conceived and implemented as a system of interconnected routes, rather than isolated, individual bridges. This allows the walkway system to grow with continuing downtown development.

The expense and responsibility of maintenance have become an issue with skywalk development in Cincinnati. The exterior escalators have proven to be expensive to build and to maintain. To avoid this problem, the network uses the vertical transportation system of the connected buildings. To reduce the maintenance costs, the City requires abutting private owners served by the skywalks to maintain and repair the bridges and pay for all the heating, air-conditioning, and lighting costs.

The Greater Cincinnati Chamber of Commerce, the Downtown Council, local businesses, and City government jointly supports and promotes the development of the skywalks and the location of businesses there. Although the business community was initially slow in accepting the system, there has been a marked increase in enthusiasm recently. The skywalk is used as an important marketing tool by the business community for the downtown.

St. Paul

As with Cincinnati, a downtown urban renewal project begun in the 1960's provided the impetus for St. Paul's skywalk network. It now includes 11 street crossings connecting a total of 15 blocks. There is one skybuilding. Local officials describe the system as well-established and taken for granted as much as the sidewalk system. They said it would be "inconceivable" for a new downtown building not to link into the system. This enables the City to use skywalks to leverage public benefits from downtown developers. The City now permits linking into the system only in return for concessions, such as public open space or employee training and hiring agreements.

Historically, the City of St. Paul, through its redevelopment agency, has paid one-half the cost of each skywalk; the building owners on either end jointly pay the other half plus all costs within each building. The owners also take full responsibility for maintenance, and must grant to the public an easement through their buildings. The City is now reassessing its cost participation policy and may in the future leave all construction costs to the building owners.

St. Paul also encourages existing buildings to connect into the system for continuity. In the past, it has always won voluntary cooperation. St. Paul officials say that this is not the case in the future; the City is prepared to use its eminent domain power to complete essential links.

St. Paul's skywalk policies are the most complete and well-considered of the cities surveyed. The policies have also achieved a high level of sophistication in the legal arrangements between the City, the redevelopment agency, and building owners for skystructure construction and maintenance.*

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*The file for this study contains the agreement for a recent St. Paul skywalk.

Minneapolis

Of all the skywalk networks in the U.S., Minneapolis's is the best-known. There are 13 street crossings linking a total of 15 blocks. Like St. Paul, the network began in the early 1960's, but with an important difference. The private sector rather than the City has been the moving force behind network development from the beginning. There was no urban renewal project, and all skywalks have been privately financed. Although the City supports skywalk development and has adopted a plan for network expansion, Minneapolis leaves many of the details that St. Paul's redevelopment agency oversees for the business community. There are no design standards, design review, or signing requirements. Instead, the City works with developers individually with the aim of agreeing on mutually satisfactory design solutions. The arrangement reflects a history and spirit of business/government/community cooperation that sets Minneapolis apart from many other cities.

Spokane

Spokane's approach to skystructures combines Minneapolis's with those of St. Paul and Cincinnati. Like Minneapolis, Spokane has a long history of business community activism in planning issues and City/business community cooperation. The business community provided the impetus for Spokane's system, which consists of 11 street crossings linking a total of 11 blocks. Parly because of disputes and problems the skywalk network system has generated, however, the City has stepped in with a detailed regulatory policy. Its skywalk policy now addresses both detail of skywalk design and such issues as the right of a business to connect into existing skywalks and procedures for allocating costs. The aim is to resolve conflicts and achieve minimum design standards, including uniform signing. Design regulations include width, street clearance and other similar standards. The policy requires a connection to the sidewalk on at least one end of each skywalk. It must be located at the perimeter of the building and near the skywalk. Only directional signs are permitted inside and out, and must conform to a uniform design. The policy also establishes a procedure for processing skywalk applications.

Buffalo

Buffalo is currently engaged in detailed downtown planning and expects to participate in the construction of skywalks as part of its efforts at downtown revitalization. Buffalo's location on the shore of Lake Erie brings the City especially severe weather, including both high winds and extreme cold that impairs downtown pedestrian circulation. Local planners see skywalks and covered sidewalks as possible answers. At the same time, however, there is concern that skystructures would block important views, an issue that Buffalo has not yet resolved.

Cities That Do Not Support Skystructures

In contrast, the cities in the second category view skystructures as inconsistent with their plans for downtown redevelopment, and assume a generally skeptical posture on skystructure proposals wherever located. In San Francisco, this mainly stems from concern over impairing the views and other amenities streets afford. In Toronto, street level pedestrian activity is the major factor. In Seattle, both factors lie behind the City's skystructure policies.

San Francisco

San Francisco's approach is to impose a heavy burden of proof on proposals for private uses of the street. The section on city pattern in the urban design element of the City's Comprehensive Plan reads in part:

> Increase the visibility of major destination areas and other points for orientation.
>
> The design of streets, the determination of street use and the control of land uses and building types along streets should all be carried out with the visibility of such orienting features taken into account. Views from streets and other public areas should be preserved, created and improved where they include the water, open spaces, large buildings and other major features of the city pattern.

The section on conservation further reads:

> Maintain a strong presumption against the giving up of street areas for private ownership or use, or for construction of public buildings.
>
> Street areas have a variety of public values in addition to the carrying of traffic. They are important, among other things, in the perception of the city pattern, in regulating the scale and organization of building development, in creating views, in affording neighborhood open space and landscaping, and in providing light and air and access to properties.
>
> Like other public resources, streets are irreplacable, and they should not be easily given up. Short-term gains in stimulating development, receipt of purchase money and additions to tax revenues will generally compare unfavorably with the long-term loss of public values. The same is true of most possible conversions of street space to other public uses, especially where construction of buildings might be proposed. A strong presumption should be maintained, therefore, against the giving up of street areas, a presumption that can be overcome only by extremely positive and far-reaching justifications.[29]

Toronto

Toronto has a tradition of active street life in its downtown, which local planners say underground malls and skystructures built in the past ten years or so began to undermine. Preserving street level activity is now a high priority. While it once supported skystructures, the City has now reversed itself and has denied several skystructure proposals in recent years to preserve street level activity.

Seattle

Seattle, too, has deliberately decided against skywalks, except under limited circumstances. The City's downtown planning policies read:

> The downtown should become much more conducive to safe and enjoyable pedestrian movement.
>
> The street level should be the primary pedestrian circulation system.
>
> A quality urban experience and personal safety require that pedestrians be concentrated. If sidewalks were established above and/or below the street level it would begin to spread people -- providing for less interaction among people, increasing their vulnerability to victimization, and decreasing support for street-level business and activity. Therefore, skybridges and covered pedestrian walkways should be encouraged only if there is sufficient pedestrian traffic for both the street level and the skybridge level, there is considerable retail or other activity on the skybridge level, and the bridges and/or covered walkways are open to the public. The exception to these criteria would be a skybridge connecting two closely-interrelated activities, e.g., two parts of the same office building, a parking garage to the related building.[30]

Seattle planners say the City also takes into account blockage of critical views, such as of Eliott Bay.

Like Spokane, both San Francisco and Seattle have adopted special procedures for considering skystructure proposals. Seattle's, in particular, carefully define what government agencies and commissions must review and/or approve skystructures, and their respective responsibilities.

SECTION VIII

EXISTING REGULATORY SETTING

Existing Procedures

The City Council issues by ordinance permits for private uses of street right-of-way not allowed categorically by the City Code or within the narrow limits under which the City Engineer can issue the permit. The procedure for obtaining this permit begins with the Right-of-Way Management Section of the Bureau of Street and Structural Engineering. In the case of skystructures, bureau staff obtain from the applicant information on the structure's location and general design. They then consult with other City bureaus and prepare an ordinance granting the permit. Assuming no opposition, the ordinance then goes to the City Engineer for approval, then to the Commissioner of Public Works. From there, it is submitted to the City Auditor to be placed on the Council's agenda. The Council considers the ordinance at one of its regularly scheduled hearings.

Right-of-way ordinances of this type generally state that:

- the structure must meet a specified minimum street clearance, and sometimes a maximum width;

- the structure must be used for pedestrian passage only;

- the structure must be built according to plans approved by the Bureau of Buildings, the Fire Bureau or the City Engineer;

- the Council can revoke the permit at any time and the applicant must remove it within 90 days;

- the applicant must indemnify the City, its officers, employees, and agents against the claims for damages arising from the structure, and provide evidence of insurance;

- the applicant must file the permit with county property records, or pay the City the fee for filing it; and

- the applicant must submit written acceptance of the terms of the permit to the City Auditor.

Below grade structure permits sometimes contain provisions not in the above grade structure permits, including:

- a provision requiring the structure owner to pay to the City "any additional costs of construction, reconstruction, altering, repairing or maintaining any municipal utility now existing which the structure causes, as determined by the City Engineer."

- a provision requiring plan approval by "all utilities involved" and that the structure owner pay all utility relocation costs.

- a provision requiring payment to the city for inspections.

- a provision requiring a performance guarantee for the construction period and a two year guarantee of street surface and utility restoration and repair.

A person proposing a skystructure must obtain a right-of-way permit as a precondition of eligibility for a building permit. Normally, an applicant is informed of this requirement when applying for a building permit. Sometimes the applicant already knows of the requirement from past experience or because he or she was informed of it when applying for a conditional use permit, and has obtained the right-of-way use permit before applying for the building permit.

Although primary responsibility for right-of-way use permits reside with the Bureau of Street and Structural Engineering, several other City bureaus also have responsibilities regarding them. The Bureaus of Traffic Engineering, Fire and Buildings, as well as Street and Structural Engineering, must all review and approve final plans for a structure before a building permit can be issued. In addition, the Design Committee must review and approve all private construction in design zones around the City. A special permit on top of a street use permit is required for conditional uses. These are normally issued by the City's Hearings Officer.

The existing procedure has several shortcomings. One is that the applicable City Code sections are vague, which contributes to the problem when someone proposing a skystructure fails to learn of the right-of-way use permit requirement or claims ignorance of it at the point of submitting a final building permit application. While any applicant is under an obligation to be aware of legal requirements of this type, the Code's vagueness weakens the City's ability to assert this obligation. A second is that the procedures described above are informal and unwritten. Nowhere are the bureaus to be consulted on a skystructure permit application listed, for example. This raises the possibility of oversights. For those bureaus that must approved building permits, such an oversight can deprive the applicant of early notice of the bureau's concerns, which sometimes causes difficulties. For other bureaus, it may deprive them of the opportunity to assert their interests at all. In addition, there is no guarantee that bureaus have sufficient time to respond when they are consulted. A third problem is that detailed plans for a skystructure can escape any kind of special review at the building permit stage after the right-of-way use permit has been issued. Normally, Fire, Engineering, and Building Bureaus plan checking can satisfy the standard permit requirements that a proposed skystructure be constructed according to plans these bureaus have approved. In fact, this is routinely the case. The requirement is redundant, and fails to accomplish its implied purpose, i.e., to ensure special consideration of the concerns bearing on use of street right-of-way. It may also engender at the ordinance stage a false sense of security that any problems will be caught later on.

There are two other problems with the permits. One is that they fail to require the applicant's insurance company to notify the City of policy cancellation. This raises the possibility of claims against the City for which it has not specifically protected itself. Another is that the permits are sometimes incomplete or loosely drafted. A recent one omits the recording requirement, for example. Another specifies minimum clearance from the street on an attachment the body refers to as specifying the structure's location.

One other shortcoming applies to the building stage of the City's approval process after the revocable permit has been issued. The Uniform Building Code fails to specifically address skystructures, so that code provisions on fire resistiveness, etc., are applied to skystructures _ad hoc_. Bureau of Buildings staff report that there have been inconsistencies; like structures have been treated in different ways due to varying code interpretations from one to the next. A proposed new code section is before the International Conference of Building Officials this year, and can be expected to be added to the state code (applicable in Portland) in the next few years. It should clarify matters. The Bureau of Buildings has proposed provisions for Portland's own code to avoid inconsistent building code administration in the meantime.

In the past the requirements of a conditional use permit and a street use permit have caused coordination problems. A potential problem occurs when the code requires either a conditional use permit of Design Committee approval and an applicant could obtain a street use permit before consideration by the Hearings Officer or Design Committee. This would represent, in effect, prior Council approval, undermining the review and fact-finding functions the Hearings Officer and Design Committee serve.

The procedure for above-grade building projections is essentially the same as for skystructures. The City has leased space over or under the right-of-way only twice, both 10 years ago. There are no routine procedures for leases of this type, although they too must be authorized by Council ordinance.

Planning Procedures

Existing zoning code does not deal specifically with encroachments in the right-of-way. It is the responsibility of the City Engineer to handle encroachments in the right-of-way.

The Hearings Officer will occasionally review encroachments in the right-of-way through the conditional use permit procedures established in the Zoning Code. Through the conditional use process, the City Engineer will be notified of an encroachment on the right-of-way. The City Engineer will comment and indicate his concerns and policies to the Hearings Officer. Recently, a problem occurred when Providence Hospital applied for a conditional use permit to construct a new parking structure and a new building, including a skywalk. The right-of-way management was consulted but failed to mention their 18-foot clearance policy. The Hearings Officer issues the conditional use permit stipulating a 14-foot clearance, which the Water Bureau had informed the applicant would be all that was necessary. The Design Committee will comment on conditional uses in Design Zones to the Hearings Officer.

The AX Zone Development Notebook, accepted by City Council on February 7, 1980, contains the only present City policy on street encroachment. The adopted policy states:

> The City shall execute public projects and encourage private development within the AX Zone to provide or directly support

within the AX Zone to provide or directly support projects which will improve the residential quality of the AX Zone. These projects may include private improvements within public rights-of-way or adjacent public and private projects which complement each other.[37]

Alternative Legal Forms

Upon determining the public benefits and cost to a proposed structure in public rights-of-way, the City can grant the right to build a skystructure one of three ways: by issuing a revocable permit, by vacating the space over the street, or by leasing the space.

Revocable permits are revocable at will or for violation of their terms, leaving the City an option of using the space for other purposes if needed without cost. The fact is that revocable permits for skystructures are seldom, if ever, actually revoked. An advantage of a revocable permit is that is requires little attention on issues: no rent to collect or renegotiate every so often. The major disadvantage is that revocable permits do not provide for compensation for use of the space over the street. One could compensate, but it would then be a lease. Another disadvantage sometimes claimed is that the permit's revocation clause impairs a lender's security interest in the skystructure, hampering a project's financing. This contention may have some validity, but most skystructures in Portland have been constructed under revocable permits.

Vacating the air space appears to have no substantial advantages and several disadvantages. The City of San Francisco sometimes vacates the air rights for a skystructure because more property tax can be collected on it than if it is covered by a permit or lease. Differences betwen California and Oregon tax laws eliminate this advantage here.*

*California law provides for taxing intangible property interests like air rights. Oregon law provides only for taxing privately-owned tangible property. Skystructures in Oregon are subject to taxation regardless of their legal status.

Leases avoid the shortcomings of the other two forms and have a crucial advantage. As stated above, a lease could provide for removal of the skystructure in case of public need. This would give the lender a greater security than would a revocable permit, but leaves the City flexible. Permits are seldom revoked, anyhow, and Oregon law requires a finding that the space is unneeded for public purposes before it can be leased. Procedures can be established to protect the public interest in the rights, as with street vacations. Skystructures covered by leases are subject to taxation. Most importantly, leases can provide for compensation to the public for the costs a skystructure imposes on it, and the compensation is paid over time to the same people who bear the costs.

The choice of legal form in each case should be based on the number of public benefits and cost of the structure. This study concludes that if a structure is approved under the procedures defined by this policy, and the structure is open to the general public, that the appropriate legal form should be by revocable permit. The basic principal here is the structure will benefit the owners of the structure as well as the general public, who will be using the structure. If the structure is not open to the general public, and the utility of the structure is restricted to the owners of the structure, then the appropriate legal form for the approved structure would be by lease. It is the position of this study that vacating a portion of right-of-way is an unacceptable alternative to the City.

City Liability

According to the City Attorney's Office, the City exposes itself to liability in two ways when it grants permission for an encroachment in the right-of-way. A person who sustains a personal injury while in a skystructure over the street might sue the owner for negligence in the design, maintenance, or operation of the structure, and include the City as a defendant. The City normally could escape liability in such situations because design, maintenance and operation are the owners' responsibility, and the City routinely requires skystructure owners to indemnify it against such suits. However, it might happen, for example, that the owner is uninsured and judgement-proof, i.e., has no assets to satisfy the claim. For that, or some other reason, the injured person might also sue the City on the grounds that it was negligent in allowing the structure in the first place.* The City can protect itself against this contingency by requiring that owners not only indemnify the City, but also obtain insurance naming the City and its officers as insureds. This also shifts to the owner the cost of the insurance, where it belongs, and to the insurance company the cost and obligation to defend suits within the terms of the policy.

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*This is despite Section 30.265 of the Oregon Statutes, which grants immunity from liability to cities and their officers and employees acting within the scope of their employment when a claim is based on "the performance of or failure to exercise or perform a discretionary function or duty whether or not discretion is abused." ORS 30.265 (1979). A court might consider the grant of the permit a ministerial instead of a discretionary function.

The insurance requirement need not exceed $50,000 per claimant for property damage, $100,000 per claimant for personal injuries, and $300,000 per occurence. Oregon law limits the liability of cities and their officers and employees to this amount.

Compensation

The issue for this section is whether the owner of structures in the public rights-of-way should compensate the public for the use and cost they impose on the public. The holders of revocable permits pay the Bureau of Street and Structures a processing fee of $10.00 and the fee for filing the permit with Multnomah County. The owners of the skybuilding at Crown Plaza pay an annual rent to the City of $676.00.* The other skystructure lease in the City, which covers the 20-foot wide skybuilding over SW Fourth Avenue and the three levels of parking beneath SW Fourth at the First National Bank Tower, pays an annual rent of $1.00.**

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*The sum of $676.00 is computed at 25 cents per square foot excluding the space occupied by the structure to be used only as a pedestrian walkway; provided, however, that if the rentable area of the space occupied by the structure furthest to the north is opened directly to the walkway along the northerly side of said structure in such a way as to give access directly from the structure into the space not occupied as a walkway, the rental sum shall be increased to $952.50 per year, computed at 25 cents per square foot. Ordinance No. 135096.

**Ordinance No. 129591.

Private structures in the public right-of-way raise compensation issues that go beyond the traditional concerns of those City bureaus to which the City Code imparts regulatory jurisdiction. The issue of compensation involves the determination of public benefits and public costs.

The argument is that if the public has no use for the space above or below the street, the abutting property owner should be able to use it without charge. The opposing argument is that the public's easement embraces the light, air, and other amenities the street provides, not just the right of travel; impairment of this right should be compensated.

There are public benefits for allowing encroachment in the right-of-way. The section and functions identified the benefits structure in the right-of-way can provide. These would include pedestrian safety, weather protection, interoffice efficiency, and improved economic development opportunities. The foregoing sections discussed the various impacts structures in the right-of-way can have, including environmental, urban design, and city policy.

A major difficulty with compensation is that assigning a value to the public benefits and city, i.e., public vistas, obstruction poses difficult theoretical and methodological problems. It is usually speculative, at best.

It is the position of this study that private structures in the public rights-of-way should not be allowed unless there is a public need. Because Downtown Portland is a special case for this policy study, only skywalks open to the public should be permitted in Downtown.

APPENDICES

APPENDIX I -- Existing Skystructures

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions Level Clearance	Use How Much * Used	Problems Benefits	Fire Provisions Contents	Enclosed, Covered or Uncovered Permit or Lease
State of Or. Board of Higher Ed. Skywalk	7-24-69 street vac. Brdwy. at Montgomery PSU	60' long 12' wide 3rd 22'	Pedestrian 1	Acc. banner hung over Broadway "Couldn't function without"	None None	Uncovered Permit
State of Or. Board of Higher Ed. Skywalk	7-24-69 street vac. Montgomery btwn. Brdwy. & 6th PSU	202' long over R/W 12' wide 3rd 22'	Pedestrian 1	None "Couldn't function without"	None None	Uncovered Permit
State of Or. Board of Higher Ed. Skywalk	7-6-67 124922 & 147708 Brdwy. at Harrison PSU	134' long over R/W 12' wide 3rd 20'	Pedestrian 1	Acc. banner hung over Broadway "Couldn't function without"	None None	Uncovered Permit
State of Or. Board of Higher Ed. Skywalk	7-6-67 124922 Harrison at Brdwy. PSU	56' long 6' wide 3rd 21'	Pedestrian 1	None "Couldn't function without"	None None	Uncovered Permit
Lloyd Corp. Skystructure	2-19-58 107468 N.E. Halsey Lloyd Center	NA 2nd NA	Vehicular 2	None Delivery access	None None	Uncovered Permit
Lloyd Corp. Skywalk	5-16-79 147739 NE 9th btwn. Multnomah & Halsey Lloyd Center	80' long 30' wide 2nd 18'	Pedestrian NA	NA Will connect shop- ping center to new office tower	NA NA	Covered Permit

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions Level Clearance	Use How Much * Used	Problems Benefits	Fire Provisions Contents	Enclosed, Covered or Uncovered Permit or Lease
Melvin-Mark Skywalk	3-19-70 130596 & 130907 1st btwn. Clay & Market Crown Plaza	87' 6" long 14' 6" wide 2nd 16'	Pedestrian 3	Clearance low Convenience, time savings	None	Uncovered Lease
Melvin-Mark Skybuilding	7-19-70 130596 & 130907 1st btwn. Clay & Market Crown Plaza	87' 6" long 60' wide 2nd 16'	Office with Pedestrian walk 1	Clearance low Time savings, protection from elements	Sprinklers	Pedestrian walk covered Lease
1st National Bank Skybuilding	8-20-69 129591 4th btwn. Jefferson & Columbia 1st Nat'l. Bank Tower	100' long 19' 6" wide 3rd 38'	Lounge; Pedestrian 1	None - restricted to employee use only Convenience, protection from elements	Doors & Sprinklers Furniture	Enclosed Lease
Portland General Electric Skywalk	5-16-74 138211 1st btwn. Salmon & Taylor Willamette Center	100' long 20' wide 2nd 24'	Pedestrian 1	None Convenience, mobility, protection from elements	Doors & Sprinklers None	Covered

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions Level Clearance	Use How Much * Used	Problems Benefits	Fire Provisions Contents	Enclosed, Covered or Uncovered Permit or Lease
Portland General Electric Skywalk	5-16-74 138211 Salmon btwn. 1st & Front Willamette Center	87' long 20' wide 2nd 24'	Pedestrian 1	None Convenience, protection from elements	Doors & Sprinklers None	Covered Permit
Meier & Frank Skystructure	7-7-55 102339 NW 14th btwn. Hoyt/Irving M & F Warehouse	Length NA 12' wide 6th & 7th 65'	Merchandise movement 3	None Convenience	Doors & Sprinklers None	Enclosed Permit
Blitz-Weinhard Co. Skystructure	3-7-68 126334 NW 12th btwn. Couch & Davis	60' long 9' wide 2nd 22' 6"	Materials movement 1	None "Essential to operation"	None Conveyor belt, pipes, hoses	Enclosed Permit
Blitz-Weinhard Co. Skystructure	3-7-68 126334 NW Couch btwn. 11th & 12th	60' long 9' wide 2nd 20'	Materials movement 1	None "Essential to operation"	None Conveyor belt, pipes, hoses	Enclosed Permit
Blitz-Weinhard Co. Skystructure	11-2-72 135521 NW 12th at Davis	60' long 7' wide 2nd NA	Materials movement 1	None "Essential to operation"	None Conveyor belt	Enclosed Permit
Blitz-Weinhard Co. Skystructure	6-28-79 148035	60' long 8' 6" wide 2nd 18' 4"	Materials movement 1	None "Essential to operation"	None Conveyor belt	Enclosed Permit

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions Level Clearance	Use How Much Used *	Problems Benefits	Fire Provisions Contents	Enclosed, Covered or Uncovered Permit or Lease
Direct Imports Skywalk	4-7-77 143431 Yamhill btwn. SW 9th & 10th Galleria	53' long, 13' high 22' wide 3rd 28'	Pedestrian 2	Loitering at first, now no problem Mobility, aesthetics, protection from elements	None Benches, planters	Covered Permit
Nicolai Co. Skystructure	12-28-67 125969 N. Columbia Blvd. near Denver Ave.	190' long, 6' high 2nd NA	Pedestrian & utility (originally lumber movement) 3	None Convenience	Doors & Sprinklers Pipes	Enclosed Permit
Hauser-Jenson Skywalk	3-8-73 136160 Salmon btwn. Park/Brdwy. Park Haviland Hotel	60' long 12' wide 2nd 17' 4:	Pedestrian 2	None Access, protection from elements, convenience	Doors & Sprinklers None	Enclosed Permit
Kaiser Foundation Skybuilding	1-30-75 139413 N. Greeley near Webster	48' long 6' wide NA NA	Pedestrian, offices 1	None Access, protection from elements	Doors & Sprinklers Office furniture	Enclosed Permit
Good Samaritan Hospital Skywalk	9-21-72 135328 NW Lovejoy at 22nd	88' long 12' wide NA 22'	Pedestrian 2	None Convenience, protection from elements	None Benches	Enclosed Permit

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions Level Clearance	Use How Much * Used	Problems Benefits	Fire Provisions Contents	Enclosed, Covered or Uncovered Permit or Lease
U. of O. Medical School Skybuilding	1953 NA SW Sam Jackson Parkway	NA 2/4 NA	Offices & Pedestrian 1	May have clearance problems Convenience, access, protection from elements	Doors & Sprinklers	Enclosed Permit (issued by Mult. Co.)
Moran Const. Skywalk	5-23-79 147770 Clay btwn. Front & 1st Marriot Hotel to Crown Plaza	60' long 11' wide 2nd 19'	Pedestrian 3	People can avoid hotel security by using	None None	Uncovered Permit

* 1 = heavy
2 = a lot
3 = moderate
4 = low
5 = hardly ever

Appendix I -- Existing Below Grade Structures

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions	Use How Much* Used	Problems Benefits	Fire Provisions Contents	Permit or Lease
Standard Insurance Underground Pedestrianway	5-31-62 115311 SW Salmon at 6th, Hilton Hotel to parking garage	8'6" high 7'6" wide	Pedestrian 3	None Ease of access, protection from elements	Sprinklers & Doors None	Permit
Portland General Electric Co. Underground parking	5-2-75 139770 Salmon btwn. Willamette Ctr. 1st & Front	N/A	Parking	None Convenience	Sprinklers None	Permit
1st National Bank Underground parking	8-20-69 129591 SW 4th btwn. Columbia and Jefferson	Entire street area (80' x 200'), 3 levels	Parking	None Convenience	Sprinklers & Doors None	Lease
Standard Insurance Underground Structure	4-16-61 113433 btwn. 5th & 6th	N/A	Motor Vehicle driveway	None Facilities Parking access	Sprinklers None	Permit
Lloyd Corp. Underground Structure	2-19-58 107468 NE Weidler	N/A	Motor Vehicle 2	None Merchandise Delivery Access	Sprinklers None	Permit
Lloyd Corp. Underground Structure	2-19-58 107468 NE 15th	N/A	Motor Vehicle 2	None Merchandise Delivery Access	Sprinklers None	Permit
Portland General Electric Co. Underground Structure	5-2-75 139770 SW 1st btwn. Salmon & Taylor	N/A	Motor Vehicle	None Access to underground parking	Sprinklers None	Permit

Appendix I -- Existing Below Grade Structures

Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions	Use How Much* Used	Problems Benefits	Fire Provisions Contents	Permit or Lease
Holliday Park Hospital Underground Pedestrianway	2-20-75 139500 NE 2nd near Hassalo	18' wide 60' long	Pedestrian 1	Protection from ele- ments, ease of access	Sprinklers & doors none	Permit
Bank of California Underground Pedestrianway	3-30-67 124335 SW Stark btwn. Park & Broadway Benson Hotel to bank building parking	12' wide 9' high 55' long	Pedestrian 3	Occasional use by derelicts and ex- hibitionists Parking access	Sprinklers & doors none	Permit
Georgia-Pacific Corp. Underground Pedestrianway	8-31-67 125302 SW 4th btwn Salmon & Taylor	17' wide 65' long	Pedestrian 2	None Protection from ele- ments	Sprinklers Sculpture	Permit
Emanuel Charity Board Underground Pedestrianway	6-23-42 74418 N. Graham btwn. Commer- cial & Ganten bein	8' high 12' wide 130' long	Pedestrian 4	None Protection from ele- ments, ease of access, time savings	Sprinklers & doors none	Permit
Emanuel Charity Board Underground Pedestrianway	6-23-42 80663 N. Gantenbein btwn. Graham & Stanton	7' wide 8' high 150' long	Pedestrian	None Protection from ele- ments, ease of access, time savings	Sprinklers & doors	Permit

Appendix I -- Existing Below Grade Structures

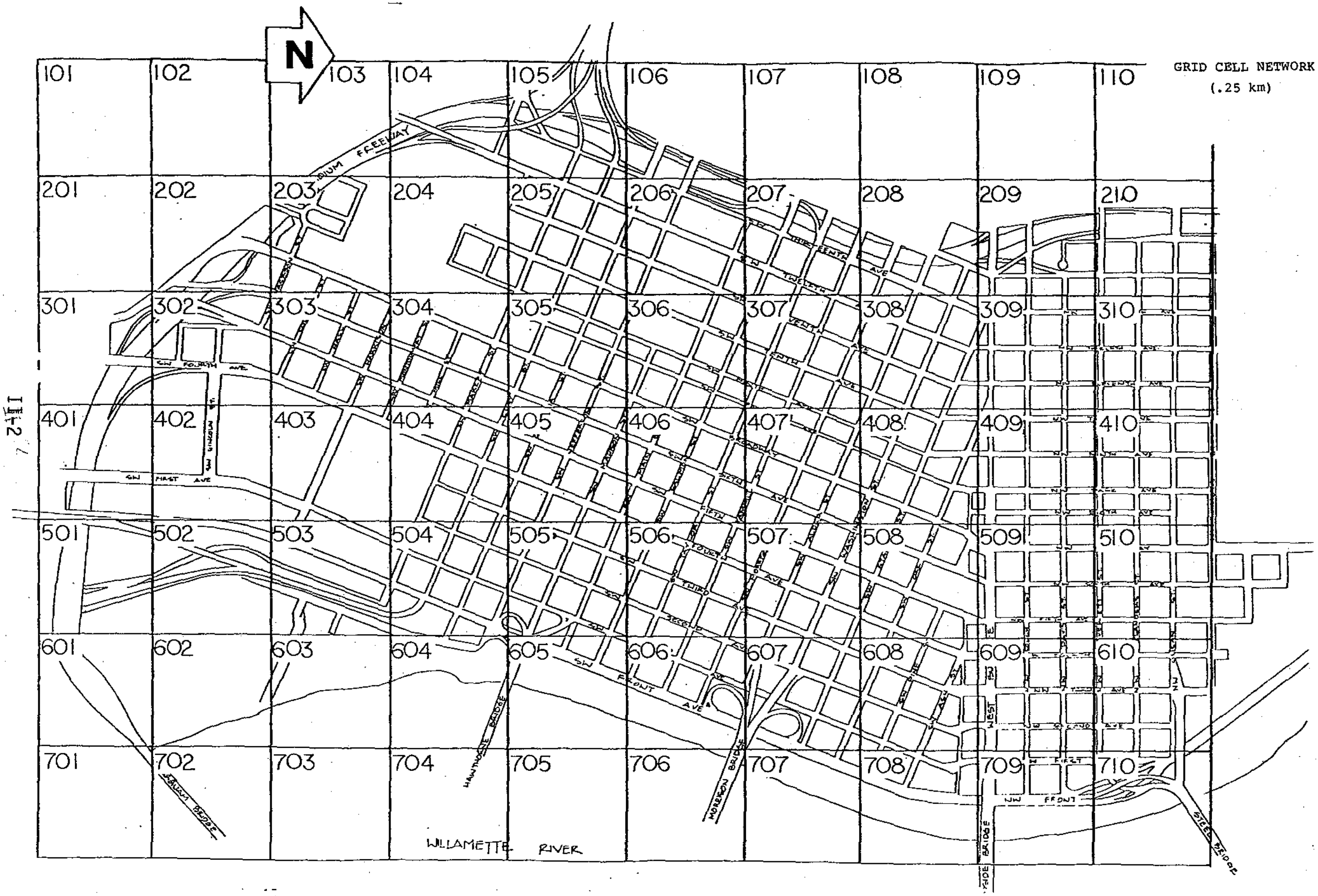
Permit Holder or Leasee Structure Type	Date Ordinance No. Location	Dimensions	Use How Much* Used	Problems Benefits	Fire Provisions Contents	Permit or Lease
Republican Co. Underground Structure	6-4-80 NA SW 17th btwn. Yamhill & Taylor	15' wide 10' 1" high 60' long	Materials in Movement NA	Not yet Constructed		Permit

Projected Compliance Year of the
Federal Maximum 8-hour CO Standard
For Downtown Portland

Grid Cells in Violation	CO Concentration (mg/m^3) 1982 Background Constant	Adjusted	1987 Background Constant	Adjusted	Compliance Year Background Constant	Adjusted
307	9.5	8.2	7.8	5.2	1982	1982
405	9.9	8.7	8.1	5.6	1983	1982
407	12.2	11.3	9.4	7.0	1987	1984
505	9.7	8.5	7.9	5.3	1983	1982
507	10.1	8.9	8.2	5.9	1983	1982
507**	10.4	9.2	8.4	6.1	1984	1982
508	10.2	9.2	8.3	5.9	1984	1982
508**	13.2	12.2	10.8	8.4	1992	1985
604	9.6	8.4	7.9	5.4	1983	1982
607	11.0	9.8	8.8	6.2	1985	1983
706	9.9	8.7	8.2	5.8	1984	1982

** Adjusted to represent third highest CO concentration in the last three years.

Compliance year determination based upon a 9.5 mg/m^3 standard (10.0 - 0.5 significance level)



GRID CELL NETWORK
(.25 km)

NOISE IMPACT PREDICTION

The procedure described below will permit the Noise Impact, NI, that will be created at street level as a result of covering a portion of the street in a urban situation where it is assumed that two or more buildings line the sides of a downtown street. The figure below shows a model layout of the situation, in which three parameters, h, w and b are specified. For simple situations, the Noise Impact can be determined with only these parameters. If the contractor proposes to provide acoustical treatment under the aerial crossing, then a slightly more involved proceedure will be required. This is discussed in the section entitled "Noise Impact Prediction with Acoustical Treatment."

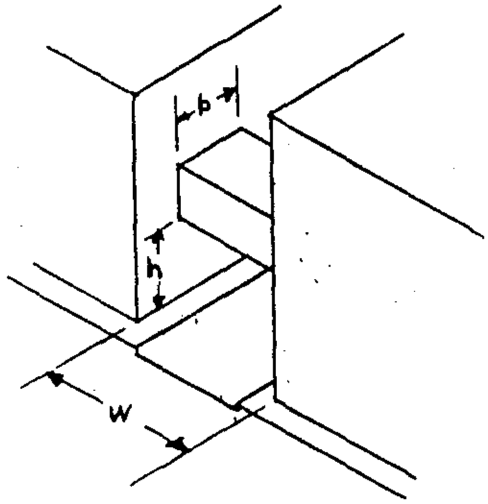


Figure 1 Typical layout of an Aerial Street Crossing showing the three parameters h, w and b. The nomogram to be used later assumes that these parameters are given in feet.

Step 1

Determine the values of the parameters b, h, and w. Enter them on the worksheet in the space provided.

Step 2

Determine the products bxh, bxw, and hxw. Enter them on the worksheet in the space provided.

Step 3

Multiply these products by the factors given on the worksheet and place the answers in the spaces provided.

Step 4

Sum the factored products as indicated on the worksheet to determine the two absorption variables A_1 and A_2.

Step 5

Locate these two points on the NOMOGRAM and connect them with a straight line.

Step 6

Read the Noise Impact, NI, from the central scale and record the value on the worksheet in the space provided. If the NI is negative, the connecting line passes below the Noise Impact line, a mistake has been made. Check to see that the values for A_1 and A_2 were entered on the proper line in the nomogram.

Noise Impact Prediction Worksheet

Location______________________

Date_______________

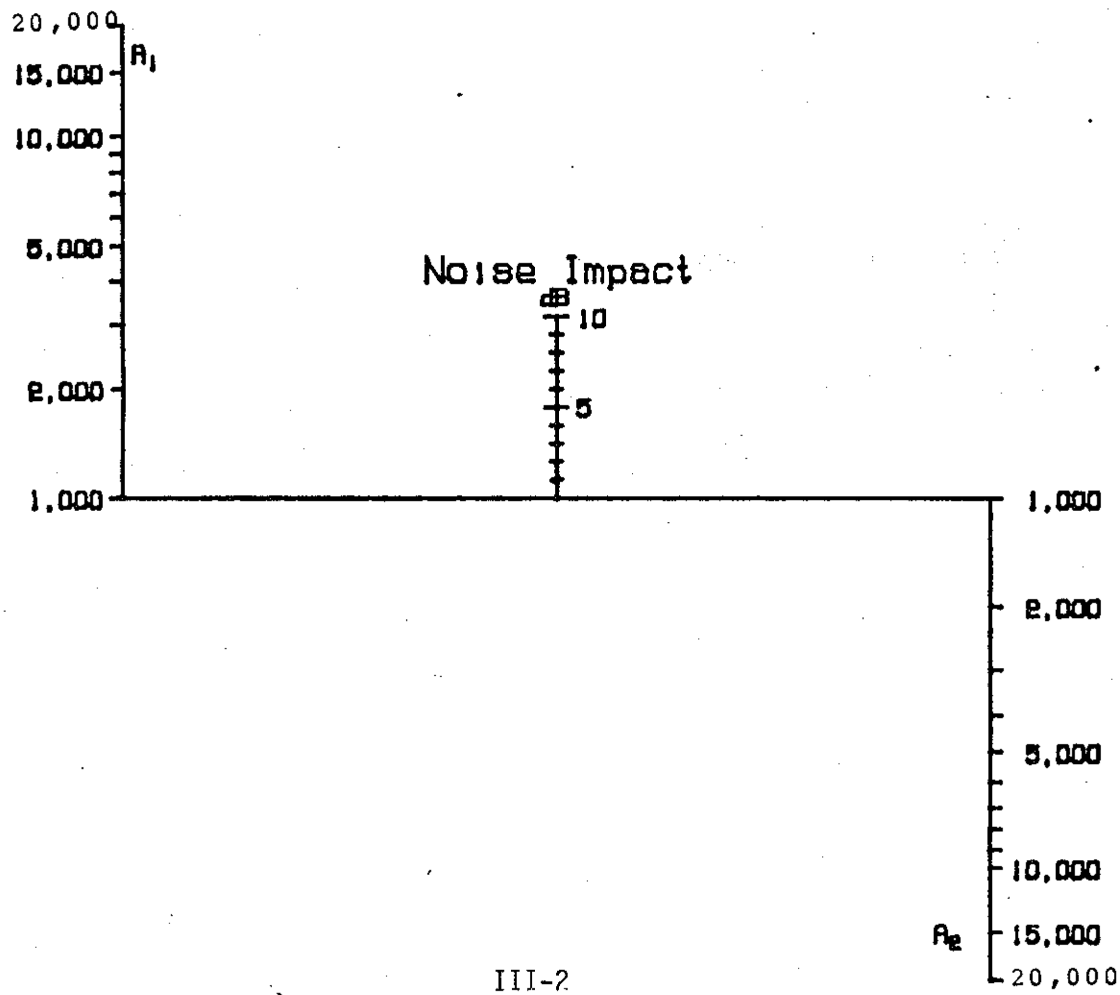
Analysis performed by__________________

Crossing Parameters		Products	Factored Products # 1	Factored Products # 2
Crossing breadth.	b=_____feet.	bxh=_____	.05xbxh_____	.05xbxh_____
Crossing height.	h=_____feet.	bxw=_____	1.02xbxw_____	.05xbxw_____
Street width.	w=_____feet.	hxw=_____	2.0xhxw_____	2.0xhxw_____
			+_____	+_____
			A_1 = _____	A_2 = _____

Noise Impact_____dB

Note:
$A_1 = 0.05bh + 1.02bw + 2hw$
$A_2 = 0.05bh + 0.05bw + 2hw$

Noise Impact Prediction Nomogram



NOISE IMPACT PREDICTION WITH ACOUSTICAL TREATMENT

Step 1

Determine the values of the parameters b, h, and w. Enter them on the worksheet in the space provided.

Step 2

Determine the products bxh, bxw, and hxw. Enter them on the worksheet in the space provided.

Step 3

Multiply these products by the factors given on the worksheet and place the answers in the spaces provided.

Step 4

Sum the factored products as indicated on the worksheet to determine the two absorption variables A_1 and A_2.

Step 5

Obtain the area of the acoustical treatment and record this value, in square feet, in the space provided.

Step 6

Enter the average "Absorption Coefficient" (Sometimes given as the "Alpha" value, and always less than unity.) for the treatment area in the space provided.

Step 7

Obtain the corrected absorption coefficient, a, by subtracting 0.025 from the absorption coefficient in Step 6.

Step 8

Multiply the corrected absorption coefficient times the treatment area, and place that value in the space provided under the value for A_2, that was computed above.

Step 9

Add this number to the value of A_2 to obtain the corrected absorption, A^*.

Step 10

Locate these two points on the NOMOGRAM and connect them with a straight line.

Step 11

Read the Noise Impact, NI, from the central scale and record the value on the worksheet in the space provided. If the NI is negative, the connecting line passes below the Noise Impact line, a mistake has been made. Check to see that the values for A_1 and A^* were entered on the proper line in the nomogram.

Noise Impact Prediction Worksheet

Location____________________________

Date__________________

Analysis performed by______________________

Crossing Parameters		Products	#1	Factored Products #2
Crossing breadth.	b=____feet.	bxh=_____	.05xbxh_____	.05xbxh_____
Crossing height.	h=____feet.	bxw=_____	1.02xbxw_____	.05xbxw_____
Street width.	w=____feet.	hxw=_____	2.0xhxw_____	2.0xhxw_____
			+_____	+_____
			A_1 = _____	A_2 = _____
				axS =_____
				+_____
				A^* = _____

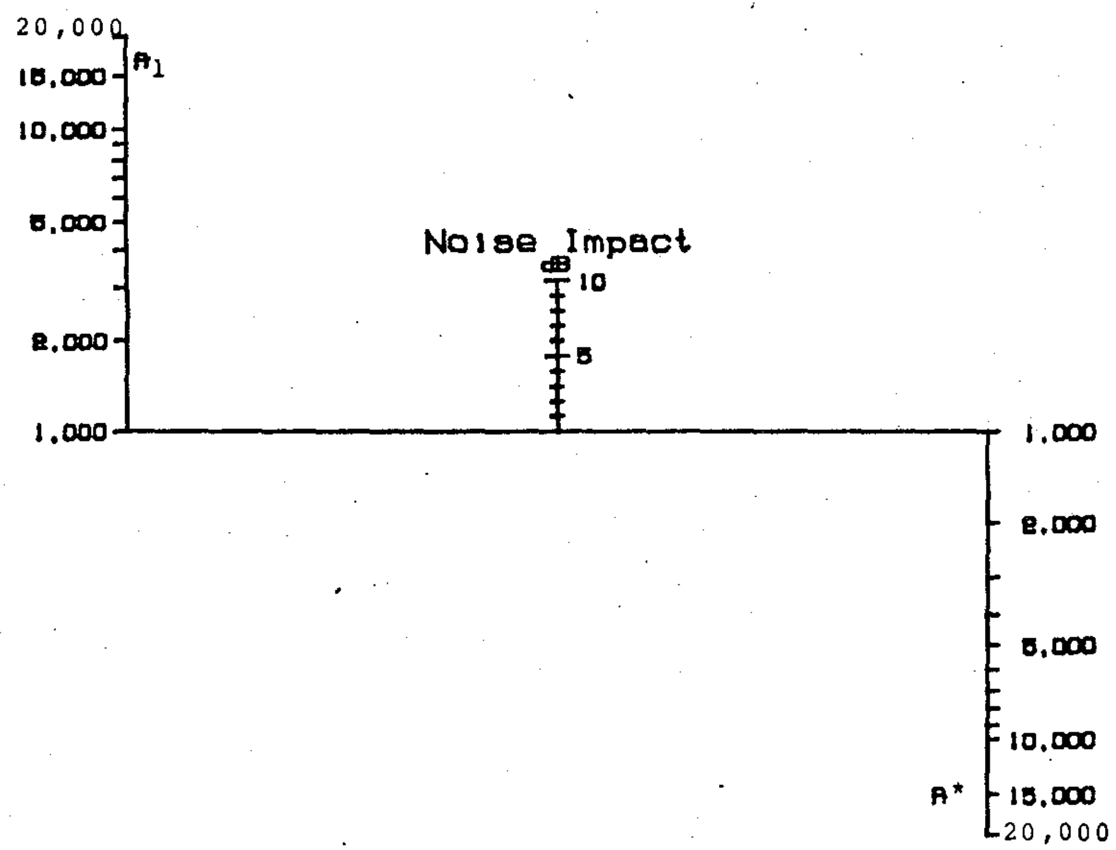
Absorption coef. α =_____
 − 0.025

Corrected coef. a =_____ Treatment area S=_____

Noise Impact_____dB

Note:
$A_1 = 0.05bh + 1.02bw + 2hw$; $A^* = A_2 + (a \times S)$
$A_2 = 0.05bh + 0.05bw + 2hw$

Noise Impact Prediction Nomogram



Example 1	Example 2

Step 1

	Example 1	Example 2
Structure width = b =	12 feet	120 feet
Ht. above grnd = h =	30 feet	30 feet
Bldg-bldg width = w =	80 feet	80 feet

Step 2

Example 1	Example 2
bxh = 360	bxh = 3600
bxw = 960	bxw = 9600
hxw = 2400	hxw = 2400

Step 3

Example 1	Example 2
.05xbxh = 18	.05xbxh = 180
1.02xbxw = 979	1.02xbxw = 9792
.05xbxw = 48	.05xbxw = 480
2.0 xhxw =4800	2.0 xhxw = 4800

Step 4

Example 1	Example 2
A1 = 18+979+4800 = 5797	A1 = 180+9792+4800 = 14,772
A2 = 18+48+4800 = 4866	A2 = 180+480+4800 = 5460

Step 5 (enter Nomogram)

Example 1	Example 2
Noise Impact = apprx. +1dBA	Impact = apprx. +4dBA

Example 3

Since example 2 indicated an increase of +4dBA, some noise reduction is indicated by the application of acoustical treatment. Materials will be applied to the underside of the skyway (in example 2, an 80x120 foot area and to about half of each side under the skyway (2x(.5x30x120) feet)). The material has an average absorbtion cooeficient of .50.

from example 2, A1 = 14,772
A2 = 5,460

Absorbtion coeff = .500
less .025
Corrected coeff. .475 = a

Treatment area (sq. feet) =
(80x120)+2 (.5x30x120) =
9600 + 3600 = 13200 = S

axS = .475x13,200 = 6270
A* = 5460+6270 = 11730

from nomogram, noise impact is now = +1dB; i.e., a 3dBA reduction from that found without acoustical treatment.

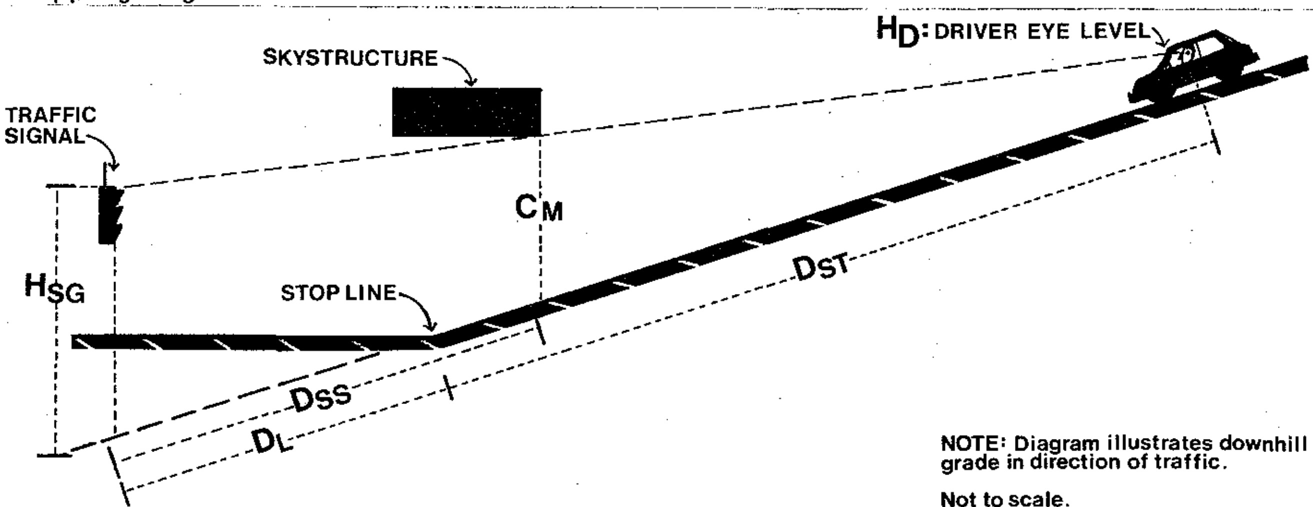
APPENDIX

Upon occasion, the value of A_1 (or A_2) will exceed 15,000 and cannot easily be entered in the nomogram. In lieu of the use of the nomogram, the acticipated approximate dBA increase may be determined from the following table, by entering it with the value of A_1/A_2.

When A_1/A_2 =	the dBA increase is =
1.0	0
1.1	.5
1.3	1.0
1.4	1.5
1.6	2.0
1.8	2.5
2.0	3.0
2.3	3.5
2.7	4.0
3.0	4.5
3.3	5.0
3.5	5.5
4.0	6.0
4.5	6.5
5.0	7.0
5.5	7.5
6.2	8.0
6.9	8.5
7.8	9.0

Appendix IV

Formula for Computing Minimum Clearance Over the Street to Preserve a Safe Stopping Sight Distance.



$$C_M = H_{SG} - \frac{D_{SS}}{D_{ST} + D_L} \quad (H_{SG} - H_D)$$

Where: $(H_{SG} - H_D) \quad (1.0 \frac{D_{SS}}{D_{ST} + D_L})$

C_M = The minimum clearance for safe stopping sight distance.

H_{SG} = The distance from the top of the traffic signal, face vertically to a line extension from the street grade beneath the skystructure.

D_{SS} = The distance along the line extension of the street grade from the point directly beneath the signal face to the point directly beneath the lowest part of the skystructure.

D_{ST} = The safe stopping sight distance given street grade, vehicle speed, and pavement condition (wet or dry) from Institute of Transportation Engineers, Transportation and Traffic Engineering Handbook (Prentice-Hall, 1976), pp. 611 and 612, or Picnatarp, L., Traffic Engineering Theory and Practice (Prentice-Hall, 1978), pp. 30 and 31.

D_L = The distance along the line extension of the street grade from the point directly beheath the signal face to the point directly beneath the intersection stop line.

H_D = The height of a driver's eyes from the street surface (ten feet if street used by tractor - trailer rigs, eight otherwise).

FOOTNOTES

Footnotes

1. City of Portland, Goals and Guidelines/Portland Downtown Plan, Oct. 1, 1980, p. 19.
2. Ibid., p. 11.
3. Ibid., p. 22.
4. Ibid., p. 35.
5. Ibid., p. 9.
6. Ibid., p. 10.
7. Ibid., p. 9.
8. Ibid.,
9. Ibid., p. 16.
10. Ibid., p. 17.
11. Ibid., p. 16.
12. Richard Podolske and Todd Healand, "Skyways in Minneapolis/St. Paul, Protoypes for the Nationa's Urban Land, September 1976, p. 6.
13. Ibid., p. 7.
14. Ibid., p. 9.
15. Letter for Lawrence M. Irwin, Directions of Planning, City of Minneapolis, Minn., 15 July, 1980.
16. City of Portland, Bureau of Planning Staff Report to Planning Commission, "Downtown Issues and Opportunities," July 18, 1980.
17. City of Portland, Downtown Design Guidelines, December 1980, p. 8.
18. Ibid., pp. 11, 16, 20, 26, 28, 38, 42 and 56.
19. Oregon Revised Statutes, 1979, Section 483.504.

20. Oregon State Highway Department, Construction Division Manual, Technical Bulletin No. 14, update 1966, p. 103a.

21. U.S. Government, Federal Highway Administration, Federal Highway Program Manual, Volume 6, Chapter 2, Section 1.

22. Portland Downtown Plan, October 1980, p. 32.

23. Ibid., p. 33.

24. State of Oregon, Department of Commerce, Oregon Administrative Rules, Section 1803, 1903, 2003, 2103 and 2203.

25. City of Portland, Oregon; Fire Marshal's Administrative Ordinance, No. 68.

26. State of Oregon, Department of Commerce, op. cit., Section 3802.

27. Ibid., Section 1807.

28. Ibid., Chapter 17, 42 and 43.