

## ABSTRACT

Title of Thesis: A STUDY ON TOTAL EVACUATION VERSUS SELECT  
EVACUATION FOR HIGH-RISE OFFICE BUILDINGS

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Over the past hundred years, high-rise office buildings have been evacuated primarily due to fire incidents and terrorism attacks. Due to these incidents, there has been attention given on how to evacuate high-rise buildings more efficiently.

Therefore, this thesis focuses on evaluating the evacuation strategies of high-rise office buildings, with particular attention directed to how these strategies are affected by a building's size and occupant density. It discusses and demonstrates the issue of evacuation time as it relates to high-rise office buildings through the use of an evacuation model, EXIT89, and reviews the resulting times established by the model for each total and select evacuation strategy.

Overall, this research resulted in identifying that there are differences in the performance of the total and select evacuation strategies, with a greater penalty in the overall evacuation case than in the local case (time to get evacuees out of the affected area).

A STUDY OF TOTAL EVACUATION VERSUS SELECT EVACUATION FOR  
HIGH-RISE OFFICE BUILDINGS

by

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DEDICATION

*My Grandmother, Marina Gilbert*

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# CHAPTER 1

## INTRODUCTION

### 1.1 DEVELOPMENT OF HIGH-RISE BUILDINGS

High-rise buildings began to appear around the 1880's (O'Hagan, 1977), and the first high-rise office building was constructed in the 1889 reaching a height of 309 feet (Matlins, n.d.). Since then, as this type of structure grew in popularity with the number and size of high-rise buildings or "skyscrapers" as they came to be called (Hall, 2001) increased rapidly. The Empire State Building, completed in 1931 at a height of 1,250 feet (The Skyscraper Museum, n.d.), held the record for tallest building in the world until 1974, when it was surpassed in height by the Sears Tower at 1,450 feet (Council on Tall Buildings and Urban Habitat, 1997).

In the 1960's and 1970's, the push to build upward was primarily driven by economics, as real estate, especially in major cities, became a premium. By 1973, New York City had 77 buildings greater than 500 feet, including the newly constructed World Trade Center Buildings (National Bureau of Standards [NBS], 1979). As of October 2001, the top ten tallest buildings in the world ranged in height from 1,148 feet to 1,483 feet, according to the list developed by the Council on Tall Buildings and Urban Habitat (2001). The current "Official World's 100 Tallest High-rise Buildings (Office Use)" lists buildings ranging in height from a low of 762 feet to a maximum of 1,671 feet (Emporis Building Database, 2004).

From the 1880's to the late 20th-century, the labeling of the high-rise buildings were redefined based on their ever increasing gross building areas. The Skyscraper Museum has developed the categories of *Jumbo* and *Super Jumbo* to describe the

biggest buildings over this period of history. Between the periods of 1880 and 1900, *Jumbo* and *Super Jumbo* were used to describe gross building areas under 250,000 and 500,000 square feet, respectively (The Skyscraper Museum, n.d.). By the last half of the 20th century, the term *Jumbo* describes a gross building area greater than 2,000,000 square feet, and *Super Jumbo* greater than 4,000,000 square feet (The Skyscraper Museum, n.d.). Since 1950, 31 high-rise buildings around the world contain two-million or more square feet in gross building area (The Skyscraper Museum, n.d.). The highest concentration is in the United States: New York City (14); Chicago (6); Pittsburgh (1); Boston (1); and Detroit (1). The remainders are in Canada (1); China (1); Japan (4) and Kuala Lumpur (2) (The Skyscraper Museum, n.d.).

While high-rise buildings create great efficiencies in the use of real estate by providing housing and/or office space for more people per square foot of land, it is these very efficiencies that create the potential for increased problems in the event of an emergency, by both increasing the consequences of the disaster and increasing the challenges in an evacuation. The evacuation of high-rise buildings, and the effect of density of people in the buildings, is the focus of this research.

## **1.2 HISTORY OF HIGH-RISE OFFICE BUILDINGS**

As mentioned previously, the first high-rise office building, The World Building, opened in New York City in 1890, at a height of 309 feet (Matlins, n.d.). In the early 1900's, high-rise office buildings began to grow dramatically, doubling and tripling in height. By 1931, the Empire State Building in New York City was



completed at a height of 1250 feet (The Skyscraper Museum, n.d.).

During the years following World War II, high-rise office buildings were built taller, and could be found in locations across the United States and around the world. The World Trade Center in New York City was completed in 1970 with the official opening on April 4, 1973 (The Skyscraper Museum, n.d.). These twin towers reached heights of 1,368 feet and 1,362 feet (The Skyscraper Museum, n.d.). Just a few years later, the Sears Tower was completed in Chicago, Illinois, reaching a height of 1,450 feet tall (The Skyscraper Museum, n.d.). In April 15, 1996, the Petronas Towers in Kuala Lumpur claimed the crown, being named the tallest two towers in the world by the Council on Tall Buildings and Urban Habitat (n.d.), at a height of 1,483 feet.

One of the factors enabling increasing heights has been the improvements in construction technology. ". . . there has been a gradual evolution in their construction from cast iron and wood to steel frame protected by concrete (O'Hagan, 1977)." An example of one of the first steel frame buildings is the Home Life Insurance Building in New York (O'Hagan, 1977). Within the 21st-century, these materials are being used to construct the even taller high-rise buildings. An example of this is in the Petronas Towers, which consist of steel-reinforced concrete columns and high-strength concrete with curtain walls of glass (The Skyscraper Museum, n.d.).

Along with improvements in exterior construction, interior design and fuel loads within high-rise buildings also changed. Earlier designs included a single stairway, protected on the landings by a metal-covered wooden door and enclosure, unenclosed elevator shafts, and interior standpipes located outside the stair enclosures

(O'Hagan, 1977). This style of design was found in the Triangle Shirtwaist Building, which had a severe fire that killed 143 garment workers. As a result of this fire, the focus of fire protection went from reducing large fires destroying entire cities to a ". . . greater appreciation of and accountability for safety of life (Grant, 1993)." From this focus, two pamphlets were published in 1912 which served as the basis for the development of the Life Safety Code (Grant, 1993)

Due to the development of Life Safety Code, the interior designs of today's buildings include multiple stairways, enclosed vertical shafts, and automatic sprinkler protection with interior stair-access standpipes (National Fire Protection Association [NFPA] 101, 2003). Along with these changes in fire protection, the interior designs now contain "...new materials such as plastics for cladding; new types of construction such as light weight walls, shafts for air conditioning etc (CFPA, 1977) ." In addition, the office walls which used to serve as part of the compartmentation of the building have been replaced by open floor plans containing modular partitions. The offices containing wood desks and metal filing cabinets were located throughout floor plans have been also replaced with modular offices which are constructed from an assortment of products including large quantities of plastics. On the negative side, these innovations have contributed to an increased fuel load, leading to the rapid build-up of heat and the fast spread of fire, and the ductwork provides a potential pathway for smoke (NBS, 1979). Furthermore, these changes have increased the exposure of occupants to toxic and smoke-filled environments which, in turn, make their evacuation in a timely manner extremely difficult.

### **1.3 CURRENT DEFINITION HIGH-RISE OFFICE BUILDINGS**

Before developing the input for evacuation model discussed later in Section 4 of this thesis, it is important to explore the various definitions of high-rise buildings. This allows for the development of baseline hypothetical buildings to be used that are representative of the high-rise community, as well as to note the variations in the definitions used.

Throughout much of the United States, the National Fire Protection Association (NFPA) codes and standards have been accepted as the basic guideline for the design and construction of life safety requirements for buildings. NFPA 101, *The Life Safety Code*, 2003 Edition, Section 3.3.27.7, defines a high-rise building as “a building greater than 23m (75 ft) in height where the building height is measured from the lowest level of fire department vehicle access to the floor of the highest occupiable story.” This 75 foot requirement was established based on the effectiveness of exterior fire fighting attack capabilities on evacuations. (Boring, Spence, and Wells, 1981)

In 1975, the Confederation of Fire Protection Association-Europe (CFPA-Europe) collected data on the heights that defined high-rise buildings based on the associated building codes of the eleven attending countries. The defining heights ranged from a building over approximately 72 feet to a building over approximately 164 feet for office buildings (CFPA, 1977)

In 1977, another definition of a high-rise building was offered based on the lack of exterior access to the upper floors for fire fighting (O'Hagan, 1977). This definition referred to the approximate reach of the standard aerial ladder engine,

which was 100 feet in height.

Another, less quantitative, definition is provided by the General Services Administration (GSA) which in an international conference on fire safety in high-rise buildings held in 1971 in Warrenton, Virginia, stated that:

A high-rise building is one in which emergency evacuation is not practical and in which fires must be fought internally because of height. The usual characteristics of such a building are: -It is beyond the reach of the fire brigade's equipment. -It provides potential for significant stack effect. -It requires unreasonable evacuation time (GSA, 1971a)

Table 1-1 summarizes the different definitions used for minimum height of high-rise office buildings. For the basis of this thesis, 75 ft (approximately five stories) will be used to define the minimum height of a high-rise office building.

Table 1-1: Definitions of high-rise office buildings.

| Source   | Definition for High-Rise Office Buildings   |
|--|---|
| NFPA 101, <i>Life Safety Code</i> (NFPA, 2003a)            | "A building greater than 23m (75 ft) in height where the building height is measured from the lowest level of fire department vehicle access to the floor of the highest occupiable story." |
| Confederation of Fire Protection Association-Europe (1977) | "A building with height ranging from a cut-off point of "over 22 meters" [approximately 72 feet] to the highest point of "over 50 meters" [approximately 164 feet] for office buildings."   |
| John O'Hagan (1977)  | "A building that lacks viable exterior access to the upper floors for fire fighting [approximately 100 feet]."  |
| General Services Administration (1971a)                    | ". . . A building beyond the reach of the fire brigade's equipment [about 75 feet]; it provides potential for significant stack effect; and it requires unreasonable evacuation time."      |

By contrast, there are no established maximum height requirements for high-rise office buildings. With the ongoing development and use of high-strength construction materials, new heights are being continually reached. In 2004, the Petronas Towers were surpassed as the highest office building in the world by the Taipei 101 (Taipei Financial Center) in Taipei, Taiwan, which reaches a height of 1,671 feet (Emporis Building Database, n.d.).

#### **1.4 SAFETY CONCERNS OF HIGH-RISE BUILDING EVACUATIONS**

There exist many situations that would require the evacuation of a high-rise office building. While fire is certainly the most likely given the historic trends, it is far from the only reason. Indeed, Pauls (1977) noted that “Fire is usually considered the most probable reason for rapid evacuation of all or part of a building; however, other emergency conditions, such as bomb threats, tornadoes, or loss of electric power might lead to evacuation in certain types of buildings.” However, as stated, review of data for the past twenty-seven years indicates that the evacuation of high-rise office buildings has been primarily due to fire incidents and terrorism attacks. (National Research Council Canada, 1977)

##### **1.4.1 FIRE**

Throughout their existence, high-rise office buildings have had their share of fire incidents. One of the most deadly fires occurred approximately 20 years after the first high-rise office building was constructed. As previously stated, the fire, which occurred in New York City on March 25, 1911, on the eighth floor of the Triangle

Shirtwaist Company, was blamed for 143 fatalities and the estimated evacuation of 600 occupants from the building (Grant, 1993). Four additional fire incidents occurring in high-rise office buildings are First Interstate Bank, One Meridian Plaza, the Los Angeles County Health Building, and the Cook County Administration Building, which are notable for their fatalities, property damage or both.

The First Interstate Bank, located in Los Angeles, CA, experienced a fire on Wednesday, May 4, 1988 after business hours (Klem, 1992). Four of the floors of the 62-story building were completely destroyed, and millions in property damage was incurred. The next major high-rise fire broke out on Saturday, February 23, 1991, in One Meridian Plaza, located in downtown Philadelphia (Klem, 1992). This fire extended over eight of the total 38 floors, from the 22<sup>nd</sup> to the 29<sup>th</sup> floor. Three fire fighters died battling this fire. This was followed just over a year later by a fire on the seventh floor of the Los Angeles County Health Building on Saturday, February 15, 1992 (Klem, 1992). Twenty-four fire fighters and one civilian were injured as a result. More recently, a high-rise office fire occurred on October 18, 2003 in the Cook County Administration Building in Chicago ("Chicago Police", 2003). The fire occurred at the close of the business day, killing six people and injuring seven others. These fires occurred during non-peak business hours.

Appendix 1 is a table of extracted listings of the fatal fires in high-rise office buildings taken from the "International Listing of Fatal High-Rise Structure Fires 1911-Present" (Hall, 2001, Appendix A). The listings include date of the fire, building, reported dollar loss, location, number of deaths, floor of origin, and height in stories. This list was last revised by the author, Hall, in October of 2001.

## **1.4.2 TERRORISM**

Within the United States, terrorist attacks have been blamed for three high-rise incidents; the damage to the World Trade Center in 1993, the devastation of the Oklahoma Federal Building in 1995, and the total devastation of the World Trade Center Towers in 2001.

On February 26, 1993, a bomb exploded in a subterranean garage of the World Trade Center in New York City. This explosion resulted in six fatalities, 1,000 injuries and the evacuation of over 100,000 people (Fahy and Proulx, 1995).

In 1995, the Alfred P. Murrah Federal Building in Oklahoma City was destroyed when a bomb was detonated parked on the outside curb of the building. This attack claimed the lives of 167 people and injured 759 people. There were 361 persons in the building (Mallonee, Shariat, Stennies, et al,1996).

To date, the most devastating attack and evacuation event in a high-rise office building occurred on September 11, 2001. This terrorist attack on the World Trade Center Twin Towers in New York City is blamed for 2,830 fatalities (Federal Emergency Management Agency, 2002), and the forced evacuation of an estimated 10,000 to 14,000 occupants in the two towers (Pauls, 2002)

These attacks and the numerous other fire-related fatalities have focused the attention of the popular media and technical experts of many disciplines on ensuring safer high-rise office buildings.



## **1.5 HIGH-RISE BUILDING CONCERNS**

Since the World Trade Center collapse in 2001, there have been questions on whether the exit capacity of the building was sufficient for the amount of occupants in the building. "A change in the New York City building code in 1968 reduced the number of stairs in tall buildings (Dwyer and Flynn, 2005, p. 109)." The authors, Dwyer and Flynn (2005), compared the number of exits provided in the Empire State Building versus the World Trade Center Towers. The Empire State Building has five stairwells from the sixth floor and up and a fire tower (a stairwell with a vestibule that functions as an air lock) for 2.25 million square feet of office space. They estimate about 15,000 occupants. The World Trade Center Towers had three stairwells to all floors for about 4 million square feet of office building. They estimate about 20,000 occupants. Not only is the number of stairs being questioned, the location of the stairs to each other is being questioned since the World Trade Center stairs were located in the center of the building. (Dwyer and Flynn, 2005)

The distance of travel of the occupants as it relates to fatigue is also being questioned. In the first bombing of the World Trade Center, the evacuation of individuals from Tower 1 took up to 4 hours 5 minutes, and from Tower 2 took up to 3 hours 27 minutes (Fahy and Proulx, 1995). The Siu Ming Lo and Barry Will (1997) have authored a paper addressing fatigue in climbing down stairs in high-rise buildings. They suggest an area of refuge be implemented for every 18 floors for individuals to rest during the evacuation of the building.

## **1.6 HIGH-RISE BUILDING EVACUATION EXPERIENCES**

When the first high-rise office buildings experienced fires in the early 1900s, rescuing large numbers of occupants from the upper floors during an emergency became a new challenge for the fire protection community. First, access to the occupants on the upper floors from the exterior of the building was limited to the reach of the aerial ladder, which was 75 feet (approximately the building's fifth floor). To reach occupants on the upper floors, rescuers had to traverse the stairwells, moving against those people trying to evacuate the building. "Such fire fighting activities must now be largely carried out inside buildings, since most floors in high-rise structures are out of the reach of effective external operations (NBS,1979)."

Second, fire protection systems were not installed in these early high-rise buildings; specifically, automatic sprinkler protection was not provided. Not only were fire fighters tasked with rescuing occupants, they also needed to control the fire to prevent the structure collapsing on them and the escaping occupants. Furthermore, the use of an emergency voice/alarm communication fire alarm system had not yet been developed. Occupants were notified by bells and horns, and were therefore unable to receive specific evacuation instructions (NBS, 1979).

In addition to design and construction issues, the increased height of high-rise buildings had other effects, which concerned the human element. In a study on the human behavior of the occupants evacuating the World Trade Center after the 1993 bombing, a total of 218 out of the 379 surveyed voluntarily left the building. Thirty-five of them attempted to leave, and 126 of them did not leave voluntarily. Of these 126 occupants, some were waiting for further instruction, did not realize that there

was a problem, or waiting on better conditions. (Fahy and Proulx, 1995) "Pauls and Proulx have indicated the need in predicting evacuation times to be sure to accurately assess this evacuation time delay relative to the population characteristics as influenced by the occupancy of the building . . . (Bryan, 1998, p. 6)."

Another aspect of the human element is the influence of fatigue in evacuation. Fatigue was characterized in an article published in the Fire Safety Science- Proceedings of the Fifth International Symposium referencing the need for areas of refuge for high-rise buildings. Here, the author states "It has been found that evacuees will normally experience fatigue while traveling in a downwards direction after approaching nearly about 5 minutes..." (Lo and Will, 1997, p. 739) They predict the evacuees will become fatigued after having traveled about 18 stories.

## **1.7 TYPES OF EVACUATION STRATEGIES**

Under Chapter 4 of the *Life Safety Code* (2003a), one of the chief objectives cited is occupant protection. Specifically, it states "a structure shall be designed, constructed, and maintained to protect occupants who are not intimate with the initial fire development for the time needed to evacuate, relocate, or defend in place." With the increase in height of high-rise buildings, considerable debate has developed concerning which of these three types of evacuation strategies to use. Each is described in the following paragraphs.

### **1.7.1 TOTAL EVACUATION STRATEGY OF HIGH-RISE BUILDINGS**

Total evacuation of a high-rise building includes the complete exiting of all

occupants within the building to the outside of the building. From childhood school days onward, fire safety education has instructed occupants to leave burning buildings upon hearing the fire alarm. The current NFPA campaign for children titled “Sparky’s ABCs of Fire Safety” includes, “Get out fast when you hear an Alarm because Big fires start small.” (NFPA, n.d.) This approach uses the "flight" mode from the instinctive "fight or flight" mechanism.

This instinct has been noted by Woods as “One of the instinctive acts of a person who finds himself in a fire, or any situation over which he does not have mastery, is to run away from the ‘hostile environment’.” (Marchant, n.d., p. 51) Woods studied 952 fire incidents to arrive at three general types of reactions individuals had to a fire. One of these reactions related to the individuals' concern with evacuating the building by themselves or as part of a group. While this instinct to flee is quite strong, it can be frustrated in high-rise buildings, as the fire may be located several floors above or below the individual's location. (Canter, 1980) Thus, danger is placed on the path of flight given the natural instinct and intuitive good sense of leaving a burning building; it should come as no surprise that, in the early years of high-rise office buildings, occupants were instructed to leave the building upon hearing the fire alarm system.

The question of how much time is required to evacuate a high-rise building has been discussed throughout the literature review. There are several estimates of times based on real evacuations and fire drills performed on high-rise buildings. One article stated “The maximum building height at which evacuation [total] is possible within five minutes via the stairway can be mathematically calculated and is

approximately twenty to twenty-five storeys.” (CFPA, 1977, p. 26) Pauls uses fire drill information to establish tables on the total evacuation of a hypothetical 15 story building. Currently, the evacuation time for high-rise buildings is estimated based on evacuation models which base their data on various fire drills. However, it is difficult to determine the exact way to give a time because the time is dependent on the building's characteristics and population reactions. (NFPA, 2000)

### **1.7.2 SELECT EVACUATION STRATEGY OF HIGH-RISE BUILDINGS**

In the 1970's, there was a shift in the evacuation procedures for high-rise office buildings from total evacuation to a select evacuation process, in which the occupants of the fire floor and the floors above and below the fire floor relocate to designated safer floors. This shift was as a result of the 1971 conferences sponsored by the Public Building Services (which is now referred to as the GSA), which were held to discuss fire safety design of the Seattle Federal Building, a 36-story, 500-foot structure scheduled to house over 3,000 employees. During the second conference in October of 1971, it was stated “We learned that total evacuation is neither feasible nor necessary since fires can be contained on one floor or a portion of a floor. Total evacuation may result in certain occupants going to areas where there is smoke and exposing themselves to increasing risks (GSA, 1971b, p. 4-3-4-4).” There was a task group developed at the conference addressing personnel movement. The group gave a description of each of the five concepts, the associated evacuation characteristics, and the group's remarks. The five concepts were titled total building movement, partial building evacuation, vertical movement within building, horizontal movement

within building, restricted movement, and staged personnel movement. (GSA, 1971b)

The shift from total evacuation to select evacuation was also discussed during the CFPA conference held in 1970. To ensure the ability to accomplish this select evacuation, the conference papers included the following statement: “Basically, taller buildings and high-rise buildings should be designed with structural and technical measures and facilities aimed at safety, so that in the event of fire, only the fire storey and the storeys immediately above and below would need to be evacuated.”(CFPA, 1977, p. 26)

Hence, the Seattle Federal Building was the first federal building in the United States being designed with the intent to a select evacuation strategy. Depending on the fire incident, the evacuation of the floors above and below the fire could consist of a range of one to five floors. The instructions for the select evacuation were given through the fire alarm notification system being used by the fire department incident commander or other fire department representative. (GSA, 1971b)

Pauls defines the select [phased] evacuation in the handbook (Proulx, 2002) describes evacuating the fire floor, the floor below and all the floors above the fire floor. The occupants proceed to the outside of the building, and then the rest of the building is evacuated. This is different than the common thought process of select evacuation in that the occupants on the fire floor and one to two floors above and below the fire floor evacuate.

During the same decade, another development in fire alarm system notification provided further ability to perform select evacuations. Before the 1970’s,

the notification component of the fire alarm system was based on bells and horns. Zoned instructions were not possible through the use of the fire alarm system given the general nature of broadcast. In the late 1970's, the beginning of voice alarm and 'zoned' fire detections systems were developed, along with the development and installation of smoke management systems within high-rise office buildings. These systems were able to exhaust the fire floor, and pressurize the floors above and below to prevent smoke from entering the areas. With these advancements, command center personnel were able to control the evacuation of people in different areas, or floors and control the spread of the smoke into other areas or floors of the building. (Sharry, 1983)

### **1.7.3 DEFEND IN PLACE STRATEGY IN HIGH-RISE BUILDINGS**

The third strategy noted by the *Life Safety Code* (NFPA, 2003a), defend in place, also called "stay-in-place" allows building occupants to remain inside the building until the fire is extinguished. This technique of stay-in-place is used within hospitals, hotels and residential buildings, which have different safeguards in place to accommodate their occupants during a fire incident. In addition, this technique is used for individuals with severe mobility impairments in multistory buildings. Specifically, Section 7.5.4 of the *Life Safety Code* (NFPA, 2003a) requires individuals with severe mobility impairments to have access to means of egress. In multistory buildings, the easiest way to meet this requirement is by providing "areas of refuge". (NFPA, 2003a) The definition area of refuge is an area to be used temporarily during egress as a staging area and which provides a relative safe

environment to the occupant while rescue efforts are being considered.

With the passage of the Americans with Disabilities Standards for Accessible Design in 1994 (Code of Federal Regulations, 1994), more and more buildings are now accessible to disabled occupants. The need to protect these individuals in an emergency situation until the fire department is able to rescue them is an issue that is being looked at in the fire safety community. In 1993, Shields and Dunlop (1993) authored a report on the experiences of disabled occupants who had survived a fire or had gone through an evacuation. Three different options being implemented include areas of refuge, safe elevators, and the buddy system. The areas of refuge would fall under the "stay-in-place" strategy because the individual stays there until the fire department rescuers can retrieve them. According to the *Life Safety Code* (NFPA, 2003a, p. 64), "Areas accessible to people with severe mobility impairment, other than existing buildings, shall have not less than two accessible means of egress." This technique is being focused on the disabled occupants not on a large population of the building's occupants to use with the exception of the Japanese. As mentioned previously, they suggest an area of refuge be implemented for every 18 floors for individuals to rest during the evacuation of the building. (Lo and Will, 1997)

The defend in place strategy is also used in the marine industry aboard various types of ships, especially cruise ships. Cruise ships are considered to be floating high-rise buildings due to their size and amount of occupants on board. The evacuation of passengers to the water is only used upon extreme fire incidents, typically, the passengers are kept in areas separated from the incident. These ships are specifically designed with compartmentation in mind to keep the fire incident,



keep the other occupants from the fire incident, and while trained fire fighting personnel on board mitigate the fire incident in the affected compartment.

The defend in place strategy does have its detractors, however, Guylene Proulx (2001) states for instance that the open concept floor plans of these office buildings reduce the containment of the fire within a compartment and limit occupant possibilities for “protect-in-place” activities. In addition, since the occupants are alert, dressed and mainly responsible for themselves, they are better prepared to evacuate their area.

## **1.8 LACK OF RESEARCH**

Currently, the nationally recognized standards and codes do not place a limitation on the amount of time necessary to evacuate or relocate occupants from high-rise office buildings. The only reference to the ability to evacuate in a timely manner is indirect, providing economic incentives for timely evacuation by putting more onerous structural requirements on those buildings with poor evacuation capability. Specifically, Section 4.2.2 of the *Life Safety Code* (NFPA, 2003a) requires that “Structural integrity shall be maintained for the time needed to evacuate, relocate, or defend in place occupants who are not intimate with the initial fire development.” The structural integrity of buildings is defined through IBC (ICC, 2003) and NFPA 5000 (NFPA, 2003b) for construction. For example, IBC requires that high-rise office buildings have building elements with at least a one-hour fire resistance rating and be fully sprinkler protected.

Along the same lines, performance based designs need to develop safety

objectives that ensure sufficient time for occupant evacuation of the building and internal fire fighting rescue efforts prior to its structural collapse. (NFPA, 2000)

## **1.9 FOCUS OF RESEARCH: TOTAL VERSUS SELECT EVACUATION STRATEGY**

This thesis focuses on evaluating the evacuation strategies of high-rise office buildings, with particular attention directed to how these strategies are affected by a building's size and occupant density. It discusses and demonstrates the issue of evacuation time as it relates to high-rise office buildings through the use of an evacuation model, EXIT89, and reviews the resulting times established by the model for each total and select evacuation. The approach will consider building size and density of occupants as they relate to total versus select evacuation strategies in order to propose which would be more suitable for each of the hypothetical building combinations reviewed.

The simulation model will be based on a representative, yet hypothetical, high-rise office building. Increases in square footage and height of the proposed layout of the building will also be incorporated into the simulations. In addition, the hypothetical high-rise office building will be designed in compliance with Chapter 38, New Business Occupancy, and Chapter 11.8, High-Rise Structures of NFPA 101 (NFPA, 2003a), especially for the capacity of the means of egress, number of exits, arrangement of the means of egress and the travel distance requirements. Chapter 38 establishes the requirements on construction, means of egress, protection of structure, building services and operating features for new business occupancies. Chapter 11.8

requires additional fire protection requirements to be installed within high-rise structures. It is presumed that the hypothetical building is equipped with the systems required in these sections, including an approved, supervised, automatic sprinkler system, so that allowances can be made to increase the travel distances to stairwells within the design of the building. As a result the hypothetical building will reflect the requirements being placed on the construction of new high-rise office buildings today. (NFPA, 2003a)

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 MEANS OF EGRESS STANDARDS**

During the Fourth International Symposium of Fire Safety Science, Hagiwara and Tanaka (1994) authored a paper which studied the prescriptive regulations of the means of escape for several countries. The countries included were Australia, France, Japan, the United Kingdom, and the United States. The authors based their comparison for each of the countries on the 1994 regulations found at the time in those countries. The regulations used are noted in the reference section. The tables from this paper have been re-generated and compiled in Appendix 2 to focus on the information on business occupancy and the limited assembly occupancy for conference room areas that are pertinent to this thesis. The table is divided into the four areas of means of egress design (which are; minimum number of means of escape, arrangement of means of escape, capacity of means of escape, and occupant load). The number of means of escape is the minimum number of exits required per story, portion of story or building. The arrangement of means of escape is the locating of the means of escape so that they are readily available at all times. (NFPA, 2003a) The capacity of means of escape is based on the occupant load of how many individuals can use a means of escape component. The occupant load is defined as the total number of persons that might occupy a building or portion thereof at any one time. (NFPA, 2003a)

In comparing the “minimum number of means of escape” for the five countries, three (France, the United Kingdom and the United States) address large amounts of persons versus the number of means of escape. In comparing these countries, the United States has a requirement of at least 4 or more exits when the occupancy of the area is at least 1,001 persons. The French standard requires an extra exit for every 500 persons over the occupancy of 501 persons which would be fewer exits than the United States standard up to 2000 persons, but more thereafter. For the United Kingdom, the minimum number of required exits is increased by varying the occupancy from 500 persons which require 2 exits to 16,000 persons which require 8 exits. Beyond 16,000 person occupancies, the number of exits increases by one for every 5,000 persons. Two others (Australia and Japan) base their minimum numbers of exits on the height of the buildings, with a minimum requirement of two exits at all times. (Hagiwara & Takeyoshi, 1994)

The “arrangement of means of egress” was divided into maximum travel distance, common path of travel, dead-end corridor and distance between exits. For the first, maximum travel distance, office spaces fall into the category of “general” requirements, which range from 131 to 164 feet in distance in Australia, France, Japan, and the United Kingdom. The United States has a maximum travel distance of 200 feet for non-sprinkler buildings, and 300 feet for fully sprinkler protected buildings. For the second, common path of travel, requirements range from 66 to 148 feet among the five countries. Here, the United States has the only allowance to increase the common path of travel based on fully sprinkler protected buildings. In the third, dead-end corridor, requirements range from 20 to 148 feet among the five

countries. Again, the United States has the only allowance to increase the dead-end corridor distance from 20 feet to 50 feet for fully sprinkler protected buildings. Finally, for distances between exits, Australia and the United States are the only two countries giving restrictions. Here, Australia allows 30 to 197 feet for the distance. This differs from the United States which requires one-third the diagonal space distance and complete sprinkler protection. (Hagiwara & Takeyoshi, 1994)

The “capacity of means of escape” is based on the occupant load factors in every country. The United Kingdom is the only country out of the five that recognizes evacuation strategies as part of the requirements for the stair widths. Australia, France, the United Kingdom and the United States have formulas on determining the stair width which are dependent on the number of persons on each floor or the total number of persons. The United States further defines the minimum stair width dependent on whether the means serves up to 49 persons or 50 persons and greater. The Japanese standard gives minimum stair widths for both general and assembly cases. The corridors and doors follow very similarly to the stair requirement with a few changes. Most notably, Australia and the United Kingdom change their formulas depending on the number of persons being served by these means of escape. (Hagiwara & Takeyoshi, 1994) This thesis will base the minimum stair width on the requirements of the United States.

The “occupant load” for office areas, Australia and France had 108 square feet per person, with France defining non-public areas as 1,076 persons per square feet. The United States uses a similar 98 square feet per person based on the gross area of the building. For buildings greater than 196 feet high, Japan defines their occupant

load factor as 67 square feet per person for the owners of the building and 43 square feet per person for renters of the building. The United Kingdom defines their occupant load factor as 54 square feet per person for open plan type, and 77 square feet per person for other layouts. Even though France has the lowest occupant load factor, the United States' occupant load factors of 100 square feet per person were used for two sizes of building in the modeling. (Hagiwara & Takeyoshi, 1994)

The above discussion gives a global perspective as of 1994 on the various egress requirements regarding means of escape. The global perspective was given to frame the requirements that are used throughout these five countries in comparison to the United States. In gathering this information and comparing it to the current requirements of the three nationally recognized codes in the United States, the following information was used because it was the strictest in the three areas.

Focusing solely on the requirements in the United States, a review of the three nationally recognized codes regarding means of egress (referred to by the Confederation of Fire Protection Association-Europe in Chapter 1 as “means of escape”) is given in Appendix 2. The three codes are the *Life Safety Code* (NFPA, 2003a); the Building Construction and Safety Code NFPA 5000 (NFPA, 2003b); and the International Building Code, IBC, (International Code Council [ICC], 2003). In using a similar format (minimum number of means of egress, arrangement of means of egress, capacity of means of egress, and occupant load factors) used in comparing the five countries' standards, Appendix 3 was composed using the three codes with the applicable sections referring to the business or limited assembly occupancy use.

As can be seen, there are very few differences among the three codes regarding the means of egress requirements. The differences are in the maximum travel distances in assembly occupancies, common path of travel, and maximum projections on the stairs. Regarding the maximum travel distances, the *Life Safety Code* (NFPA, 2003a) was the most restrictive, with the maximum distance of 150 feet in non-sprinkler protected assemblies, and 200 feet in fully sprinkler protected assemblies. NFPA 5000 (NFPA, 2003b) and the IBC's (ICC, 2003) requirements for maximum travel distance in a non-sprinkler protected assembly was 200 feet, and in a fully sprinkler protected assembly was 250 feet. Under the common path of travel, the IBC (ICC, 2003) designation for offices falls under the general definition which in turn is less than the maximum travel distance requirements. This would allow the maximum travel distance to be 200 feet for non-sprinkler protected business occupancies, and 300 feet for fully sprinkler protected business occupancies. For assembly occupancies, the maximum travel distance would be 200 feet for non-sprinkler protected occupancies, and 250 feet for fully sprinkler protected occupancies. These allowances are greater than the *Life Safety Code* (NFPA, 2003a) and the NFPA 5000 (NFPA, 2003b) distances, which specify maximum common path distances of 75 feet for non-sprinkler protected occupancies, and 100 feet for fully sprinkler protected occupancies. The last difference is the maximum allowed projections into stairways which is only stated in the *Life Safety Code* (NFPA, 2003a) and NFPA 5000 (NFPA, 2003b). For this, the *Life Safety Code* (NFPA, 2003a) allows a 3-1/2 inch projection, while NFPA 5000 (NFPA, 2003b) has an allowance of a 4-1/2 inch projection.



In this research, the means of egress for the hypothetical buildings will be based on the *Life Safety Code* (NFPA, 2003a).

## **2.2 EVACUATION STRATEGIES**

In reviewing the evacuation standards, the standards do not discuss the different evacuation strategies for high-rise buildings, with the exception of the United Kingdom. The United Kingdom bases their stair width on whether the building design is based on total evacuation or phase evacuation. Currently, the nationally recognized codes in the United States, *Life Safety Code* (NFPA, 2003a), NFPA 5000 (NFPA, 2003B), and IBC (ICC, 2003), do not require a certain type of evacuation strategy for high-rise business occupancies.

Few researchers have examined in detail the advantages and disadvantages of the two type of evacuation strategies to be used in high-rise office buildings. As stated by Guylene Proulx (2001), “Evacuation of multistory office buildings can be though of as being of two types: uncontrolled total evacuation, and controlled selective evacuation. The former is dependent largely on the nature of evacuation sequencing or deference behavior required, and the latter on the type of control imposed and the availability of voice communication system to manage the evacuation.” (Proulx, 2002) As stated in the previous section of this thesis, a third evacuation strategy is termed as “defend in place” or “stay-in-place”. The research on this topic is limited also, with the main focus on the relative merits of having mobility-impaired occupants in high-rise buildings staying in place awaiting the fire department rescuers.

As noted, the literature on comparing uncontrolled total evacuations versus controlled selective evacuation in high-rise office buildings is limited. Jake Pauls (1977) published two articles based on observations of Canadian fire drills using these two types of evacuation. The basis of this work has been published by the Society of Fire Protection Engineers (Proulx, 2002). Based on Canadian observations of 29 evacuation drills in Canadian office buildings ranging from 8 to 21 stories in height, Pauls developed a graph illustrating the "...what can be reasonably expected in an uncontrolled total evacuation of a 15-story building occupied by 70 able-bodied persons per floor-a fairly high-population condition that would be expected with about 15,000 square feet on each floor." (Proulx, 2002, p. 3-355) He also developed a graph depicting a controlled select evacuation of a hypothetical 15-story office building. Here, floors nine through fifteen were evacuated, and then the rest of the floors. It appears as though the floors nine through fifteen are starting to evacuate at different times. The data was based on Canadian observations of ten evacuation drills. (Proulx, 2002)

### **2.3 OVERALL EVACUATION MODELING**

Given that no one has yet designed a building guaranteed to be free of mishaps, the evacuation process (and thus evacuation modeling) is critical to ensuring life safety. Indeed, the prediction of occupant movement one of the key elements performance-based fire protection. (NFPA, 2000) In addition, the studying of emergency movement of people has been around for numerous years. "The major

contributors include Predtechenskii and Milinskii, Fruin and Pauls” (Nelson & Mowrer, 2002, p. 367)

Egress time is affected by the number of occupants, their distribution in the building, their response to the notification used, their mental and physical characteristics, level of training, and the physical design of the egress system. Modeling of movement phenomena (as affected by these variables) is based on data collected on the emergency movement of occupants through fire drills. Many different types of models exist, including hydraulically-based models, in which the relationship between speed and density of the occupants is treated in a manner analogous to the effects of water through a piping system. (Nelson & Mowrer, 2002)

In the hydraulic model, the water moves in a homogenous manner without interruptions until reaches its endpoint. The modeled persons are assumed to travel in a homogenous manner without any interruptions due to individual decision making and they are all able bodied individuals. This allows a direct correlation between the speed of the group, the density of the group and the different size buildings with respect to evacuation time. As noted in the Society of Fire Protection Engineers Handbook,

The use of the model calculations provides a reproducible base of reference in appraising the impact of overall systems, individual components, or changes in systems. If, however, the results of the modeled evacuation time are to be compared to a realistically expected evacuation time or to expected fire growth, it is important that the user understand that the modeled evacuation time is seldom achieved in reality. (Nelson & Mowrer, 2002, p. 368)

Within the latter part of the last century, the focus of emergency movement research is being directed on human behavior, decision making and actions taken just prior to and during an emergency situation so that this information can be incorporated with the evacuation modeling. This research is in the developing states and a consensus in the published works has not yet occurred, therefore the modeling chosen for this thesis is based on hydraulic modeling.

Even though the occupant's movements are treated similar to the movement of water, there are several formulas being used in the modeling that are based on tests and observations of occupant movements in fire drills. In the *Society of Fire Protection Engineers Handbook*, Chapter 14, Emergency Movement (Nelson & Mowrer, 2002), the formulas for emergency movement are presented and a hand calculation of an office building is given. A combinational analysis can be accomplished with evacuation modeling. The analysis is able to use computer algorithms to search through the numerous combinations of the inputted networks. (Watts, 1987) Evacuation modeling has taken these formulas and developed software to assist into repetitive iterations to optimize the modelers time.

A further decomposition of evacuation modeling is provided by Gwynne and Galea (n.d.), who published a research report reviewing 16 different developed evacuation models with descriptions on the modeling approaches and capabilities of each model, and six models which were under different development stages. This research was supplemented by the review in Erica Kuligowski's (2003) thesis work, which looked at a total of 28 computer models focusing on evacuation movement. The additional models include in this review included FPETool, Pathfinder,

TIMTEX, EESCAPE, EgressPro, STEPs, Gridflow, ALLSAFE, AERI, BFIREs-2, Legion and Myriad.

These reviews were divided into four main interacting aspects of evacuation design, which are “nature of the model application”, “enclosure representation”, “population perspectives”, and “behavioral perspective”. The “nature of the model application” aspect separates the evacuations models further according to three different model types which are optimization, simulation and risk assessment. Optimization models look for the optimal path for occupants to evacuate the building, given flow characteristics and exits. These models generally treat the occupants as a homogenous group or as a large group of people without the influences of individual human behavior. (Gwynne and Galea, n.d.; Kuligowski, 2003)

Simulation models attempt to combine the individual human behavioral aspects and the movements observed in evacuations in order to achieve a realistic representation of the decisions and paths that are used during an evacuation. These models vary in the representation of the behavioral characteristics of the individuals therefore the accuracy of the results will also vary. (Gwynne and Galea, n.d.)

The last model type is the risk assessment model. This model quantifies the risks associated with the identification of hazards based on the fire or related incident and the resulting evacuation. The model runs through several iterations of different scenarios to assess the risk statistically for the changes. (Gwynne and Galea, n.d. )

For this thesis, a simulation model has been chosen due to the fact that individual movements through the egress paths can be tracked and the ability to ignore peripheral and non-evacuation activities.

The “enclosure representation” in the models refers to the enclosure from which the evacuation occurs. The enclosure can be represented with a network, which can be described as: “(a) is a natural analog of the egress flows for occupants evacuating a building; (b) provides a clear, graphic description of the important spatial relationships of the building’s egress system; (c) provides a building description that is easily modified to reflect changes in design; and (d) has a number of readily available algorithms for studying flow problems (Watts, 1987).” There are two types of networks, a course network or a fine network. These networks break down the enclosure into varying degrees of sub-regions. In the case of the course network, the enclosure is broken down into sub-regions based on the actual partitions of the structure. In the course network, the enclosure is defined using nodes to represent the room or corridor, and arcs representing the actual connections within the actual structure. The occupant moves from one segment to the next segment. In the fine network, the enclosure floor space is broken into tiles or nodes which vary in size dependent on the model. This allows the representation of entire geometry of the space to include internal obstacles and the location of each individual at during the evacuation modeling. Due to the size of the buildings being used, this thesis will be using a course network model.

“Population perspectives” is also broken down into two approaches; the individual perspective and the global perspective. For the individual perspective, the personal attributes of the individuals are used as part of the movement and decision making process. This allows the trajectories and histories of the individuals to be followed during the evacuation simulation. For the global perspective, the

individual's personal attributes are not recognized and the population is treated as a homogenous group. These models track the number of occupants escaping as opposed to which individual is evacuating. The model chosen for this thesis is based on a global perspective due to the size and number of people evacuating the hypothetical high-rise office buildings. (Gwynne and Galea, n.d.)

“Behavioral perspective” takes into account the occupants decision making process and applies it determining their behavior during a evacuation. The authors (Gwynne and Galea, n.d.) divide the models into five behavioral systems which are “no behavioral rules”, “functional analogy behavior”, “implicit behavior”, “rules based behavioral system”, and “artificial intelligence based behavioral system.”

“Implicit behavior” models “...do not declare behavioral rules, but instead assume them to be implicitly represented through the use of complicated physical methods.” (Gwynne and Galea, n.d., p. 9) This type of model will be used for this thesis, due to the fact that behavior is not considered within the model, so that the principal consideration are the physical attributes of the population and their movement through the inputted area.

The rest of the systems deal with the behavioral traits, either through assumptions of the model or inputs into the model. These traits are not addressed in this thesis, which focuses on the influence of some of the primary parameters (density, building height, etc.) on determining the penalty associated with total evacuations versus select. It should be noted (as Gwynne and Galea (n.d.) did) that “...human behavior is the most complex and difficult aspect of the evacuation process to simulate. No model to date fully addresses all the identified behavioral aspects of

evacuation.” (Gwynne and Galea, n.d., p. 10) “Furthermore, not all these behavioral aspects are fully understood or quantified.” (Gwynne and Galea, n.d., p. 10)

Therefore, this thesis is only modeling the very basics- the occupants’ have no behavioral data associated with them, and move in an ideal manner.

These four characteristics and their individual sub-categories are illustrated in Appendix 4 (Gwynne and Galea, n.d., p. 11).

## **2.4 MODEL DESCRIPTION**

As discussed, computer models are available to estimate the evacuation times from rooms to high-rise buildings with and without taking into account these influences. A brief review of some of these is presented here, in order to indicate the strengths and limitations of the software selected (EXIT89) for this research on the difference between total and select evacuations. (Fahy, 1999a)

The National Institute of Standards and Technology Center for Fire Research (NIST/CFR) developed a program called Hazard I. Hazard I has three modeling components within it which are FAST, EXITT and TENAB. Accordingly, each component models the fire growth and smoke spread in a building, the evacuation of occupants from the building, and the impact of combustion products on the occupants as they travel through the building. The Hazard I model was limited to one- and two-family dwellings. (Fahy, 1999b)

EXITT was written by Bernard M. Levin, formerly of NIST/CFR. The program input required “...a network description of the building, the geometry of the rooms, and descriptions of the occupants (age, sex, awake/sleep, dependent on



assistance. etc.)” (Fahy, 1999b, p. 816) The output of the program included “...the actions and locations of the occupants as they evacuate along optimal escape routes.”

This program was limited to modeling 12 rooms and 35 nodes. (Fahy, 1993)

Through project developments at NFPA, the need arose to model the influences of fire growth, smoke spread and combustion products on occupants as they evacuate high-rise buildings. In order to achieve this modeling, focus was placed on modifying the evacuation model, EXITT so as to handle a large building. EXITT did not have the capability of analyzing the effects of queuing, which is a critical component for large building evacuations. Additionally, if the model had the capacity to input the information of a large building, the model would run slowly due to the amount of bookkeeping needed to monitor each individual’s characteristics, capabilities, location and motivation for their actions; and the time used due to the fact the model recalculates the escape routes for the entire building each time a room or node is blocked by smoke. (Fahy, 1999b, p. 816)

The replacement version of EXITT, which is EXIT89, has been chosen to be used as the evacuation model for this thesis. EXIT89 was developed by Fahy (1999a) to model the movement of large number of people from high-rise buildings.

“EXIT89 uses a coarse network description of the geometry and a global perception of the population.” This model uses the Hillier and Lieberman shortest route algorithm where individuals move to the closest exit from a local perspective even though this may not be the shortest exit path out of the building. The movement equations used in the model are based on the work of Predtechenskii and Milinskii. This model has the capacity to trace the individuals as they travel to exit the building,

yet they do not have identifying traits, therefore they are considered a homogenous population. (Gwynne and Galea, n.d., pp. 17-19)

As noted, EXIT89 was developed to be used as a replacement of EXITT within Hazard I program so as to handle high-rise building evacuations with large occupant populations. The development for the model design was patterned similar to EXITT with the exception of not including detailed behavioral considerations. This was due to the belief that there were less impersonal settings in offices and hotels as opposed to homes. (Fahy, 1999b, p. 817) The model uses a network description of the building based on the "...geometrical data for each room and for openings between the rooms, the number of occupants located at each node throughout the building, and smoke data if the effect of smoke blockages is to be considered." (Fahy, n.d., p. 658) Several options are given for the user to chose:

...whether the occupants of the building will follow shortest paths of the building or will use familiar routes; whether smoke data, if any, comes from a fire and smoke model or will be input as blockages by the user; whether there are any delays in evacuation throughout the building; whether there are any additional delays in evacuation among the occupants of the building and, if so, what percentage of the occupants will delay and what are the minimum and maximum delay times. (Fahy, n.d., p. 658)

The evacuation of the occupants can begin for all the occupants at time equal to zero or delays can be included within the input parameters.

EXIT89 begins by calculating the shortest routes from each building location on the floor down or up a stairwell to a location of safety (usually outside), or sets

user-defined routes through the building. (Fahy, n.d., p. 658) If smoke data are incorporated into the input of the program, the program has the occupants travel along the calculated routes until a smoke blockage is encountered. At that point, the exit route is recalculated and the occupants continue to travel until either the next smoke blockage or they have reached the outside. If the occupants are in the stairwell and encounter fire, the model moves them out of the stairs onto the nearest floor. The basis for calculating the shortest routes are based on an algorithm by Hillier and Lieberman. (Fahy, n.d.) “The algorithm begins by identifying the origin of a network and then fans out from the origin, identifying the shortest routes to all the other nodes until the destination is reached.” (Fahy, 1999b) “The locations of safety can include horizontal exits or areas on the other side of fire floor. In order for the model to recognize these locations as safety, the user identifies them as part of the building description input data.” (Fahy, n.d., p. 661)

EXIT89 has the ability to handle a larger occupant population than EXITT. The program’s data arrays can handle up to 700 occupants in the total of 80 nodes or building spaces over 100 10-second time intervals. (Fahy, 1999b, p. 817) “EXIT89 is set to allow 1000 5-second time steps, 10,000 links, 20,000 occupants ...” (Kuligowski, 2003, p.106) The maximum number of nodes per floor is 89 nodes, including 10 nodes reserved for a maximum of 10 stairwells. (Fahy, 1999a)

EXIT89 is able to track the occupants as they move through the buildings by recording each occupant’s location at set time intervals during the fire. (Fahy, 1999b, p. 817) In addition, it can calculate walking speeds as a function of density to

account for changes in the crowdedness of the nodes during the evacuation. This reflects the effects of queuing found in large populated buildings.

EXIT89 can be used in three different ways. One way is a modification to the first method, with no blockages assigned and having the model evacuate the building without a fire occurring. The second way is for the user to assign the smoke blocked nodes and the time those blockages occur. The third way is to have the program read the data output from a CFAST file as input into the model. (Fahy, 1999a)

The input of the model as stated before is based on a network description of the building. The nodes can either be set up as individual rooms, sections of rooms, or corridors. The nodes are to reflect the most realistic travel paths in the building being modeled. The description of each node includes the following:

- useable floor area
- the height of the ceiling
- initial occupant load
- the number of seconds the original occupants of that room will delay before beginning evacuation
- the node an occupant will move to if the user chooses the option of having occupants move along defined routes. (Fahy, n.d., p. 660)

The nodes are then connected by a series of arcs. The arcs are considered bidirectional, and described by both the distance between nodes and the width of the openings between the nodes.

EXIT89 has seven user options to choose from at the beginning of the input file. The first option allows selection of the type of measurements (standard scale

will be used in the input and output file). The second option has the user select the body size of the evacuee (Austrian selected). The third option has the user choose between emergency and normal movement of occupants based on Predtechenskii and Milinskii's work. (Fahy, 1999a) Emergency movement was used in all the modeling with the exception of normal movement for the re-generation of Paul's work discussed in Chapter 6.2. The fourth option of the shortest paths between nodes is to be used. The fifth option of using smoke data was not exercised for this modeling. The full output of all the data points was chosen for the sixth option. No additional, randomly distributed delay times were used in the last option.

The occupants are tracked in the model by assigning a number to each occupant in the building. Based on this occupant number, the output of the model describes each occupant's original location node, the node it travels from, the node it travels to, the number of occupants having left the building, and the number of occupant trapped in the building by time step.

“The method chosen for EXIT89 uses walking speeds calculated as a function of density based on formulas from Predtechenskii and Milinskii (Fahy, 1999b, p. 819).” The density calculation includes an allowance for body size of the occupants. The body size is based on the measurement of the area of horizontal projection of a person. “This measure is the area of an ellipse whose axes correspond to the width of a person at shoulder level and breadth at chest level.” Based on their work, the maximum density established is 0.92. Predtechenskii and Milinskii (1978) developed an equation for the “..mean values of velocity as a function of density for horizontal paths:

For the mean values of velocity as a function of density for horizontal paths:

$$V = 112D^4 - 380D^3 + 434D^2 - 217D + 57 \quad (\text{m/min})$$

for  $0 < D \leq 0.92$ .

For movement down stairs

$$V_{\downarrow} = Vm_{\downarrow} \quad (\text{m/min})$$

where  $m_{\downarrow} = 0.775 + 0.44e^{-0.39D_{\downarrow}} \cdot \sin(5.61D_{\downarrow} - 0.224)$ .

For movement up stairs

$$V_{\uparrow} = Vm_{\uparrow} \quad (\text{m/min})$$

where  $m_{\uparrow} = 0.785 + 0.09e^{3.45D_{\uparrow}} \cdot \sin 15.7D_{\uparrow}$  for  $0 < D_{\uparrow} < 0.6$ ;  
where  $m_{\uparrow} = 0.785 - 0.10 \sin(7.85D_{\uparrow} + 1.57)$   
for  $0.6 \leq D_{\uparrow} \leq 0.92$  (Fahy, 1999a).

For emergencies, Predtechenskii and Milinskii (1978) developed the following relationships between the two velocities.

$$V(e) = \mu_e * v, \text{ where } \mu_e = 1.49 - 0.36D,$$

for horizontal paths and through openings, and

$$\mu_e = 1.21 \text{ for descending stairs. (Fahy, 1999b, p. 820)}$$

Tables of velocities by density were established by Predtechenskii and Milinskii (1978) for normal, emergency and comfortable movement along horizontal paths, through openings and on stairs. "EXIT89 originally assumed that people are aware of the fire emergency when they evacuate, so only the velocities for emergency movement were included in this model." (Fahy, 1999b, p. 820)

In terms of the occupant size, the body size calculations have been based on three different measurements. The first measurement given is based on Predtechenskii and Milinskii's work on measurements of Soviet subjects. The second measurement was based on work by Ezel Kendik measuring Austrian subjects. The

third measurement was based on dimensions obtained from Occupational Safety and Health in Business and Industry for American subjects. (Fahy, n.d., p. 663) For the Austrian subjects (selected for this research) EXIT89 uses a horizontal projection area of 1.22 square feet, which were cited as the mean dimensions of an adult in mid-season street dress.

Velocities are calculated for both segments of the arc between two nodes, based on the different densities and floor areas for the two nodes. Densities are calculated in the program based upon the layouts and distribution of occupants as input by the user, with usable floor area for corridors being close to that of Predtechenskii and Milinskii's. (Fahy, 1999b, p. 820) Values for density are used to look up the velocity from the tables provided, with an upper limit on density being 0.92.

Movement within EXIT89 is based upon the parameters specified in the input data (including the aforementioned density), with the program determining how long it would take to travel from the currently occupied node to the connected node based on the occupant characteristics. The event log (noting transition to a new node) is triggered when the occupant has been at a current node long enough for them to have traversed to the next node via the specified arc, at which point the waiting time at that new node is reset to 0. Here, waiting times are actually melded into the arc traversal times. At each event (node transition), densities and time to traverse arcs are recalculated until all occupants have left the building. (Fahy, 1999b, p. 821)

Queuing in EXIT89 is addressed by adjusting walking speeds that result from the increase in density. Currently, the program does not allow occupants to shift from

a congested route to a less crowded route, forcing them instead to join the queue along the shortest route. (Fahy, 1999b, p. 822)

EXIT89 has been validated by the developer, Rita Fahy, by comparing the results of the model versus the fire drill results from the three studies. The first study was based on the results from a fire drill involving 100 occupants from a 9-story building. The second validation study was based on a fire drill on a 7-story office building in Newcastle-on-Tyne in the United Kingdom. The third validation study was based on a fire drill performed on a major department store by the University of Ulster in the United Kingdom. (Kuligowski, 2003, p. 102) This model has the capacity to analyze multi-story buildings which assists in the focus of this thesis.



## **CHAPTER 3**

### **EVALUATION METHODOLOGY**

#### **3.1 INTRODUCTION OF METHODOLOGY**

As outlined previously, the focus of this research is on evaluating the relative merits of total versus select evacuation under varying building design conditions. Specifically, the time to evacuate a building using these two evacuation methods are determined in the three varying heights of buildings, sizes of buildings and two occupant loadings, in order to determine if the optimal method changes under varying extremes and to ascertain the magnitude of the difference between the evacuation strategies in both absolute and relative terms. This not only provides a characterization of the sensitivity of the optimal evacuation method to these primary parameters, but also provides an indication of the importance of these basic parameters. The twenty-four scenarios provided by these varying values were then used as inputs to the EXIT89 model (Fahy, 1999), and evaluations made regarding the time required to evacuate the total building and the time to evacuate the select floors under each strategy, with the optimal (shortest time) strategy identified. The first method compares the overall time for evacuees to get out of the building (total evacuation time). The second compares the time to evacuate the affected region (floors at which the emergency situation exists, taken as the top five floors here). Adding this second evaluation allows consideration to be made of the increase in relative safety by being off of the affected floors enroute the exterior of the building. The results (optimal strategies) across these scenarios depicted below provide the

desired insights as a function of the primary parameters mentioned previously. Each of these parameters is discussed in turn.

### **3.2 OCCUPANT LOAD**

The first parameter considered here is initial density. Here, occupant load (inversely related to density) is taken as the proxy for density for each floor. The minimum occupant load of an office building has been established in the *Life Safety Code* (NFPA, 2003a) as stated in the previous chapter, but has been questioned based on survey work both in the United States and in Canada. The *Life Safety Code* (NFPA, 2003a) defines occupant load as “the total number of persons that might occupy a building or portion thereof at any one time.” The occupant loads for the hypothetical office buildings will be using two values which establish a range of reasonable estimates based upon traditional code values and field data collected.

The maximum occupant load is provided by section 7.3.1.2 of the *Life Safety Code* (NFPA, 2003a), which states that the occupant load for “Business Use” shall not be less than 100 square feet per person. The 100 square feet per person is based on “gross floor area” which *Life Safety Code* (NFPA, 2003a) defines as “the floor area within the inside perimeter of the outside walls of the building under consideration with no deductions for hallways, stairs, closets, thickness of interior walls, columns, or other features.” Due to changes in the office layouts from compartmented offices to open plan offices, this occupant load factor has been questioned as being too conservative.

One of the individuals questioning the occupant load factor as too conservative has been Jake Pauls, who puts the load factor greater, based on both his work in Canada on evacuations and his recent review of the World Trade Center collapse on September 11, 2001. In *Fires and Human Behavior*, Pauls calculates the occupant load for one of the studied buildings with a gross rentable area of 2,765,000 square feet to be 27,650 persons. He stated, "In eighteen evacuation drills in the buildings there were only 10,281 persons counted. (In buildings where more than one drill was studied only the drills with larger populations are considered in this calculation.) The mean gross rentable area per person was 26 meters squared (278 feet squared) and not 9.3 meters squared (100 feet squared)." (Canter, 1980, p. 271)

In a recent article in *Fire Engineering*, Jake Pauls (2002) commented on the varying populations and estimating of populations for the World Trade Center. "Assuming eight million square feet of total rentable area for the two towers, with about 270 square feet per occupant, an estimate based on some my work on office building evacuations in Canada 30 years ago, there would be 30,000 occupants, total, in the two towers. Based on the *Life Safety Code* (NFPA, 2003a) occupant load factor of 100 square feet of gross area, he calculates an occupant load of 80,000. According to Pauls, the Port Authority reported having 60,000 people working in the complex, with the two towers having two-thirds the rentable area. He states that based on the two-thirds rentable area this would suggest 40,000 persons total for the two towers, which would support his estimates on total population for both towers. (Pauls, 2002)

In 1996, the Milke and Caro (1996) in conjunction published a survey of occupant load factors based on 23 office buildings which included federal government, county government, and private sector buildings. The office designs were either open plan office or well-compartmented offices. Based on the walk-through and telephone surveys, the mean occupant load factor of all the observations was 248 square feet per person based on gross area, with a standard deviation of 67.3 square feet per person. The range of data from all the observations was 140 to 418 square feet per person. The 95% confidence interval for the occupant load factor for the entire sample was 230 to 266 square feet per person. (Milke and Caro, 1996, p. 13) These values are greater than the occupant load factor established in the *Life Safety Code* (NFPA, 2003a) and form the low density scenario used here. Pauls' occupant load factor appears to be within the 95% confidence interval established under the survey by the Milke and Caro (1996).

Therefore for this thesis, the “high” occupant load factor being used will be based on the Life Safety Code (NFPA, 2003a) minimum of 100 square feet per person (gross area). This value was selected given its prominence as the code standard for approximately 70 years. The “low” occupant load factor decision was based on Jake Pauls' research over the past 30 years, which is within the confidence interval established in the Milke and Caro's survey accomplished in 1996. The “low” occupant load factor being used will be based on 278 square feet per person (gross area).

### **3.3 BUILDING SIZE**

The third parameter, paired with occupant load and occupants, will be the building's size. The building size for the hypothetical, high-rise office building will vary in dimension by both floor plan dimensions and building height. The floor plan layout will be based on a square building, with the number of corresponding exits based on the *Life Safety Code* (NFPA, 2003a).

The floor plan area will be based on achieving an occupant load of approximately 100 persons per floor and 500 persons per floor, using the two densities previously stated. The number of persons that require 2 exits is less than 500 persons, with 3 exits required for 500 persons up to 1,000 persons. The resultant areas for the 100 square feet per person density will be 10,000 square feet per floor for 100 occupants, and 50,625 square feet per floor for 500 occupants. The corresponding dimensions of the building will be 100 feet by 100 feet and 225 feet by 225 feet.

The resultant area for the 278 square feet per person density will be 27,800 square feet per floor for 100 occupants and 140,625 square feet per floor for 500 occupants. The corresponding dimensions will be 166 feet by 166 feet and 375 feet by 375 feet.

### **3.4 BUILDING LAYOUT**

The floor plan layouts for each building will be based on capacity of the means of egress, number of exits, arrangement of the means of egress and the travel distance requirements, as previously discussed in Chapter 1. The initial basis of these

layout areas are based on the maximum occupant load per exit requirement. This would result in a requirement to have two exits per floor for up to 499 occupants, and three exits per floor for 500 to 999 occupants. As the floor layouts were designed with office spaces and corridors, the maximum allowable travel distances from the *Life Safety Code* (NFPA, 2003a) based on a fully sprinkler protected building were used in combination with the exit requirements. For both the 100 feet by 100 feet and 166 feet by 166 feet layouts, two stairwells for each floor were sufficient to meet travel distance requirements. However, for the 225 feet by 225 feet building, the capacity of the stairs was insufficient with only three stairwells. As such, four stairwells were used for each floor. Similarly, for the 375 feet by 375 feet building, the travel path requirements and the egress capacity of the stairs were not met with three stairwells; therefore it also has four stairwells per floor.

Each floor layout was based on a core plan, where elevators and restrooms are located in the middle of the floor plan and an open office plan surrounds the elevators and restrooms. The stairwells have been located within the outer edges of the building to provide some equidistance for the occupants, with each having a 44 inch clear width with tread 7 inches deep by 11 inches high. Two illustrations of the 44 inch stairs are shown in Appendix 5. This compared well with Pauls, who used 44 inch stairs in his 15-story building. The doors leading into the stairwells are 36 inches, and are served by five-foot corridors, which are connected in rings, so that travel paths were not exceeded. The ceiling height on the floors is 12 feet high. To ease calculations, the open floor plan was divided up into office spaces, within which it was envisioned that the floor plan was a typical open office floor plan. The sizes of

the restrooms were calculated based on typical industry requirements, as were the elevators. (ICC, 2003) The original design was to increase the 100 feet by 100 feet building in increments according to the rest of the sizes. As this was developed the floor layout has to be manipulated to adjust for the amount of occupants. For example, when going from the 100 feet to 100 feet building to the 166 feet by 166 feet building the office spaces were increased due to the fact that the occupants had more space per person. Appendix 6 has illustrations showing the floor layouts for each building.

### **3.5 BUILDING HEIGHT**

The building height of this “high-rise” office building will begin above the previously defined height of 75 feet. Therefore, the building heights chosen are 11-story, 21-story, and a 31-story tall building. This would have the occupants actually traveling 10 stories, 20 stories, and 30 stories in the stairwells to the first floor because of the way the model recognized floors. In addition, the building heights will be based on a 12 feet floor to floor distance. The height dimensions would be 132 feet high, 252 feet high and 372 feet high, respectively

Table 3-1 captures the three parameters used in this examination, along with the values tested.

Table 3-1

Parameters used in this examination and the values being used as a basis for the input files.

| Number of Exits | Density of People                                    | Building Height               |                               |                               |
|-----------------|--|-------------------------------|-------------------------------|-------------------------------|
|                 |  | 10-story                      | 20-story                      | 30-story                      |
| 2 Exits         | 100 square feet gross area per person (High Density) | 2 Exits&High Density&10-story | 2 Exits&High Density&20-story | 2 Exits&High Density&30-story |
|                 | 278 square feet gross area per person (Low Density)  | 2 Exits&Low Density&10-story  | 2 Exits&Low Density&20-story  | 2 Exits&Low Density&30-story  |
| 4 Exits         | 100 square feet gross area per person (High Density) | 4 Exits&High Density&10-story | 4 Exits&High Density&20-story | 4 Exits&High Density&30-story |
|                 | 278 square feet gross area per person (Low Density)  | 4 Exits&Low Density&10-story  | 4 Exits&Low Density&20-story  | 4 Exits&Low Density&30-story  |



## **CHAPTER 4**

### **EVACUATION MODEL**

#### **4.1 INTRODUCTION**

“Prediction of occupants’ movement during egress is an essential part of meeting life safety goals. The essential issue here is the estimation or prediction of the time needed for egress.” (NFPA, 2000, pp. 56-57) Egress time is affected by the number of occupants, their distribution in the building, their response to the notification used, their mental and physical characteristics, level of training, and the physical design of the egress system. EXIT89 (Fahy, 1999) is a FORTRAN-based model which has the capacity to estimate the evacuation times from high-rise buildings for large populations of occupants with and without taking into account the effects of smoke and limited behavioral influences.

#### **4.2 USER OPTIONS FOR THIS APPLICATION**

As previously stated, there are ten user options to choose from at the beginning of the input file. For this thesis, the Figure 4-1 shows the options that were chosen for the all the hypothetical buildings.

|                               |                        |
|-------------------------------|------------------------|
| UNITS (1-METRIC, 2-STD)       | =2                     |
| SIZE (1-AUST, 2-SOVIET, 3-US) | =1                     |
| SPEED (1-EMER, 2-NORMAL)      | =1                     |
| PATH (1-SHORTEST, 2-DIRECTED) | =1                     |
| SMOKE (1-CFAST, 2-USER/NONE)  | =2                     |
| CONTRA (1-IF CONTRA FLOWS)    | =0                     |
| OUTPUT (1-FULL, 2-BRIEF)      | =1                     |
| NUM OF STAIRWAYS (00-10)      | =02 or 04              |
| STAIR TRAVEL (1-DOWN, 2-UP)   | =1                     |
| RANDOM DELAY (1-Y, 2-N)       | =2, PROB = 50,         |
| MIN TIME (SEC) =              | 1, MAX TIME (SEC) = 5. |

*Figure 4-1.* The ten user options chosen for the hypothetical buildings.

To explain further, the building layouts were developed in standard, i.e. English units. Next, the body size measurement selected was based on the largest area of occupant. This selection is the greatest density of the three choices, and thus the most stressing on the exit capacity.

Next, the emergency velocity was selected based on the assumption that the occupants movement will be under a fire [emergency] condition. Fourth, the shortest path option was chosen, to target the minimum evacuation time for these buildings. The fifth option, including smoke data from CFAST, was not chosen, as this thesis focuses only on the effects of the building design and evacuees. Therefore, there are no smoke blockages or the effects of smoke used during the modeling. Option six, contra flow was not chosen. The full output was chosen for option seven, so as to obtain the occupants' travel paths throughout the building with their associated time step, the summary of the floor and stairwell clearing times, the final time for all the occupants to exit the building per stairwell, and the associated number of occupants using each stairwell. The number of stairwells was inputted into option eight. This thesis will be using the two stairwells for the 100 and 166 foot square buildings, and four stairwells for the 225 and 375 foot

square buildings. The downward travel direction was chosen since the building's occupants were traveling in this direction in order to leave the building.

Finally, the random delay option was not exercised, given the focus of this research on comparing the minimum time for these hypothetical building evacuations using total and select evacuation strategies. Therefore, all the occupants begin the evacuation at the same time.

### **4.3 NODE INPUT**

The input of the model, as previously stated, is based on a network description of the building. The network consists of up to 89 nodes and 10 stairways. The nodes were established based on combining offices, combining offices and conference rooms, individual conference rooms, sections of corridors, and the stairwells due to the nodal restrictions on the model. The nodes have been chosen to attempt to reflect the most realistic travel paths in the building being modeled.

The first task for the node description input data was to establish the nodes for each building floor plan and take the appropriate measurements. The node numbering system for the 100 foot square building was completed to include the offices, conference rooms, and corridors, with nodes 98 and 99 used for the stairwells. The rest of the buildings used the nodes 1-89 throughout the floor plan, with 96-99 used for the stairwells (depending on the number of stairs for each building). In the 225 foot square and 375 foot square buildings, the node sizes were increased to include a combination of either office spaces and conference rooms, or multiple office spaces. The nodes did not

include the restroom and elevator areas since the occupants were assumed not to be located in these areas, and were not traveling through these areas to reach a stairwell.

#### **4.4 CHARACTERISTICS OF NODES**

Once these nodes were established and numbered, a node description spreadsheet was developed. An example of this node table can be found in Appendix 7. For each node, the floor area was inputted. The area of each stairwell was based on the following information (Fahy, 1999, p. A-15). The ceiling height of 12 feet was entered. The capacity of the node was entered as 100, as the current version of this model does not recognize this parameter (It is a planned addition by the developer, Rita Fahy.) The number of occupants at the node at the initial time of evacuation was also entered. For the office spaces this was based on the different occupant loads, and for the conference rooms this was based on the 15 square foot per person area established in the *Life Safety Code*. (NFPA, 2003a) No disabled occupants were considered, as this was not the focus of this thesis. The designation of “intermediate exit” was given to all the stairwells, with no wait times entered for any node, the focus being on having all occupants moving at the same time (at time equal to zero). It should be noted that relaxing this assumption could remove (to an unknown degree) the congestion in the total case, and thus the difference between the two. The shortest option was selected under the above user inputs. The text file of the node input for the 100 by 100 feet, 10 story building has been included within Appendix 8.

#### **4.5 NETWORK LINK DESCRIPTIONS**

The network link descriptions (which can be thought of as arcs) were also part of the input file. The arcs established for each building were designed to balance between having the shortest paths to the stairwells and evenly dividing the occupants between stairwells. The measurements were then taken from the center of the node the occupant was located in to the center of the node they were traveling to within the floor plan. The travel paths were usually from an office to a series of one to three corridors, then into the stairwell. The width of restrictions or openings used varied from three feet for office and stairwell doors to five feet for corridor widths. (Fahy, 1999)

#### **4.6 LOGIC AND OUTPUT DATA**

According to the EXIT89 user's manual (Fahy, 1999), the program goes through the user selected options, and then reads the network links into arrays. The reverse directions of these links are stored into the arrays. The arrays are sorted by the program by order based on the from-nodes. The program then proceeds to read in the node descriptions. An array is established by the program containing the occupant locations by time interval based on the number of occupants within each node.

Since the "shortest routes" option was chosen, the model uses the network descriptions to calculate the shortest paths on each floor to the stairways or to the outside. The model then proceeds to a subroutine that checks the travel paths for both the user-defined egress and shortest paths to verify that all the nodes reach the outside. Once this is all accomplished, the evacuation begins and the model summarizes the details of the evacuation in a separate output file. An example of this output file in the form of a two-

story, total evacuation, 225 foot square building has been included in Appendix 9. This output file was chosen due to the minimum size of the hypothetical building output files is over 50 pages. The file describes the user's input variables chosen, the occupant's movement by time step, the total time to evacuate with amount of occupants, the overall exiting times to clear each floor through the stairways, and the amount of occupants using each stair. (Fahy, 1999)

## **Chapter 5**

### **MODEL RESULTS**

#### **5.1 OVERALL RESULTS**

This chapter provides the basic results of running EXIT89 as described in Chapters 3 and 4. It is comprised as an overview of the output of the modeling program, the overall evacuation times, the individual (floor by floor) clearance times for the various buildings tested, and an illustrative tracing of the evacuation path for an individual, each will be discussed in turn.

#### **5.2 MODEL OUTPUT**

Output from EXIT89 is separated into five sections. The first section summarizes the user options that were chosen, as discussed in Section 3. The second and third sections restate the input file nodes and arcs with introductory descriptions of the significance of each column of the data. The fourth section decomposes the time steps with the associated occupant number (assigned by the model) and their associated travel paths. Finally, the fifth section summarizes the “evacuation statistics”, which shows the overall times and occupant population evacuating the building using the stairs. Table 5-1 provides an example of the “evacuation statistics” summary section. It is the summary of the 100 foot square building containing 10 stories of evacuation. The primary elements in each of these sections will be discussed in turn.

Table 5-1: An example of the “evacuation statistics” summary section of EXIT89.

| Evacuation Statistics                    |     |    |                |
|--|-----|----|----------------|
| 1380 Occupants escaped in 634.87 seconds |     |    |                |
| 0 occupants were trapped                 |     |    |                |
| ---Floor clearing times---               |     |    |                |
| Floor                                    | 1   | at | 634.87 seconds |
| Floor                                    | 2   | at | 628.00 seconds |
| Floor                                    | 3   | at | 600.85 seconds |
| Floor                                    | 4   | at | 562.28 seconds |
| Floor                                    | 5   | at | 501.69 seconds |
| Floor                                    | 6   | at | 434.57 seconds |
| Floor                                    | 7   | at | 363.10 seconds |
| Floor                                    | 8   | at | 294.46 seconds |
| Floor                                    | 9   | at | 220.56 seconds |
| Floor                                    | 10  | at | 150.36 seconds |
| Floor                                    | 11  | at | 83.08 seconds  |
| ---Stair clearing times---               |     |    |                |
| Stairway                                 | 99  | at | 634.87 seconds |
| Stairway                                 | 98  | at | 429.31 seconds |
| ---Exit clearing times---                |     |    |                |
| 670 People used exit at node             | 198 | by | 429. sec       |
| 710 People used exit at node             | 199 | by | 635. sec       |

“Floor clearing time” and “Stair clearing time” areas show the time associated with the last person to pass the associated nodes. For example; the time of 501.69 seconds found under the “Floor clearing time” for Floor 5 is the time associated with the last person from all the above floors (11 through 6) clearing the floors and to the middle of the landing of the 4<sup>th</sup> floor stairwell.

“Exit clearing time” details the number of occupants having used “node 198” or “node 199” which are the designated numbers associated with the two stairwells in this building’s summary.



Due to the size of the runs from the 10, 20 and 30 story buildings, their output files could not be included. Therefore, a scaled down version of the 225 square foot building output file has been included within Appendix 9. It is a two-story, 225 foot square building, evacuating 506 occupants to the outside.

### **5.3 EVACUATION TIMES**

Table 5-2 summarizes some of the primary parameters and the overall evacuation times for the 24 variations of the hypothetical buildings.

### **5.4 EVACUATION TIME FOR EACH BUILDING**

Tables 5-3 through 5-6 are the evacuation times for the last person to pass through a given stair level enroute the outside. For example; under Floor 7 of the “100/10 Total” column, the time reflects the seconds for the last person to clear floors 11 through 7 and arrive at the middle landing of the 6<sup>th</sup> floor stairwell. These data provide more detailed insight, allowing the user to identify queuing locations and other phenomena. Additionally, the user can determine the evacuation times in the affected region (top five floors).

Table 5-2: *The evacuation times for all the hypothetical buildings.*

| Evacuation Statistics for Each Building               |                           |                               |                |
|---|---------------------------|-------------------------------|----------------|
| Square Foot of Building/Stories & Evacuation Strategy | Total Number of Occupants | Number of Occupants per Floor | Time (seconds) |
| 100/10 Total  | 1380                      | 138                           | 635            |
| 100/10 Select   | 690                       | 138                           | 503            |
| 100/20 Total  | 2760                      | 138                           | 1047           |
| 100/20 Select   | 690                       | 138                           | 947            |
| 100/30 Total  | 4140                      | 138                           | 1607           |
| 100/30 Select   | 690                       | 138                           | 1430           |
|   |                           |                               |                |
| 166/10 Total  | 1350                      | 135                           | 587            |
| 166/10 Select   | 675                       | 135                           | 521            |
| 166/20 Total  | 2700                      | 135                           | 1172           |
| 166/20 Select   | 675                       | 135                           | 765            |
| 166/30 Total  | 4050                      | 135                           | 1718           |
| 166/30 Select   | 675                       | 135                           | 1020           |
|   |                           |                               |                |
| 225/10 Total  | 5060                      | 506                           | 918            |
| 225/10 Select   | 2530                      | 506                           | 869            |
| 225/20 Total  | 10120                     | 506                           | 1882           |
| 225/20 Select   | 2530                      | 506                           | 1579           |
| 225/30 Total  | 15180                     | 506                           | 2744           |
| 225/30 Select   | 2530                      | 506                           | 2122           |
|   |                           |                               |                |
| 375/10 Total  | 5170                      | 517                           | 855            |
| 375/10 Select   | 2593                      | 517                           | 841            |
| 375/20 Total  | 10340                     | 517                           | 1768           |
| 375/20 Select   | 2593                      | 517                           | 1547           |
| 375/30 Total  | 15510                     | 517                           | 2654           |
| 375/30 Select   | 2593                      | 517                           | 2191           |

Table 5-3: *Time for the last occupant to pass to the next stairwell for the 100 foot square buildings.*

| Time (Seconds) for the Last Occupant to Pass to the Next Stairwell |              |               |              |               |              |               |
|--|--------------|---------------|--------------|---------------|--------------|---------------|
| Floor  | 100/10 Total | 100/10 Select | 100/20 Total | 100/20 Select | 100/30 Total | 100/30 Select |
| 31   |              |               |              |               | 83.08        | 77.11         |
| 30   |              |               |              |               | 150.36       | 130.43        |
| 29   |              |               |              |               | 220.56       | 170.06        |
| 28   |              |               |              |               | 294.46       | 223.80        |
| 27   |              |               |              |               | 363.10       | 278.45        |
| 26   |              |               |              |               | 434.56       | 329.95        |
| 25   |              |               |              |               | 501.69       | 382.59        |
| 24   |              |               |              |               | 562.28       | 429.34        |
| 23   |              |               |              |               | 600.85       | 472.21        |
| 22   |              |               |              |               | 640.71       | 524.58        |
| 21   |              |               | 83.08        | 77.11         | 682.84       | 573.76        |
| 20   |              |               | 150.36       | 130.43        | 732.40       | 625.47        |
| 19   |              |               | 220.56       | 170.06        | 781.96       | 671.98        |
| 18   |              |               | 294.46       | 223.80        | 831.51       | 176.91        |
| 17   |              |               | 363.10       | 278.45        | 872.95       | 772.58        |
| 16   |              |               | 434.57       | 329.95        | 900.64       | 820.06        |
| 15   |              |               | 501.69       | 382.59        | 950.20       | 870.68        |
| 14   |              |               | 562.27       | 429.34        | 997.34       | 926.71        |
| 13   |              |               | 600.85       | 472.21        | 1037.38      | 980.17        |
| 12   |              |               | 628.62       | 491.64        | 1063.39      | 994.60        |
| 11   | 83.08        | 77.11         | 668.28       | 540.60        | 1116.51      | 1044.43       |
| 10   | 150.36       | 130.43        | 723.58       | 588.11        | 1173.72      | 1096.02       |
| 9  | 220.56       | 170.06        | 758.44       | 634.74        | 1227.88      | 1133.28       |
| 8  | 294.46       | 223.80        | 814.84       | 685.46        | 1282.73      | 1188.60       |
| 7  | 363.10       | 278.45        | 871.35       | 722.26        | 1342.15      | 1219.52       |
| 6  | 434.57       | 329.95        | 895.98       | 777.68        | 1403.04      | 1258.68       |
| 5  | 501.69       | 382.59        | 932.97       | 833.05        | 1453.29      | 1298.84       |
| 4  | 562.28       | 429.34        | 972.35       | 865.23        | 1518.91      | 1344.10       |
| 3  | 600.85       | 472.21        | 1030.39      | 926.03        | 1577.52      | 1401.30       |
| 2  | 628.00       | 498.54        | 1046.71      | 940.79        | 1607.31      | 1426.07       |
| 1  | 634.87       | 503.02        | 1046.71      | 946.96        | 1607.31      | 1429.53       |

Table 5-4: *Time for the last occupant to pass to the next stairwell for the 166 foot square buildings.*

| Time (Seconds) for the Last Occupant to Pass to the Next Stairwell |              |               |              |               |              |               |
|--|--------------|---------------|--------------|---------------|--------------|---------------|
| Floor  | 166/10 Total | 166/10 Select | 166/20 Total | 166/20 Select | 166/30 Total | 166/30 Select |
| 31   |              |               |              |               | 95.70        | 86.25         |
| 30   |              |               |              |               | 134.15       | 126.78        |
| 29   |              |               |              |               | 182.40       | 156.87        |
| 28   |              |               |              |               | 217.13       | 187.07        |
| 27   |              |               |              |               | 272.44       | 248.77        |
| 26   |              |               |              |               | 318.38       | 277.92        |
| 25   |              |               |              |               | 379.06       | 309.90        |
| 24   |              |               |              |               | 416.87       | 327.80        |
| 23   |              |               |              |               | 462.07       | 354.99        |
| 22   |              |               |              |               | 534.54       | 389.91        |
| 21   |              |               | 95.70        | 86.25         | 607.02       | 426.66        |
| 20   |              |               | 134.15       | 126.78        | 636.73       | 452.55        |
| 19   |              |               | 177.52       | 156.87        | 685.27       | 480.36        |
| 18   |              |               | 217.54       | 187.07        | 711.57       | 500.67        |
| 17   |              |               | 271.36       | 248.77        | 745.44       | 526.91        |
| 16   |              |               | 316.55       | 277.92        | 792.24       | 541.54        |
| 15   |              |               | 373.81       | 309.90        | 839.87       | 575.76        |
| 14   |              |               | 426.17       | 327.80        | 897.48       | 594.23        |
| 13   |              |               | 487.02       | 354.99        | 963.69       | 628.73        |
| 12   |              |               | 559.64       | 389.91        | 1036.17      | 668.26        |
| 11   | 96.96        | 91.65         | 634.08       | 426.66        | 1108.64      | 706.92        |
| 10   | 166.22       | 147.12        | 705.47       | 463.41        | 1181.12      | 744.06        |
| 9  | 221.17       | 206.77        | 767.93       | 500.16        | 1253.59      | 779.07        |
| 8  | 284.60       | 262.00        | 821.91       | 538.00        | 1326.07      | 820.55        |
| 7  | 342.98       | 308.83        | 882.23       | 576.49        | 1398.54      | 856.37        |
| 6  | 400.72       | 355.52        | 949.92       | 616.49        | 1471.01      | 888.84        |
| 5  | 456.01       | 404.66        | 1018.31      | 661.07        | 1543.49      | 926.61        |
| 4  | 514.21       | 445.34        | 1090.48      | 699.51        | 1615.96      | 967.67        |
| 3  | 563.64       | 499.70        | 1153.35      | 737.47        | 1688.44      | 1001.17       |
| 2  | 581.02       | 517.36        | 1172.39      | 760.88        | 1718.30      | 1019.87       |
| 1  | 587.43       | 521.11        | 1172.39      | 765.28        | 1718.30      | 1019.87       |

Table 5-5: *Time for the last occupant to pass to the next stairwell for the 225 foot square buildings.*

| Time (Seconds) for the Last Occupant to Pass to the Next Stairwell |              |               |              |               |              |               |
|--|--------------|---------------|--------------|---------------|--------------|---------------|
| Floor  | 225/10 Total | 225/10 Select | 225/20 Total | 225/20 Select | 225/30 Total | 225/30 Select |
| 31   |              |               |              |               | 122.16       | 122.16        |
| 30   |              |               |              |               | 223.19       | 227.15        |
| 29   |              |               |              |               | 309.81       | 303.34        |
| 28   |              |               |              |               | 418.30       | 405.68        |
| 27   |              |               |              |               | 537.12       | 485.03        |
| 26   |              |               |              |               | 616.66       | 566.42        |
| 25   |              |               |              |               | 716.64       | 646.27        |
| 24   |              |               |              |               | 816.51       | 728.46        |
| 23   |              |               |              |               | 937.41       | 835.99        |
| 22   |              |               |              |               | 1055.80      | 920.51        |
| 21   |              |               | 122.16       | 122.16        | 1157.89      | 1013.90       |
| 20   |              |               | 223.19       | 227.15        | 1235.40      | 1058.41       |
| 19   |              |               | 309.81       | 303.34        | 1312.92      | 1131.06       |
| 18   |              |               | 394.24       | 405.68        | 1399.30      | 1195.04       |
| 17   |              |               | 509.13       | 485.03        | 1479.30      | 1243.28       |
| 16   |              |               | 616.66       | 566.42        | 1560.67      | 1306.50       |
| 15   |              |               | 702.93       | 645.62        | 1652.53      | 1370.65       |
| 14   |              |               | 783.66       | 724.90        | 1730.61      | 1426.01       |
| 13   |              |               | 855.05       | 805.67        | 1788.80      | 1491.86       |
| 12   |              |               | 955.31       | 885.94        | 1879.96      | 1543.44       |
| 11   | 122.16       | 122.06        | 1056.79      | 949.69        | 1994.51      | 1603.20       |
| 10   | 223.19       | 227.15        | 1143.26      | 1013.43       | 2081.50      | 1650.52       |
| 9  | 309.81       | 303.34        | 1247.20      | 1087.56       | 2164.12      | 1715.30       |
| 8  | 394.24       | 405.68        | 1329.51      | 1163.79       | 2250.23      | 1762.89       |
| 7  | 509.13       | 485.03        | 1439.76      | 1240.02       | 2336.33      | 1827.48       |
| 6  | 624.82       | 567.91        | 1539.15      | 1316.24       | 2418.02      | 1876.97       |
| 5  | 702.93       | 646.27        | 1619.20      | 1392.47       | 2499.31      | 1934.48       |
| 4  | 773.10       | 725.55        | 1722.79      | 1468.70       | 2572.77      | 1984.32       |
| 3  | 845.17       | 795.53        | 1795.24      | 1544.93       | 2658.08      | 2049.46       |
| 2  | 915.85       | 861.88        | 1872.44      | 1573.08       | 2727.38      | 2119.45       |
| 1  | 917.85       | 869.03        | 1882.46      | 1578.50       | 2743.98      | 2122.46       |

Table 5-6: *Time for the last occupant to pass to the next stairwell for the 375 foot square buildings.*

| Time (Seconds) for the Last Occupant to Pass to the Next Stairwell |              |               |              |               |              |               |
|--|--------------|---------------|--------------|---------------|--------------|---------------|
| Floor  | 375/10 Total | 375/10 Select | 375/20 Total | 375/20 Select | 375/30 Total | 375/30 Select |
| 31   |              |               |              |               | 192.73       | 184.87        |
| 30   |              |               |              |               | 280.94       | 259.37        |
| 29   |              |               |              |               | 391.60       | 333.87        |
| 28   |              |               |              |               | 484.19       | 408.36        |
| 27   |              |               |              |               | 549.10       | 482.86        |
| 26   |              |               |              |               | 640.58       | 557.36        |
| 25   |              |               |              |               | 741.58       | 631.86        |
| 24   |              |               |              |               | 809.63       | 706.36        |
| 23   |              |               |              |               | 895.41       | 780.86        |
| 22   |              |               |              |               | 1005.15      | 855.35        |
| 21   |              |               | 192.73       | 184.87        | 1102.04      | 929.85        |
| 20   |              |               | 280.94       | 259.37        | 1187.71      | 1004.35       |
| 19   |              |               | 391.60       | 333.87        | 1256.24      | 1078.85       |
| 18   |              |               | 484.19       | 408.36        | 1366.76      | 1141.56       |
| 17   |              |               | 549.10       | 482.86        | 1443.07      | 1204.28       |
| 16   |              |               | 640.58       | 557.36        | 1546.89      | 1266.99       |
| 15   |              |               | 741.58       | 631.86        | 1615.79      | 1324.23       |
| 14   |              |               | 809.63       | 706.36        | 1713.63      | 1395.18       |
| 13   |              |               | 895.41       | 780.86        | 1785.39      | 1465.92       |
| 12   |              |               | 1005.15      | 855.35        | 1862.55      | 1523.53       |
| 11   | 192.73       | 184.87        | 1101.02      | 929.85        | 1972.65      | 1593.27       |
| 10   | 280.94       | 259.37        | 1187.71      | 1004.35       | 2053.02      | 1652.83       |
| 9  | 378.86       | 333.87        | 1257.03      | 1078.85       | 2139.35      | 1720.62       |
| 8  | 471.11       | 408.36        | 1324.64      | 1141.56       | 2214.49      | 1780.59       |
| 7  | 543.26       | 482.86        | 1389.97      | 1204.28       | 2292.59      | 1850.31       |
| 6  | 615.17       | 557.36        | 1485.18      | 1266.99       | 2369.30      | 1907.52       |
| 5  | 677.99       | 631.86        | 1554.89      | 1324.23       | 2446.14      | 1975.57       |
| 4  | 748.97       | 706.36        | 1618.64      | 1395.18       | 2523.59      | 2046.06       |
| 3  | 819.96       | 780.86        | 1683.82      | 1465.92       | 2580.04      | 2108.77       |
| 2  | 854.74       | 840.51        | 1759.66      | 1547.46       | 2640.16      | 2190.12       |
| 1  | 854.74       | 840.51        | 1768.44      | 1547.46       | 2654.18      | 2190.59       |

## 5.5 TRACING AN OCCUPANT'S TRAVEL

An example of the use of the fourth section of EXIT89 output is provided in the Table 5-7. This output presents the event time log, from which it is possible to look at the temporal and geospatial path for a particular occupant. The example provided is for occupant number 1288 in the 10 story, total evacuation, 100 foot square building.

Table 5-7: *EXIT89* output regarding the travel of occupant number 1288 from the 10-story, total evacuation strategy, 100 foot building.

| TIME   | OCC<br>NUM | ORIG<br>NUM | FROM<br>NODE | TO<br>NODE | NUM<br>OUT | NUM<br>TRAPD |
|--------|------------|-------------|--------------|------------|------------|--------------|
| 3.08   | 1288       | 1107        | 1107         | 1179       | 0          | 0            |
| 14.36  | 1288       | 1107        | 1179         | 1178       | 0          | 0            |
| 29.74  | 1288       | 1107        | 1178         | 1185       | 0          | 0            |
| 42.87  | 1288       | 1107        | 1185         | 1199       | 12         | 0            |
| 83.08  | 1288       | 1107        | 1199         | 1099       | 102        | 0            |
| 135.76 | 1288       | 1107        | 1099         | 999        | 296        | 0            |
| 212.65 | 1288       | 1107        | 999          | 899        | 584        | 0            |
| 289.55 | 1288       | 1107        | 899          | 799        | 926        | 0            |
| 363.10 | 1288       | 1107        | 799          | 699        | 1086       | 0            |
| 430.44 | 1288       | 1107        | 699          | 599        | 1242       | 0            |
| 501.69 | 1288       | 1107        | 599          | 499        | 1242       | 0            |
| 562.28 | 1288       | 1107        | 499          | 399        | 1242       | 0            |
| 600.85 | 1288       | 1107        | 399          | 299        | 1242       | 0            |
| 628.00 | 1288       | 1107        | 299          | 199        | 1342       | 0            |
| 634.87 | 1288       | 1107        | 199          | 0          | 1369       | 0            |

The first column in Table 5-7 indicates the time in seconds of occupant 1288 travel from one node to the next node. The second and third column show the occupant number (1288) and the original node where occupant 1288 is located. The fourth and fifth columns indicate the number of the from and to node in which occupant 1288 is traveling through. The “num out” indicates the number of occupants that have left the building at the corresponding time step. “Num trapd” is the number of occupants trapped in the building.

This route found in Table 5-7 is illustrated in the Appendix 10. Nodes 1199 through 0 indicate the stairwell nodes to the outside of the building which are not shown in Appendix 10.



## CHAPTER 6

### ANALYSIS OF RESULTS

#### 6.1 OVERALL ANALYSIS

An examination of the predictive capability of EXIT89 versus the actual performance has been accomplished through the comparison of Pauls' predictions versus the hypothetical buildings' result times. The second analysis presented is the overall times to evacuate the occupants and the times to evacuate the affected floors (top five floors). This shows a comparison of how queuing affects the times of the two types of evacuation strategies.

#### 6.2 COMPARISON OF RESULTS WITH PAULS' PREDICTIONS

In order to check if the results from all the hypothetical buildings were within reason, a comparison between Pauls' works was accomplished. In the Society Fire Protection Engineers Handbook, Proulx presents Pauls' predicted and observed total evacuation times based on Pauls' equations to predict total evacuation time for a 15 story building. To compare the results from EXIT89, the occupant load used for each of the total evacuation strategy, hypothetical buildings were divided by their effective width (in meters) and inserted in the two equations given by Pauls. The occupant loads of less than 800 persons per meter of effective stair width used Equation 6-1, and above 800 persons per meter of effective stair width used Equation 6-2 (Proulx, 2002).

$$T = 2.00 + 0.0117p \quad (6-1)$$

$$T = 0.70 + 0.0133p \quad (6-2)$$

This was then plotted against the total evacuation times (in minutes) from the results of the model runs. As seen Figure 6-1, there is a high degree of agreement between the results as predicted by Pauls and those obtained in this use of EXIT89. Furthermore, the linear regression analysis provided a “best fit” line through the data in Figure 6-1 (for the modeling performed here) indicates not only a highly linear relationship between evacuation population and overall evacuation time (as shown by the high coefficient of determination), but also a slope that lies between that of the linearized versions of the low density (less than 800 persons per meter of effective stair width) and high density (more than 800 persons per meter of effective stair width) cases. This should be expected, as this research used a combination of low and high density cases.

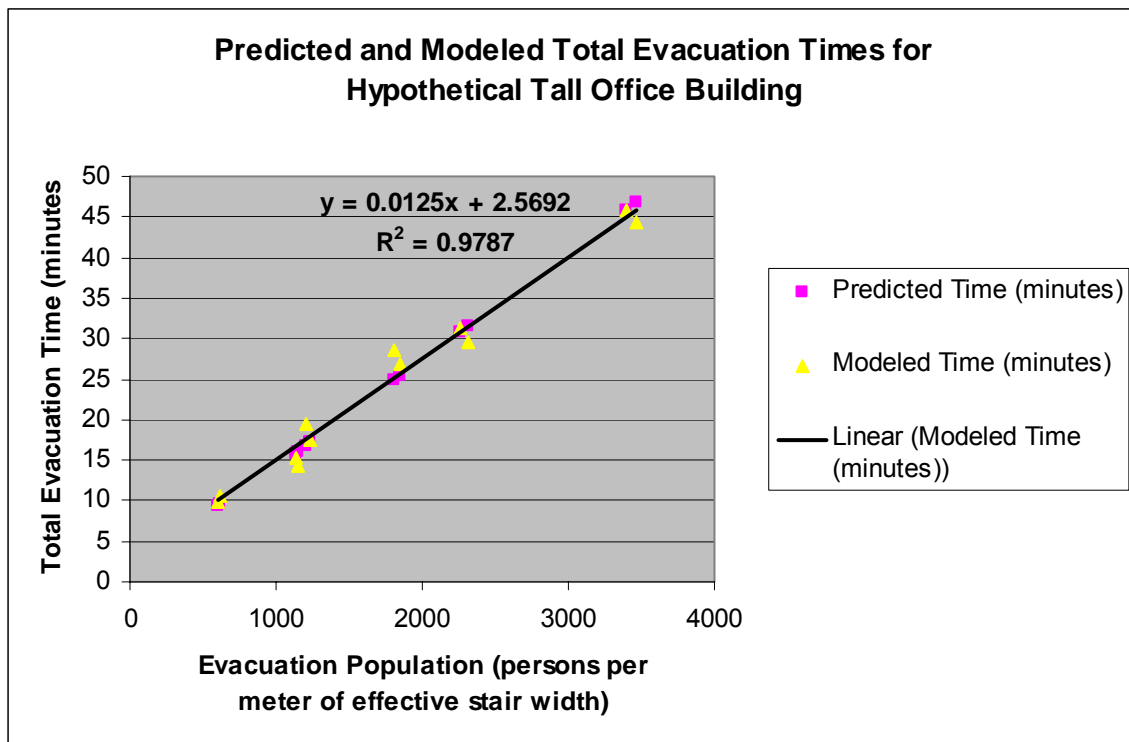


Figure 6-1. Predicted and modeled total evacuation times for hypothetical tall office buildings.

The next comparison undertaken was to develop a similar graph to Pauls work illustrating the predicted times for an uncontrolled total evacuation of a 15-story, hypothetical building. Similar charts have been used by Predtechenskii and Milinskii (Pauls, 1977, p. 283). The walking speeds used in EXIT89 are also based on formulas from Predtechenskii and Milinskii (Fahy, 1999).

The details of the building layout of Pauls' hypothetical, 15-story building are not available. Therefore, the hypothetical, 100 foot square building was used as a basis for the graph. The occupant density of each floor was reduced to 70 occupants per floor, similar to Pauls' work. The building height was increased to 15 stories with the evacuation of 14 stories. The movement parameter in the user option section of the program was changed to "normal evacuation movement" due to the fact Pauls' used fire drill information as opposed to actual fire evacuation times.

As discussed previously, time to evacuate has been considered as the sum of time spent waiting at each floor and the time spent transiting between the floors summed over all the floors. The presentation of Pauls' work in the Society of Fire Protection Engineer Handbook assumed that all the waiting time was at the floor of origin. As such, his graph shows only horizontal bands for each occupant and equal slopes afterwards (stair transit rates constant). Figures 6-2a and 6-2b relaxes the assumption that all the waiting takes place before initiating evacuation (using actual floor clearing time) which was constant as illustrated by the figure. A relative stair transit rate was then developed that took into account the fact that waiting occurred at all floors. As such, the slopes varied between initiating floors, with those starting higher in the building having a level slope.

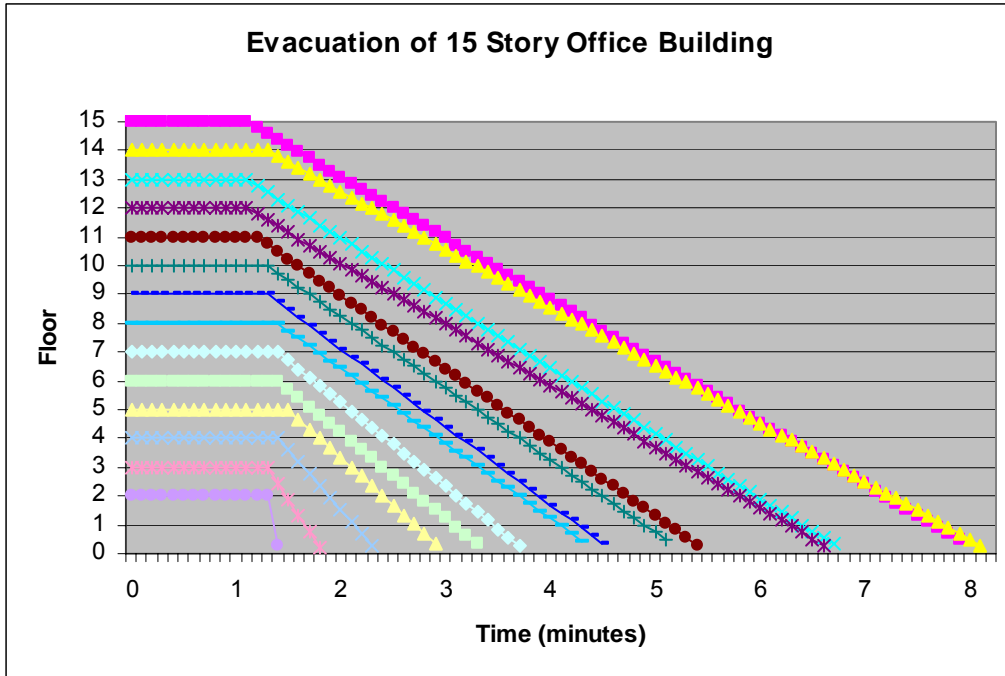


Figure 6-2a. Evacuation of a 15 story office building based on the 100 foot square hypothetical building floor plan

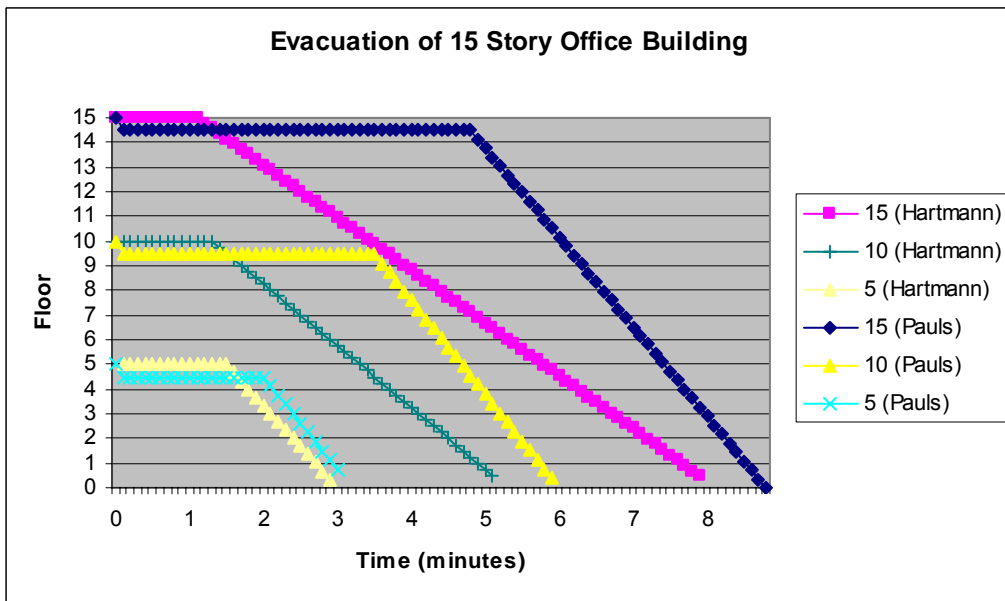


Figure 6-2b. Evacuation of floors 5, 10 and 15 of a 15 story office building based on the 100 foot square hypothetical building floor plan (Hartmann) versus Pauls' hypothetical uncontrolled total evacuation of a 15-story office building (Proulx, 2002, p. 355).

### **6.3 OVERALL RESULTS ANALYSIS**

Before presenting the analysis of the results, it is worthwhile revisiting the focus of this research. Specifically, this research attempts to determine and explain any observed differences between total and select evacuation strategies. Furthermore, this research attempts to explore the effect of variations in key parameters (building height, area and number of occupants) on the difference between the performances of the two strategies. This is developed in two primary metrics- first, in the comparison of the overall time for evacuees to get out of the building (total evacuation time), and second, in the comparison of the time to evacuate the affected region (floors at which the emergency situation exists, taken as the top five floors here). Adding this second metric allows consideration to be made of the increase in relative safety by traveling off of the affected floors through the stairwells to the outside of the building. Here, the overall time to evacuate the building is considered first, followed by the consideration of the time to leave the affected floors. The overall times to evacuate compared by evacuation strategy establish the time differences by height and building size for the occupants to reach the outside of the buildings. The time to leave the affected floors (top five floors) establishes the evacuation times for the same number of occupants, which in comparing these to the overall time to evacuate will show the time differences due to queuing.

### **6.4 ANALYSIS OF OVERALL EVACUATION TIMES**

Overall travel time for both total and select evacuation strategies can be considered as a combination of transit time and waiting (queuing) time. As the occupants in the comparable total and select evacuation strategies must traverse the same distance

(number of stairs), the transit times for corresponding cases are expected to be equal. As such, the difference is in the waiting time, taking the difference between total and select evacuation strategies captures this absolute difference. To place this difference into context, the relative difference between total and select evacuation strategies is also considered, which is taken in the following sections as the ratio of time in the select evacuation strategy to the time in the total evacuation strategy. This is done in the subsequent sections as a function first of building floor plan area, and then as a function of building height.

#### 6.4.1 100 FOOT SQUARE BUILDING

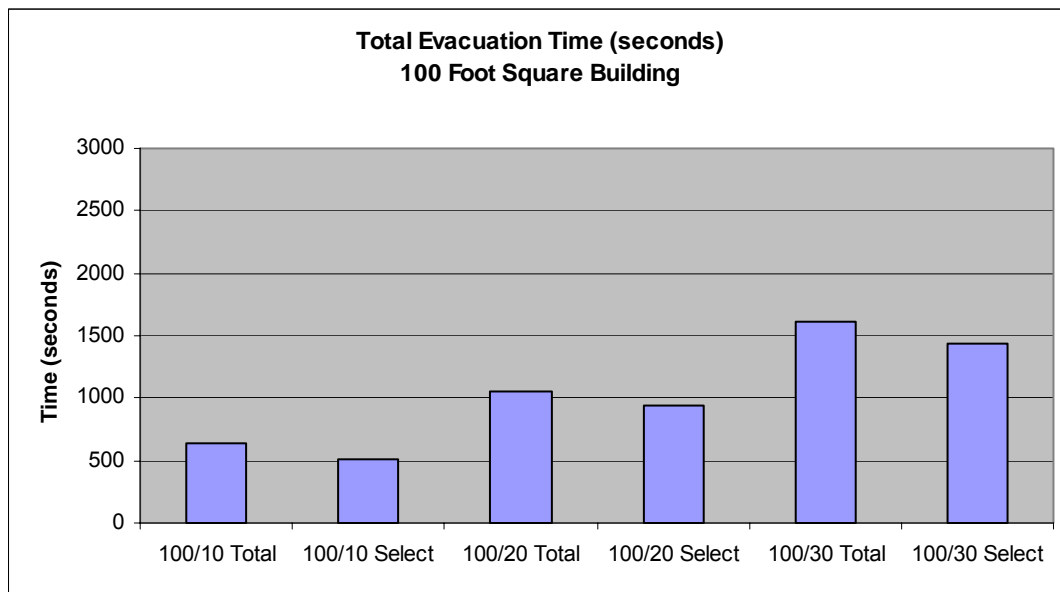


Figure 6-3. Total evacuation time for the 100 foot square building.

As can be seen by Figure 6-3, the time for the total evacuation time increases with the type of evacuation strategy (total and select) as the stories of the building increases. The total evacuation time increases approximately by a factor of approximately 2 from the 10-story building to the 20-story building. From the 20-story building to the 30-story

building, the total evacuation time increases approximately by 64%. Overall the time factor from the 10-story building to the 30-story building increases approximately by a factor of 3 for the total evacuation strategy.

For the select evacuation strategy, the total evacuation time factor increases by a factor of approximately 2 from the 10-story building to the 20-story building; and by 51% from the 20-story to the 30-story building. Overall the time factor from the 10-story, select evacuation strategy to the 30-story, select evacuation strategy also increases approximately by a factor of 3.

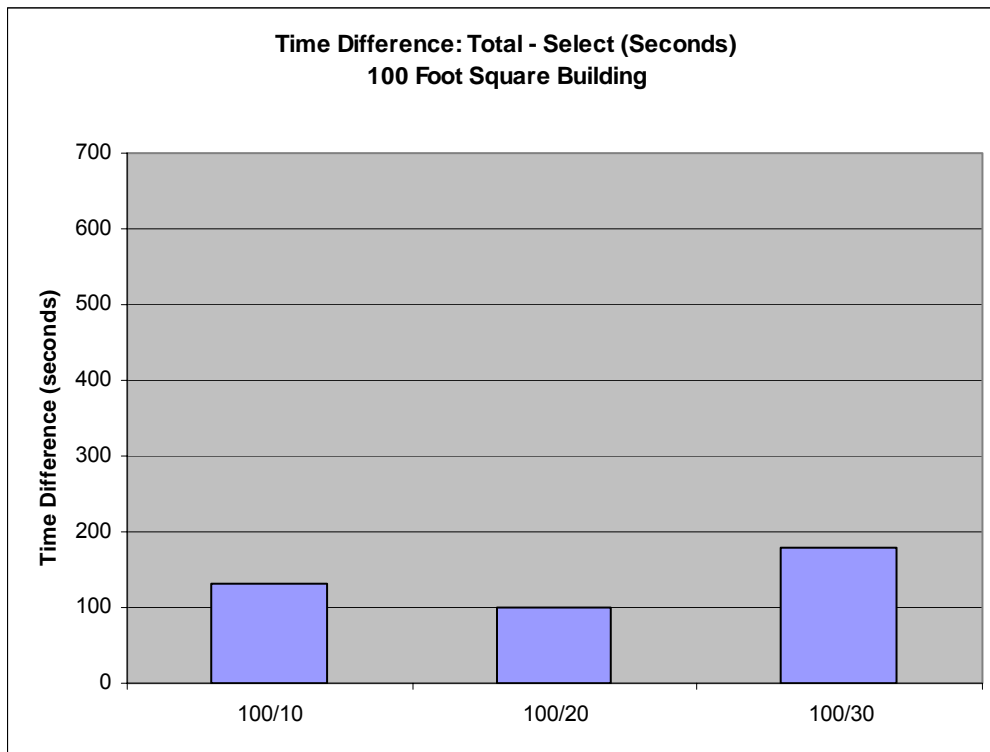


Figure 6-4. Time difference: total – select for the 100 foot square building.

In Figure 6-4, it can be seen that the time differences (total time for total evacuation strategy minus total time for select evacuation strategy) for different heights of the 100 foot square building begin at approximately 132 seconds, then decrease to approximately 99 seconds, and then increase again to approximately 178 seconds. On a

relative basis between building heights, it can be seen that varying from the 10-story to the 20-story decreases the time difference slightly (25%). From the 20-story to the 30-story, this time difference increases by 75%. Overall, the time difference between the 10-story and 30-story buildings increases by approximately 35%. One may think that the trend in the time difference would increase as the stories of the building increase, although the time differences here appear to be influenced by a degree of queuing causing them to reach a plateau at the 10 story case and then not grow dramatically in the range of buildings considered. This phenomena is addressed later in the concluding chapter as an area of future study.

As a percentage of the time for the total evacuation strategy, the select evacuation strategy varies from 79% for the 10 story building to 90% for the 20 and 89% for the 30 story structure. As such, the relative time difference is not as significant as had been originally anticipated, and is relatively stable as building height varies.

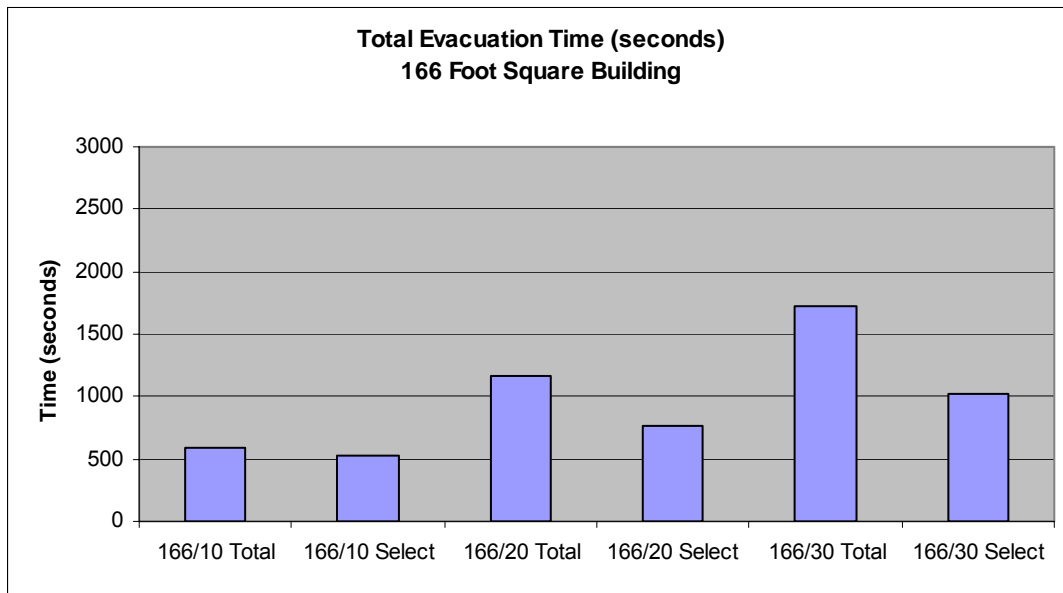
#### **6.4.2 166 FOOT SQUARE BUILDING**

Figure 6-5 also illustrates (unsurprisingly) an increase of time by type of building evacuation as the stories increase. The total evacuation time increases approximately by a factor of 2 from the 10-story building to the 20-story building. From the 20-story building to the 30-story building, the total evacuation time increases approximately by approximately 47%. Overall the time factor from the 10-story building to the 30-story building increases approximately by a factor of 3 for the total evacuation strategy.

For the select evacuation strategy, the time factor again increases by approximately 47% from the 10-story building to the 20-story building; and



approximately 33% from the 20-story to the 30-story building. Overall the time factor from the 10-story, select evacuation strategy to the 30-story, select evacuation strategy increases approximately by a factor of 2.



*Figure 6-5.* Total evacuation time for the 166 foot square building.

As can be seen in Figure 6-6, the time differences for this particular building increase as the building stories increase. This would be sensible based on the fact that more queuing is occurring in the total evacuation strategy of the taller buildings. Here, the time difference from the 10-story building to the 30-story building is approximately 632 seconds.

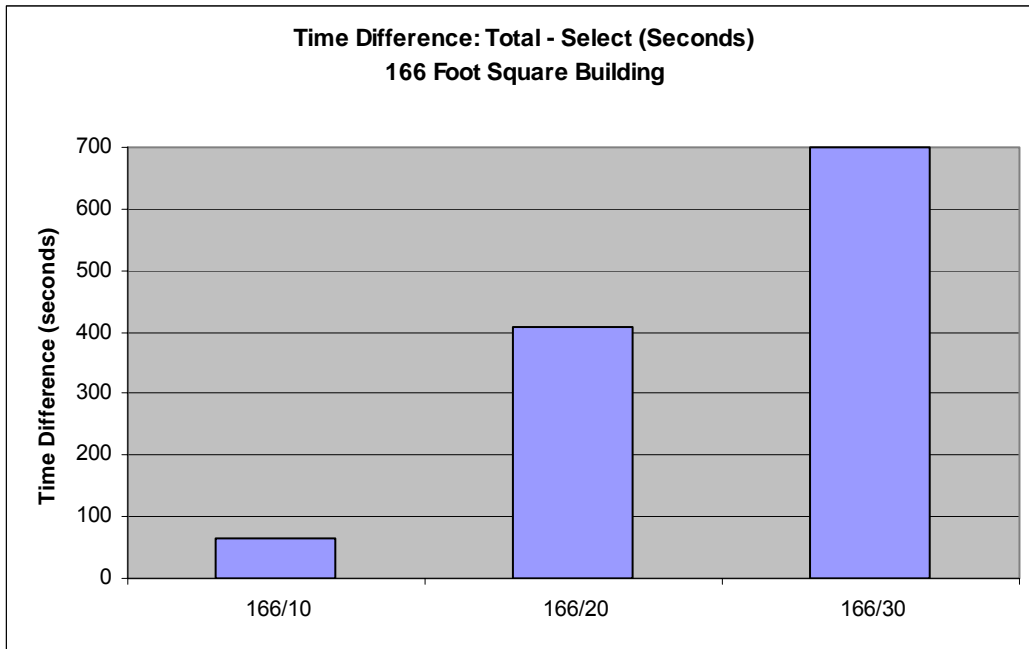


Figure 6-6. Time difference: total – select for the 166 foot square building.

From the 10-story building to the 20-story building, the time factor difference increased by a factor of approximately 6. Between the 20-story building and 30-story building time difference, the time factor only increased by approximately 72%. Overall, the time factor increases approximately by a factor of 11 between the 10-story building and the 30-story building.

As a percent of the time for the total evacuation strategy, select evacuation strategy varies from 88% for the 10-story building to 65% for the 20-story building and 59% for the 30-story building. As such, the relative time difference is more significant than in the 100 foot square building. This is perhaps due to the potential queuing in both total and select evacuation strategies for the 100 foot square building, with queuing in only the total evacuation strategy in the lower occupant load, 166 foot square building. Furthermore, the relative time difference was found to decrease with increased building

height, indicating that while the time difference increased, the effects reduced in comparison to the increased transit time for the taller buildings.

### 6.4.3 225 FOOT SQUARE BUILDING

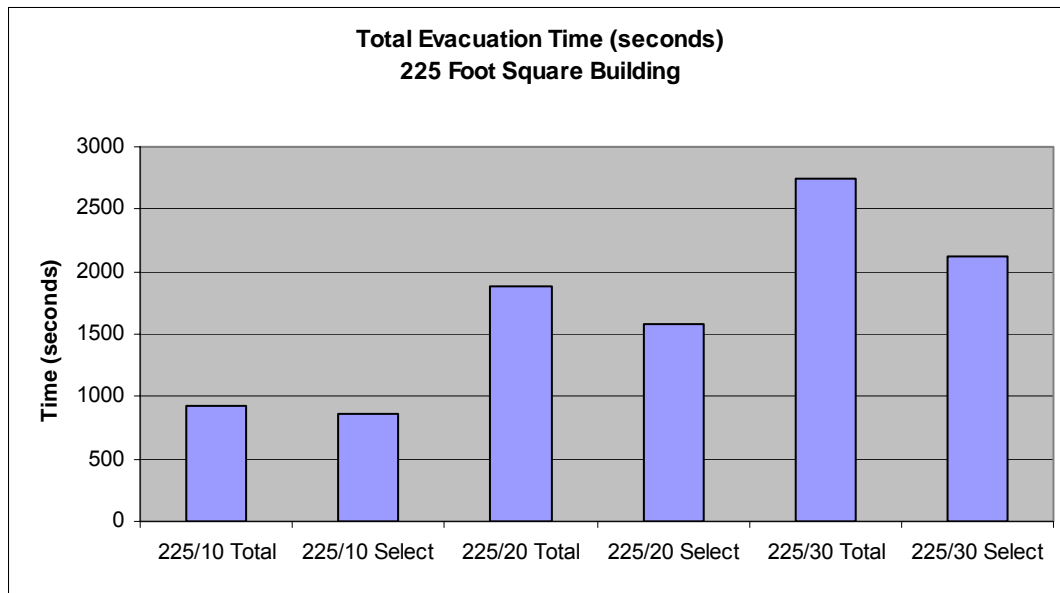


Figure 6-7. Total evacuation time for the 225 foot square building.

Figure 6-7 results are similar to the 166 foot square building illustrating an increase of time by type of building evacuation strategy as the building height increases. The time for the total evacuation strategy increases approximately by a factor of 2 between the 10-story building and the 20-story building. From the 20-story building to the 30-story building, the total evacuation time increases approximately by 46%. Overall the time factor from the 10-story building to the 30-story building increases approximately by a factor of 3 for the total evacuation strategy.

For the select evacuation strategy, the time factor increases by approximately 81% from the 10-story building to the 20-story building; and by approximately 34% from the 20-story to the 30-story building. Overall, the time factor from the 10-story select

evacuation strategy to the 30-story select evacuation strategy increases by a factor of approximately 2.4.

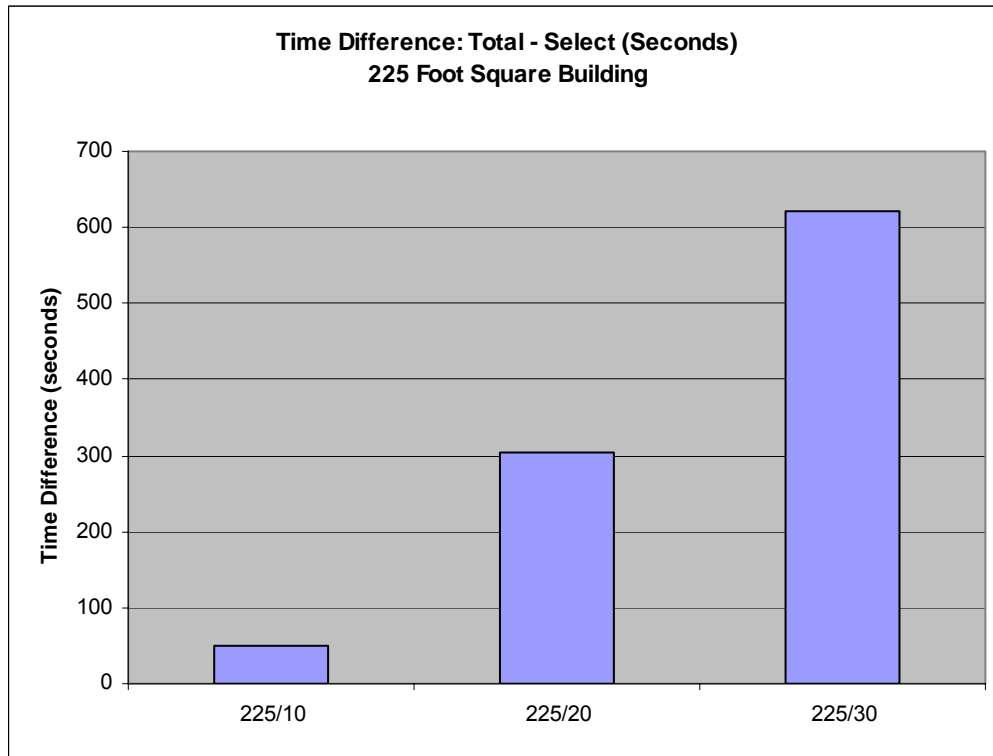


Figure 6-8. Time difference: total – select for the 225 foot square building.

As before, the time differences for the 225 foot square building increase as the number of stories increases. Here in Figure 6-8, the time differences for the 225 foot square building increased from approximately 49 seconds to approximately 651 seconds.

From the 10-story building to the 20-story building, the time difference increased by a factor of approximately 6. The time difference further increased approximately by a factor of 2 between the 20-story building and the 30-story building, with an overall time difference between the 10-story and the 30-story buildings increases approximately by a factor of 13.

As a percent of the time for the total evacuation case, select evacuation varies from 95% for the 10 story building to 84% for the 20 and 77% for the 30 story structures. As such, the relative time difference is more significant than in the 100 square foot building but less than for the 166 square foot building. This is perhaps due to the occupant load factor of the 225 foot square building (occupant load factor equaling 100 square feet per person) being between the 100 foot square building (occupant load factor equaling 72.5 square feet per person) and 166 foot square building (occupant load factor equaling 204 square feet per person). The occupant load factor has been calculated based on the area of the building divided by the actual amount of occupants used in the model. Here, as in the 166 square foot building, the relative time difference was found to decrease with increased building height, indicating that while the time difference increased, the effects reduced in comparison to the increased transit time for the taller buildings.

#### **6.4.4 375 FOOT SQUARE BUILDING**

The graph in Figure 6-9 also indicates an increase of time by type of building evacuation as the building height increases. The time for the total evacuation increases approximately by a factor of 2 from the 10-story building to the 20-story building, with another increase of approximately 50% between the 20-story building and the 30-story building. Overall the time between the 10-story building and the 30-story building increases approximately by a factor of 3 for the total evacuation strategy.

For the select evacuation the evacuation time increases by approximately 84% from the 10-story building to the 20-story building; and approximately 42% from the 20-

story to the 30-story building. Overall the time from the 10-story select evacuation to the 30-story select evacuation increases approximately by a factor of 2.6.

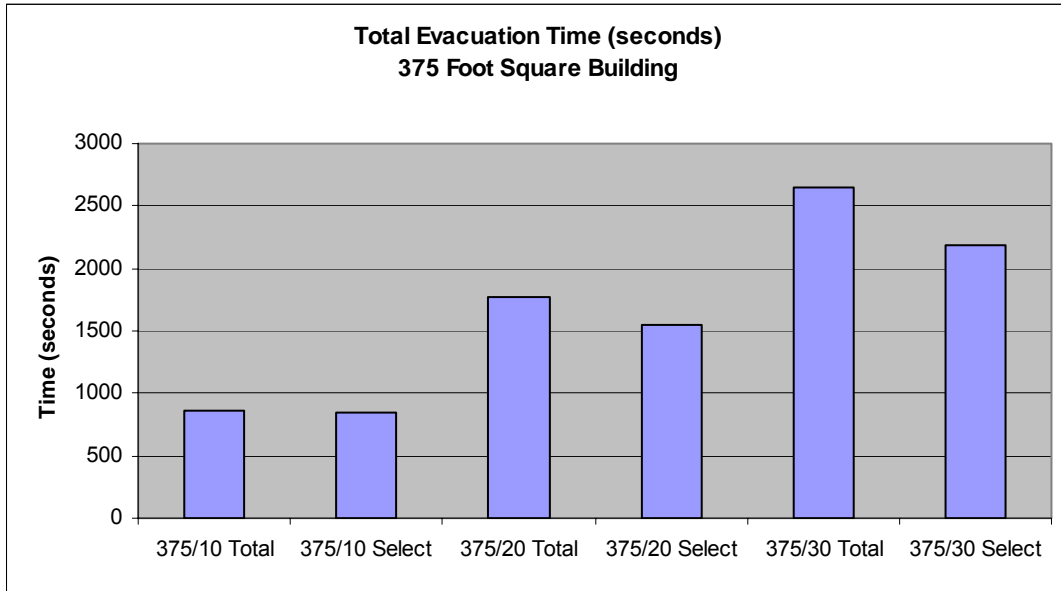


Figure 6-9. Total evacuation time for the 375 foot square building.

As shown in Figure 6-10, the time differences for this particular building increase as the building stories increase. Here, the time difference from the 10-story building to the 30-story building grew by approximately 450 seconds.

From the 10-story building to the 20-story building, the time difference increased by a factor of approximately 16. The time difference further increased approximately by a factor of 2 between the 20-story building and the 30-story building time difference, with an overall increase of the time difference between the 10-story to the 30-story building by a factor of approximately 33.

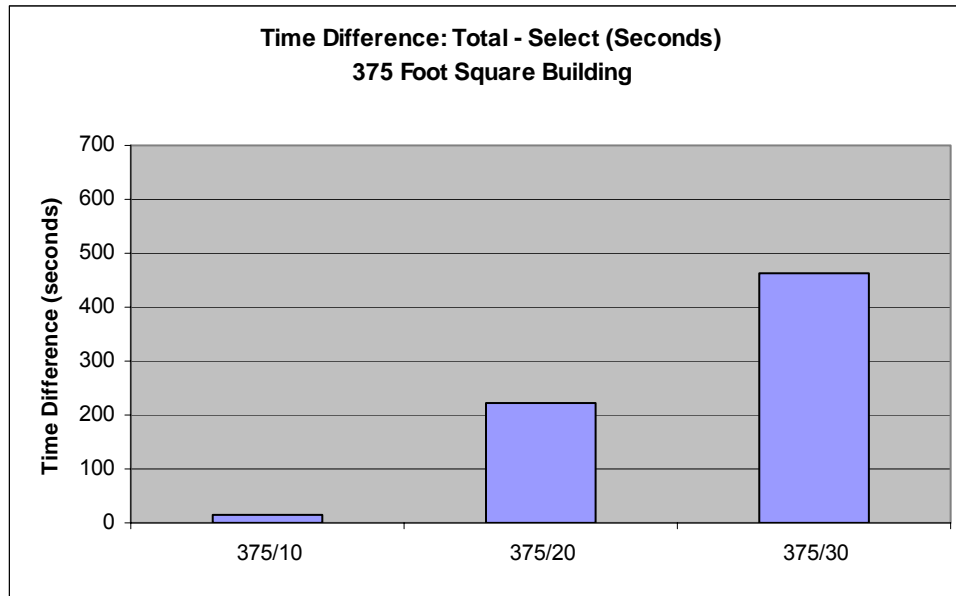


Figure 6-10. Time difference: total – select for the 375 foot square building.

As a percent of the time for the total evacuation case, select evacuation varies from 98% for the 10 story building to 88% for the 20 and 83% for the 30 story structure. As such, the relative time difference is greater than in the 100 square foot building but less than for the 166 square foot building and the 225 square foot building. Here, as in the 166 and 225 square foot buildings, the relative time difference was found to decrease with increased building height, indicating that while the time difference increased, the effects reduced in comparison to the increased transit time for the taller buildings.

In summary, unsurprisingly, the overall results from running EXIT89 with the four types of hypothetical buildings shows that the total evacuation strategy results in a longer time to get evacuees out of the building than the select evacuation strategy. However, the absolute and relative differences between the two were not as large as expected. To further review these differences, the subsequent examination of the differences (both absolute and relative) between the strategies (total and select) in terms of the time to evacuate the affected region was made.

## 6.4.5 ALL BUILDINGS

As shown in the following, the time differences between the total versus select evacuation type decreases as the area of the building increases.

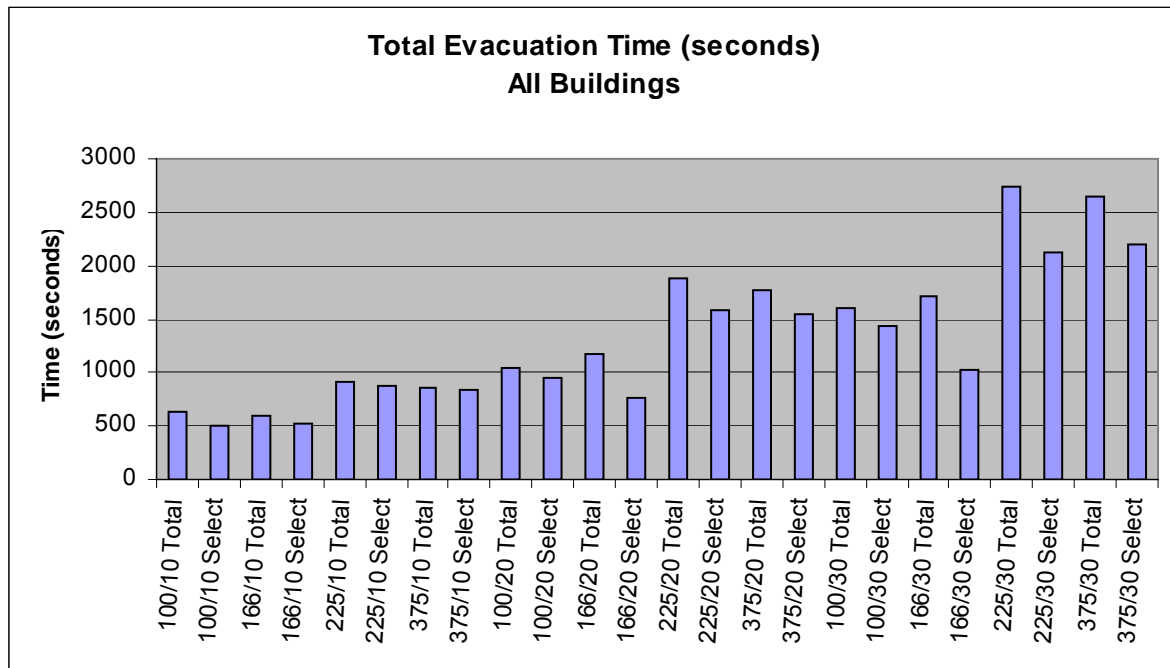


Figure 6-11. Total evacuation time for all hypothetical buildings.

This makes sense, as the occupant density (the area of the building divided by the occupant load factor) decreases.

In reviewing the times of the different stories, the total evacuation time increases for each evacuation strategy as the building heights increase, with the exception of the 20-story and 30-story, 166 foot square buildings. The time differences between the total evacuation strategies for the 10-story, 100 foot square building and the 10-story, 166 foot square buildings were approximately 48 seconds. For the select evacuation strategies for these same buildings, the approximate time difference is 18 seconds. Comparing these times to the 10-story, 225 foot square buildings and the 10-story, 375 square foot



buildings, they increase by approximately 2 seconds for the total evacuation strategies, and decrease by approximately 4 seconds for the select evacuation strategies. There are several buildings with lower occupant densities per floor having greater evacuation time than the buildings with higher occupant densities per floor. This occurs among the following: 10-story, select evacuation strategy, 100 square foot building and the 166 foot square building; 20-story, total evacuation strategy, 100 foot square building and the 166 foot square building; 30-story, total evacuation strategy, 100 foot square building and the 166 foot square building; and the 30-story, select evacuation strategy, 225 foot square building and 375 foot square building.

The larger buildings have more occupants and longer travel distances which intuitively would be expected to result in greater overall evacuation times. However, the converse was determined by the model. Therefore, a further analysis of the data was accomplished to determine the speed and density of the occupants in the 100 foot square and 166 foot square buildings. This analysis led to the observation that the waiting time prior to entering the stair for the 166 foot square building was less than the waiting time in the 100 foot square building. Thus, the occupants in the 166 foot square building were reaching the stairwell in lower time than the 100 foot square building. In addition, the results showed the densities in the stair increase for the larger building, resulting in a decrease in the speed of the occupants. So, it appears that the larger buildings have reduced waiting times which are making up for their travel times to cause an overall reduction in the total building evacuation times.

The time differences for these buildings for the 10-story evacuation strategies decreased from approximately 132 seconds to approximately 14 seconds. For the 20-story cases, the time differences increase from approximately 100 seconds to approximately 407 seconds; and then decreased to approximately 221 seconds. The 30-story case also increased from approximately 178 seconds to 698 seconds; and then decreased to approximately 463 seconds.

The time differences for these buildings as seen in Figure 6-12 were more significant, with Total-Select for the 10-story, 100 foot square building being about 9 times that of the 10-story, 375 foot square building. The 20-story and 30-story buildings have a greater separation between the individual results for each building size, except for the 100 foot square building being 25% less than the 166 foot square building (greatest time difference).

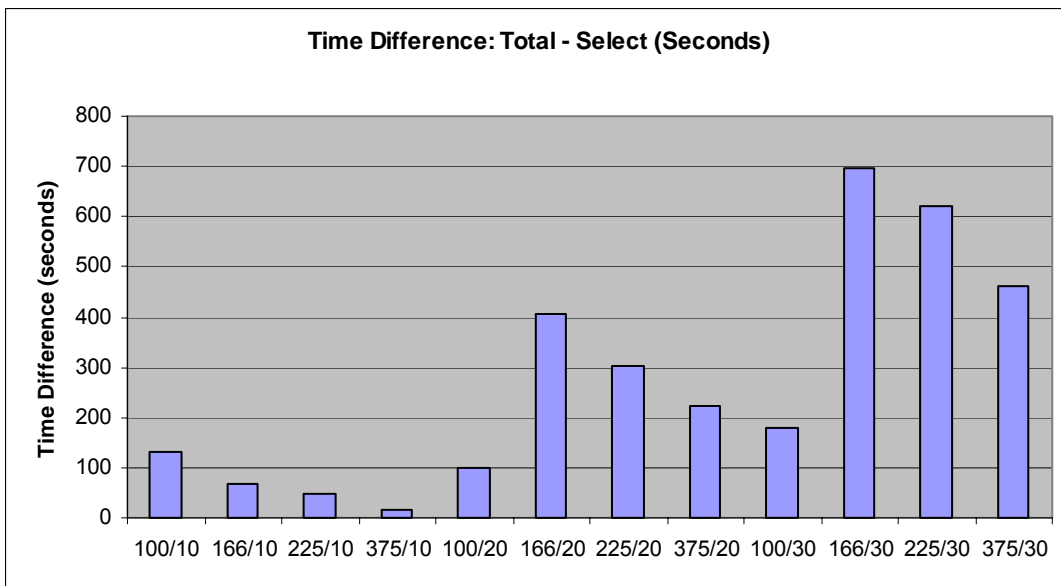
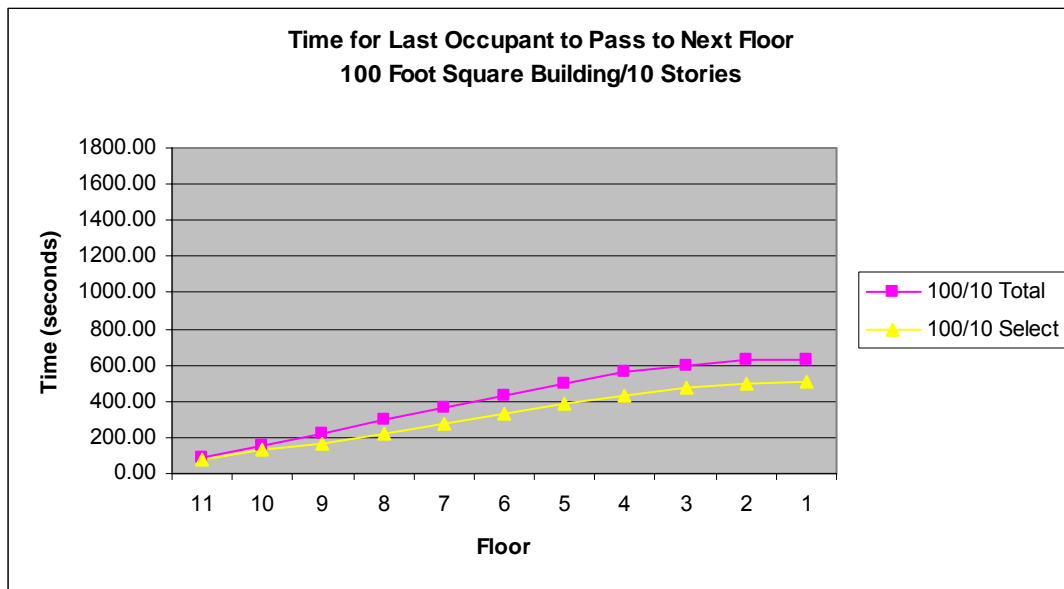


Figure 6-12. Time difference: total – select for all the hypothetical buildings.

## 6.5 ANALYSIS OF RESULTS BY STAIRWELL EVACUATION TIMES

While the Section 6.4 focused on the overall time for all the evacuations (total evacuation time), these sections focus on the time for occupants to move between floors (i.e., time for the last person to leave a particular floor). Additionally, these sections focuses further on the time to evacuate the more hazardous affected region (i.e. time to clear the top five floors). This is considered by building footprint and height.

### 6.5.1 100 FOOT SQUARE BUILDING



*Figure 6-13.* Time for last occupant to pass to the next floor for the 100 foot square building, 10 stories.

As shown in Figure 6-13, to clear the ninth floor (floor at which the hazard exists), the time difference is approximately 71 seconds. However for the occupants of the top five floors (Floor 11 to Floor 7) to pass onto the next floor, Floor 6, the difference between total and select evacuation strategies ranges only from approximately 6 seconds

to 105 seconds. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 6 seconds to approximately 132 seconds.

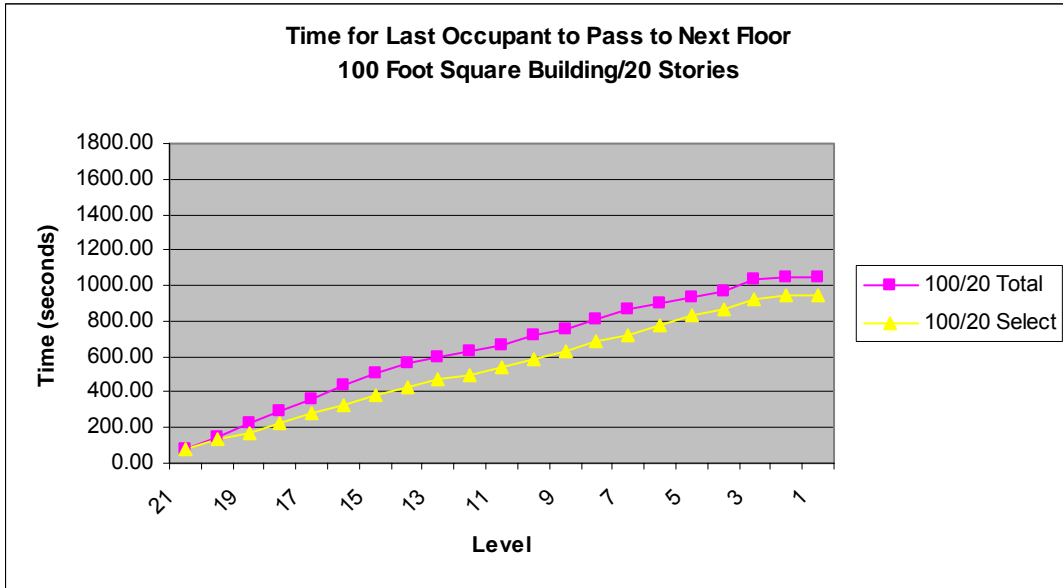


Figure 6-14. Time for last occupant to pass to the next floor for the 100 foot square building, 20 stories.

As seen in Figure 6-14, to clear the nineteenth floor (floor at which the hazard exists), the time difference is also approximately 71 seconds, again, similar to the 10-story case. However for the top five floors (Floor 21 to Floor 17) to pass onto the next floor, Floor 16, the difference ranges only from approximately 6 seconds to 105 seconds, similar to the 10-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 6 seconds to a maximum of approximately 149 seconds. Here, the peak difference occurs on the seventh floor.

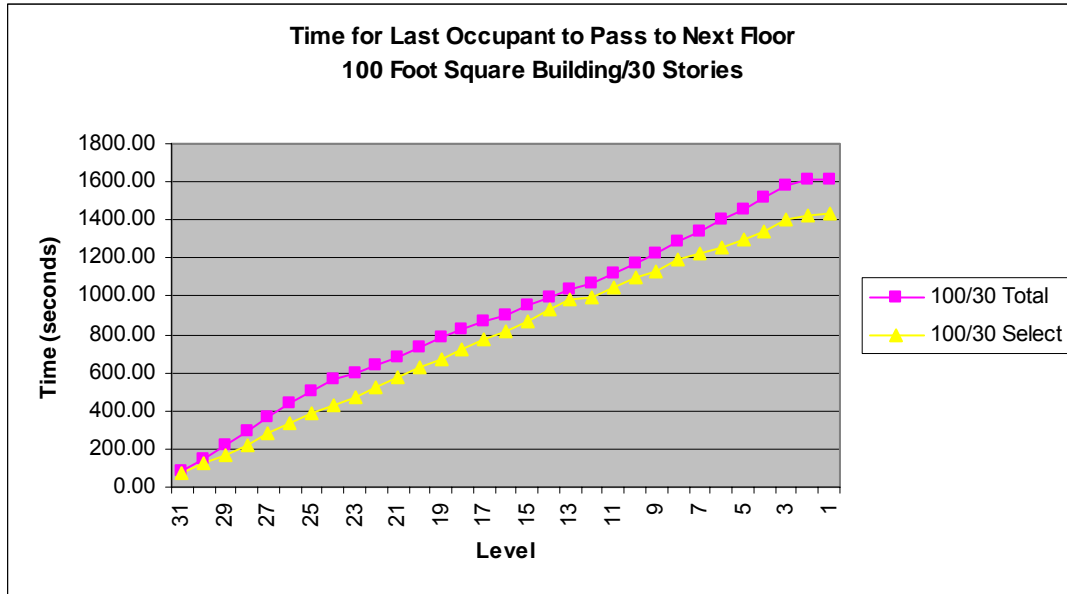


Figure 6-15. Time for last occupant to pass to the next floor for the 100 foot square building, 30 stories.

Finally in Figure 6-15, to clear the twenty-ninth floor (floor at which the hazard exists), the time difference is also approximately 71 seconds, same as the 10-story and 20-story cases. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 6 seconds to a maximum of approximately 181 seconds. The peak difference occurs on the second floor, yet there is a decrease in the differences from the 16<sup>th</sup> floor to the 8<sup>th</sup> floor, with a downward peak at the 13<sup>th</sup> floor.

Overall, at the beginning of the total and select evacuation strategies evacuation time differences are approximately 6 seconds, and at the first floor these differences are approximately 132 seconds, 100 seconds, and 178 seconds for the 10-story, 20-story, and 30-story buildings, respectively.

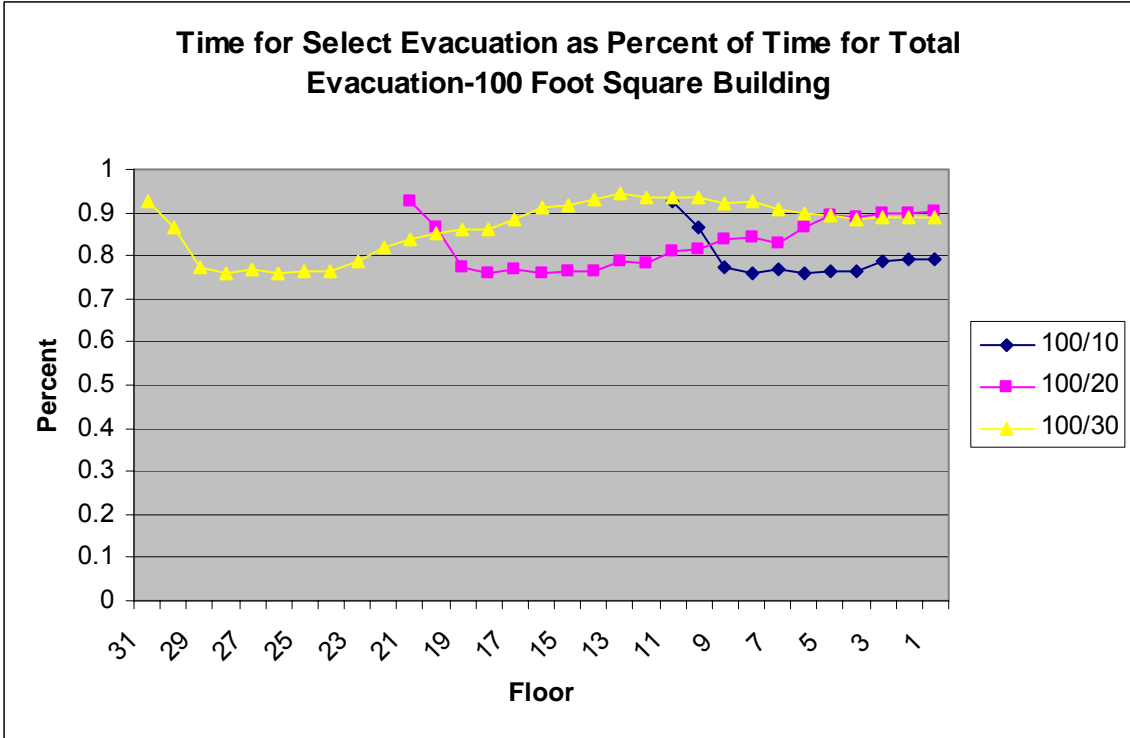


Figure 6-16. Overall time for select evacuation as percent of time for total evacuation for the 100 foot square buildings.

While Figure 6-16 shows an absolute difference, a more detailed examination was undertaken to determine how significant this difference was relative to the total evacuation time. As shown in the above for the 100 foot square building, the time for the select evacuation strategy ranges from 76% to 94% of the total evacuation strategy time. In noting the line patterns, they are relatively similar in pattern (especially for the top five floors, as should be expected).

## 6.5.2 166 FOOT SQUARE BUILDING

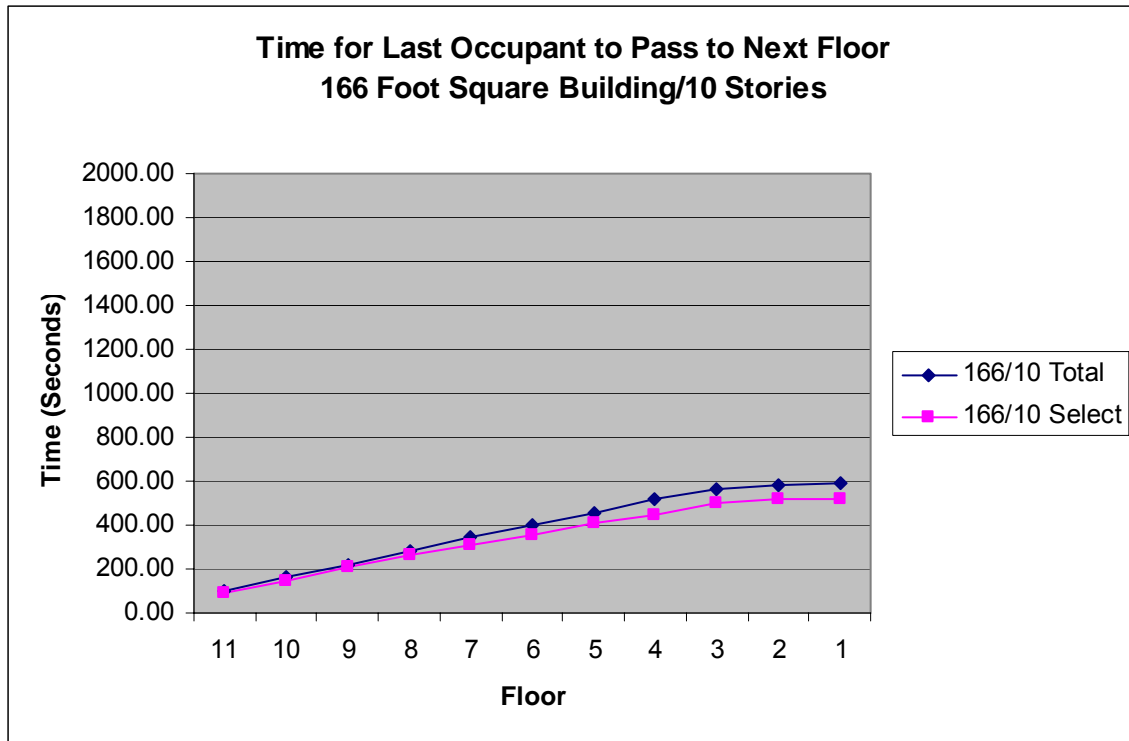


Figure 6-17. Time for last occupant to pass to the next floor for the 166 foot square building, 10 stories.

In Figure 6-17, to clear the ninth floor (floor at which the hazard exists), the time difference is approximately 23 seconds. However for the top five floors (Floor 11 to Floor 7) to pass onto the next floor, Floor 6, the difference ranges only from approximately 6 seconds to 45 seconds. The time results were somewhat similar, as shown in the 100 foot square building. Here, the time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 5 seconds to a maximum of approximately 69 seconds. This peak occurs at the fourth floor.

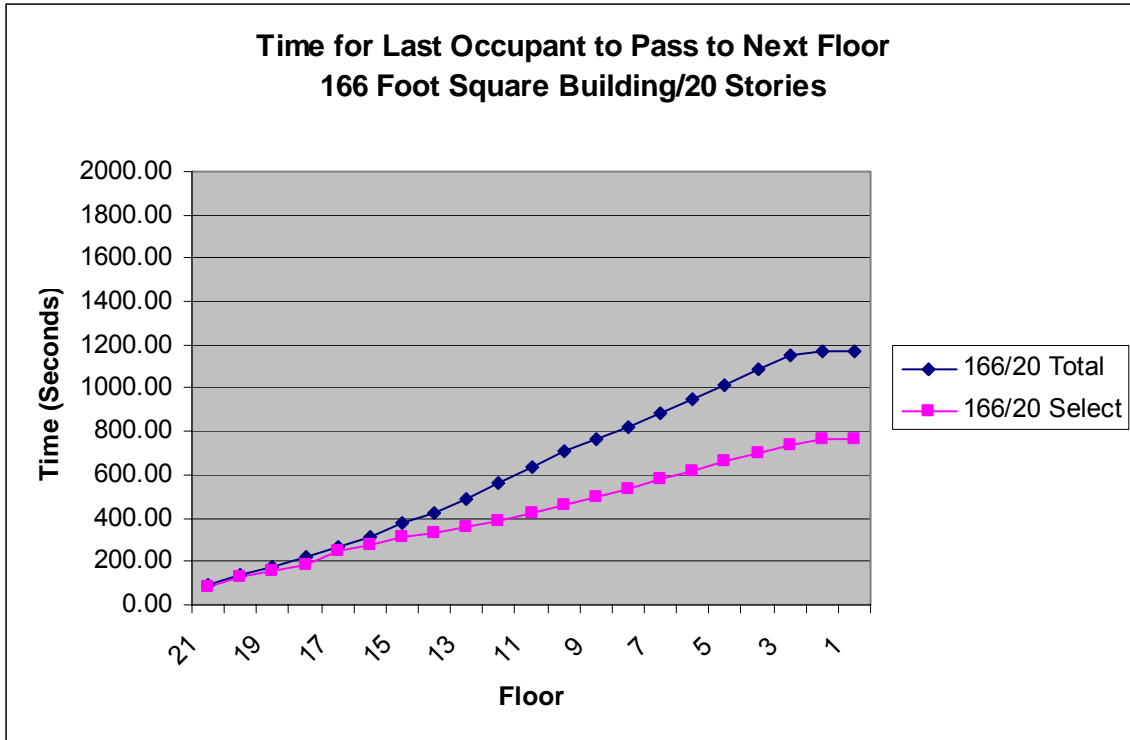


Figure 6-18. Time for last occupant to pass to the next floor for the 166 foot square building, 20 stories.

In Figure 6-18, the time difference for clearing the nineteenth floor (floor at which the hazard exists) is also significantly smaller, at approximately 30 seconds, although greater than to the 10-story case. However for the top five floors (Floor 21 to Floor 17) to pass onto the next floor, Floor 16, the difference is significantly smaller, ranging only from approximately 6 seconds to 39 seconds below the 10-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor grows from approximately 9 seconds to a maximum of approximately 407 seconds. However for the top five floors (Floor 21 to Floor 17) to pass onto the next floor, Floor 16, the difference is significantly smaller, ranging only from approximately 6 seconds to 39 seconds below the 10-story case.



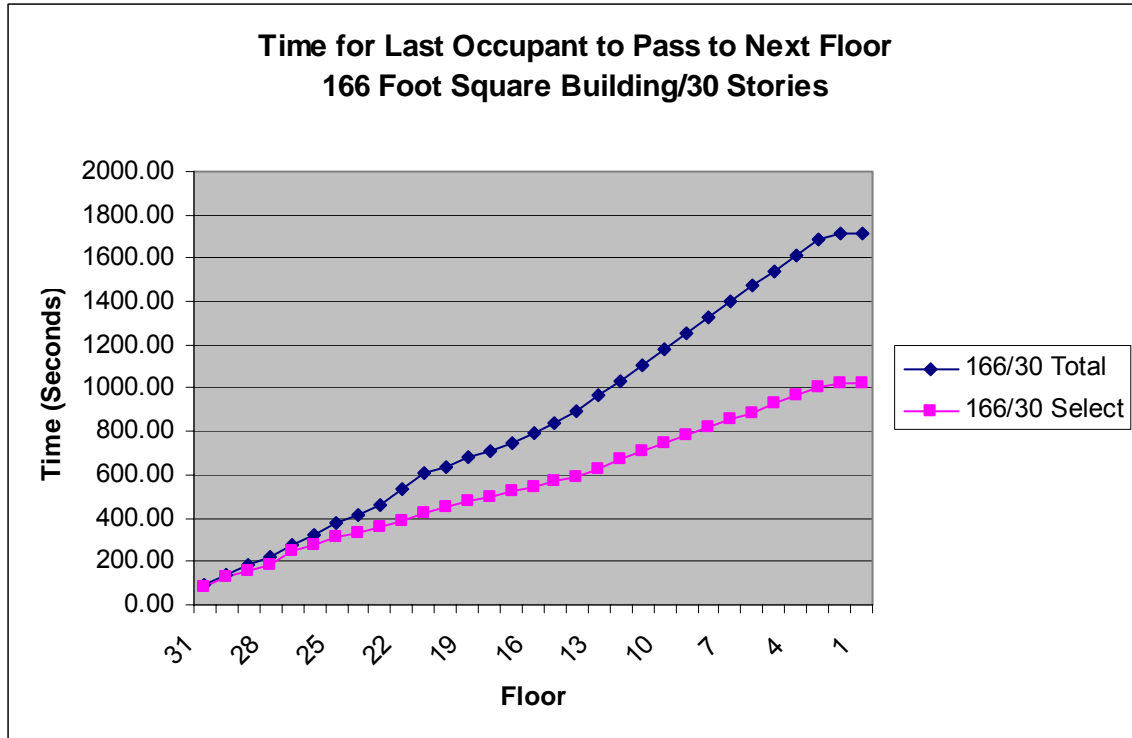


Figure 6-19. Time for last occupant to pass to the next floor for the 166 foot square building, 30 stories.

For Figure 6-19, to clear the twenty-ninth floor (floor at which the hazard exists), the time difference is also approximately 30 seconds, greater than the 10-story case, and similar to the 20-story case. However for the top five floors (Floor 31 to Floor 27) to pass onto the next floor, Floor 26, the difference ranges only from approximately 9 seconds to 40 seconds, less than the 10-story case and greater than the 20-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 9 seconds to a maximum of approximately 698 seconds.

Overall, the absolute differences between total and select evacuation strategies was initially between approximately 5 seconds to 9 seconds, and increased to 66 seconds,

407 seconds and 698 seconds at the first floor of the 10-story, 20-story, and 30-story buildings.

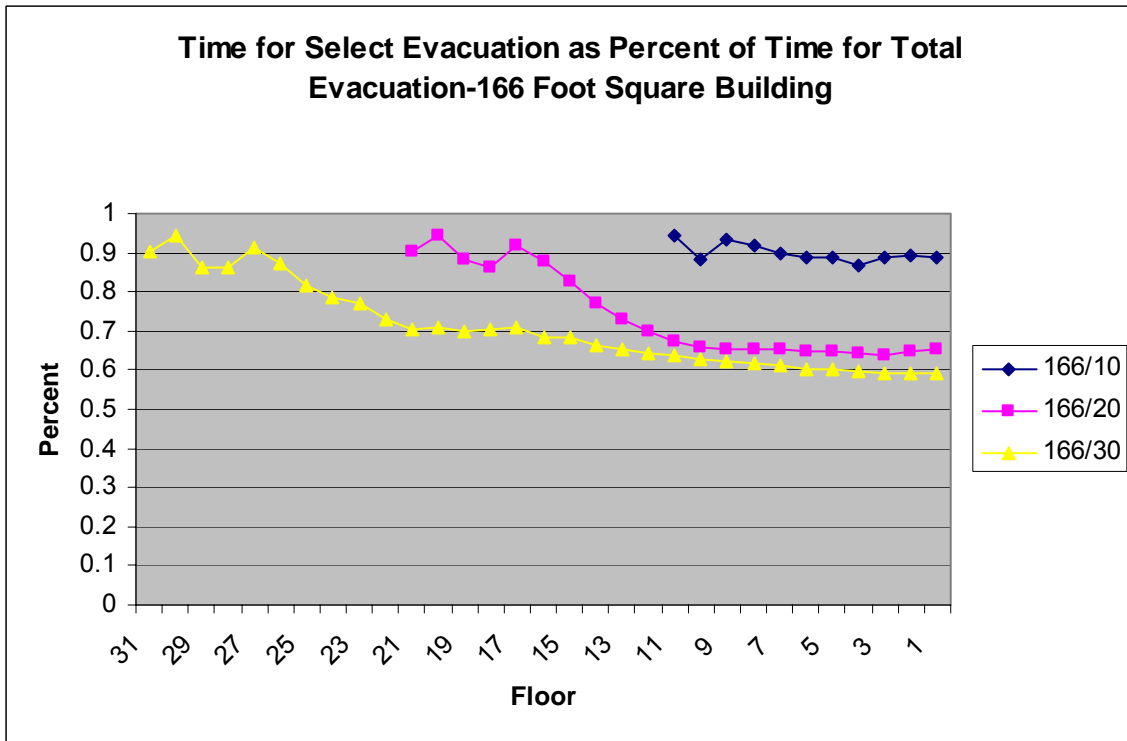


Figure 6-20. Overall time for select evacuation as percent of time for total evacuation for the 166 foot square buildings.

In Figure 6-20, the relative difference between total and select evacuation strategy times (as measured by the ratio of select to total evacuation times) shows that select evacuation strategy ranges from 59% to 94% of the time for the total evacuation strategy time. However, for the top five floors (affected region), this difference is much less significant, with select being at least 85% of total. In noting the line patterns, they are relatively similar in pattern especially for the top five floors.

### 6.5.3 225 FOOT SQUARE BUILDING

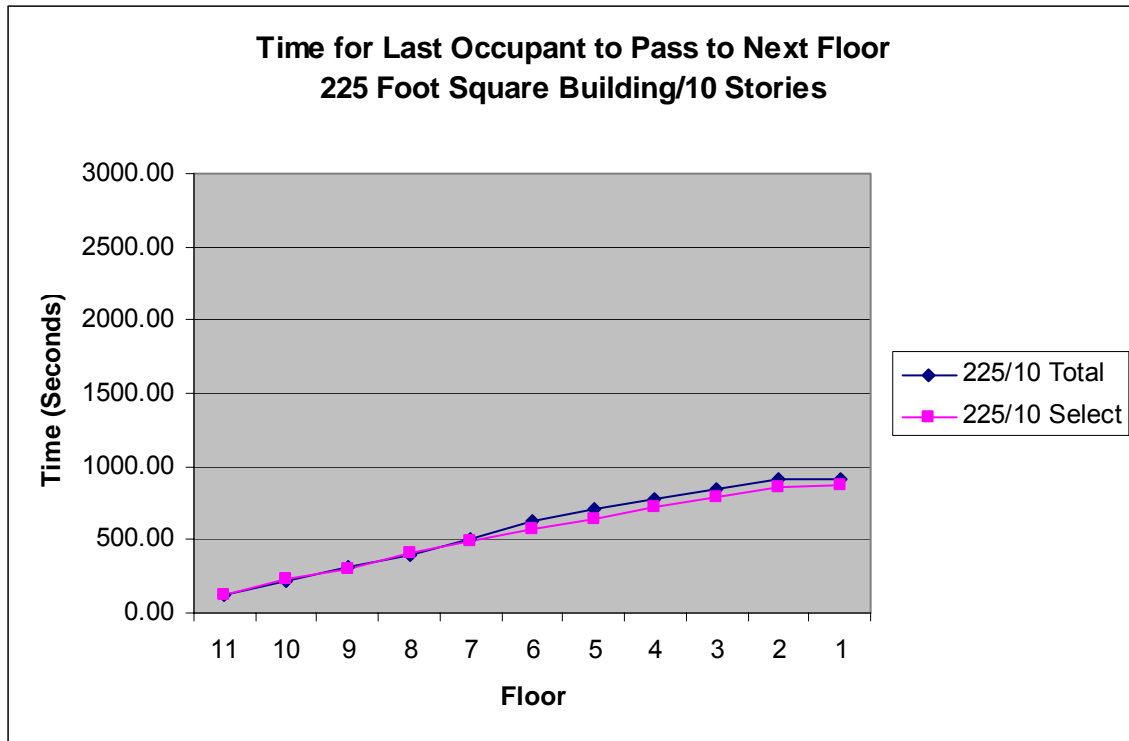


Figure 6-21. Time for last occupant to pass to the next floor for the 225 foot square building, 10 stories.

To clear the ninth floor (floor at which the hazard exists), the time difference is approximately 11 seconds as seen in Figure 6-21. However for the top five floors (Floor 11 to Floor 7) to pass onto the next floor, Floor 6, the difference goes from 0 seconds to 57 seconds. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building goes from 0 seconds to a maximum of approximately 57 seconds. This peak occurs at the sixth floor.

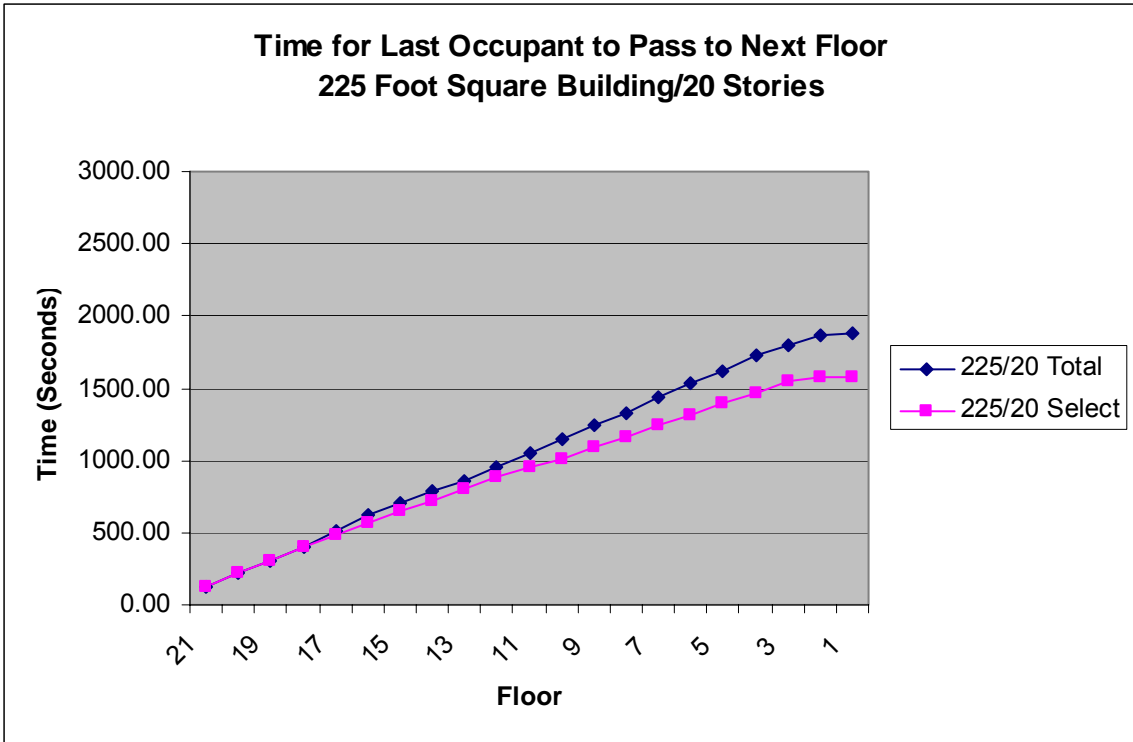


Figure 6-22. Time for last occupant to pass to the next floor for the 225 foot square building, 20 stories.

In Figure 6-22, to clear the nineteenth floor (floor at which the hazard exists), the time difference is also approximately 11 seconds, which is the same as the 10-story case. However for the top five floors (Floor 21 to Floor 17) to pass onto the next floor, Floor 16, the difference goes from 0 seconds to 50 seconds below the 10-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from 0 seconds to a maximum of approximately 303 seconds.

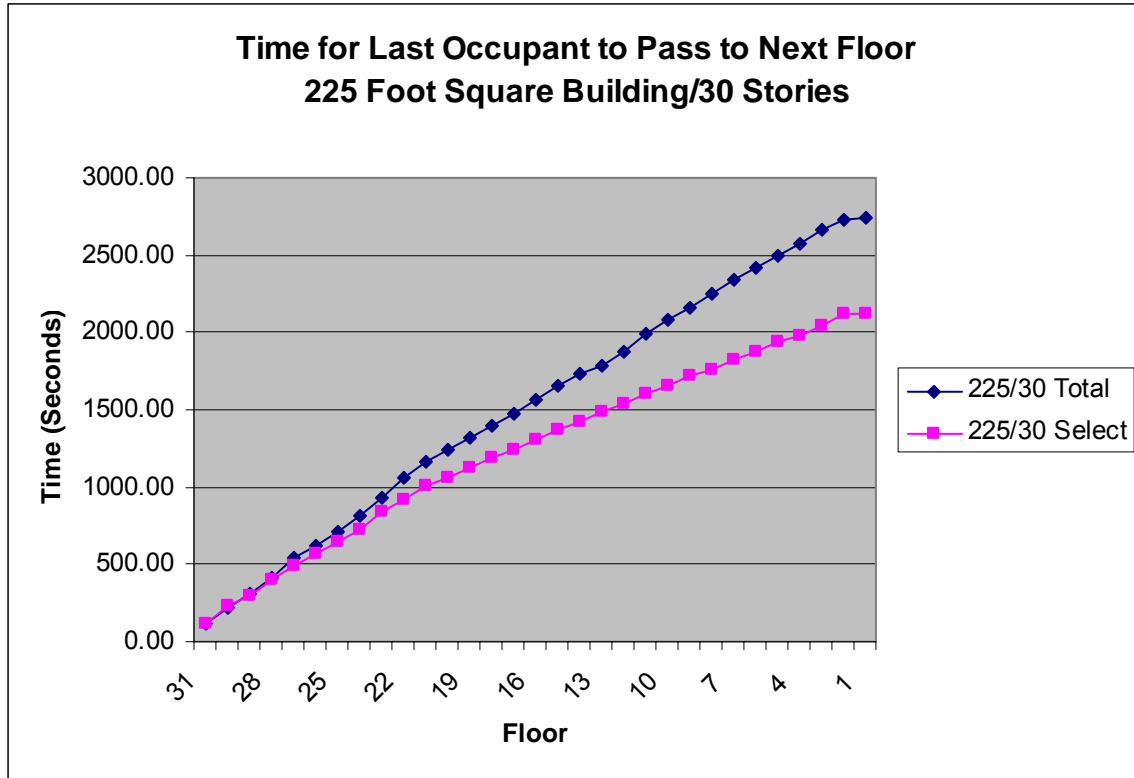


Figure 6-23. Time for last occupant to pass to the next floor for the 225 foot square building, 30 stories.

In Figure 6-23, the time difference to clear the twenty-ninth floor (floor at which the hazard exists) is also approximately 13 seconds, greater than the 10-story case and the 20-story case. However for the top five floors (Floor 31 to Floor 27) to pass onto the next floor, Floor 26, the difference goes from 0 seconds to 50 seconds less than the 10-story case and similar to the 20-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from 0 seconds to a maximum of approximately 621 seconds.

Overall, the differences begin at zero, and by the first floor the times increased to approximately 49 seconds, 304 seconds, and 622 seconds for the 10-story, 20-story, and 30-story buildings.

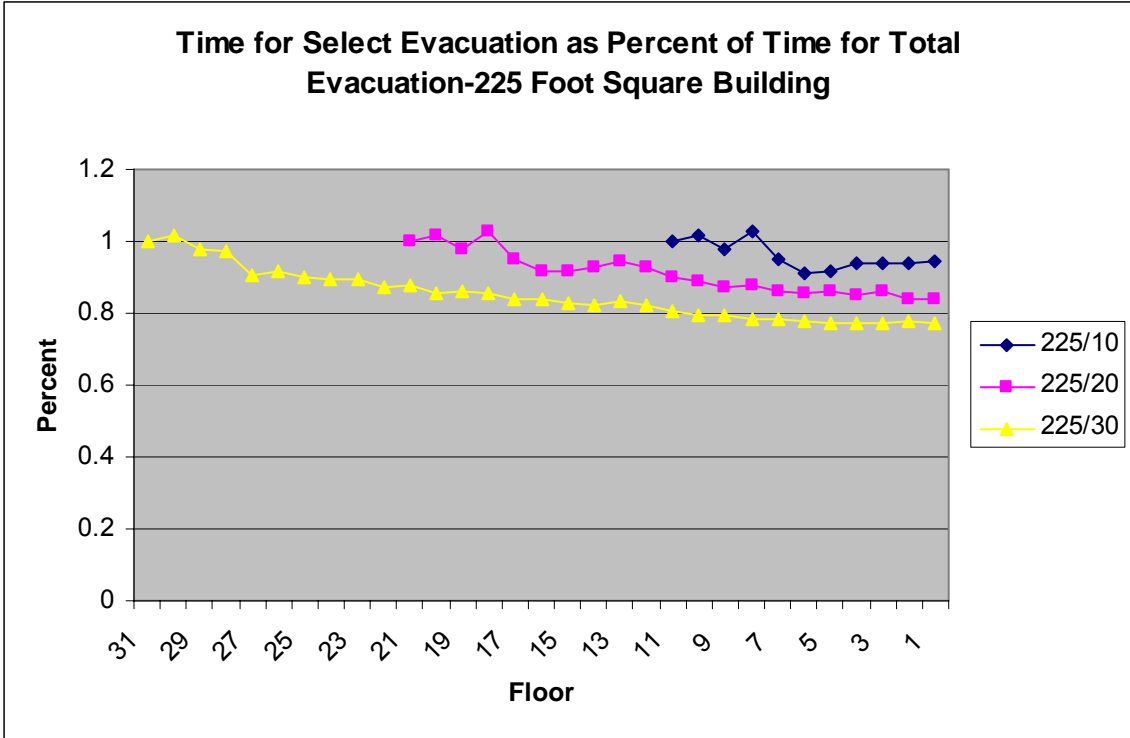


Figure 6-24. Overall time for select evacuation as percent of time for total evacuation for the 225 foot square buildings.

The time for select evacuation strategy ranges from 77% to 102% of the time for the total evacuation strategy. In noting the line patterns, they are relatively similar in pattern especially for the top five floors. The results are closer together than the 166 foot square buildings.

#### 6.5.4 375 FOOT SQUARE BUILDING

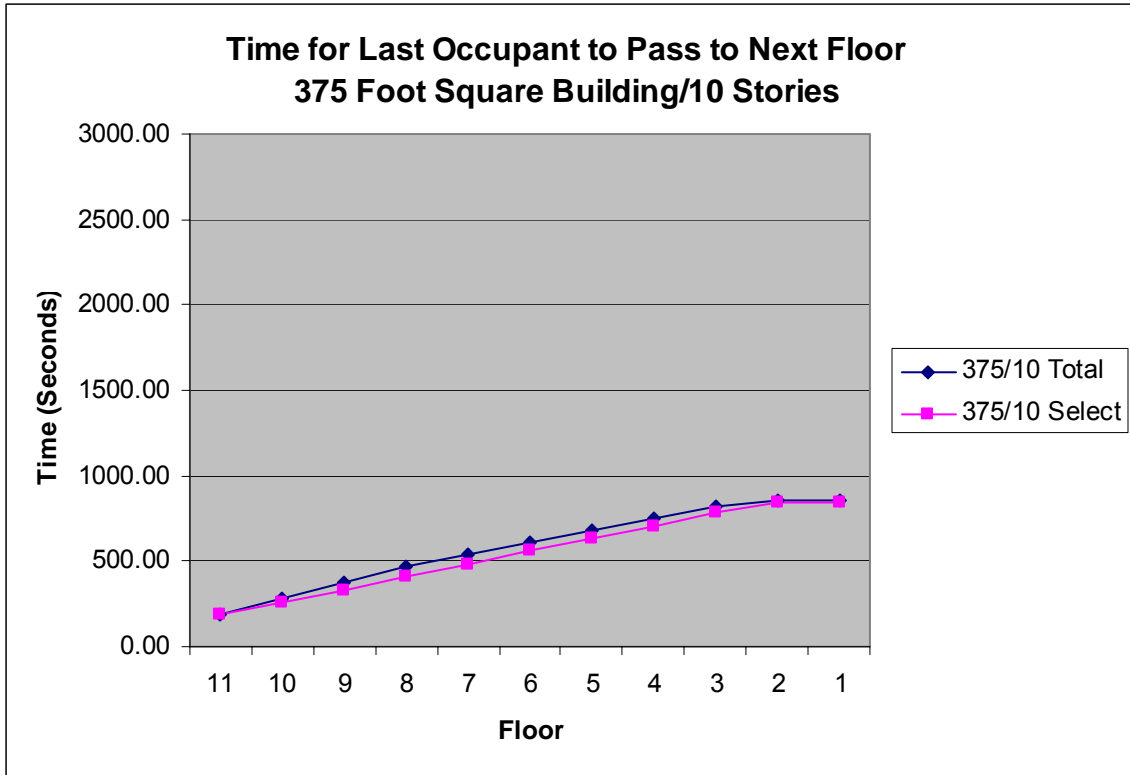


Figure 6-25. Time for last occupant to pass to the next floor for the 375 foot square building, 10 stories.

To clear the ninth floor (floor at which the hazard exists), the time difference is approximately 63 seconds as seen in Figure 6-25. However for the top five floors (Floor 11 to Floor 7) to pass onto the next floor, Floor 6, the difference goes from approximately 8 seconds to 58 seconds. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building goes from approximately 8 seconds to a maximum of approximately 63 seconds. This peak occurs at the eighth floor

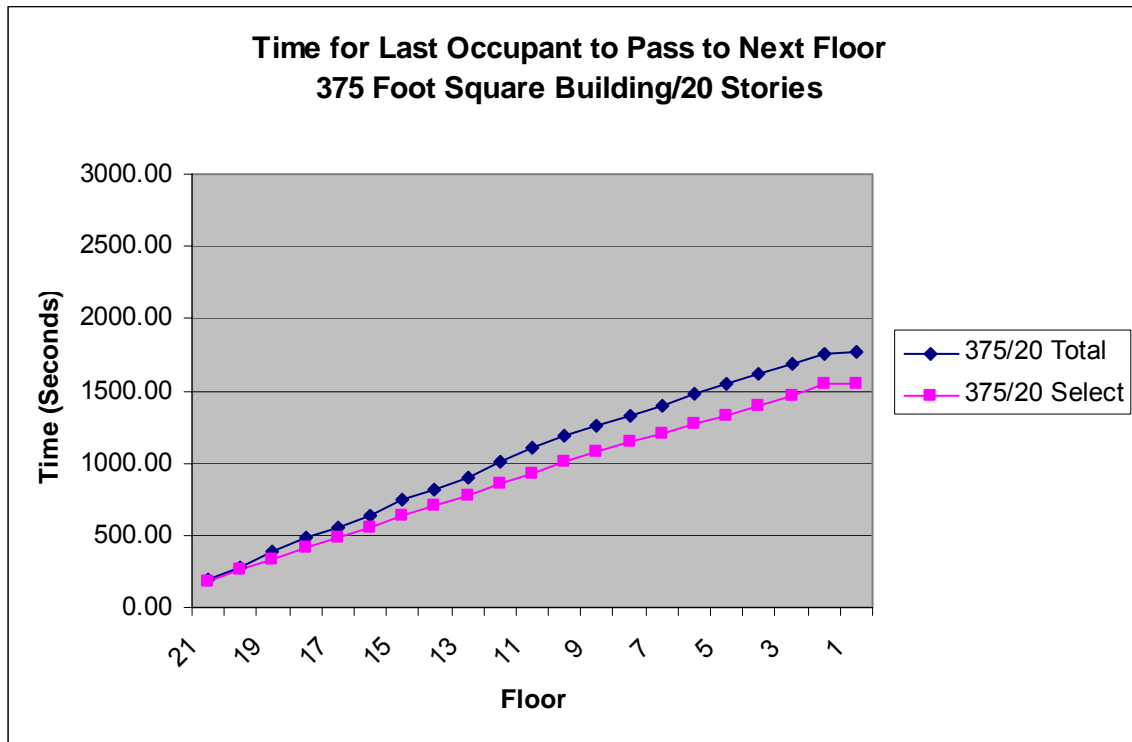


Figure 6-26. Time for last occupant to pass to the next floor for the 375 foot square building, 20 stories.

Figure 6-26 shows that to clear the nineteenth floor (floor at which the hazard exists), the time difference is also approximately 76 seconds, greater than the 10-story case. However for the top five floors (Floor 21 to Floor 17) to pass onto the next floor, Floor 16, the difference goes from approximately 8 seconds to 83 seconds greater than the 10-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 8 seconds to a maximum of approximately 221 seconds.



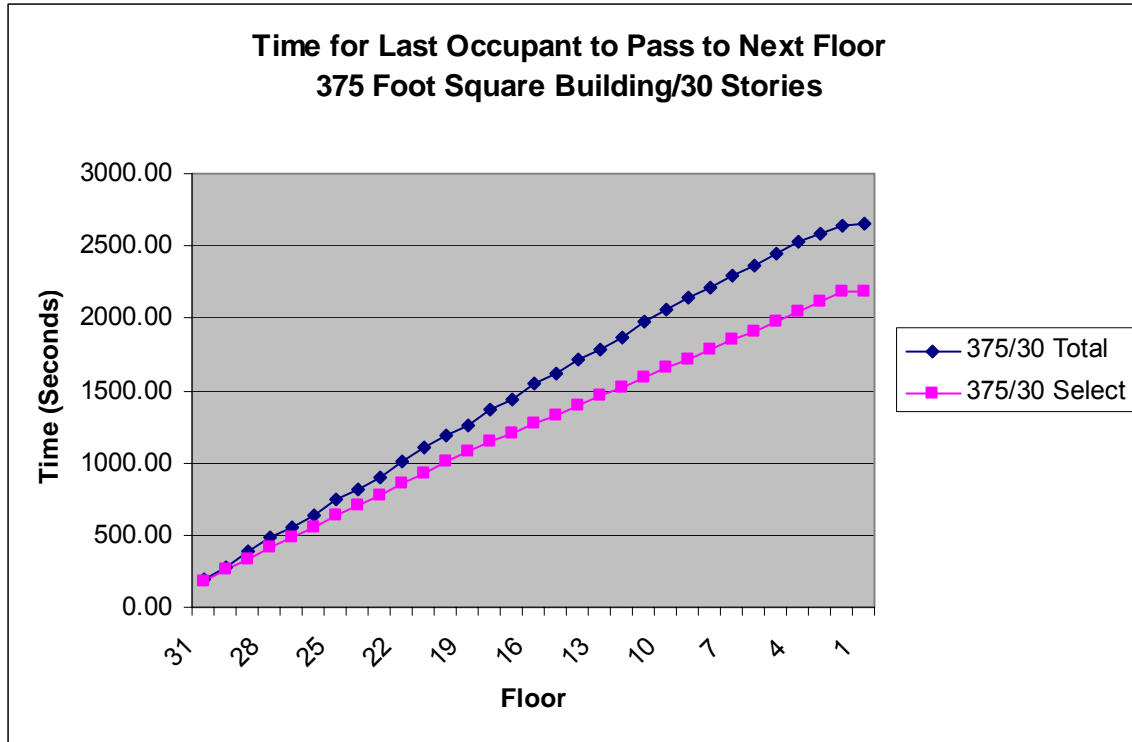


Figure 6-27. Time for last occupant to pass to the next floor for the 375 foot square building, 30 stories.

In Figure 6-27, the time difference to clear the twenty-ninth floor (floor at which the hazard exists) is also approximately 76 seconds, greater than the 10-story case and similar to the 20-story case. However for the top five floors (Floor 31 to Floor 27) to pass onto the next floor, Floor 26, the difference goes from approximately 8 seconds to 83 seconds greater than the 10-story case and similar to the 20-story case. The time difference between the total and select evacuation strategies for the last occupant to pass to the next floor of this building grows from approximately 8 seconds to a maximum of approximately 478 seconds

Overall, the time differences begin as approximately 8 seconds, and by the first floor the times increased to approximately 14 seconds, 221 seconds, and 464 seconds for the 10-story, 20-story, and 30-story buildings. These results are less than the results in

the 225 building by approximately 35 seconds, 83 seconds, and 158 seconds, respectively.

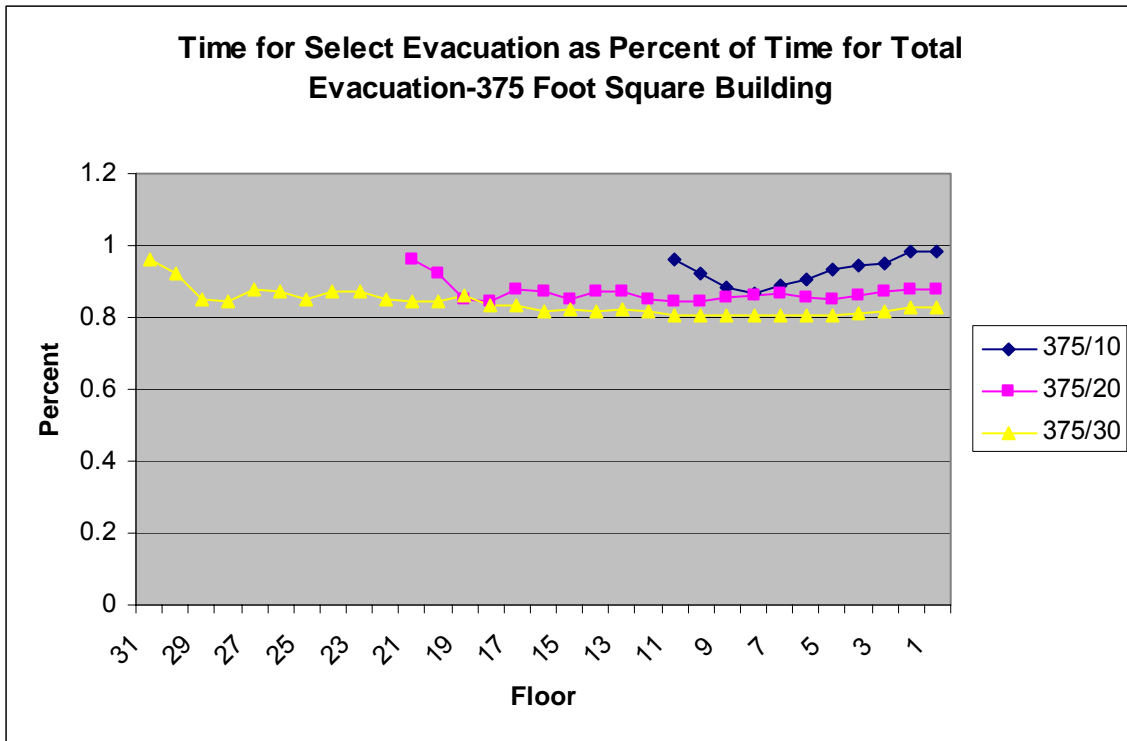


Figure 6-28. Overall time for select evacuation as percent of time for total evacuation for the 375 foot square buildings.

The time for select evacuation strategy ranges from 80% to 98% of the time for the total evacuation strategy. In noting the line patterns, they are relatively similar in pattern especially for the top five floors. The results are closer together than the 166 foot square buildings and the 225 foot square building.

## 6.6 CONCLUSION

In examining the model runs with the four hypothetical buildings, the total evacuation time for the total evacuation strategy shows a longer time to get the occupants out of the building than total evacuation time for the select evacuation strategy. In the

overall evacuation case, this penalty ranged from 14 to 698 seconds as a function of both building size and height, as shown in Figure 6-29. The absolute and relative differences between the two evacuation strategies were not as large as expected. In addition, when evaluated on a relative basis (ratio of select to total, which attempts to address scaling issues associated with longer evacuations), this difference is less significant, as shown in Figure 6-30.

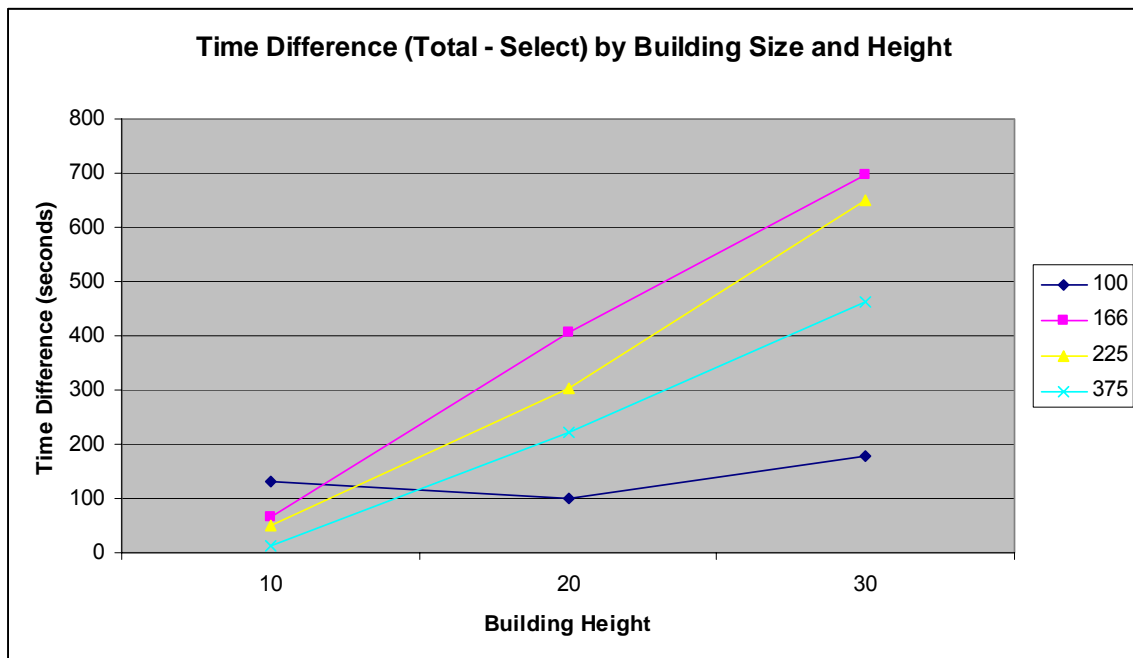


Figure 6-29. Time difference (total – select) by building size and height for all hypothetical buildings.

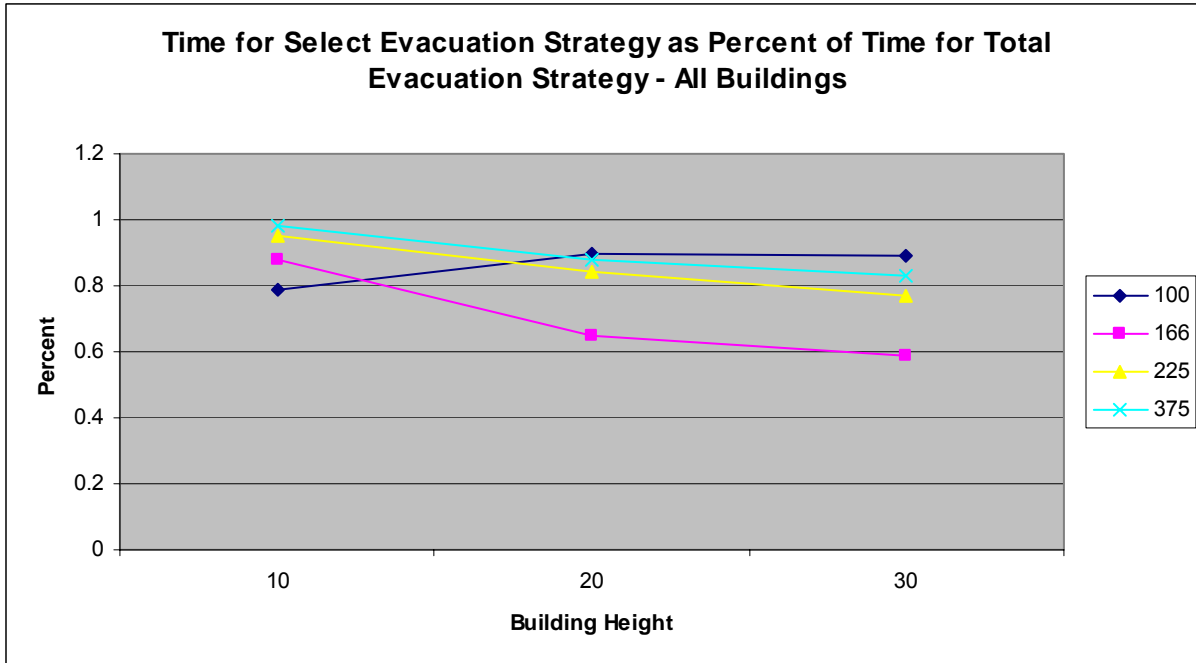


Figure 6-30. Time for select evacuation strategy as percent of time for total evacuation strategy for total evacuation – all buildings.

Regarding the times for the last occupant to pass the next floor (time for occupants to move between floors), the time differences started out relatively close, and then increased towards the end of the evacuation times as the number of stories increased. In reviewing the time to clear the top five floors (time to evacuate the more hazardous affected region), the time differences between the evacuation strategies were very close for all the buildings. This is summarized in Figures 6-31 and 6-32.

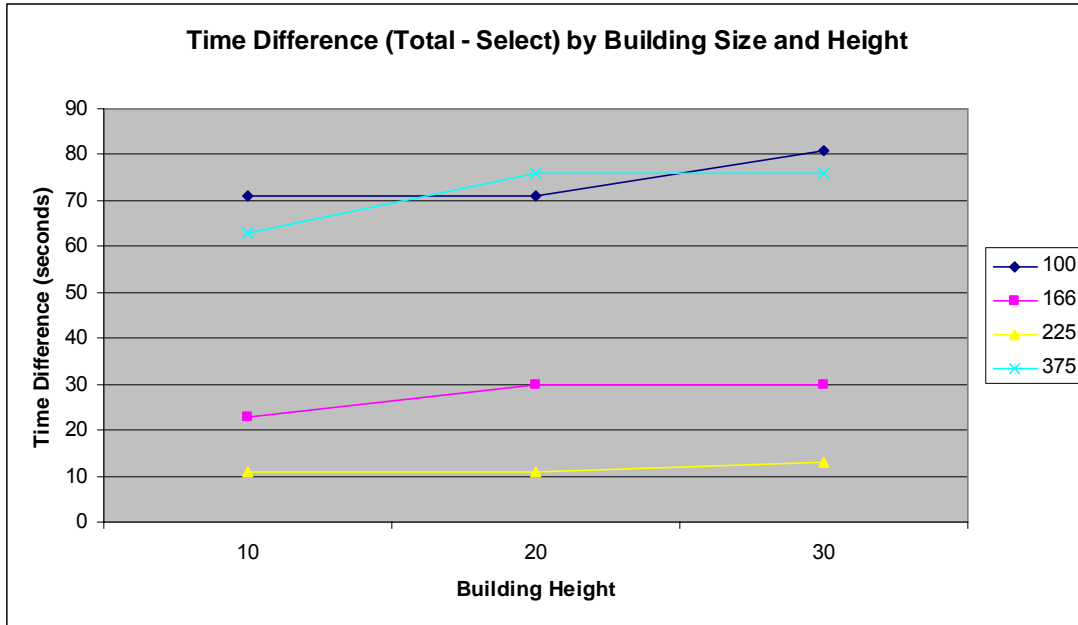


Figure 6-31. Time difference (total – select) to clear the affected floors (top five floors) by building size and height for all hypothetical buildings.

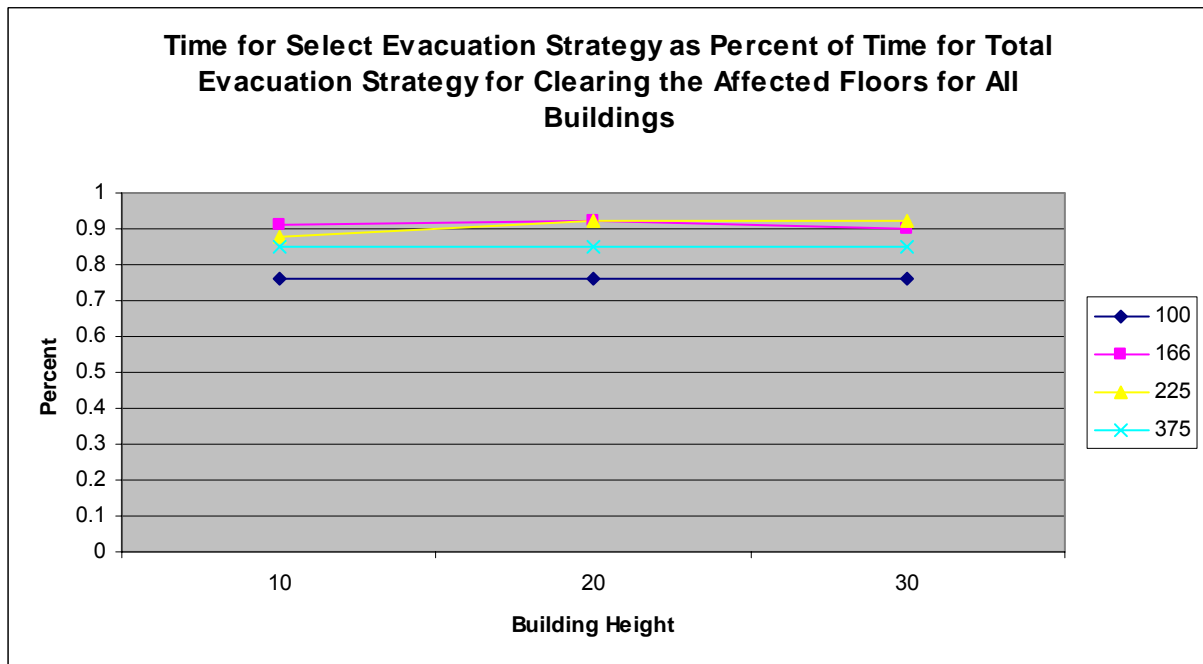


Figure 6-32. Time for select evacuation strategy as percent of time for total evacuation strategy for clearing the affected floors (top five floors) for all buildings.

## **CHAPTER 7**

### **CONCLUSION**

#### **7.1 CONCLUSION**

As stated previously, the focus of this research is to inform decision-makers regarding tradeoffs between total and select evacuation strategies. Specifically, this research sought to identify the performance differences between the two strategies in terms of the overall time to evacuate and the time to evacuate the affected area in this research, the top five floors).

Overall, this research has identified that there are differences in the performance of the total and select evacuation strategies, with a greater penalty in the overall evacuation case (time to get evacuees out of the building) than in the local case (time to get evacuees out of the affected area). The degree to which either difference is significant is not able to be determined here, given the lack of a stochastic element to the EXIT89 modeling, and given the interpretive aspects of the difference noted- i.e., whatever difference is noted must be considered in conjunction with other tradeoffs as associated with the strategies. These other tradeoffs include potential safety and liability issues with the select evacuation (e.g., evacuating only a few floors in the select strategy assumes that the danger will not spread beyond those boundaries- an assumption that might not bear out and could those expose occupants to danger and decision makers to liability), as well potentially avoids evacuating floors not in danger (and therefore potentially lowering the likelihood that personnel unnecessarily evacuated will evacuate in the event of subsequent emergencies).

While this research addressed some major questions pertinent to the total and select evacuation strategies, it also raised some questions as well. One such question that is recommended for further research is to determine the height at which the total and select evacuations differ significantly (this requires that "significant" be defined as noted above). This research focused on the scenario of having the affected floors located at the top of the building. Given that the time to clear the affected region would be the same for a fire at the base of the building in both total and select strategies, there is at least hypothetically a fire location at which the difference grows to a significant level. Another pertinent question pertains to the effect of fatigue (as was noted in the evacuation following first attack versus the World Trade Center), which may cause the times to vary in a very significant manner.

In conclusion, this research attempted to provide insight for decision-makers regarding the selection of the total versus select strategies. It is hoped that the results provide insights of value to building and emergency managers.

## **7.2 TOPICS FOR FUTURE RESEARCH**

Some topics for future research based on this thesis are as follows.

- Explore the same hypothetical buildings introducing human behavior aspects, especially fatigue, to see how this would affect the evacuation times.
- Increase the number of stairwells in the hypothetical buildings until an equilibrium in time is achieved between the total evacuation strategy and the select evacuation strategy.
- Establish protocols on how to direct occupants during a wide range of

emergency scenarios with the focus on simultaneous conditions such as fire and terrorism attacks.

- Obtain more real data on both emergency evacuations and fire drills for high-rise office buildings.
- Determine the floor level in which one evacuation strategy would be used over the other.
- Introduce smoke effects into the hypothetical buildings to how this would affect the evacuation times.



## Appendix 1

### Extracted Listings of the Fatal Fires in High-Rise Office Buildings from 1911-2001

| Date              | Building                                       | Reported Dollar Loss | Location               | Number of Deaths | Floor of Origin | Height in Stories |
|-------------------|--|----------------------|------------------------|------------------|-----------------|-------------------|
| March 25, 1911    | ASCH Building (Traingle Shirtwaist Co.)        | Unknown              | New York, NY           | 146              | 8               | 10                |
| January 19, 1912  | Equitable Building                             | 2,500,000            | New York, NY           | 6                | Basement        | 10                |
| October 8, 1925   | LeClede Gas Light Co.                          | 71,000               | St. Louis, MO          | 4                | Basement        | 11                |
| October 4, 1936   | Liberty Building                               | 280,000              | Waco, TX               | 1                | Basement        | 9                 |
| July 28, 1945     | Empire State Building                          | 500,000              | New York, NY           | 11               | 79              | 102               |
| November 22, 1961 | The Times Tower                                | 100,000              | New York, NY           | 3                | Sub-basement    | 25                |
| June 28, 1963     | Astoria Building                               | 78,000               | Rio de Janeiro, Brazil | 7                | 14              | 22                |
| November 27, 1964 | Tishman Office Building                        | Unknown              | New York, NY           | 1                | Basement        | 39                |
| December 9, 1964  | Edificio Office Building                       | 500,000              | Mexico City, Mexico    | 1                | 8               | 12                |
| February 22, 1966 | Richmond York Office Building                  | 210,000              | Toronto, Canada        | 1                | 6               | 13                |
| March 11, 1966    | Four Corners Office Building                   | Unknown              | Rochester, NY          | 1                | 4               | 10                |
| December 7, 1967  | Time-Life Office Building                      | 1,300,000            | Paris, France          | 2                | 8               | 8                 |
| February 7, 1968  | Borax Building                                 | 100,000              | Los Angeles, CA        | 1                | 2               | 9                 |
| December 5, 1968  | Atlanta Gaslight Towers (Office Building)      | 200,000              | Atlanta, GA            | 4                | 20              | 24                |
| August 5, 1970    | One New York Plaza                             | 10,000,000           | New York, NY           | 2                | 33              | 50                |
| December 4, 1970  | 919 Third Avenue Office Building               | 2,500,000            | New York, NY           | 3                | 5               | 47                |
| April 8, 1971     | John Hancock Building                          | Unknown              | Chicago, IL            | 1                | 61              | 100               |
| January 12, 1972  | Canadian Liquid Air Building (Office Building) | 371,000              | Montreal, PQ           | 5                | 2               | 10                |
| February 24, 1972 | Andraus Building                               | 2,000,000            | Sao Paulo, Brazil      | 16               | 5               | 31                |
| April 11, 1973    | Sears Tower                                    | 1,000                | Chicago, IL            | 4                | 33              | 110               |

### Extracted Listings of the Fatal Fires in High-Rise Office Buildings from 1911-2001 (Continued)

| Extracts of High-Rise Office Buildings from # |  |                      |                        |                  |                 |                   |
|---|--|----------------------|------------------------|------------------|-----------------|-------------------|
| Date  | Building   | Reported Dollar Loss | Location               | Number of Deaths | Floor of Origin | Height in Stories |
| July 23, 1973                                 | Avianca Tower                                    | Unknown              | Bogota, Columbia       | 4                | 13              | 36                |
| February 1, 1974                              | Joelma Building (Cresfisul Bank Building)        | 3,000,000            | Sao Paulo, Brazil      | 179              | 12              | 25                |
| February 28, 1975                             | Idle Building                                    | Unknown              | Philadelphia, PA       | 1                | 4               | 8                 |
| March 10, 1975                                | Office Building                                  | Unknown              | Brooklyn, NY           | 1                | 13              | Not reported      |
| May 10, 1977                                  | U.S. Fidelity & Guaranty Office Building         | Unknown              | Baltimore, MD          | 1                | 11              | 40                |
| September 22, 1981                            | Willoughby Office Building                       | Unknown              | Chicago, IL            | 2                | 25              | 38                |
| July 24, 1982                                 | Schmid Towers                                    | 3,000                | Erie, PA               | 1                | 5               | 7                 |
| June 6, 1983                                  | Office Building                                  | Unknown              | New Delhi, India       | 1                | Unknown         | 14                |
| August 12, 1984                               | Gilbralter Office Building                       | Unknown              | Newark, NJ             | 1                | 7               | 14                |
| September 5, 1984                             | Office Building Under Construction               | Unknown              | San Diego, CA          | 2                | Sub-level       | 24                |
| September 23, 1985                            | Bank Building                                    | 150,000              | Chattanooga, TN        | 1                | 18              | 18                |
| February 17, 1986                             | Office Building                                  | Unknown              | Rio de Janeiro, Brazil | 23               | Unknown         | 13                |
| August 21, 1986                               | Office Building                                  | 100,000              | Cincinnati, OH         | 1                | 8               | 15                |
| November 1, 1986                              | Talbot Towers                                    | Unknown              | Braddock, PA           | 4                | 6               | 7                 |
| May 13, 1987                                  | Office Building                                  | Unknown              | Chicago, IL            | 1                | 20              | 30                |
| May 4, 1988                                   | First Interstate Bank Building (Office Building) | 50,000,000           | Los Angeles, CA        | 1                | 12              | 62                |
| June 30, 1989                                 | Office Building                                  | 2,500,000            | Atlanta, GA            | 5                | 6               | 10                |
| February 23, 1991                             | Office Building                                  | Unknown              | Philadelphia, PA       | 3                | 22              | 38                |
| March 26, 1991                                | Office Building                                  | 12,000,000           | Oakland, CA            | 1                | 2               | 18                |
| February 26, 1993                             | Office Building Complex                          | 230,000,000          | Brooklyn, NY           | 6                | Sub-basement    | 110               |
| April 19, 1995                                | Office Building                                  | 135,929,000          | Oklahoma City, OK      | 168              | Outside         | 9                 |

These listings in Appendix 1 were extracted from "International Listing of Fatal High-Rise Structure Fires 1911-Present" (Hall, 2001, Appendix A).

## Appendix 2

### Re-structured International Egress Standards List from Hagiwara and Takeyoshi (1994)

|  | Australia   | France   | Japan   | U.K.   | U.S.  |
|--|---|--|---|--|---|
| <b>Minimum Number of Means of Escape</b> |   |  |   |  |   |
| General                                  | 2 exits for story<br>a) >6 stories<br><br>b) >25 m height | for story or part of story<br>[<=]50 persons - 1 exit<br><br>[<=]100 persons - 2 exits<br><br>or 1+ sub-exits<br>[<=]500 persons - 2 exits<br>[>=]501 persons - +1<br>per 500 persons over 500 | 2 exits for story<br>a) >5th floor<br>b) on 3-5th floor room area > 200 sq. m<br>c) on 2nd floor room area > 400 sq. m  | for story or part of story<br>[<=] 50 persons - 1 exit<br><br>[<=]500 persons - 2 exits<br><br>[<=]1000 persons - 3 exits<br>[<=]2000 persons - 4 exits<br>[<=]4000 persons - 5 exits<br>[<=]7000 persons - 6 exits<br>[<=]11000 persons - 7 exits<br>[<=]16000 persons - 8 exits<br>[>]16000 persons - +1 exits<br>per 5000 persons over 16000  | for story or part of story<br>[<=] 50 persons - 1 exit<br><br>[<=]500 persons - 2 exits<br><br>[<=]1000 persons - 3 exits<br>[>=]1001 persons - 4 exits |
| <b>Arrangement of Means of Escape</b>    |   |  |   |  |   |
| Maximum Travel Distance                  | General - 40 m<br><br><br>Assembly (good) - 60 m          | General - 40 m   | General<br><br><br>[<=] 14th floor - 50 m<br>[>=] 15th floor - 40 m<br>good material (means interior surfaces are noncombustible or quasi-noncombustible) - +10 m | Assembly - 15 m/32 m (the travel distance must not be more than 32 meters where the travel is possible in more than one direction, and must not be more than 15 meters where travel is possible in one direction only.)<br>Office - 18 m/45 m (the travel distance must not be more than 45 meters where he travel is possible in more than one direction, and must not be more than 18 meters where travel is possible in one direction only) | Assembly - 45 m (60 m in a sprinkler protected building)<br><br>Office - 60 m (91 m in a sprinkler protected building)                                  |
| Common Path of Travel                    | General - 20 m  | General - 30 m   | 1/2 maximum travel distance   | Assembly - 15 m/32 m (the travel distance must not be more than 32 meters where the travel is possible in more than one direction, and must not be more than 15 meters where travel is possible in one direction only.)<br>Office - 18 m/45 m (the travel distance must not be more than 45 meters where he travel is possible in more than one direction, and must not be more than 18 meters where travel is possible in one direction only) | Assembly - 6.1<br><br>Office - 23 m (30 m in a sprinkler protected building)  |
| Dead-end Corridor                        | General - 20 m  | from room door - 10 m  | 10 m  | Assembly - 15 m/32 m (the travel distance must not be more than 32 meters where the travel is possible in more than one direction, and must not be more than 15 meters where travel is possible in one direction only.)<br>Office - 18 m/45 m (the travel distance must not be more than 45 meters where he travel is possible in more than one direction, and must not be more than 18 meters where travel is possible in one direction only) | Assembly - 6.1<br><br>Office - 6.1 m (15 m in a sprinkler protected building)   |
| Distance between Exits                   | General - 9 to 60 m                                       | not reported for this application  | not reported  | not reported   | a) >=1/2 D<br>b) sprinkler & >+1/3 D<br>D:diagonal space distance   |

## Re-structured International Egress Standards List from Hagiwara and Takeyoshi (1994) (Continued)

|  | Australia  |   | France   |  | Japan  |                | U.K.  |   | U.S.   |   |
|--|--|---|--|--|--|----------------|---|---|--|---|
| <b>Capacity of Means of Escape</b>   |  |   |  |  |  |                |   |   |  |   |
| Stairs   | Pn: [ $\leq$ ] 100 persons<br>[ $\leq$ ] 200 persons<br>[ $\geq$ ] 201 persons | 1m<br>$1+0.25x\{((Pn-101)/25)+1\}$ meter<br>$2+0.5x\{((Pn-201)/60)+1\}$ meter | $\sum Pn$ : [ $\leq$ ] 50 persons<br>[ $\leq$ ] 100 persons<br>[ $\geq$ ] 101 persons  | 0.9 m<br>0.9 m x 2 or 1.4 m<br>$1.2+0.6x\{(\sum Pn-1)/100\}$ meter | Minimum<br>General<br>Assembly   | 1.2 m<br>1.4 m | a) Total Evacuation<br>$\sum Pn=200w+50(w-0.3)(n-1)$<br>n: no. of stories served<br>w: stairs width (m)<br>b) Phased Evacuation<br>Pn: [ $\geq$ ] 100 persons<br>[ $\geq$ ] 120 persons<br>[ $\geq$ ] 120 persons | 1 m<br>1.1 m<br>$1.1+0.1x\{(Pmax-111)/10\}$ meters<br>Stair with largest width is discounted. | General<br>Minimum<br>[ $\geq$ ] 49 persons<br>[ $\geq$ ] 50 persons | 0.008xPn meters<br>0.91 meters<br>1.21 meters     |
| Corridor, Door   | same as stairs, except<br>[ $\geq$ ] 201 persons                               | $2+0.5x\{((Pn-201)/75)+1\}$ meters  | same as stairs   |  | Assembly (doors) same as stairs  |                | Pn (served)<br>[ $\geq$ ] 50 persons<br>[ $\geq$ ] 110 persons<br>[ $\geq$ ] 220 persons<br>[ $\geq$ ] 220 persons  | 0.8 m<br>0.9 m<br>1.1 m<br>$1.1+0.1x\{(Pn-201)/20\}$ meters                                   | General<br>Minimum   | 0.005xPn meters<br>0.81 m                         |
| Pn: number of persons on n-th floor, $\sum Pn$ : total number of persons, [x]: the largest integer no more than x. (Gauss' notation) |  |   |  |  |  |                |   |   |  |   |
| <b>Occupant Load Factors</b>   |  |   |  |  |  |                |   |   |  |   |
| Assembly   | board room-0.050 person/sq. m  |   | not reported for this application  |  | meeting room[ $\leq$ ]400 sq.m-1.5 person/sq. m<br>meeting room[ $>$ ]400 sq.m-0.6 person/sq. m          |                | conference room-1.0 person/sq. m  |   |  | less concentrated without fixed-0.72 person/sq. m |
| Office   | 0.10 person/sq. m  |   | public access area-0.10 persons/sq. m<br>no public-0.010 persons/ sq. m.<br>If area public access are not defined. 1/3 of floor area is subjected. |  | >60 m high - 0.125 person/sq. m<br><60 m owner - 0.16 person/sq. m<br><60 m for rent - 0.25 person/sq. m |                | open plan type - 0.2 person/sq. m<br>others - 0.14 person/sq. m   |   |  | 0.11 person/ sq. m (gross)                        |

### Appendix 3

## Listing of United States Evacuation Standards from Life Safety Code (NFPA,2003a), Building Construction and Safety Code (NFPA 2003b), and International Building Code (ICC, 2003)

| Life Safety Code, NFPA 101, 2003 Edition |          |   | Building Construction and Safety Code, NFPA 5000, 2003 Edition  |  |   | International Building Code, 2003 Edition  |   |                   |   |  |
|--|----------|---|---|--|---|--|---|-------------------|---|--|
| Minimum Number of Means of Escape        |          |   |   |  |   |  |   |                   |   |  |
|  | Section  | Reference Section   | Requirement   | Section  | Reference Section   | Requirement  | Section   | Reference Section | Requirement   |  |
| General                                  |          | 7.4.1.1   | The number of means of egress from any balcony, mezzanine, story, or portion thereof shall be not less than two.  | 28.2.4.2   |   | The number of exits shall comply with any one of the following:  | 1018.1  |                   | All rooms and spaces within each story shall be provided with and have access to the minimum number or approved independent exits as required by Table 1018.1 based on the occupant load, except as modified in Section 1014.1 or 1018.2. For the purposes of t |  |
|  |          | 7.4.1.2   | The number of means of egress from any balcony, mezzanine, story, or portion thereof, other than for existing buildings as permitted in Chapters 12 through 42, shall be as follows:<br>(1) Occupant load more than 500 but not more than 1000-not less than 3<br>(2) Occupant load more than 1000 - not less than 4. |  |   | (1) the minimum number of exits shall be in accordance with Section 11.4, and not less than two separate exits that are accessible from every part of every story shall be provided. Exit access travel shall be permitted to be common for the distances perm | Table 1018.1  | Occupant load     | Minimum Number of Exits   |  |
|  |          |   |   | 11.4.1.2   | The number of means of egress from any balcony, mezzanine, story, or portion thereof shall be as follows:                     |  |   |                   |   |  |
|  |          |   |   |  | (1) Occupant load more than 500 but not more than 1000-not less than 3<br>(2) Occupant load more than 1000 - not less than 4. |  |   |                   |   |  |
|  | 11.4.1.4 | The occupant load of each story considered individually shall be required to be used in computing the number of means of egress at each story, provided that the required number of means of egress is not decreased in the direction of egress travel. |   |  |   |  |   |                   |   |  |
| Arrangement of Means of Escape           |          |   |   |  |   |  |   |                   |   |  |
| Maximum Travel Distance                  |          |   |   |  |   |  |   |                   |   |  |
|  |          |   |   |  |   |  |   |                   |   |  |
| Assembly                                 | 12.2.6   |   | Exits shall be arranged so that the total length of travel from any point to reach an exit shall not exceed 150 ft (45 m) in any assembly occupancy. Exception No. 1: The travel distance shall not exceed 200 ft (60 m) in assembly occupancies protected thr  | 16.2.6   |   | Exits shall be arranged so that the total length of travel from any point to reach an exit shall not exceed 200 ft (60 m) in any assembly occupancy. Exception No. 1: The travel distance shall not exceed 250 ft (75 m) in assembly occupancies protected thr | 1015.1  |                   | Exits shall be so located on each story such that the maximum length of exit access travel, measured from the most remote point within a story to the entrance to an exit along the natural and unobstructed path of egress travel, shall not exceed the distan |  |
|  | 12.2.6   |   | Exits shall be arranged so that the total length of travel from any point to reach an exit shall not exceed 150 ft (45 m) in any assembly occupancy.  | 16.2.6   |   | Exits shall be arranged so that the total length of travel from any point to reach an exit shall not exceed 200 ft (60 m) in any assembly occupancy.   | Table 1015.1  |                   | Exit travel distance sprinkler system is 250 feet. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where sprinkler systems according to Section 903.3.1.2   |  |
|  | Office   | 38.2.6  | 7.5   | Travel distances to exits, measure in accordance with Section 7.6, shall not exceed 200 ft (60 m). Exception: Travel distance shall not exceed 300 ft (91 m) in buildings protected throughout by an approved, supervised automatic sprinkler system in accord | 28.2.6.1  |  | In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 55.3 and 55.3.2, the travel distance shall not exceed 300 ft (91 m). | Table 1015.1      |   | Exit travel distance without sprinkler system is 200 feet. |
|  |          |   |   | 28.2.6.2   |   | In all other buildings, the travel distance to exits, measured in accordance with Section 11.6, shall not exceed 200 ft (60 m).  | Table 1015.1  |                   | Exit travel distance without sprinkler system is 200 feet.  |  |
| Common Path of Travel                    |          |   |   |  |   |  |   |                   |   |  |
| Assembly                                 |          |   | Not specified in code for Assembly, Less Concentrated Use, without fixed seating.   | 16.2.5.1.2   |   | Common path of travel shall be permitted for the first 20 ft (6.1 m) from any point where serving any number of occupants and for the first 75 ft (23 m) from any point where serving not more than 50 occupants.  | 1024.8  |                   | The common path of travel shall not exceed 30 feet (9144 mm) from any seat to a point where a person has a choice of two paths of egress travel to two exits. Exception: For areas serving not more than 50 occupants, the common path of travel shall not exc  |  |
| Office                                   | 38.2.5.3 | 7.5   | Common paths of travel shall not exceed 75 ft (23 m). Exception No. 1: A common path of travel shall be permitted for the first 100 ft (30 m) in a building protected throughout by an approved, supervised automatic sprinkler system in accordance with Sect  | 28.2.5.3.1   |   | A common path of travel shall be permitted for the first 100 ft (30 m) in a building protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 55.3 and 55.3.2.  | 1002.1  |                   | That portion of exit access which the occupants are required to traverse before two separate and distinct paths of egress travel to two exits are available. Paths that merge are common paths of travel. Common paths of egress travel shall be included with  |  |
|  |          |   |   | 28.2.5.3.3   |   | In all other buildings, the common path of travel shall not exceed 75 ft (23 m).   |   |                   |   |  |

## Listing of United States Evacuation Standards from Life Safety Code (NFPA,2003a), Building Construction and Safety Code (NFPA 2003b), and International Building Code (ICC, 2003) Continued

| Life Safety Code, NFPA 101, 2003 Edition |            |                   | Building Construction and Safety Code, NFPA 5000, 2003 Edition   |            |   | International Building Code, 2003 Edition  |             |   |   |
|--|------------|-------------------|--|------------|---|--|-------------|---|---|
| <b>Dead-end Corridor</b>                 |            |                   |  |            |   |  |             |   |   |
| Assembly                                 |            |                   | Not specified in code for Assembly, Less Concentrated Use, without fixed seating.  |            |   |  | 1016.3      | Sprinkler protected assembly areas not addressed.   |   |
|  |            |                   |  | 16.2.5.1.3 | Dead-end corridors shall not exceed 20 ft (6.1 m).  |  | 1016.3      | Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20 feet (6096 mm) in length.   |   |
| Office                                   | 38.2.5.2   | 7.5               | Dead-end corridors shall not exceed 20 ft (6.1 m). <i>Exception: In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7, dead-end corridors shall not exceed 50 ft (15 m).</i>                 | 28.2.5.2.1 | In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 55.3 and 55.3.2, dead-end corridors shall not exceed 50 ft (15 m). |  | Exception 2 | Exceptions: 2. In occupancies in Groups B and F where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of dead-end corridors shall not exceed 50 feet (15,240 mm). |   |
|  |            |                   |  | 28.2.5.2.2 | In all other buildings, the common paths of travel shall not exceed 75 ft (23 m).   |  |             | Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20 feet (6096 mm) in length.   |   |
| <b>Capacity of Means of Escape</b>       |            |                   |  |            |   |  |             |   |   |
| <b>Stairs</b>                            |            |                   |  |            |   |  |             |   |   |
|  | 38.2.2.3.1 | Table 7.2.2.1 (a) | Minimum width clear of all obstructions, except projections not more than 3 1/2 in. (8.9 cm) at or below handrail height on each side [shall be] 44 in. (112 cm), 36 in. (91 cm) where total occupant load of all stories served by stairways is fewer than 50 | 28.2.2.3.1 | Table 11.2.2.2.1  | Minimum width clear of all obstructions, except projections not more than 4 1/2 in. (8.9 cm) at or below handrail height on each side [shall be] 44 in. (112 cm), 36 in. (91 cm) where total occupant load of all stories served by stairways is fewer than 50 |             | 1009.1  | The width of stairways shall be determined as specified in Section 1005.1, but such width shall not be less than 44 inches (1118 mm). See section 1007.3 for accessible means of egress stairways.  |
|  | 38.2.2.3.1 | Table 7.2.2.1 (a) | Maximum height of risers [shall be] 7 in. (17.9 cm)  | 28.2.2.3.1 | Table 11.2.2.2.1  | Maximum height of risers [shall be] 7 in. (17.9 cm)  |             | 1009.3  | Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum.   |
|  | 38.2.2.3.1 | Table 7.2.2.1 (a) | Minimum height of risers [shall be] 4 in. (10.2 cm)  | 28.2.2.3.1 | Table 11.2.2.2.1  | Minimum height of risers [shall be] 4 in. (10.2 cm)  |             | 1009.3  | Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum.   |
|  | 38.2.2.3.1 | Table 7.2.2.1 (a) | Minimum tread depth [shall be] 11 in. (27.9 cm)  | 28.2.2.3.1 | Table 11.2.2.2.1  | Minimum tread depth [shall be] 11 in. (27.9 cm)  |             | 1009.3  | Stair tread depths shall be 11 inches (279 mm) minimum.   |
|  | 38.2.2.3.1 | Table 7.2.2.1 (a) | Minimum headroom [shall be] 6 ft 8 in. (203 cm)  | 28.2.2.3.1 | Table 11.2.2.2.1  | Minimum headroom [shall be] 6 ft 8 in. (203 cm)  |             | 1009.2  | Stairways shall have a minimum headroom clearance of 80 inches (2032 mm) measured vertically from a line connecting the edge of the nosings.  |
|  | 38.2.3.1   | Table 7.3.3.1     | Capacity factors for all others [includes business and assembly] for stairways is 0.3 inches (0.8 cm) width per person.  | 28.2.3.1   | Table 11.3.3.1  | Capacity factors for all others [includes business and assembly] for stairways is 0.3 inches (0.75 cm) per person.   |             | Table 1005.1  | Egress width per occupant served without sprinklers for stairways is 0.3 inches per occupant.   |
|  |            |                   |  |            |   |  |             | Table 1005.1  | Egress width per occupant served with sprinklers for stairways is 0.2 inches per occupant. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1 and 903.3.1.2.   |
| <b>Corridor</b>                          |            |                   |  |            |   |  |             |   |   |
|  | 38.2.3.2   |                   | The clear width of any corridor or passageway serving an occupant load of 50 or more shall not be less than 44 in. (112 cm).   | 28.2.3.2   |   | The clear width of any corridor or passageway serving an occupant load of 50 or more shall not be less than 44 in. (112 cm).   |             | 1016.2  | The minimum corridor width shall be as determined in Section 1005.1, but not less than 44 inches (1118 mm).   |
|  | 38.2.3.1   | Table 7.3.3.1     | Capacity factors for all others [includes business and assembly] for level components and ramps is 0.2 inches (0.5 cm) width per person.   | 28.2.3.1   | Table 11.3.3.1  | Capacity factors for all others [includes business and assembly] for level components and ramps is 0.2 inches (0.5 cm) per person.   |             | Table 1005.1  | Egress width per occupant served without sprinklers for other egress components is 0.2 inches per occupant.   |
|  |            |                   |  |            |   |  |             | Table 1005.1  | Egress width per occupant served with sprinklers for other egress components is 0.15 inches per occupant. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1 and 903.3.1.2.                                  |
| <b>Door</b>                              |            |                   |  |            |   |  |             |   |   |
|  | 38.2.2.2.1 | 7.2.1.2.3         | Door openings in means of egress shall be not less than 32 in. (81 cm) in clear width. Where a pair of doors is provided, or less than one of the doors shall provide not less than a 32-in. (81-cm) clear width opening.                                      | 28.2.2.2.1 | 11.2.1  | Door openings in means of egress shall be not less than 32 in. (81 cm) in clear width. Where a pair of doors is provided, or less than one of the doors shall provide not less than a 32-in. (81-cm) clear width opening.                                      |             | 1008.1.1  | The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 32 inches (813 mm). Clear openings of doorways with swinging doors shall be measured between the face of the door a |
|  | 38.2.3.1   | Table 7.3.3.1     | Capacity factors for all others [includes business and assembly] for level components and ramps is 0.2 inches (0.5 cm) width per person.   | 28.2.3.1   | Table 11.3.3.1  | Capacity factors for all others [includes business and assembly] for level components and ramps is 0.2 inches (0.5 cm) per person.   |             | Table 1005.1  | Egress width per occupant served without sprinklers for other egress components is 0.2 inches per occupant.   |
|  |            |                   |  |            |   |  |             | Table 1005.1  | Egress width per occupant served with sprinklers for other egress components is 0.15 inches per occupant. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1 and 903.3.1.2.                                  |
| <b>Occupant Load Factors</b>             |            |                   |  |            |   |  |             |   |   |
| Assembly                                 | 38.1.7     | Table 7.3.1.2     | Assembly Use, Less Concentrated Use, without fixed seating, 15 net square feet per person  | 28.1.6     | Table 11.3.1.2  | Assembly Use, Less Concentrated Use, without fixed seating, 15 net square feet per person  | 1004.1      | Table 1004.1.2  | Assembly Use, without fixed seating, Unconcentrated (tables and chairs) 15 net square feet per occupant.  |
| Office                                   | 38.1.7     | Table 7.3.1.2     | Business Use 100 square feet per person  | 28.1.6     | Table 11.3.1.2  | Business Use 100 square feet per person  | 1004.1      | Table 1004.1.2  | Business Use 100 gross square feet per occupant.  |

## Appendix 4

“Figure 3.1: Diagram representing evacuation methodologies” from Gwynne and Galea (n.d., p. 11)

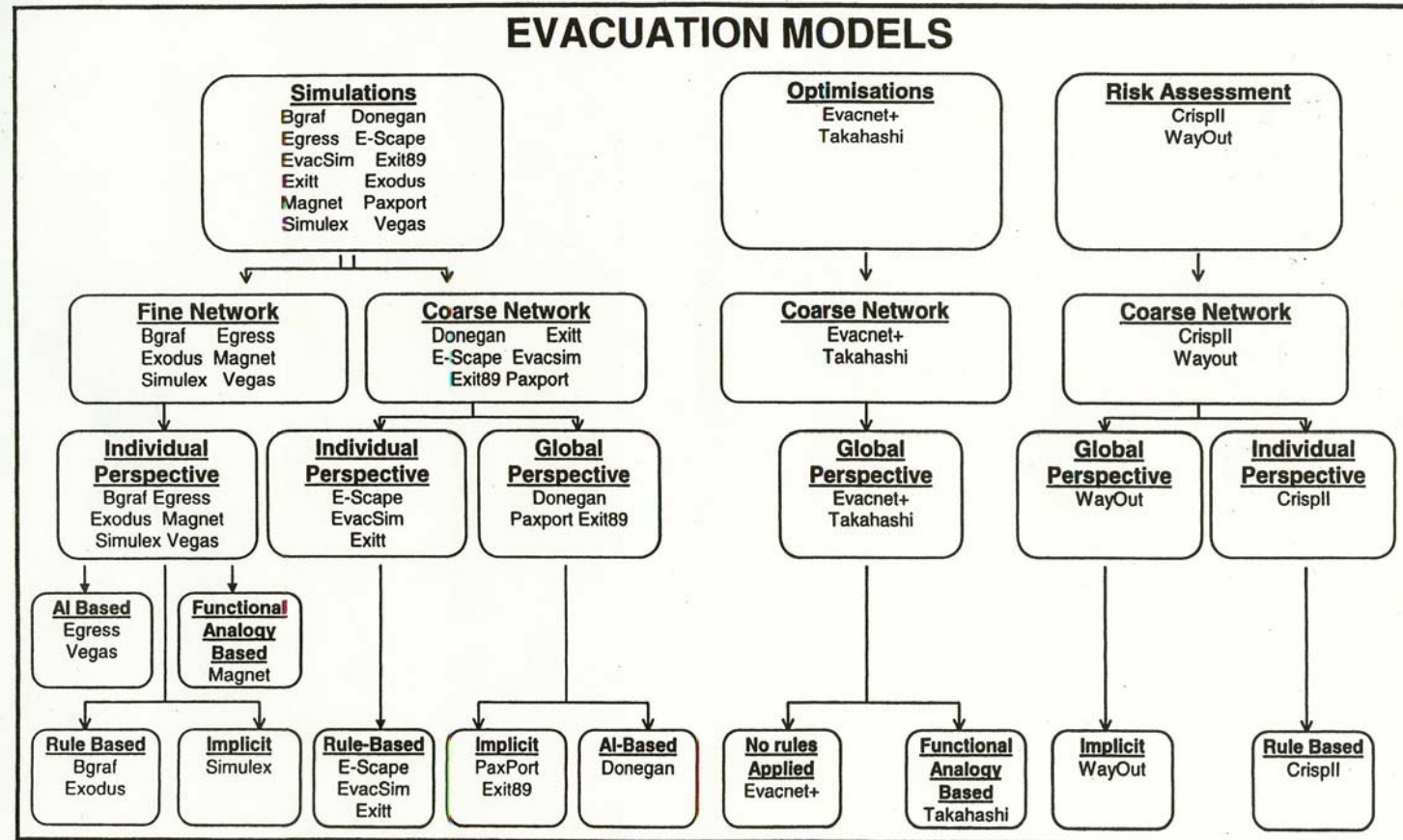
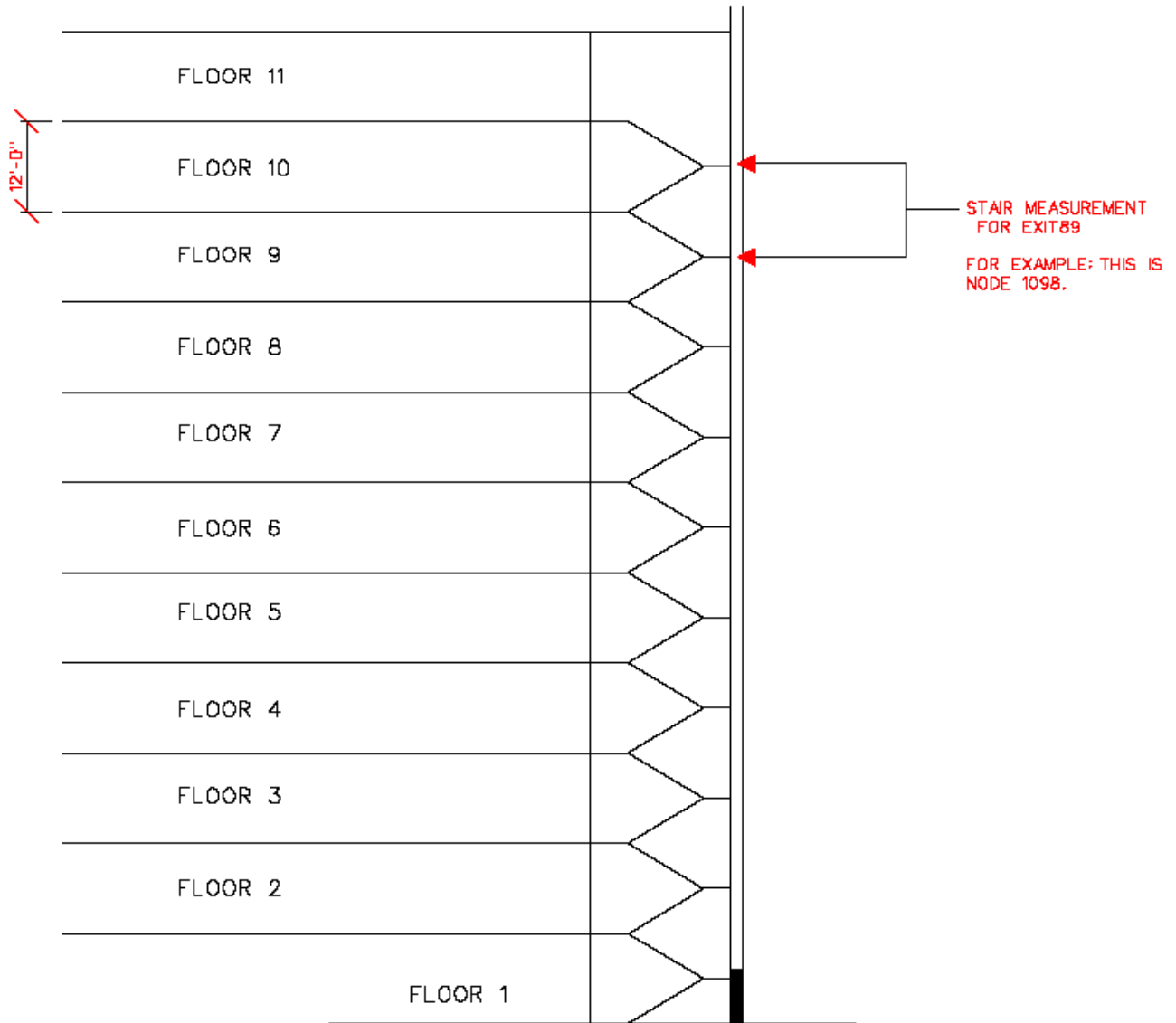


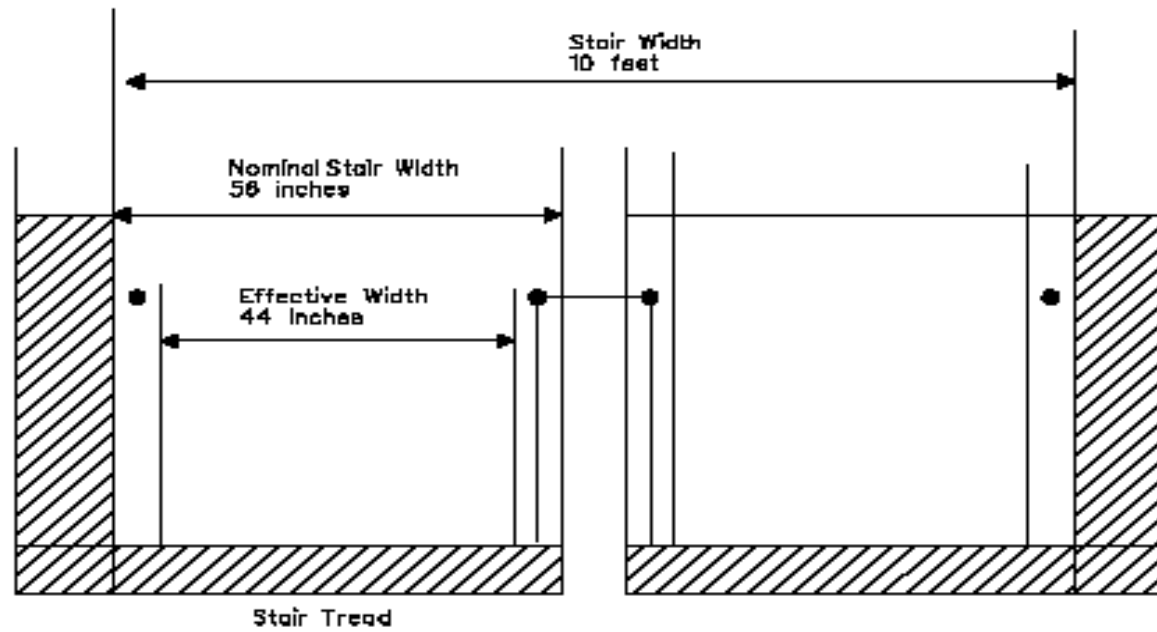
Figure 3.1: Diagram representing evacuation methodologies.

## Appendix 5

### Illustrations of one of the stairwells serving the 10-story buildings (not to scale)

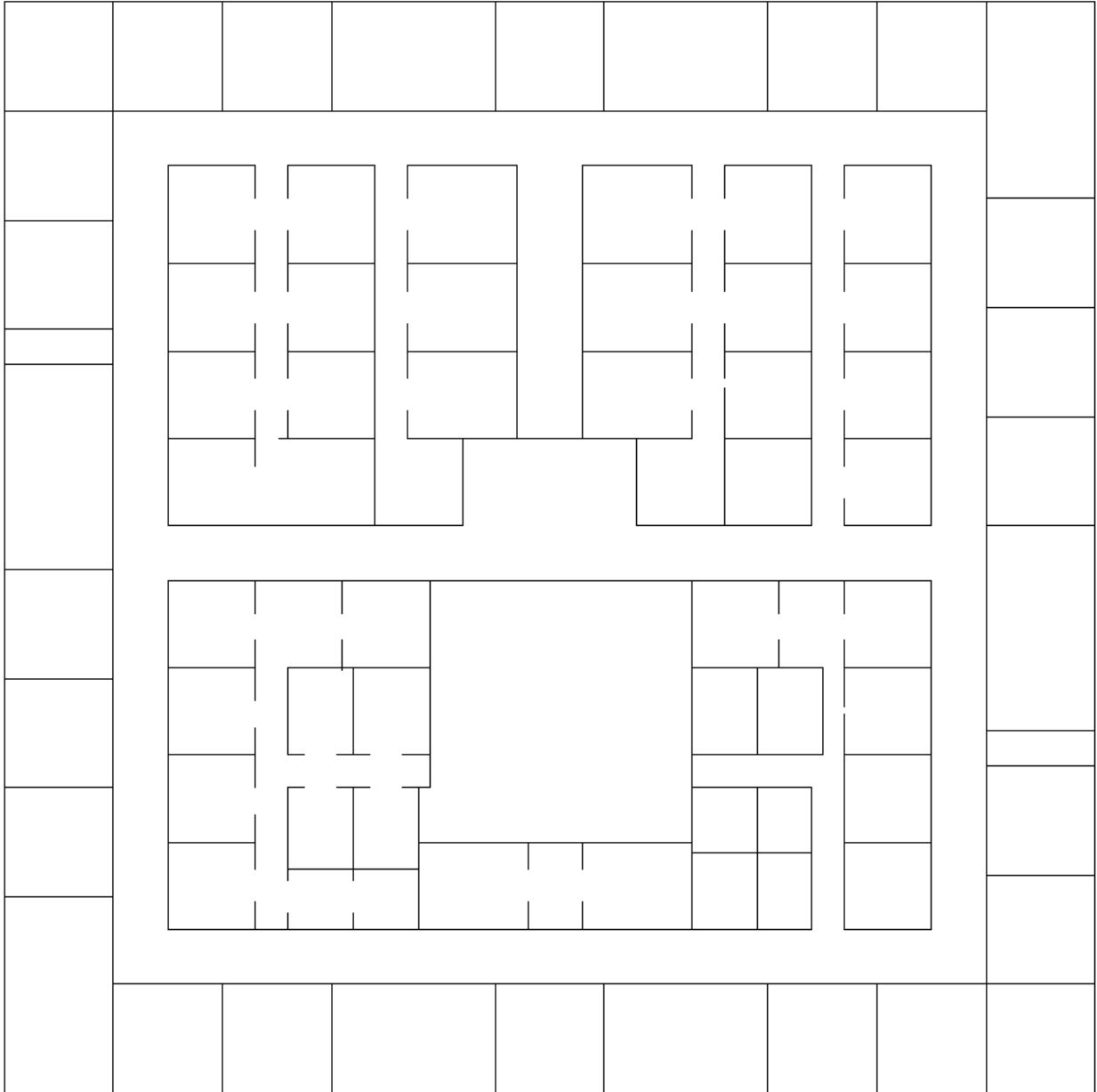




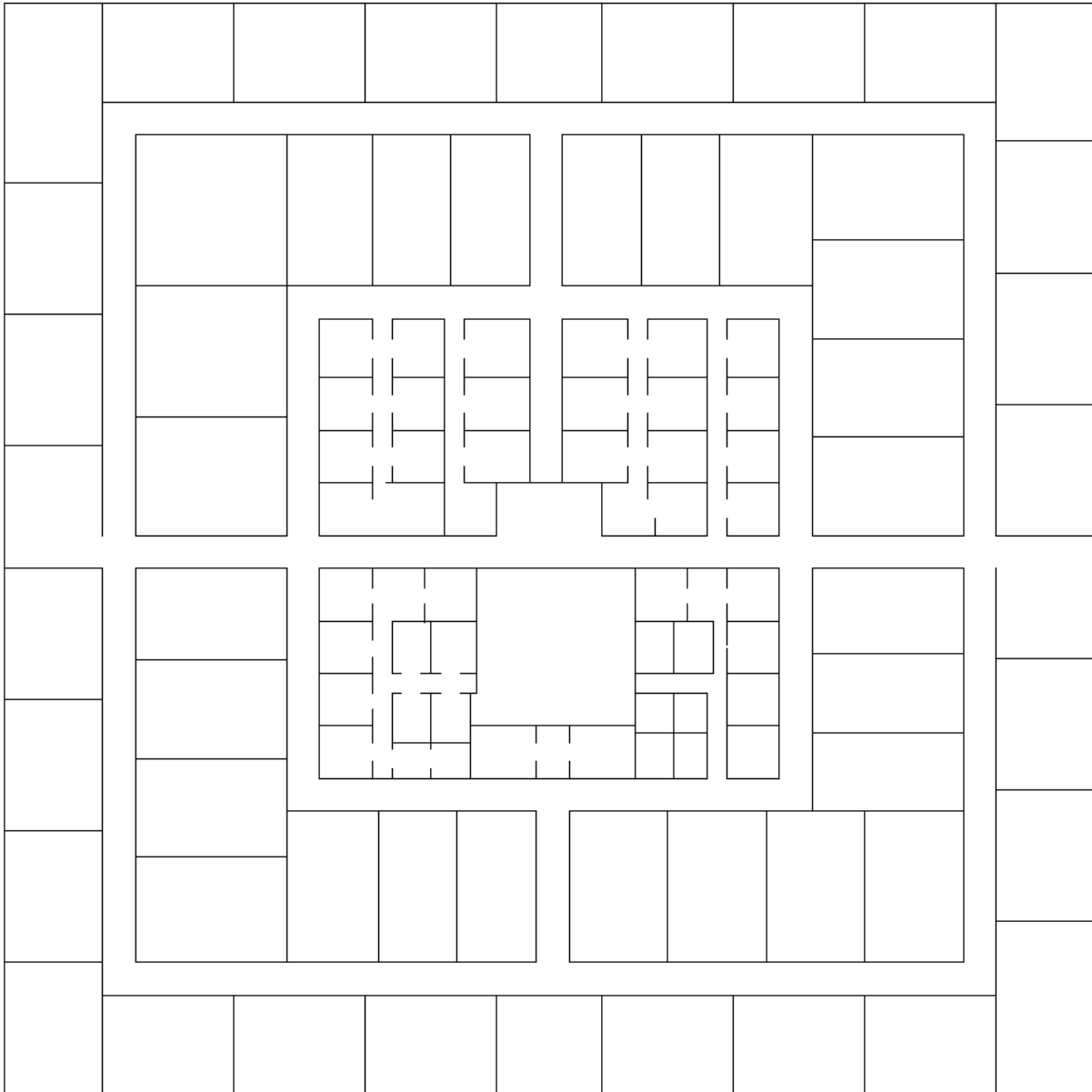


## Appendix 6

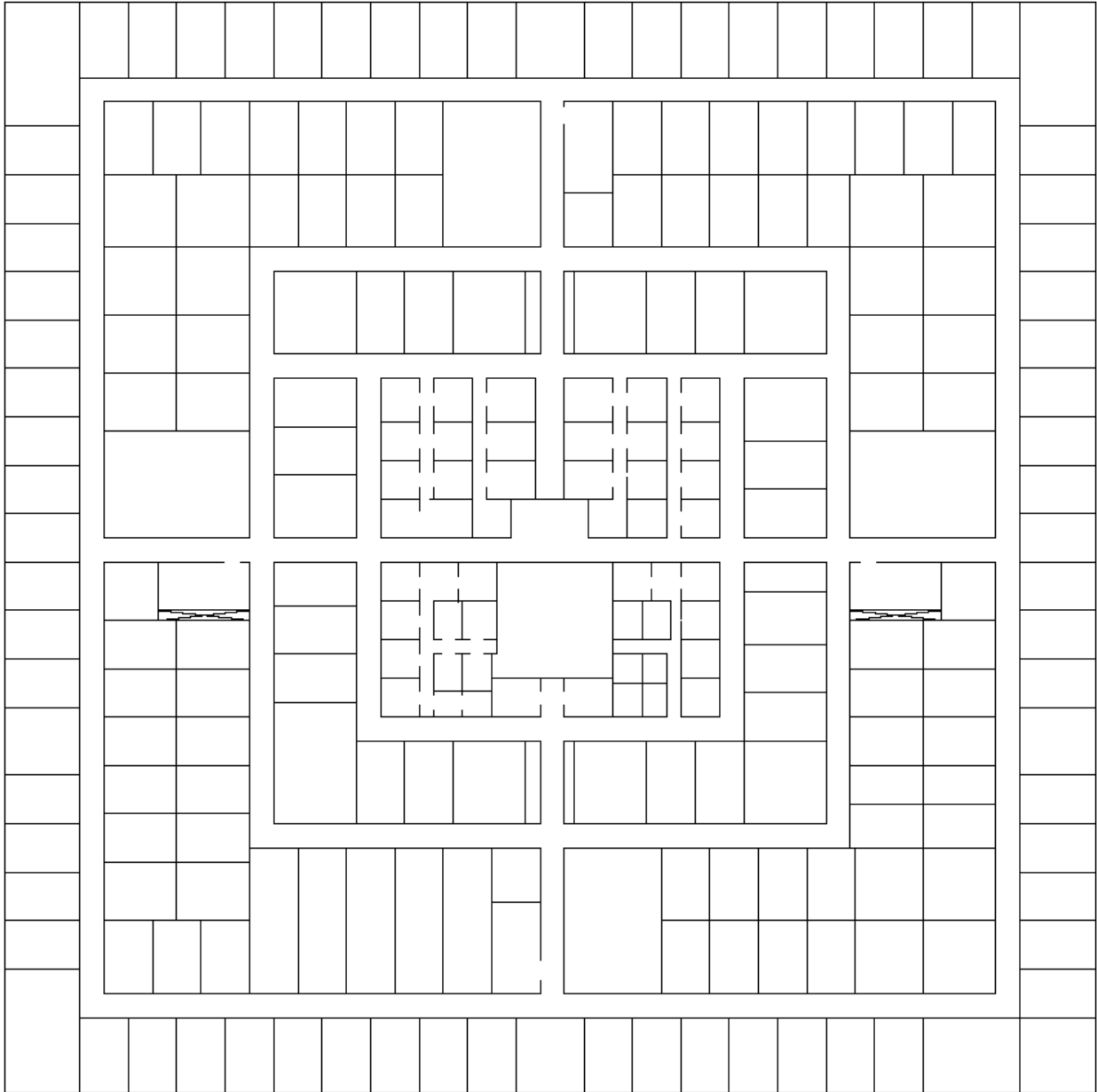
### 100 Foot Square Building Floor Layout (not to scale)



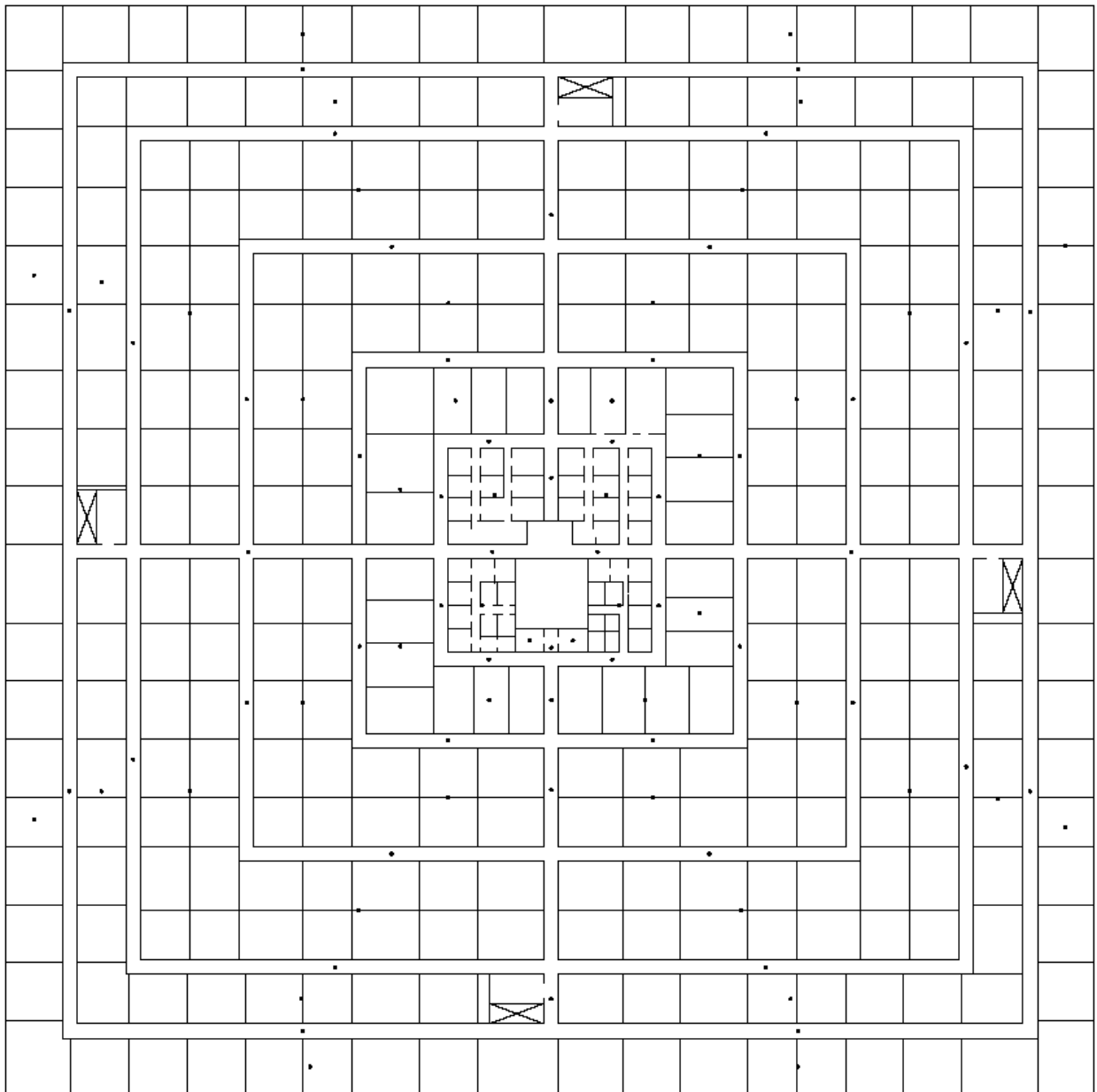
**166 Foot Square Building Floor Layout (not to scale)**



**225 Foot Square Building Floor Layout (not to scale)**



375 Foot Square Building Floor Layout (not to scale)



## Appendix 7

### Node Table for the One-Story, 225 Foot Square Building

| NODES | AREA | H    | NCAP | NOCC |
|-------|------|------|------|------|
| 196   | 188  | 12.0 | 100  | 0    |
| 197   | 188  | 12.0 | 100  | 0    |
| 198   | 188  | 12.0 | 100  | 0    |
| 199   | 188  | 12.0 | 100  | 0    |
| 201   | 1041 | 12.0 | 100  | 11   |
| 202   | 1016 | 12.0 | 100  | 11   |
| 203   | 704  | 12.0 | 100  | 12   |
| 204   | 736  | 12.0 | 100  | 12   |
| 205   | 848  | 12.0 | 100  | 37   |
| 206   | 935  | 12.0 | 100  | 22   |
| 207   | 918  | 12.0 | 100  | 22   |
| 208   | 629  | 12.0 | 100  | 36   |
| 209   | 918  | 12.0 | 100  | 4    |
| 210   | 112  | 12.0 | 100  | 1    |
| 211   | 1500 | 12.0 | 100  | 10   |
| 212   | 450  | 12.0 | 100  | 3    |
| 213   | 960  | 12.0 | 100  | 8    |
| 214   | 960  | 12.0 | 100  | 8    |
| 215   | 112  | 12.0 | 100  | 1    |
| 216   | 1020 | 12.0 | 100  | 6    |
| 217   | 1020 | 12.0 | 100  | 7    |
| 218   | 1185 | 12.0 | 100  | 7    |
| 219   | 1185 | 12.0 | 100  | 8    |
| 220   | 112  | 12.0 | 100  | 1    |
| 221   | 720  | 12.0 | 100  | 7    |
| 222   | 720  | 12.0 | 100  | 7    |
| 223   | 1035 | 12.0 | 100  | 6    |
| 224   | 1035 | 12.0 | 100  | 6    |
| 225   | 217  | 12.0 | 100  | 15   |
| 226   | 1395 | 12.0 | 100  | 9    |
| 227   | 1020 | 12.0 | 100  | 30   |
| 228   | 217  | 12.0 | 100  | 15   |
| 229   | 2255 | 12.0 | 100  | 38   |
| 230   | 1395 | 12.0 | 100  | 9    |
| 231   | 217  | 12.0 | 100  | 15   |
| 232   | 1395 | 12.0 | 100  | 9    |
| 233   | 2255 | 12.0 | 100  | 39   |
| 234   | 217  | 12.0 | 100  | 15   |

| NODES | AREA | H    | NCAP | NOCC |
|-------|------|------|------|------|
| 235   | 1015 | 12.0 | 100  | 30   |
| 236   | 1395 | 12.0 | 100  | 9    |
| 237   | 80   | 12.0 | 100  | 1    |
| 238   | 80   | 12.0 | 100  | 1    |
| 239   | 646  | 12.0 | 100  | 3    |
| 242   | 160  | 12.0 | 100  | 0    |
| 243   | 485  | 12.0 | 100  | 0    |
| 244   | 490  | 12.0 | 100  | 0    |
| 245   | 160  | 12.0 | 100  | 0    |
| 246   | 350  | 12.0 | 100  | 0    |
| 247   | 300  | 12.0 | 100  | 0    |
| 248   | 285  | 12.0 | 100  | 0    |
| 249   | 265  | 12.0 | 100  | 0    |
| 250   | 165  | 12.0 | 100  | 0    |
| 251   | 445  | 12.0 | 100  | 0    |
| 252   | 275  | 12.0 | 100  | 0    |
| 253   | 265  | 12.0 | 100  | 0    |
| 254   | 475  | 12.0 | 100  | 0    |
| 255   | 470  | 12.0 | 100  | 0    |
| 256   | 440  | 12.0 | 100  | 0    |
| 257   | 450  | 12.0 | 100  | 0    |
| 258   | 470  | 12.0 | 100  | 0    |
| 259   | 475  | 12.0 | 100  | 0    |
| 260   | 450  | 12.0 | 100  | 0    |
| 261   | 440  | 12.0 | 100  | 0    |
| 262   | 275  | 12.0 | 100  | 0    |
| 263   | 299  | 12.0 | 100  | 0    |
| 264   | 295  | 12.0 | 100  | 0    |
| 265   | 275  | 12.0 | 100  | 0    |
| 266   | 65   | 12.0 | 100  | 0    |
| 267   | 285  | 12.0 | 100  | 0    |
| 268   | 570  | 12.0 | 100  | 3    |
| 269   | 570  | 12.0 | 100  | 3    |
| 270   | 561  | 12.0 | 100  | 3    |
| 271   | 165  | 12.0 | 100  | 0    |
| 272   | 561  | 12.0 | 100  | 3    |
| 273   | 570  | 12.0 | 100  | 3    |
| 274   | 570  | 12.0 | 100  | 3    |
| 275   | 110  | 12.0 | 100  | 1    |

## Appendix 8

### Input File for the 10-Story, 100 Foot Square Building

Ten Story Detailed Exercise - evacuation/emergency spd

```
UNITS (1-METRIC,2-STD) =2
SIZE (1-AUST,2-SOVIET,3-US) =1
SPEED (1-EMER,2-NORMAL) =1
PATH (1-SHORTEST,2-DIRECTED)=1
SMOKE (1-CFAST,2-USER/NONE) =2
CONTRA (1-IF CONTRA FLOWS) =0
OUTPUT (1-FULL,2-BRIEF) =1
NUM OF STAIRWAYS (00-10) =02
STAIR TRAVEL (1-DOWN, 2-UP) =1
RANDOM DELAY (1-Y,2-N) =2, PROB = 50,
  MIN TIME (SEC) = 1, MAX TIME (SEC) = 5.
198 5.0 3.0 15.0 000
199 5.0 3.0 15.0 000
201 9.5 3.0 11.0 274
202 5.0 3.0 4.5 274
203 5.0 3.0 15.0 275
204 7.0 3.0 5.5 276
205 7.0 3.0 11.0 277
206 5.5 3.0 13.5 278
207 7.0 3.0 5.5 279
208 5.5 3.0 6.5 280
209 7.0 3.0 5.0 281
210 6.5 3.0 5.0 282
211 5.0 3.0 13.5 283
212 15.5 3.0 5.5 284
213 16.5 3.0 7.5 274
214 15.5 3.0 9.0 276
215 16.0 3.0 4.5 285
216 16.0 3.0 4.5 281
217 4.0 3.0 3.5 280
218 4.0 3.0 3.5 280
219 16.5 3.0 4.0 279
274 18.0 5.0 13.0 283
275 13.0 5.0 18.5 276
276 16.0 5.0 16.0 277
277 15.5 5.0 16.5 285
278 15.5 5.0 16.5 285
278 15.5 5.0 15.0 279
280 5.5 5.0 17.5 279
280 5.0 5.0 17.5 281
281 16.0 5.0 15.5 282
282 15.5 5.0 17.5 284
283 15.5 5.0 16.0 284
284 19.5 3.0 5.0 298
285 19.5 3.0 5.0 299
298 21.3 3.7 21.3 198
299 21.3 3.7 21.3 199
301 9.5 3.0 11.0 374
302 5.0 3.0 4.5 374
303 5.0 3.0 15.0 375
304 7.0 3.0 5.5 376
```



|     |      |     |      |     |
|-----|------|-----|------|-----|
| 305 | 7.0  | 3.0 | 11.0 | 377 |
| 306 | 5.5  | 3.0 | 13.5 | 378 |
| 307 | 7.0  | 3.0 | 5.5  | 379 |
| 308 | 5.5  | 3.0 | 6.5  | 380 |
| 309 | 7.0  | 3.0 | 5.0  | 381 |
| 310 | 6.5  | 3.0 | 5.0  | 382 |
| 311 | 5.0  | 3.0 | 13.5 | 383 |
| 312 | 15.5 | 3.0 | 5.5  | 384 |
| 313 | 16.5 | 3.0 | 7.5  | 374 |
| 314 | 15.5 | 3.0 | 9.0  | 376 |
| 315 | 16.0 | 3.0 | 4.5  | 385 |
| 316 | 16.0 | 3.0 | 4.5  | 381 |
| 317 | 4.0  | 3.0 | 3.5  | 380 |
| 318 | 4.0  | 3.0 | 3.5  | 380 |
| 319 | 16.5 | 3.0 | 4.0  | 379 |
| 374 | 18.0 | 5.0 | 13.0 | 383 |
| 375 | 13.0 | 5.0 | 18.5 | 376 |
| 376 | 16.0 | 5.0 | 16.0 | 377 |
| 377 | 15.5 | 5.0 | 16.5 | 385 |
| 378 | 15.5 | 5.0 | 16.5 | 385 |
| 378 | 15.5 | 5.0 | 15.0 | 379 |
| 380 | 5.5  | 5.0 | 17.5 | 379 |
| 380 | 5.0  | 5.0 | 17.5 | 381 |
| 381 | 16.0 | 5.0 | 15.5 | 382 |
| 382 | 15.5 | 5.0 | 17.5 | 384 |
| 383 | 15.5 | 5.0 | 16.0 | 384 |
| 384 | 19.5 | 3.0 | 5.0  | 398 |
| 385 | 19.5 | 3.0 | 5.0  | 399 |
| 398 | 21.3 | 3.7 | 21.3 | 298 |
| 399 | 21.3 | 3.7 | 21.3 | 299 |
| 401 | 9.5  | 3.0 | 11.0 | 474 |
| 402 | 5.0  | 3.0 | 4.5  | 474 |
| 403 | 5.0  | 3.0 | 15.0 | 475 |
| 404 | 7.0  | 3.0 | 5.5  | 476 |
| 405 | 7.0  | 3.0 | 11.0 | 477 |
| 406 | 5.5  | 3.0 | 13.5 | 478 |
| 407 | 7.0  | 3.0 | 5.5  | 479 |
| 408 | 5.5  | 3.0 | 6.5  | 480 |
| 409 | 7.0  | 3.0 | 5.0  | 481 |
| 410 | 6.5  | 3.0 | 5.0  | 482 |
| 411 | 5.0  | 3.0 | 13.5 | 483 |
| 412 | 15.5 | 3.0 | 5.5  | 484 |
| 413 | 16.5 | 3.0 | 7.5  | 474 |
| 414 | 15.5 | 3.0 | 9.0  | 476 |
| 415 | 16.0 | 3.0 | 4.5  | 485 |
| 416 | 16.0 | 3.0 | 4.5  | 481 |
| 417 | 4.0  | 3.0 | 3.5  | 480 |
| 418 | 4.0  | 3.0 | 3.5  | 480 |
| 419 | 16.5 | 3.0 | 4.0  | 479 |
| 474 | 18.0 | 5.0 | 13.0 | 483 |
| 475 | 13.0 | 5.0 | 18.5 | 476 |
| 476 | 16.0 | 5.0 | 16.0 | 477 |
| 477 | 15.5 | 5.0 | 16.5 | 485 |
| 478 | 15.5 | 5.0 | 16.5 | 485 |
| 478 | 15.5 | 5.0 | 15.0 | 479 |
| 480 | 5.5  | 5.0 | 17.5 | 479 |
| 480 | 5.0  | 5.0 | 17.5 | 481 |

|     |      |     |      |     |
|-----|------|-----|------|-----|
| 481 | 16.0 | 5.0 | 15.5 | 482 |
| 482 | 15.5 | 5.0 | 17.5 | 484 |
| 483 | 15.5 | 5.0 | 16.0 | 484 |
| 484 | 19.5 | 3.0 | 5.0  | 498 |
| 485 | 19.5 | 3.0 | 5.0  | 499 |
| 498 | 21.3 | 3.7 | 21.3 | 398 |
| 499 | 21.3 | 3.7 | 21.3 | 399 |
| 501 | 9.5  | 3.0 | 11.0 | 574 |
| 502 | 5.0  | 3.0 | 4.5  | 574 |
| 503 | 5.0  | 3.0 | 15.0 | 575 |
| 504 | 7.0  | 3.0 | 5.5  | 576 |
| 505 | 7.0  | 3.0 | 11.0 | 577 |
| 506 | 5.5  | 3.0 | 13.5 | 578 |
| 507 | 7.0  | 3.0 | 5.5  | 579 |
| 508 | 5.5  | 3.0 | 6.5  | 580 |
| 509 | 7.0  | 3.0 | 5.0  | 581 |
| 510 | 6.5  | 3.0 | 5.0  | 582 |
| 511 | 5.0  | 3.0 | 13.5 | 583 |
| 512 | 15.5 | 3.0 | 5.5  | 584 |
| 513 | 16.5 | 3.0 | 7.5  | 574 |
| 514 | 15.5 | 3.0 | 9.0  | 576 |
| 515 | 16.0 | 3.0 | 4.5  | 585 |
| 516 | 16.0 | 3.0 | 4.5  | 581 |
| 517 | 4.0  | 3.0 | 3.5  | 580 |
| 518 | 4.0  | 3.0 | 3.5  | 580 |
| 519 | 16.5 | 3.0 | 4.0  | 579 |
| 574 | 18.0 | 5.0 | 13.0 | 583 |
| 575 | 13.0 | 5.0 | 18.5 | 576 |
| 576 | 16.0 | 5.0 | 16.0 | 577 |
| 577 | 15.5 | 5.0 | 16.5 | 585 |
| 578 | 15.5 | 5.0 | 16.5 | 585 |
| 578 | 15.5 | 5.0 | 15.0 | 579 |
| 580 | 5.5  | 5.0 | 17.5 | 579 |
| 580 | 5.0  | 5.0 | 17.5 | 581 |
| 581 | 16.0 | 5.0 | 15.5 | 582 |
| 582 | 15.5 | 5.0 | 17.5 | 584 |
| 583 | 15.5 | 5.0 | 16.0 | 584 |
| 584 | 19.5 | 3.0 | 5.0  | 598 |
| 585 | 19.5 | 3.0 | 5.0  | 599 |
| 598 | 21.3 | 3.7 | 21.3 | 498 |
| 599 | 21.3 | 3.7 | 21.3 | 499 |
| 601 | 9.5  | 3.0 | 11.0 | 674 |
| 602 | 5.0  | 3.0 | 4.5  | 674 |
| 603 | 5.0  | 3.0 | 15.0 | 675 |
| 604 | 7.0  | 3.0 | 5.5  | 676 |
| 605 | 7.0  | 3.0 | 11.0 | 677 |
| 606 | 5.5  | 3.0 | 13.5 | 678 |
| 607 | 7.0  | 3.0 | 5.5  | 679 |
| 608 | 5.5  | 3.0 | 6.5  | 680 |
| 609 | 7.0  | 3.0 | 5.0  | 681 |
| 610 | 6.5  | 3.0 | 5.0  | 682 |
| 611 | 5.0  | 3.0 | 13.5 | 683 |
| 612 | 15.5 | 3.0 | 5.5  | 684 |
| 613 | 16.5 | 3.0 | 7.5  | 674 |
| 614 | 15.5 | 3.0 | 9.0  | 676 |
| 615 | 16.0 | 3.0 | 4.5  | 685 |
| 616 | 16.0 | 3.0 | 4.5  | 681 |

|     |      |     |      |     |
|-----|------|-----|------|-----|
| 617 | 4.0  | 3.0 | 3.5  | 680 |
| 618 | 4.0  | 3.0 | 3.5  | 680 |
| 619 | 16.5 | 3.0 | 4.0  | 679 |
| 674 | 18.0 | 5.0 | 13.0 | 683 |
| 675 | 13.0 | 5.0 | 18.5 | 676 |
| 676 | 16.0 | 5.0 | 16.0 | 677 |
| 677 | 15.5 | 5.0 | 16.5 | 685 |
| 678 | 15.5 | 5.0 | 16.5 | 685 |
| 678 | 15.5 | 5.0 | 15.0 | 679 |
| 680 | 5.5  | 5.0 | 17.5 | 679 |
| 680 | 5.0  | 5.0 | 17.5 | 681 |
| 681 | 16.0 | 5.0 | 15.5 | 682 |
| 682 | 15.5 | 5.0 | 17.5 | 684 |
| 683 | 15.5 | 5.0 | 16.0 | 684 |
| 684 | 19.5 | 3.0 | 5.0  | 698 |
| 685 | 19.5 | 3.0 | 5.0  | 699 |
| 698 | 21.3 | 3.7 | 21.3 | 598 |
| 699 | 21.3 | 3.7 | 21.3 | 599 |
| 701 | 9.5  | 3.0 | 11.0 | 774 |
| 702 | 5.0  | 3.0 | 4.5  | 774 |
| 703 | 5.0  | 3.0 | 15.0 | 775 |
| 704 | 7.0  | 3.0 | 5.5  | 776 |
| 705 | 7.0  | 3.0 | 11.0 | 777 |
| 706 | 5.5  | 3.0 | 13.5 | 778 |
| 707 | 7.0  | 3.0 | 5.5  | 779 |
| 708 | 5.5  | 3.0 | 6.5  | 780 |
| 709 | 7.0  | 3.0 | 5.0  | 781 |
| 710 | 6.5  | 3.0 | 5.0  | 782 |
| 711 | 5.0  | 3.0 | 13.5 | 783 |
| 712 | 15.5 | 3.0 | 5.5  | 784 |
| 713 | 16.5 | 3.0 | 7.5  | 774 |
| 714 | 15.5 | 3.0 | 9.0  | 776 |
| 715 | 16.0 | 3.0 | 4.5  | 785 |
| 716 | 16.0 | 3.0 | 4.5  | 781 |
| 717 | 4.0  | 3.0 | 3.5  | 780 |
| 718 | 4.0  | 3.0 | 3.5  | 780 |
| 719 | 16.5 | 3.0 | 4.0  | 779 |
| 774 | 18.0 | 5.0 | 13.0 | 783 |
| 775 | 13.0 | 5.0 | 18.5 | 776 |
| 776 | 16.0 | 5.0 | 16.0 | 777 |
| 777 | 15.5 | 5.0 | 16.5 | 785 |
| 778 | 15.5 | 5.0 | 16.5 | 785 |
| 778 | 15.5 | 5.0 | 15.0 | 779 |
| 780 | 5.5  | 5.0 | 17.5 | 779 |
| 780 | 5.0  | 5.0 | 17.5 | 781 |
| 781 | 16.0 | 5.0 | 15.5 | 782 |
| 782 | 15.5 | 5.0 | 17.5 | 784 |
| 783 | 15.5 | 5.0 | 16.0 | 784 |
| 784 | 19.5 | 3.0 | 5.0  | 798 |
| 785 | 19.5 | 3.0 | 5.0  | 799 |
| 798 | 21.3 | 3.7 | 21.3 | 698 |
| 799 | 21.3 | 3.7 | 21.3 | 699 |
| 801 | 9.5  | 3.0 | 11.0 | 874 |
| 802 | 5.0  | 3.0 | 4.5  | 874 |
| 803 | 5.0  | 3.0 | 15.0 | 875 |
| 804 | 7.0  | 3.0 | 5.5  | 876 |
| 805 | 7.0  | 3.0 | 11.0 | 877 |

|     |      |     |      |     |
|-----|------|-----|------|-----|
| 806 | 5.5  | 3.0 | 13.5 | 878 |
| 807 | 7.0  | 3.0 | 5.5  | 879 |
| 808 | 5.5  | 3.0 | 6.5  | 880 |
| 809 | 7.0  | 3.0 | 5.0  | 881 |
| 810 | 6.5  | 3.0 | 5.0  | 882 |
| 811 | 5.0  | 3.0 | 13.5 | 883 |
| 812 | 15.5 | 3.0 | 5.5  | 884 |
| 813 | 16.5 | 3.0 | 7.5  | 874 |
| 814 | 15.5 | 3.0 | 9.0  | 876 |
| 815 | 16.0 | 3.0 | 4.5  | 885 |
| 816 | 16.0 | 3.0 | 4.5  | 881 |
| 817 | 4.0  | 3.0 | 3.5  | 880 |
| 818 | 4.0  | 3.0 | 3.5  | 880 |
| 819 | 16.5 | 3.0 | 4.0  | 879 |
| 874 | 18.0 | 5.0 | 13.0 | 883 |
| 875 | 13.0 | 5.0 | 18.5 | 876 |
| 876 | 16.0 | 5.0 | 16.0 | 877 |
| 877 | 15.5 | 5.0 | 16.5 | 885 |
| 878 | 15.5 | 5.0 | 16.5 | 885 |
| 878 | 15.5 | 5.0 | 15.0 | 879 |
| 880 | 5.5  | 5.0 | 17.5 | 879 |
| 880 | 5.0  | 5.0 | 17.5 | 881 |
| 881 | 16.0 | 5.0 | 15.5 | 882 |
| 882 | 15.5 | 5.0 | 17.5 | 884 |
| 883 | 15.5 | 5.0 | 16.0 | 884 |
| 884 | 19.5 | 3.0 | 5.0  | 898 |
| 885 | 19.5 | 3.0 | 5.0  | 899 |
| 898 | 21.3 | 3.7 | 21.3 | 798 |
| 899 | 21.3 | 3.7 | 21.3 | 799 |
| 901 | 9.5  | 3.0 | 11.0 | 974 |
| 902 | 5.0  | 3.0 | 4.5  | 974 |
| 903 | 5.0  | 3.0 | 15.0 | 975 |
| 904 | 7.0  | 3.0 | 5.5  | 976 |
| 905 | 7.0  | 3.0 | 11.0 | 977 |
| 906 | 5.5  | 3.0 | 13.5 | 978 |
| 907 | 7.0  | 3.0 | 5.5  | 979 |
| 908 | 5.5  | 3.0 | 6.5  | 980 |
| 909 | 7.0  | 3.0 | 5.0  | 981 |
| 910 | 6.5  | 3.0 | 5.0  | 982 |
| 911 | 5.0  | 3.0 | 13.5 | 983 |
| 912 | 15.5 | 3.0 | 5.5  | 984 |
| 913 | 16.5 | 3.0 | 7.5  | 974 |
| 914 | 15.5 | 3.0 | 9.0  | 976 |
| 915 | 16.0 | 3.0 | 4.5  | 985 |
| 916 | 16.0 | 3.0 | 4.5  | 981 |
| 917 | 4.0  | 3.0 | 3.5  | 980 |
| 918 | 4.0  | 3.0 | 3.5  | 980 |
| 919 | 16.5 | 3.0 | 4.0  | 979 |
| 974 | 18.0 | 5.0 | 13.0 | 983 |
| 975 | 13.0 | 5.0 | 18.5 | 976 |
| 976 | 16.0 | 5.0 | 16.0 | 977 |
| 977 | 15.5 | 5.0 | 16.5 | 985 |
| 978 | 15.5 | 5.0 | 16.5 | 985 |
| 978 | 15.5 | 5.0 | 15.0 | 979 |
| 980 | 5.5  | 5.0 | 17.5 | 979 |
| 980 | 5.0  | 5.0 | 17.5 | 981 |
| 981 | 16.0 | 5.0 | 15.5 | 982 |

|      |      |     |      |      |
|------|------|-----|------|------|
| 982  | 15.5 | 5.0 | 17.5 | 984  |
| 983  | 15.5 | 5.0 | 16.0 | 984  |
| 984  | 19.5 | 3.0 | 5.0  | 998  |
| 985  | 19.5 | 3.0 | 5.0  | 999  |
| 998  | 21.3 | 3.7 | 21.3 | 898  |
| 999  | 21.3 | 3.7 | 21.3 | 899  |
| 1001 | 9.5  | 3.0 | 11.0 | 1074 |
| 1002 | 5.0  | 3.0 | 4.5  | 1074 |
| 1003 | 5.0  | 3.0 | 15.0 | 1075 |
| 1004 | 7.0  | 3.0 | 5.5  | 1076 |
| 1005 | 7.0  | 3.0 | 11.0 | 1077 |
| 1006 | 5.5  | 3.0 | 13.5 | 1078 |
| 1007 | 7.0  | 3.0 | 5.5  | 1079 |
| 1008 | 5.5  | 3.0 | 6.5  | 1080 |
| 1009 | 7.0  | 3.0 | 5.0  | 1081 |
| 1010 | 6.5  | 3.0 | 5.0  | 1082 |
| 1011 | 5.0  | 3.0 | 13.5 | 1083 |
| 1012 | 15.5 | 3.0 | 5.5  | 1084 |
| 1013 | 16.5 | 3.0 | 7.5  | 1074 |
| 1014 | 15.5 | 3.0 | 9.0  | 1076 |
| 1015 | 16.0 | 3.0 | 4.5  | 1085 |
| 1016 | 16.0 | 3.0 | 4.5  | 1081 |
| 1017 | 4.0  | 3.0 | 3.5  | 1080 |
| 1018 | 4.0  | 3.0 | 3.5  | 1080 |
| 1019 | 16.5 | 3.0 | 4.0  | 1079 |
| 1074 | 18.0 | 5.0 | 13.0 | 1083 |
| 1075 | 13.0 | 5.0 | 18.5 | 1076 |
| 1076 | 16.0 | 5.0 | 16.0 | 1077 |
| 1077 | 15.5 | 5.0 | 16.5 | 1085 |
| 1078 | 15.5 | 5.0 | 16.5 | 1085 |
| 1078 | 15.5 | 5.0 | 15.0 | 1079 |
| 1080 | 5.5  | 5.0 | 17.5 | 1079 |
| 1080 | 5.0  | 5.0 | 17.5 | 1081 |
| 1081 | 16.0 | 5.0 | 15.5 | 1082 |
| 1082 | 15.5 | 5.0 | 17.5 | 1084 |
| 1083 | 15.5 | 5.0 | 16.0 | 1084 |
| 1084 | 19.5 | 3.0 | 5.0  | 1098 |
| 1085 | 19.5 | 3.0 | 5.0  | 1099 |
| 1098 | 21.3 | 3.7 | 21.3 | 998  |
| 1099 | 21.3 | 3.7 | 21.3 | 999  |
| 1101 | 9.5  | 3.0 | 11.0 | 1174 |
| 1102 | 5.0  | 3.0 | 4.5  | 1174 |
| 1103 | 5.0  | 3.0 | 15.0 | 1175 |
| 1104 | 7.0  | 3.0 | 5.5  | 1176 |
| 1105 | 7.0  | 3.0 | 11.0 | 1177 |
| 1106 | 5.5  | 3.0 | 13.5 | 1178 |
| 1107 | 7.0  | 3.0 | 5.5  | 1179 |
| 1108 | 5.5  | 3.0 | 6.5  | 1180 |
| 1109 | 7.0  | 3.0 | 5.0  | 1181 |
| 1110 | 6.5  | 3.0 | 5.0  | 1182 |
| 1111 | 5.0  | 3.0 | 13.5 | 1183 |
| 1112 | 15.5 | 3.0 | 5.5  | 1184 |
| 1113 | 16.5 | 3.0 | 7.5  | 1174 |
| 1114 | 15.5 | 3.0 | 9.0  | 1176 |
| 1115 | 16.0 | 3.0 | 4.5  | 1185 |
| 1116 | 16.0 | 3.0 | 4.5  | 1181 |
| 1117 | 4.0  | 3.0 | 3.5  | 1180 |

|      |      |      |      |      |   |   |     |   |
|------|------|------|------|------|---|---|-----|---|
| 1118 | 4.0  | 3.0  | 3.5  | 1180 |   |   |     |   |
| 1119 | 16.5 | 3.0  | 4.0  | 1179 |   |   |     |   |
| 1174 | 18.0 | 5.0  | 13.0 | 1183 |   |   |     |   |
| 1175 | 13.0 | 5.0  | 18.5 | 1176 |   |   |     |   |
| 1176 | 16.0 | 5.0  | 16.0 | 1177 |   |   |     |   |
| 1177 | 15.5 | 5.0  | 16.5 | 1185 |   |   |     |   |
| 1178 | 15.5 | 5.0  | 16.5 | 1185 |   |   |     |   |
| 1178 | 15.5 | 5.0  | 15.0 | 1179 |   |   |     |   |
| 1180 | 5.5  | 5.0  | 17.5 | 1179 |   |   |     |   |
| 1180 | 5.0  | 5.0  | 17.5 | 1181 |   |   |     |   |
| 1181 | 16.0 | 5.0  | 15.5 | 1182 |   |   |     |   |
| 1182 | 15.5 | 5.0  | 17.5 | 1184 |   |   |     |   |
| 1183 | 15.5 | 5.0  | 16.0 | 1184 |   |   |     |   |
| 1184 | 19.5 | 3.0  | 5.0  | 1198 |   |   |     |   |
| 1185 | 19.5 | 3.0  | 5.0  | 1199 |   |   |     |   |
| 1198 | 5.0  | 3.7  | 21.3 | 1098 |   |   |     |   |
| 1199 | 5.0  | 3.7  | 21.3 | 1099 |   |   |     |   |
| 9999 | 0.0  | 0.0  | 0.0  | 000  |   |   |     |   |
| 198  | 39   | 12.0 | 100  | 0    | 0 | 1 | 0.0 | 0 |
| 199  | 39   | 12.0 | 100  | 0    | 0 | 1 | 0.0 | 0 |
| 201  | 200  | 12.0 | 100  | 2    | 0 | 0 | 0.0 | 0 |
| 202  | 250  | 12.0 | 100  | 11   | 0 | 0 | 0.0 | 0 |
| 203  | 80   | 12.0 | 100  | 1    | 0 | 0 | 0.0 | 0 |
| 204  | 350  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |
| 205  | 500  | 12.0 | 100  | 16   | 0 | 0 | 0.0 | 0 |
| 206  | 300  | 12.0 | 100  | 3    | 0 | 0 | 0.0 | 0 |
| 207  | 350  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |
| 208  | 80   | 12.0 | 100  | 1    | 0 | 0 | 0.0 | 0 |
| 209  | 350  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |
| 210  | 500  | 12.0 | 100  | 16   | 0 | 0 | 0.0 | 0 |
| 211  | 200  | 12.0 | 100  | 2    | 0 | 0 | 0.0 | 0 |
| 212  | 608  | 12.0 | 100  | 8    | 0 | 0 | 0.0 | 0 |
| 213  | 363  | 12.0 | 100  | 4    | 0 | 0 | 0.0 | 0 |
| 214  | 599  | 12.0 | 100  | 8    | 0 | 0 | 0.0 | 0 |
| 215  | 341  | 12.0 | 100  | 4    | 0 | 0 | 0.0 | 0 |
| 216  | 772  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |
| 217  | 64   | 12.0 | 100  | 1    | 0 | 0 | 0.0 | 0 |
| 218  | 64   | 12.0 | 100  | 1    | 0 | 0 | 0.0 | 0 |
| 219  | 756  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |
| 274  | 183  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 275  | 150  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 276  | 185  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 277  | 158  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 278  | 158  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 279  | 175  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 280  | 75   | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 281  | 180  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 282  | 158  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 283  | 155  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 284  | 196  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 285  | 195  | 12.0 | 100  | 0    | 0 | 0 | 0.0 | 0 |
| 298  | 39   | 12.0 | 100  | 0    | 0 | 1 | 0.0 | 0 |
| 299  | 39   | 12.0 | 100  | 0    | 0 | 1 | 0.0 | 0 |
| 301  | 200  | 12.0 | 100  | 2    | 0 | 0 | 0.0 | 0 |
| 302  | 250  | 12.0 | 100  | 11   | 0 | 0 | 0.0 | 0 |
| 303  | 80   | 12.0 | 100  | 1    | 0 | 0 | 0.0 | 0 |
| 304  | 350  | 12.0 | 100  | 12   | 0 | 0 | 0.0 | 0 |

|     |     |      |     |    |   |   |     |   |
|-----|-----|------|-----|----|---|---|-----|---|
| 305 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 306 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 307 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 308 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 309 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 310 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 311 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 312 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 313 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 314 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 315 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 316 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 317 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 318 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 319 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 374 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 375 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 376 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 377 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 378 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 379 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 380 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 381 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 382 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 383 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 384 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 385 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 398 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 399 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 401 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 402 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 403 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 404 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 405 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 406 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 407 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 408 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 409 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 410 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 411 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 412 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 413 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 414 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 415 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 416 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 417 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 418 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 419 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 474 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 475 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 476 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 477 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 478 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 479 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 480 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 481 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 482 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |

|     |     |      |     |    |   |   |     |   |
|-----|-----|------|-----|----|---|---|-----|---|
| 483 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 484 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 485 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 498 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 499 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 501 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 502 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 503 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 504 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 505 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 506 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 507 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 508 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 509 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 510 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 511 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 512 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 513 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 514 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 515 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 516 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 517 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 518 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 519 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 574 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 575 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 576 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 577 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 578 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 579 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 580 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 581 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 582 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 583 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 584 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 585 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 598 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 599 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 601 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 602 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 603 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 604 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 605 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 606 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 607 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 608 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 609 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 610 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 611 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 612 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 613 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 614 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 615 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 616 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 617 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 618 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 619 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |



|     |     |      |     |    |   |   |     |   |
|-----|-----|------|-----|----|---|---|-----|---|
| 674 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 675 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 676 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 677 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 678 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 679 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 680 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 681 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 682 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 683 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 684 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 685 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 698 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 699 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 701 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 702 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 703 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 704 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 705 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 706 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 707 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 708 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 709 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 710 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 711 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 712 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 713 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 714 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 715 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 716 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 717 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 718 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 719 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 774 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 775 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 776 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 777 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 778 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 779 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 780 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 781 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 782 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 783 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 784 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 785 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 798 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 799 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 801 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 802 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 803 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 804 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 805 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 806 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 807 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 808 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 809 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 810 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |

|      |     |      |     |    |   |   |     |   |
|------|-----|------|-----|----|---|---|-----|---|
| 811  | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 812  | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 813  | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 814  | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 815  | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 816  | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 817  | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 818  | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 819  | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 874  | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 875  | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 876  | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 877  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 878  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 879  | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 880  | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 881  | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 882  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 883  | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 884  | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 885  | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 898  | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 899  | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 901  | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 902  | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 903  | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 904  | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 905  | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 906  | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 907  | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 908  | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 909  | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 910  | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 911  | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 912  | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 913  | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 914  | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 915  | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 916  | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 917  | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 918  | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 919  | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 974  | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 975  | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 976  | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 977  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 978  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 979  | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 980  | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 981  | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 982  | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 983  | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 984  | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 985  | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 998  | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 999  | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 1001 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |

|      |     |      |     |    |   |   |     |   |
|------|-----|------|-----|----|---|---|-----|---|
| 1002 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 1003 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1004 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1005 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 1006 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 1007 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1008 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1009 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1010 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 1011 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 1012 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 1013 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 1014 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 1015 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 1016 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1017 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1018 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1019 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1074 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1075 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1076 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1077 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1078 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1079 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1080 | 75  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1081 | 180 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1082 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1083 | 155 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1084 | 196 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1085 | 195 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1098 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 1099 | 39  | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 1101 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 1102 | 250 | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 1103 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1104 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1105 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 1106 | 300 | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 1107 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1108 | 80  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1109 | 350 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1110 | 500 | 12.0 | 100 | 16 | 0 | 0 | 0.0 | 0 |
| 1111 | 200 | 12.0 | 100 | 2  | 0 | 0 | 0.0 | 0 |
| 1112 | 608 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 1113 | 363 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 1114 | 599 | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 1115 | 341 | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 1116 | 772 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1117 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1118 | 64  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 1119 | 756 | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 1174 | 183 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1175 | 150 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1176 | 185 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1177 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1178 | 158 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 1179 | 175 | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |

|      |      |      |     |   |   |   |     |   |
|------|------|------|-----|---|---|---|-----|---|
| 1180 | 75   | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1181 | 180  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1182 | 158  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1183 | 155  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1184 | 196  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1185 | 195  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 1198 | 39   | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |
| 1199 | 39   | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |
| 9999 | 9999 |      |     |   |   |   |     |   |

## Appendix 9

### Output File for 2 Stories of the 225 Foot Square Building

-----  
-----  
Title and User Options  
-----  
-----

One Story 225 Building Total Detailed Exercise - evacuation spd

UNITS = 2    1=Metric,            2=Standard  
SIZE = 1    1=Austrian,        2=Soviet            3=US  
SPEED = 1    1=Emergency,    2=Normal  
PATH = 1    1=Shortest,        2=Directed  
SMOKE = 2    1=CFAST,            2=User defined or none  
CONTRA= 0    1=Contra flows will occur  
FULL = 1    1=Full output, 2=Simple output

NO OF STAIRS = 4 (Must be an integer from 0 to 10)  
STAIR TRAVEL = 1    1=Down stairs    2=Up stairs

Additional randomly distributed delays value = 2 (1=Yes,  
2=No)

-----  
-----  
Building link input descriptions:

Format is:

x1 x2 x3 x4 x5,    where

x1 = The from-node of the link.

Node names are 3 or 4 digit integers where:

The first 1 or 2 digits are the floor number.

The last 2 digits uniquely number the spaces on that  
floor.

Space numbers 1-89 are occupant spaces on the floor.

Numbers 90-99 are reserved for stairways.

Locations of safety are numbered 0 (the entire node  
name is 1 digit).

x2 = The distance from the first node to the center of  
the opening between the two nodes of the link.

Each link must have an "opening" in it.

x3 = The opening width.

x4 = The distance from the center of the opening to the  
second node.

x5 = The to-node of the link.  
-----  
-----

|     |      |     |      |     |
|-----|------|-----|------|-----|
| 196 | 5.0  | 3.0 | 15.0 | 0   |
| 197 | 5.0  | 3.0 | 15.0 | 0   |
| 198 | 5.0  | 3.0 | 15.0 | 0   |
| 199 | 5.0  | 3.0 | 15.0 | 0   |
| 201 | 17.0 | 3.0 | 29.0 | 244 |
| 202 | 17.0 | 3.0 | 30.0 | 243 |
| 203 | 15.0 | 3.0 | 25.0 | 243 |
| 204 | 15.0 | 3.0 | 24.0 | 244 |
| 205 | 8.0  | 3.0 | 9.0  | 245 |
| 206 | 8.0  | 3.0 | 2.5  | 263 |
| 207 | 8.0  | 3.0 | 3.0  | 264 |
| 208 | 8.5  | 3.0 | 3.0  | 242 |
| 209 | 8.0  | 3.0 | 3.5  | 248 |
| 210 | 5.0  | 3.0 | 3.0  | 247 |
| 211 | 14.0 | 3.0 | 6.0  | 246 |
| 212 | 7.5  | 3.0 | 27.0 | 254 |
| 213 | 7.5  | 3.0 | 4.0  | 261 |
| 214 | 7.5  | 3.0 | 16.0 | 253 |
| 215 | 5.0  | 3.0 | 39.0 | 244 |
| 216 | 7.0  | 3.0 | 25.0 | 263 |
| 217 | 7.0  | 3.0 | 3.0  | 259 |
| 218 | 7.0  | 3.0 | 20.0 | 264 |
| 219 | 7.0  | 3.0 | 3.0  | 258 |
| 220 | 5.0  | 3.0 | 38.0 | 243 |
| 221 | 7.5  | 3.0 | 8.0  | 249 |
| 222 | 7.5  | 3.0 | 10.0 | 256 |
| 223 | 7.0  | 3.0 | 25.0 | 248 |
| 224 | 7.0  | 3.0 | 8.0  | 248 |
| 225 | 7.0  | 3.0 | 28.0 | 247 |
| 226 | 7.0  | 3.0 | 4.0  | 254 |
| 227 | 16.0 | 3.0 | 26.0 | 254 |
| 228 | 8.0  | 3.0 | 8.0  | 261 |
| 229 | 8.0  | 3.0 | 8.0  | 260 |
| 230 | 7.0  | 3.0 | 3.0  | 259 |
| 231 | 7.0  | 3.0 | 28.0 | 267 |
| 232 | 7.0  | 3.0 | 3.0  | 258 |
| 233 | 8.0  | 3.0 | 8.0  | 250 |
| 234 | 8.0  | 3.0 | 8.0  | 256 |
| 235 | 8.0  | 3.0 | 32.0 | 256 |
| 236 | 8.0  | 3.0 | 3.0  | 255 |
| 237 | 5.0  | 3.0 | 3.0  | 266 |
| 238 | 5.0  | 3.0 | 3.0  | 266 |
| 239 | 8.5  | 3.0 | 11.0 | 246 |
| 242 | 16.0 | 5.0 | 12.0 | 243 |
| 243 | 30.0 | 3.0 | 2.5  | 299 |
| 244 | 17.0 | 3.0 | 2.5  | 298 |
| 245 | 18.0 | 5.0 | 12.0 | 244 |
| 246 | 30.0 | 5.0 | 9.0  | 247 |
| 247 | 20.0 | 3.0 | 2.5  | 297 |
| 248 | 29.0 | 5.0 | 9.0  | 247 |
| 249 | 26.0 | 5.0 | 12.0 | 243 |
| 250 | 17.0 | 5.0 | 12.0 | 243 |
| 252 | 27.5 | 5.0 | 8.0  | 262 |
| 253 | 27.0 | 5.0 | 12.0 | 244 |
| 254 | 47.0 | 5.0 | 26.0 | 247 |

|      |      |     |      |     |
|------|------|-----|------|-----|
| 255  | 46.0 | 5.0 | 26.0 | 247 |
| 256  | 44.0 | 5.0 | 46.0 | 243 |
| 257  | 45.0 | 5.0 | 46.0 | 243 |
| 258  | 47.0 | 5.0 | 26.0 | 267 |
| 259  | 47.0 | 5.0 | 26.0 | 267 |
| 260  | 45.0 | 5.0 | 47.0 | 244 |
| 261  | 44.0 | 5.0 | 47.0 | 244 |
| 262  | 28.0 | 5.0 | 12.0 | 244 |
| 263  | 33.0 | 5.0 | 9.0  | 267 |
| 264  | 32.0 | 5.0 | 9.0  | 267 |
| 265  | 28.0 | 5.0 | 12.0 | 243 |
| 266  | 6.0  | 3.0 | 28.0 | 247 |
| 267  | 21.0 | 3.0 | 2.5  | 296 |
| 268  | 7.5  | 3.0 | 5.0  | 260 |
| 269  | 7.5  | 3.0 | 14.0 | 262 |
| 270  | 8.0  | 3.0 | 2.0  | 271 |
| 271  | 17.0 | 5.0 | 11.0 | 244 |
| 272  | 8.5  | 3.0 | 2.0  | 250 |
| 273  | 7.5  | 3.0 | 13.0 | 265 |
| 274  | 7.5  | 3.0 | 6.0  | 257 |
| 275  | 5.0  | 3.0 | 3.0  | 267 |
| 296  | 21.3 | 3.7 | 21.3 | 196 |
| 297  | 21.3 | 3.7 | 21.3 | 197 |
| 298  | 21.3 | 3.7 | 21.3 | 198 |
| 299  | 21.3 | 3.7 | 21.3 | 199 |
| 9999 | 0.0  | 0.0 | 0.0  | 0   |

-----  
 -----  
 Building node input descriptions:

Format is:

x1 x2 x3 x4 x5 x6 x7 x8 x9, where

- x1 = The node being described.
- x2 = The usable floor area at the node.
- x3 = Height of the ceiling at the node.
- x4 = Capacity of the space the node represents.
- x5 = The number of people there initially.
- x6 = The number of these people who have travel speeds differing from the norm.  
 If this value is non - zero, a line of the form  
 y1 y2 .....yn will follow the node input description line, where y1 is the fraction of normal speed at which the first occupant of the node will move, y2 = the fraction applying to the 2nd one, etc.
- x7 = A flag indicating if the node is a location of safety such as the outside, a horizontal exit, or a stairway node.
- x8 = The time that occupants of the node will delay before beginning evacuation.
- x9 = (optional) The next node along a directed path to which occupants will move. If shortest path

selection was chosen rather than directed, these values are all 0.

---

|     |       |      |     |    |   |   |     |   |
|-----|-------|------|-----|----|---|---|-----|---|
| 196 | 94.   | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 197 | 94.   | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 198 | 94.   | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 199 | 94.   | 12.0 | 100 | 0  | 0 | 1 | 0.0 | 0 |
| 201 | 1041. | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 202 | 1016. | 12.0 | 100 | 11 | 0 | 0 | 0.0 | 0 |
| 203 | 704.  | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 204 | 736.  | 12.0 | 100 | 12 | 0 | 0 | 0.0 | 0 |
| 205 | 848.  | 12.0 | 100 | 37 | 0 | 0 | 0.0 | 0 |
| 206 | 935.  | 12.0 | 100 | 22 | 0 | 0 | 0.0 | 0 |
| 207 | 918.  | 12.0 | 100 | 22 | 0 | 0 | 0.0 | 0 |
| 208 | 629.  | 12.0 | 100 | 36 | 0 | 0 | 0.0 | 0 |
| 209 | 918.  | 12.0 | 100 | 4  | 0 | 0 | 0.0 | 0 |
| 210 | 112.  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 211 | 1500. | 12.0 | 100 | 10 | 0 | 0 | 0.0 | 0 |
| 212 | 450.  | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 213 | 960.  | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 214 | 960.  | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 215 | 112.  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 216 | 1020. | 12.0 | 100 | 6  | 0 | 0 | 0.0 | 0 |
| 217 | 1020. | 12.0 | 100 | 7  | 0 | 0 | 0.0 | 0 |
| 218 | 1185. | 12.0 | 100 | 7  | 0 | 0 | 0.0 | 0 |
| 219 | 1185. | 12.0 | 100 | 8  | 0 | 0 | 0.0 | 0 |
| 220 | 112.  | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 221 | 720.  | 12.0 | 100 | 7  | 0 | 0 | 0.0 | 0 |
| 222 | 720.  | 12.0 | 100 | 7  | 0 | 0 | 0.0 | 0 |
| 223 | 1035. | 12.0 | 100 | 6  | 0 | 0 | 0.0 | 0 |
| 224 | 1035. | 12.0 | 100 | 6  | 0 | 0 | 0.0 | 0 |
| 225 | 217.  | 12.0 | 100 | 15 | 0 | 0 | 0.0 | 0 |
| 226 | 1395. | 12.0 | 100 | 9  | 0 | 0 | 0.0 | 0 |
| 227 | 1020. | 12.0 | 100 | 30 | 0 | 0 | 0.0 | 0 |
| 228 | 217.  | 12.0 | 100 | 15 | 0 | 0 | 0.0 | 0 |
| 229 | 2255. | 12.0 | 100 | 38 | 0 | 0 | 0.0 | 0 |
| 230 | 1395. | 12.0 | 100 | 9  | 0 | 0 | 0.0 | 0 |
| 231 | 217.  | 12.0 | 100 | 15 | 0 | 0 | 0.0 | 0 |
| 232 | 1395. | 12.0 | 100 | 9  | 0 | 0 | 0.0 | 0 |
| 233 | 2255. | 12.0 | 100 | 39 | 0 | 0 | 0.0 | 0 |
| 234 | 217.  | 12.0 | 100 | 15 | 0 | 0 | 0.0 | 0 |
| 235 | 1015. | 12.0 | 100 | 7  | 0 | 0 | 0.0 | 0 |
| 236 | 1395. | 12.0 | 100 | 28 | 0 | 0 | 0.0 | 0 |
| 237 | 80.   | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 238 | 80.   | 12.0 | 100 | 1  | 0 | 0 | 0.0 | 0 |
| 239 | 646.  | 12.0 | 100 | 3  | 0 | 0 | 0.0 | 0 |
| 242 | 160.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 243 | 485.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 244 | 490.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 245 | 160.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 246 | 350.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 247 | 300.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 248 | 285.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |
| 249 | 265.  | 12.0 | 100 | 0  | 0 | 0 | 0.0 | 0 |



|     |      |      |     |   |   |   |     |   |
|-----|------|------|-----|---|---|---|-----|---|
| 250 | 165. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 252 | 275. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 253 | 265. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 254 | 475. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 255 | 470. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 256 | 440. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 257 | 450. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 258 | 470. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 259 | 475. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 260 | 450. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 261 | 440. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 262 | 275. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 263 | 299. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 264 | 295. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 265 | 275. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 266 | 65.  | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 267 | 285. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 268 | 285. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 269 | 570. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 270 | 561. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 271 | 165. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 272 | 561. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 273 | 570. | 12.0 | 100 | 3 | 0 | 0 | 0.0 | 0 |
| 274 | 570. | 12.0 | 100 | 1 | 0 | 0 | 0.0 | 0 |
| 275 | 110. | 12.0 | 100 | 0 | 0 | 0 | 0.0 | 0 |
| 296 | 94.  | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |
| 297 | 94.  | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |
| 298 | 94.  | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |
| 299 | 94.  | 12.0 | 100 | 0 | 0 | 1 | 0.0 | 0 |

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 -----  
 Notification of occupants will occur at time zero.  
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 Start of building evacuation  
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| 1 | TIME | OCC NUM | ORIG NODE | FROM NODE | TO NODE | NUM OUT | NUM TRAPD |
|---|------|---------|-----------|-----------|---------|---------|-----------|
|   | 1.79 | 168     | 247       | 210       | 247     | 0       | 0         |
|   | 1.84 | 483     | 266       | 237       | 266     | 0       | 0         |
|   | 1.84 | 484     | 266       | 238       | 266     | 0       | 0         |
|   | 2.24 | 205     | 259       | 217       | 259     | 0       | 0         |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 2.24 | 206  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 207  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 208  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 209  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 210  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 211  | 259 | 217  | 259  | 0    | 0   |       |
| 2.24 | 219  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 220  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 221  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 222  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 223  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 224  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 225  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 226  | 258 | 219  | 258  | 0    | 0   |       |
| 2.24 | 361  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 362  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 363  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 364  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 365  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 366  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 367  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 368  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 369  | 259 | 230  | 259  | 0    | 0   |       |
| 2.24 | 385  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 386  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 387  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 388  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 389  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 390  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 391  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 392  | 258 | 232  | 258  | 0    | 0   |       |
| 2.24 | 393  | 258 | 232  | 258  | 0    | 0   |       |
| 2.36 | 500  | 250 | 272  | 250  | 0    | 0   |       |
| 2.36 | 501  | 250 | 272  | 250  | 0    | 0   |       |
| 2.36 | 502  | 250 | 272  | 250  | 0    | 0   |       |
| 2.47 | 269  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 270  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 271  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 272  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 273  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 274  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 275  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 276  | 254 | 226  | 254  | 0    | 0   |       |
| 2.47 | 277  | 254 | 226  | 254  | 0    | 0   |       |
| 2.58 | 182  | 213 | 213  | 261  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 2.58 | 183  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 184  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 185  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 186  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 187  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 188  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 189  | 213 | 213  | 261  | 0    | 0   |       |
| 2.58 | 164  | 209 | 209  | 248  | 0    | 0   |       |
| 2.58 | 165  | 209 | 209  | 248  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 2.58 | 166  | 209 | 209  | 248  | 0    | 0   |       |
| 2.58 | 167  | 209 | 209  | 248  | 0    | 0   |       |
| 2.58 | 84   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 85   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 86   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 87   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 88   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 89   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 90   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 91   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 92   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 93   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 94   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 95   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 96   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 97   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 98   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 99   | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 100  | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 101  | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 102  | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 103  | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 104  | 206 | 206  | 263  | 0    | 0   |       |
| 2.58 | 105  | 206 | 206  | 263  | 0    | 0   |       |
| 2.62 | 455  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 456  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 457  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 458  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 459  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 460  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 461  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 462  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 463  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 464  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 465  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 466  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 467  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 468  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 469  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 470  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 471  | 236 | 236  | 255  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 2.62 | 472  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 473  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 474  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 475  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 476  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 477  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 478  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 479  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 480  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 481  | 236 | 236  | 255  | 0    | 0   |       |
| 2.62 | 482  | 236 | 236  | 255  | 0    | 0   |       |
| 2.70 | 106  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 107  | 207 | 207  | 264  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 2.70 | 108  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 109  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 110  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 111  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 112  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 113  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 114  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 115  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 116  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 117  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 118  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 119  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 120  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 121  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 122  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 123  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 124  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 125  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 126  | 207 | 207  | 264  | 0    | 0   |       |
| 2.70 | 127  | 207 | 207  | 264  | 0    | 0   |       |
| 2.87 | 491  | 268 | 268  | 260  | 0    | 0   |       |
| 2.87 | 492  | 268 | 268  | 260  | 0    | 0   |       |
| 2.87 | 493  | 268 | 268  | 260  | 0    | 0   |       |
| 3.03 | 506  | 274 | 274  | 257  | 0    | 0   |       |
| 3.29 | 128  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 129  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 130  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 131  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 132  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 133  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 134  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 135  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 136  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 137  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 138  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 139  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 140  | 208 | 208  | 242  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 3.29 | 141  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 142  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 143  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 144  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 145  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 146  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 147  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 148  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 149  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 150  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 151  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 152  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 153  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 154  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 155  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 156  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 157  | 208 | 208  | 242  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 3.29 | 158  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 159  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 160  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 161  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 162  | 208 | 208  | 242  | 0    | 0   |       |
| 3.29 | 163  | 208 | 208  | 242  | 0    | 0   |       |
| 3.44 | 248  | 224 | 224  | 248  | 0    | 0   |       |
| 3.44 | 249  | 224 | 224  | 248  | 0    | 0   |       |
| 3.44 | 250  | 224 | 224  | 248  | 0    | 0   |       |
| 3.44 | 251  | 224 | 224  | 248  | 0    | 0   |       |
| 3.44 | 252  | 224 | 224  | 248  | 0    | 0   |       |
| 3.44 | 253  | 224 | 224  | 248  | 0    | 0   |       |
| 3.55 | 228  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 229  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 230  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 231  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 232  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 233  | 221 | 221  | 249  | 0    | 0   |       |
| 3.55 | 234  | 221 | 221  | 249  | 0    | 0   |       |
| 3.74 | 323  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 324  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 325  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 326  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 327  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 328  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 329  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 330  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 331  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 332  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 333  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 334  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 335  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 336  | 229 | 229  | 260  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 3.74 | 337  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 338  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 339  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 340  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 341  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 342  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 343  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 344  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 345  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 346  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 347  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 348  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 349  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 350  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 351  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 352  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 353  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 354  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 355  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 356  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 357  | 229 | 229  | 260  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 3.74 | 358  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 359  | 229 | 229  | 260  | 0    | 0   |       |
| 3.74 | 360  | 229 | 229  | 260  | 0    | 0   |       |
| 3.89 | 394  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 395  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 396  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 397  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 398  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 399  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 400  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 401  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 402  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 403  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 404  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 405  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 406  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 407  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 408  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 409  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 410  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 411  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 412  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 413  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 414  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 415  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 416  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 417  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 418  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 419  | 233 | 233  | 250  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 3.89 | 420  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 421  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 422  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 423  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 424  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 425  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 426  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 427  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 428  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 429  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 430  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 431  | 233 | 233  | 250  | 0    | 0   |       |
| 3.89 | 432  | 233 | 233  | 250  | 0    | 0   |       |
| 3.99 | 235  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 236  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 237  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 238  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 239  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 240  | 222 | 222  | 256  | 0    | 0   |       |
| 3.99 | 241  | 222 | 222  | 256  | 0    | 0   |       |
| 4.30 | 47   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 48   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 49   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 50   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 51   | 205 | 205  | 245  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 4.30 | 52   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 53   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 54   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 55   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 56   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 57   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 58   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 59   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 60   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 61   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 62   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 63   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 64   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 65   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 66   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 67   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 68   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 69   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 70   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 71   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 72   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 73   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 74   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 75   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 76   | 205 | 205  | 245  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 4.30 | 77   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 78   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 79   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 80   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 81   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 82   | 205 | 205  | 245  | 0    | 0   |       |
| 4.30 | 83   | 205 | 205  | 245  | 0    | 0   |       |
| 4.37 | 485  | 239 | 239  | 246  | 0    | 0   |       |
| 4.37 | 486  | 239 | 239  | 246  | 0    | 0   |       |
| 4.37 | 487  | 239 | 239  | 246  | 0    | 0   |       |
| 4.49 | 169  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 170  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 171  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 172  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 173  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 174  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 175  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 176  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 177  | 211 | 211  | 246  | 0    | 0   |       |
| 4.49 | 178  | 211 | 211  | 246  | 0    | 0   |       |
| 4.53 | 433  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 434  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 435  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 436  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 437  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 438  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 439  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 440  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 441  | 234 | 234  | 256  | 0    | 0   |       |

|      |      |     |      |      |      |     |       |
|------|------|-----|------|------|------|-----|-------|
| 4.53 | 442  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 443  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 444  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 445  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 446  | 234 | 234  | 256  | 0    | 0   |       |
| 4.53 | 447  | 234 | 234  | 256  | 0    | 0   |       |
| 4.60 | 503  | 273 | 273  | 265  | 0    | 0   |       |
| 4.60 | 504  | 273 | 273  | 265  | 0    | 0   |       |
| 4.60 | 505  | 273 | 273  | 265  | 0    | 0   |       |
| 4.61 | 308  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 309  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 310  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 311  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 312  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 313  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 314  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 315  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 316  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 317  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 318  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 319  | 228 | 228  | 261  | 0    | 0   |       |
| 1    |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|      | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 4.61 | 320  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 321  | 228 | 228  | 261  | 0    | 0   |       |
| 4.61 | 322  | 228 | 228  | 261  | 0    | 0   |       |
| 4.82 | 494  | 269 | 269  | 262  | 0    | 0   |       |
| 4.82 | 495  | 269 | 269  | 262  | 0    | 0   |       |
| 4.82 | 496  | 269 | 269  | 262  | 0    | 0   |       |
| 5.27 | 190  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 191  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 192  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 193  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 194  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 195  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 196  | 214 | 214  | 253  | 0    | 0   |       |
| 5.27 | 197  | 214 | 214  | 253  | 0    | 0   |       |
| 5.46 | 488  | 267 | 267  | 296  | 0    | 0   |       |
| 5.46 | 489  | 267 | 267  | 296  | 0    | 0   |       |
| 5.46 | 490  | 267 | 267  | 296  | 0    | 0   |       |
| 6.60 | 497  | 271 | 271  | 244  | 0    | 0   |       |
| 6.60 | 498  | 271 | 271  | 244  | 0    | 0   |       |
| 6.60 | 499  | 271 | 271  | 244  | 0    | 0   |       |
| 6.84 | 168  | 247 | 247  | 297  | 0    | 0   |       |
| 8.25 | 179  | 212 | 212  | 254  | 0    | 0   |       |
| 8.25 | 180  | 212 | 212  | 254  | 0    | 0   |       |
| 8.25 | 181  | 212 | 212  | 254  | 0    | 0   |       |
| 8.42 | 242  | 223 | 223  | 248  | 0    | 0   |       |
| 8.42 | 243  | 223 | 223  | 248  | 0    | 0   |       |
| 8.42 | 244  | 223 | 223  | 248  | 0    | 0   |       |
| 8.42 | 245  | 223 | 223  | 248  | 0    | 0   |       |
| 8.42 | 246  | 223 | 223  | 248  | 0    | 0   |       |
| 8.42 | 247  | 223 | 223  | 248  | 0    | 0   |       |
| 8.48 | 212  | 218 | 218  | 264  | 0    | 0   |       |
| 8.48 | 213  | 218 | 218  | 264  | 0    | 0   |       |
| 8.48 | 214  | 218 | 218  | 264  | 0    | 0   |       |



|      |     |      |      |      |     |       |
|------|-----|------|------|------|-----|-------|
| 8.48 | 215 | 218  | 218  | 264  | 0   | 0     |
| 8.48 | 216 | 218  | 218  | 264  | 0   | 0     |
| 8.48 | 217 | 218  | 218  | 264  | 0   | 0     |
| 8.48 | 218 | 218  | 218  | 264  | 0   | 0     |
| 8.61 | 254 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 255 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 256 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 257 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 258 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 259 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 260 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 261 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 262 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 263 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 264 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 265 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 266 | 225  | 225  | 247  | 0   | 0     |
| 1    |     |      |      |      |     |       |
|      | OCC | ORIG | FROM | TO   | NUM | NUM   |
| TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 8.61 | 267 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 268 | 225  | 225  | 247  | 0   | 0     |
| 8.61 | 370 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 371 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 372 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 373 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 374 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 375 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 376 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 377 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 378 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 379 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 380 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 381 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 382 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 383 | 231  | 231  | 267  | 0   | 0     |
| 8.61 | 384 | 231  | 231  | 267  | 0   | 0     |
| 9.03 | 35  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 36  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 37  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 38  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 39  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 40  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 41  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 42  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 43  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 44  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 45  | 204  | 204  | 244  | 0   | 0     |
| 9.03 | 46  | 204  | 204  | 244  | 0   | 0     |
| 9.26 | 23  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 24  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 25  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 26  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 27  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 28  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 29  | 203  | 203  | 243  | 0   | 0     |
| 9.26 | 30  | 203  | 203  | 243  | 0   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 9.26  | 31  | 203  | 203  | 243  | 0   | 0     |
|   | 9.26  | 32  | 203  | 203  | 243  | 0   | 0     |
|   | 9.26  | 33  | 203  | 203  | 243  | 0   | 0     |
|   | 9.26  | 34  | 203  | 203  | 243  | 0   | 0     |
|   | 10.21 | 199 | 216  | 216  | 263  | 0   | 0     |
|   | 10.21 | 200 | 216  | 216  | 263  | 0   | 0     |
|   | 10.21 | 201 | 216  | 216  | 263  | 0   | 0     |
|   | 10.21 | 202 | 216  | 216  | 263  | 0   | 0     |
|   | 10.21 | 203 | 216  | 216  | 263  | 0   | 0     |
|   | 10.21 | 204 | 216  | 216  | 263  | 0   | 0     |
|   | 10.74 | 227 | 220  | 220  | 243  | 0   | 0     |
|   | 10.79 | 278 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 279 | 227  | 227  | 254  | 0   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 10.79 | 280 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 281 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 282 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 283 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 284 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 285 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 286 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 287 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 288 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 289 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 290 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 291 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 292 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 293 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 294 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 295 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 296 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 297 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 298 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 299 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 300 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 301 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 302 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 303 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 304 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 305 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 306 | 227  | 227  | 254  | 0   | 0     |
|   | 10.79 | 307 | 227  | 227  | 254  | 0   | 0     |
|   | 11.28 | 448 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 449 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 450 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 451 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 452 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 453 | 235  | 235  | 256  | 0   | 0     |
|   | 11.28 | 454 | 235  | 235  | 256  | 0   | 0     |
|   | 11.39 | 198 | 215  | 215  | 244  | 0   | 0     |
|   | 11.56 | 12  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 13  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 14  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 15  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 16  | 202  | 202  | 243  | 0   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 11.56 | 17  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 18  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 19  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 20  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 21  | 202  | 202  | 243  | 0   | 0     |
|   | 11.56 | 22  | 202  | 202  | 243  | 0   | 0     |
|   | 11.60 | 1   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 2   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 3   | 201  | 201  | 244  | 0   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 11.60 | 4   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 5   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 6   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 7   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 8   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 9   | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 10  | 201  | 201  | 244  | 0   | 0     |
|   | 11.60 | 11  | 201  | 201  | 244  | 0   | 0     |
|   | 11.72 | 483 | 266  | 266  | 247  | 0   | 0     |
|   | 11.72 | 484 | 266  | 266  | 247  | 0   | 0     |
|   | 12.40 | 497 | 271  | 244  | 298  | 0   | 0     |
|   | 12.40 | 498 | 271  | 244  | 298  | 0   | 0     |
|   | 12.40 | 499 | 271  | 244  | 298  | 0   | 0     |
|   | 13.68 | 228 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 229 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 230 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 231 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 232 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 233 | 221  | 249  | 243  | 0   | 0     |
|   | 13.68 | 234 | 221  | 249  | 243  | 0   | 0     |
|   | 14.28 | 164 | 209  | 248  | 247  | 0   | 0     |
|   | 14.28 | 165 | 209  | 248  | 247  | 0   | 0     |
|   | 14.28 | 166 | 209  | 248  | 247  | 0   | 0     |
|   | 14.28 | 167 | 209  | 248  | 247  | 0   | 0     |
|   | 14.70 | 248 | 224  | 248  | 247  | 0   | 0     |
|   | 14.70 | 249 | 224  | 248  | 247  | 0   | 0     |
|   | 14.70 | 250 | 224  | 248  | 247  | 0   | 0     |
|   | 14.70 | 251 | 224  | 248  | 247  | 0   | 0     |
|   | 14.70 | 252 | 224  | 248  | 247  | 0   | 0     |
|   | 14.70 | 253 | 224  | 248  | 247  | 0   | 0     |
|   | 14.73 | 35  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 36  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 37  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 38  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 39  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 40  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 41  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 42  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 43  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 44  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 45  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 46  | 204  | 244  | 298  | 0   | 0     |
|   | 14.73 | 494 | 269  | 262  | 244  | 0   | 0     |
|   | 14.73 | 495 | 269  | 262  | 244  | 0   | 0     |
|   | 14.73 | 496 | 269  | 262  | 244  | 0   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 14.98 | 503 | 273  | 265  | 243  | 0   | 0     |
|   | 14.98 | 504 | 273  | 265  | 243  | 0   | 0     |
|   | 14.98 | 505 | 273  | 265  | 243  | 0   | 0     |
|   | 15.49 | 370 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 371 | 231  | 267  | 296  | 0   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 15.49 | 372 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 373 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 374 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 375 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 376 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 377 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 378 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 379 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 380 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 381 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 382 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 383 | 231  | 267  | 296  | 0   | 0     |
|   | 15.49 | 384 | 231  | 267  | 296  | 0   | 0     |
|   | 15.54 | 190 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 191 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 192 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 193 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 194 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 195 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 196 | 214  | 253  | 244  | 0   | 0     |
|   | 15.54 | 197 | 214  | 253  | 244  | 0   | 0     |
|   | 15.95 | 485 | 239  | 246  | 247  | 0   | 0     |
|   | 15.95 | 486 | 239  | 246  | 247  | 0   | 0     |
|   | 15.95 | 487 | 239  | 246  | 247  | 0   | 0     |
|   | 15.95 | 169 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 170 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 171 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 172 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 173 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 174 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 175 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 176 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 177 | 211  | 246  | 247  | 0   | 0     |
|   | 15.95 | 178 | 211  | 246  | 247  | 0   | 0     |
|   | 17.07 | 106 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 107 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 108 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 109 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 110 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 111 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 112 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 113 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 114 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 115 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 116 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 117 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 118 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 119 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 120 | 207  | 264  | 267  | 0   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
| 1 | 17.07 | 121 | 207  | 264  | 267  | 0   | 0     |
|   |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 17.07 | 122 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 123 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 124 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 125 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 126 | 207  | 264  | 267  | 0   | 0     |
|   | 17.07 | 127 | 207  | 264  | 267  | 0   | 0     |
|   | 17.57 | 198 | 215  | 244  | 298  | 0   | 0     |
|   | 17.86 | 1   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 2   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 3   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 4   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 5   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 6   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 7   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 8   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 9   | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 10  | 201  | 244  | 298  | 0   | 0     |
|   | 17.86 | 11  | 201  | 244  | 298  | 0   | 0     |
|   | 18.22 | 128 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 129 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 130 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 131 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 132 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 133 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 134 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 135 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 136 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 137 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 138 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 139 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 140 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 141 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 142 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 143 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 144 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 145 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 146 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 147 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 148 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 149 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 150 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 151 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 152 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 153 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 154 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 155 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 156 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 157 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 158 | 208  | 242  | 243  | 0   | 0     |
|   | 18.22 | 159 | 208  | 242  | 243  | 0   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 18.22 | 160  | 208 | 242  | 243  | 0    | 0   |       |
| 18.22 | 161  | 208 | 242  | 243  | 0    | 0   |       |
| 18.22 | 162  | 208 | 242  | 243  | 0    | 0   |       |
| 18.22 | 163  | 208 | 242  | 243  | 0    | 0   |       |
| 18.43 | 84   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 85   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 86   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 87   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 88   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 89   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 90   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 91   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 92   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 93   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 94   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 95   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 96   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 97   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 98   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 99   | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 100  | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 101  | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 102  | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 103  | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 104  | 206 | 263  | 267  | 0    | 0   |       |
| 18.43 | 105  | 206 | 263  | 267  | 0    | 0   |       |
| 18.68 | 254  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 255  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 256  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 257  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 258  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 259  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 260  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 261  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 262  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 263  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 264  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 265  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 266  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 267  | 225 | 247  | 297  | 0    | 0   |       |
| 18.68 | 268  | 225 | 247  | 297  | 0    | 0   |       |
| 18.70 | 242  | 223 | 248  | 247  | 0    | 0   |       |
| 18.70 | 243  | 223 | 248  | 247  | 0    | 0   |       |
| 18.70 | 244  | 223 | 248  | 247  | 0    | 0   |       |
| 18.70 | 245  | 223 | 248  | 247  | 0    | 0   |       |
| 18.70 | 246  | 223 | 248  | 247  | 0    | 0   |       |
| 18.70 | 247  | 223 | 248  | 247  | 0    | 0   |       |
| 19.89 | 47   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 48   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 49   | 205 | 245  | 244  | 0    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 19.89 | 50   | 205 | 245  | 244  |      | 0   | 0     |
| 19.89 | 51   | 205 | 245  | 244  |      | 0   | 0     |
| 19.89 | 52   | 205 | 245  | 244  |      | 0   | 0     |
| 19.89 | 53   | 205 | 245  | 244  |      | 0   | 0     |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 19.89 | 54   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 55   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 56   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 57   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 58   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 59   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 60   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 61   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 62   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 63   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 64   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 65   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 66   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 67   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 68   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 69   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 70   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 71   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 72   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 73   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 74   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 75   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 76   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 77   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 78   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 79   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 80   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 81   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 82   | 205 | 245  | 244  | 0    | 0   |       |
| 19.89 | 83   | 205 | 245  | 244  | 0    | 0   |       |
| 21.12 | 500  | 250 | 250  | 243  | 0    | 0   |       |
| 21.12 | 501  | 250 | 250  | 243  | 0    | 0   |       |
| 21.12 | 502  | 250 | 250  | 243  | 0    | 0   |       |
| 21.13 | 483  | 266 | 247  | 297  | 0    | 0   |       |
| 21.13 | 484  | 266 | 247  | 297  | 0    | 0   |       |
| 21.26 | 212  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 213  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 214  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 215  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 216  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 217  | 218 | 264  | 267  | 0    | 0   |       |
| 21.26 | 218  | 218 | 264  | 267  | 0    | 0   |       |
| 22.21 | 394  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 395  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 396  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 397  | 233 | 250  | 243  | 0    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 22.21 | 398  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 399  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 400  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 401  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 402  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 403  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 404  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 405  | 233 | 250  | 243  | 0    | 0   |       |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 22.21 | 406  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 407  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 408  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 409  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 410  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 411  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 412  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 413  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 414  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 415  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 416  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 417  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 418  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 419  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 420  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 421  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 422  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 423  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 424  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 425  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 426  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 427  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 428  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 429  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 430  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 431  | 233 | 250  | 243  | 0    | 0   |       |
| 22.21 | 432  | 233 | 250  | 243  | 0    | 0   |       |
| 22.96 | 494  | 269 | 244  | 298  | 0    | 0   |       |
| 22.96 | 495  | 269 | 244  | 298  | 0    | 0   |       |
| 22.96 | 496  | 269 | 244  | 298  | 0    | 0   |       |
| 23.48 | 199  | 216 | 263  | 267  | 0    | 0   |       |
| 23.48 | 200  | 216 | 263  | 267  | 0    | 0   |       |
| 23.48 | 201  | 216 | 263  | 267  | 0    | 0   |       |
| 23.48 | 202  | 216 | 263  | 267  | 0    | 0   |       |
| 23.48 | 203  | 216 | 263  | 267  | 0    | 0   |       |
| 23.48 | 204  | 216 | 263  | 267  | 0    | 0   |       |
| 23.53 | 164  | 209 | 247  | 297  | 0    | 0   |       |
| 23.53 | 165  | 209 | 247  | 297  | 0    | 0   |       |
| 23.53 | 166  | 209 | 247  | 297  | 0    | 0   |       |
| 23.53 | 167  | 209 | 247  | 297  | 0    | 0   |       |
| 23.65 | 248  | 224 | 247  | 297  | 0    | 0   |       |
| 23.65 | 249  | 224 | 247  | 297  | 0    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 23.65 | 250  | 224 | 247  | 297  | 0    | 0   |       |
| 23.65 | 251  | 224 | 247  | 297  | 0    | 0   |       |
| 23.65 | 252  | 224 | 247  | 297  | 0    | 0   |       |
| 23.65 | 253  | 224 | 247  | 297  | 0    | 0   |       |
| 23.99 | 190  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 191  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 192  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 193  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 194  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 195  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 196  | 214 | 244  | 298  | 0    | 0   |       |
| 23.99 | 197  | 214 | 244  | 298  | 0    | 0   |       |



|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 24.13 | 169  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 170  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 171  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 172  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 173  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 174  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 175  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 176  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 177  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 178  | 211 | 247  | 297  | 0    | 0   |       |
| 24.13 | 455  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 456  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 457  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 458  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 459  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 460  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 461  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 462  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 463  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 464  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 465  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 466  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 467  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 468  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 469  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 470  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 471  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 472  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 473  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 474  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 475  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 476  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 477  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 478  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 479  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 480  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 481  | 236 | 255  | 247  | 0    | 0   |       |
| 24.13 | 482  | 236 | 255  | 247  | 0    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 24.13 | 485  | 239 | 247  | 297  | 0    | 0   |       |
| 24.13 | 486  | 239 | 247  | 297  | 0    | 0   |       |
| 24.13 | 487  | 239 | 247  | 297  | 0    | 0   |       |
| 25.03 | 488  | 267 | 296  | 196  | 0    | 0   |       |
| 25.03 | 489  | 267 | 296  | 196  | 0    | 0   |       |
| 25.03 | 490  | 267 | 296  | 196  | 0    | 0   |       |
| 28.16 | 47   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 48   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 49   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 50   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 51   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 52   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 53   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 54   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 55   | 205 | 244  | 298  | 0    | 0   |       |
| 28.16 | 56   | 205 | 244  | 298  | 0    | 0   |       |

|       |      |      |      |      |     |       |
|-------|------|------|------|------|-----|-------|
| 28.16 | 57   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 58   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 59   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 60   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 61   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 62   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 63   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 64   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 65   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 66   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 67   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 68   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 69   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 70   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 71   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 72   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 73   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 74   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 75   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 76   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 77   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 78   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 79   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 80   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 81   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 82   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 83   | 205  | 244  | 298  | 0   | 0     |
| 28.16 | 182  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 183  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 184  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 185  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 186  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 187  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 188  | 213  | 261  | 244  | 0   | 0     |
| 1     | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 28.16 | 189  | 213  | 261  | 244  | 0   | 0     |
| 28.16 | 308  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 309  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 310  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 311  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 312  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 313  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 314  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 315  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 316  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 317  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 318  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 319  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 320  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 321  | 228  | 261  | 244  | 0   | 0     |
| 28.16 | 322  | 228  | 261  | 244  | 0   | 0     |
| 29.81 | 242  | 223  | 247  | 297  | 0   | 0     |
| 29.81 | 243  | 223  | 247  | 297  | 0   | 0     |
| 29.81 | 244  | 223  | 247  | 297  | 0   | 0     |
| 29.81 | 245  | 223  | 247  | 297  | 0   | 0     |

|       |      |      |      |      |     |       |
|-------|------|------|------|------|-----|-------|
| 29.81 | 246  | 223  | 247  | 297  | 0   | 0     |
| 29.81 | 247  | 223  | 247  | 297  | 0   | 0     |
| 30.00 | 269  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 270  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 271  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 272  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 273  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 274  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 275  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 276  | 254  | 254  | 247  | 0   | 0     |
| 30.00 | 277  | 254  | 254  | 247  | 0   | 0     |
| 30.75 | 23   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 24   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 25   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 26   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 27   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 28   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 29   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 30   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 31   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 32   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 33   | 203  | 243  | 299  | 0   | 0     |
| 30.75 | 34   | 203  | 243  | 299  | 0   | 0     |
| 30.93 | 205  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 206  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 207  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 208  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 209  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 210  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 211  | 259  | 259  | 267  | 0   | 0     |
| 1     | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 30.93 | 361  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 362  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 363  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 364  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 365  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 366  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 367  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 368  | 259  | 259  | 267  | 0   | 0     |
| 30.93 | 369  | 259  | 259  | 267  | 0   | 0     |
| 31.14 | 227  | 220  | 243  | 299  | 0   | 0     |
| 31.27 | 488  | 267  | 196  | 0    | 1   | 0     |
| 31.27 | 489  | 267  | 196  | 0    | 2   | 0     |
| 31.27 | 490  | 267  | 196  | 0    | 3   | 0     |
| 32.04 | 12   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 13   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 14   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 15   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 16   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 17   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 18   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 19   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 20   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 21   | 202  | 243  | 299  | 3   | 0     |
| 32.04 | 22   | 202  | 243  | 299  | 3   | 0     |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 33.02 | 491  | 268 | 260  | 244  | 3    | 0   |       |
| 33.02 | 492  | 268 | 260  | 244  | 3    | 0   |       |
| 33.02 | 493  | 268 | 260  | 244  | 3    | 0   |       |
| 33.04 | 228  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 229  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 230  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 231  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 232  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 233  | 221 | 243  | 299  | 3    | 0   |       |
| 33.04 | 234  | 221 | 243  | 299  | 3    | 0   |       |
| 33.30 | 370  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 371  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 372  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 373  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 374  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 375  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 376  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 377  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 378  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 379  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 380  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 381  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 382  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 383  | 231 | 296  | 196  | 3    | 0   |       |
| 33.30 | 384  | 231 | 296  | 196  | 3    | 0   |       |
| 33.32 | 106  | 207 | 267  | 296  | 3    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 33.32 | 107  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 108  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 109  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 110  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 111  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 112  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 113  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 114  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 115  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 116  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 117  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 118  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 119  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 120  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 121  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 122  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 123  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 124  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 125  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 126  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 127  | 207 | 267  | 296  | 3    | 0   |       |
| 33.32 | 84   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 85   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 86   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 87   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 88   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 89   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 90   | 206 | 267  | 296  | 3    | 0   |       |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 33.32 | 91   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 92   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 93   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 94   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 95   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 96   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 97   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 98   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 99   | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 100  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 101  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 102  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 103  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 104  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 105  | 206 | 267  | 296  | 3    | 0   |       |
| 33.32 | 219  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 220  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 221  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 222  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 223  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 224  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 225  | 258 | 258  | 267  | 3    | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 33.32 | 226  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 385  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 386  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 387  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 388  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 389  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 390  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 391  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 392  | 258 | 258  | 267  | 3    | 0   |       |
| 33.32 | 393  | 258 | 258  | 267  | 3    | 0   |       |
| 33.67 | 503  | 273 | 243  | 299  | 3    | 0   |       |
| 33.67 | 504  | 273 | 243  | 299  | 3    | 0   |       |
| 33.67 | 505  | 273 | 243  | 299  | 3    | 0   |       |
| 33.81 | 323  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 324  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 325  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 326  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 327  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 328  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 329  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 330  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 331  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 332  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 333  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 334  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 335  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 336  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 337  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 338  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 339  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 340  | 229 | 260  | 244  | 3    | 0   |       |
| 33.81 | 341  | 229 | 260  | 244  | 3    | 0   |       |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 33.81 | 342 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 343 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 344 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 345 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 346 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 347 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 348 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 349 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 350 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 351 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 352 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 353 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 354 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 355 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 356 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 357 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 358 | 229  | 260  | 244  | 3   | 0     |
|   | 33.81 | 359 | 229  | 260  | 244  | 3   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 33.81 | 360 | 229  | 260  | 244  | 3   | 0     |
|   | 35.21 | 212 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 213 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 214 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 215 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 216 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 217 | 218  | 267  | 296  | 3   | 0     |
|   | 35.21 | 218 | 218  | 267  | 296  | 3   | 0     |
|   | 35.43 | 179 | 212  | 254  | 247  | 3   | 0     |
|   | 35.43 | 180 | 212  | 254  | 247  | 3   | 0     |
|   | 35.43 | 181 | 212  | 254  | 247  | 3   | 0     |
|   | 36.04 | 455 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 456 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 457 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 458 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 459 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 460 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 461 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 462 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 463 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 464 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 465 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 466 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 467 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 468 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 469 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 470 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 471 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 472 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 473 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 474 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 475 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 476 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 477 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 478 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 479 | 236  | 247  | 297  | 3   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 36.04 | 480 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 481 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 482 | 236  | 247  | 297  | 3   | 0     |
|   | 36.04 | 278 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 279 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 280 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 281 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 282 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 283 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 284 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 285 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 286 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 287 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 288 | 227  | 254  | 247  | 3   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 36.04 | 289 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 290 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 291 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 292 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 293 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 294 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 295 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 296 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 297 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 298 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 299 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 300 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 301 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 302 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 303 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 304 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 305 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 306 | 227  | 254  | 247  | 3   | 0     |
|   | 36.04 | 307 | 227  | 254  | 247  | 3   | 0     |
|   | 36.55 | 128 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 129 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 130 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 131 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 132 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 133 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 134 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 135 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 136 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 137 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 138 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 139 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 140 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 141 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 142 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 143 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 144 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 145 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 146 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 147 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 148 | 208  | 243  | 299  | 3   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 36.55 | 149 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 150 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 151 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 152 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 153 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 154 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 155 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 156 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 157 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 158 | 208  | 243  | 299  | 3   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 36.55 | 159 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 160 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 161 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 162 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 163 | 208  | 243  | 299  | 3   | 0     |
|   | 36.55 | 235 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 236 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 237 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 238 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 239 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 240 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 241 | 222  | 256  | 243  | 3   | 0     |
|   | 36.55 | 433 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 434 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 435 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 436 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 437 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 438 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 439 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 440 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 441 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 442 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 443 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 444 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 445 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 446 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 447 | 234  | 256  | 243  | 3   | 0     |
|   | 36.55 | 506 | 274  | 257  | 243  | 3   | 0     |
|   | 36.87 | 199 | 216  | 267  | 296  | 3   | 0     |
|   | 36.87 | 200 | 216  | 267  | 296  | 3   | 0     |
|   | 36.87 | 201 | 216  | 267  | 296  | 3   | 0     |
|   | 36.87 | 202 | 216  | 267  | 296  | 3   | 0     |
|   | 36.87 | 203 | 216  | 267  | 296  | 3   | 0     |
|   | 36.87 | 204 | 216  | 267  | 296  | 3   | 0     |
|   | 38.32 | 182 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 183 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 184 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 185 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 186 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 187 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 188 | 213  | 244  | 298  | 3   | 0     |
|   | 38.32 | 189 | 213  | 244  | 298  | 3   | 0     |
|   | 39.27 | 308 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 309 | 228  | 244  | 298  | 3   | 0     |



|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 39.27 | 310 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 311 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 312 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 313 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 314 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 315 | 228  | 244  | 298  | 3   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 39.27 | 316 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 317 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 318 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 319 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 320 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 321 | 228  | 244  | 298  | 3   | 0     |
|   | 39.27 | 322 | 228  | 244  | 298  | 3   | 0     |
|   | 39.70 | 500 | 250  | 243  | 299  | 3   | 0     |
|   | 39.70 | 501 | 250  | 243  | 299  | 3   | 0     |
|   | 39.70 | 502 | 250  | 243  | 299  | 3   | 0     |
|   | 40.34 | 394 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 395 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 396 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 397 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 398 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 399 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 400 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 401 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 402 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 403 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 404 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 405 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 406 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 407 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 408 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 409 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 410 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 411 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 412 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 413 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 414 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 415 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 416 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 417 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 418 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 419 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 420 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 421 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 422 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 423 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 424 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 425 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 426 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 427 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 428 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 429 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 430 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 431 | 233  | 243  | 299  | 3   | 0     |

|   |       |     |      |      |      |     |       |
|---|-------|-----|------|------|------|-----|-------|
|   | 40.34 | 432 | 233  | 243  | 299  | 3   | 0     |
|   | 40.34 | 448 | 235  | 256  | 243  | 3   | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 40.34 | 449 | 235  | 256  | 243  | 3   | 0     |
|   | 40.34 | 450 | 235  | 256  | 243  | 3   | 0     |
|   | 40.34 | 451 | 235  | 256  | 243  | 3   | 0     |
|   | 40.34 | 452 | 235  | 256  | 243  | 3   | 0     |
|   | 40.34 | 453 | 235  | 256  | 243  | 3   | 0     |
|   | 40.34 | 454 | 235  | 256  | 243  | 3   | 0     |
|   | 40.56 | 370 | 231  | 196  | 0    | 4   | 0     |
|   | 40.56 | 371 | 231  | 196  | 0    | 5   | 0     |
|   | 40.56 | 372 | 231  | 196  | 0    | 6   | 0     |
|   | 40.56 | 373 | 231  | 196  | 0    | 7   | 0     |
|   | 40.56 | 374 | 231  | 196  | 0    | 8   | 0     |
|   | 40.56 | 375 | 231  | 196  | 0    | 9   | 0     |
|   | 40.56 | 376 | 231  | 196  | 0    | 10  | 0     |
|   | 40.56 | 377 | 231  | 196  | 0    | 11  | 0     |
|   | 40.56 | 378 | 231  | 196  | 0    | 12  | 0     |
|   | 40.56 | 379 | 231  | 196  | 0    | 13  | 0     |
|   | 40.56 | 380 | 231  | 196  | 0    | 14  | 0     |
|   | 40.56 | 381 | 231  | 196  | 0    | 15  | 0     |
|   | 40.56 | 382 | 231  | 196  | 0    | 16  | 0     |
|   | 40.56 | 383 | 231  | 196  | 0    | 17  | 0     |
|   | 40.56 | 384 | 231  | 196  | 0    | 18  | 0     |
|   | 43.47 | 491 | 268  | 244  | 298  | 18  | 0     |
|   | 43.47 | 492 | 268  | 244  | 298  | 18  | 0     |
|   | 43.47 | 493 | 268  | 244  | 298  | 18  | 0     |
|   | 43.66 | 219 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 220 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 221 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 222 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 223 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 224 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 225 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 226 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 385 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 386 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 387 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 388 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 389 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 390 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 391 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 392 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 393 | 258  | 267  | 296  | 18  | 0     |
|   | 43.66 | 205 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 206 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 207 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 208 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 209 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 210 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 211 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 361 | 259  | 267  | 296  | 18  | 0     |
|   | 43.66 | 362 | 259  | 267  | 296  | 18  | 0     |
| 1 |       | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME  | NUM | NODE | NODE | NODE | OUT | TRAPD |

|       |      |      |      |      |     |       |
|-------|------|------|------|------|-----|-------|
| 43.66 | 363  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 364  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 365  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 366  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 367  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 368  | 259  | 267  | 296  | 18  | 0     |
| 43.66 | 369  | 259  | 267  | 296  | 18  | 0     |
| 44.04 | 323  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 324  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 325  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 326  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 327  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 328  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 329  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 330  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 331  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 332  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 333  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 334  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 335  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 336  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 337  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 338  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 339  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 340  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 341  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 342  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 343  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 344  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 345  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 346  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 347  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 348  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 349  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 350  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 351  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 352  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 353  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 354  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 355  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 356  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 357  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 358  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 359  | 229  | 244  | 298  | 18  | 0     |
| 44.04 | 360  | 229  | 244  | 298  | 18  | 0     |
| 44.16 | 269  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 270  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 271  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 272  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 273  | 254  | 247  | 297  | 18  | 0     |
| 1     | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 44.16 | 274  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 275  | 254  | 247  | 297  | 18  | 0     |
| 44.16 | 276  | 254  | 247  | 297  | 18  | 0     |

|       |      |      |      |      |     |       |
|-------|------|------|------|------|-----|-------|
| 44.16 | 277  | 254  | 247  | 297  | 18  | 0     |
| 44.21 | 506  | 274  | 243  | 299  | 18  | 0     |
| 45.62 | 278  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 279  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 280  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 281  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 282  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 283  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 284  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 285  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 286  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 287  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 288  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 289  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 290  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 291  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 292  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 293  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 294  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 295  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 296  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 297  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 298  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 299  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 300  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 301  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 302  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 303  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 304  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 305  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 306  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 307  | 227  | 247  | 297  | 18  | 0     |
| 45.62 | 179  | 212  | 247  | 297  | 18  | 0     |
| 45.62 | 180  | 212  | 247  | 297  | 18  | 0     |
| 45.62 | 181  | 212  | 247  | 297  | 18  | 0     |
| 48.25 | 448  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 449  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 450  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 451  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 452  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 453  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 454  | 235  | 243  | 299  | 18  | 0     |
| 48.25 | 235  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 236  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 237  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 238  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 239  | 222  | 243  | 299  | 18  | 0     |
| 1     | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 48.25 | 240  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 241  | 222  | 243  | 299  | 18  | 0     |
| 48.25 | 433  | 234  | 243  | 299  | 18  | 0     |
| 48.25 | 434  | 234  | 243  | 299  | 18  | 0     |
| 48.25 | 435  | 234  | 243  | 299  | 18  | 0     |
| 48.25 | 436  | 234  | 243  | 299  | 18  | 0     |
| 48.25 | 437  | 234  | 243  | 299  | 18  | 0     |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 48.25 | 438  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 439  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 440  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 441  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 442  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 443  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 444  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 445  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 446  | 234 | 243  | 299  | 18   | 0   |       |
| 48.25 | 447  | 234 | 243  | 299  | 18   | 0   |       |
| 79.66 | 168  | 247 | 297  | 197  | 18   | 0   |       |
| 85.21 | 497  | 271 | 298  | 198  | 18   | 0   |       |
| 85.21 | 498  | 271 | 298  | 198  | 18   | 0   |       |
| 85.21 | 499  | 271 | 298  | 198  | 18   | 0   |       |
| 85.83 | 168  | 247 | 197  | 0    | 19   | 0   |       |
| 87.93 | 35   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 36   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 37   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 38   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 39   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 40   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 41   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 42   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 43   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 44   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 45   | 204 | 298  | 198  | 19   | 0   |       |
| 87.93 | 46   | 204 | 298  | 198  | 19   | 0   |       |
| 91.50 | 254  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 255  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 256  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 257  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 258  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 259  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 260  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 261  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 262  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 263  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 264  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 265  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 266  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 267  | 225 | 297  | 197  | 19   | 0   |       |
| 91.50 | 268  | 225 | 297  | 197  | 19   | 0   |       |
| 92.47 | 497  | 271 | 198  | 0    | 20   | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 92.47 | 498  | 271 | 198  | 0    | 21   | 0   |       |
| 92.47 | 499  | 271 | 198  | 0    | 22   | 0   |       |
| 93.62 | 198  | 215 | 298  | 198  | 22   | 0   |       |
| 94.47 | 1    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 2    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 3    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 4    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 5    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 6    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 7    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 8    | 201 | 298  | 198  | 22   | 0   |       |

|       |      |     |      |      |      |     |       |
|-------|------|-----|------|------|------|-----|-------|
| 94.47 | 9    | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 10   | 201 | 298  | 198  | 22   | 0   |       |
| 94.47 | 11   | 201 | 298  | 198  | 22   | 0   |       |
| 96.64 | 35   | 204 | 198  | 0    | 23   | 0   |       |
| 96.64 | 36   | 204 | 198  | 0    | 24   | 0   |       |
| 96.64 | 37   | 204 | 198  | 0    | 25   | 0   |       |
| 96.64 | 38   | 204 | 198  | 0    | 26   | 0   |       |
| 96.64 | 39   | 204 | 198  | 0    | 27   | 0   |       |
| 96.64 | 40   | 204 | 198  | 0    | 28   | 0   |       |
| 96.64 | 41   | 204 | 198  | 0    | 29   | 0   |       |
| 96.64 | 42   | 204 | 198  | 0    | 30   | 0   |       |
| 96.64 | 43   | 204 | 198  | 0    | 31   | 0   |       |
| 96.64 | 44   | 204 | 198  | 0    | 32   | 0   |       |
| 96.64 | 45   | 204 | 198  | 0    | 33   | 0   |       |
| 96.64 | 46   | 204 | 198  | 0    | 34   | 0   |       |
| 98.65 | 483  | 266 | 297  | 197  | 34   | 0   |       |
| 98.65 | 484  | 266 | 297  | 197  | 34   | 0   |       |
| 98.99 | 254  | 225 | 197  | 0    | 35   | 0   |       |
| 98.99 | 255  | 225 | 197  | 0    | 36   | 0   |       |
| 98.99 | 256  | 225 | 197  | 0    | 37   | 0   |       |
| 98.99 | 257  | 225 | 197  | 0    | 38   | 0   |       |
| 98.99 | 258  | 225 | 197  | 0    | 39   | 0   |       |
| 98.99 | 259  | 225 | 197  | 0    | 40   | 0   |       |
| 98.99 | 260  | 225 | 197  | 0    | 41   | 0   |       |
| 98.99 | 261  | 225 | 197  | 0    | 42   | 0   |       |
| 98.99 | 262  | 225 | 197  | 0    | 43   | 0   |       |
| 98.99 | 263  | 225 | 197  | 0    | 44   | 0   |       |
| 98.99 | 264  | 225 | 197  | 0    | 45   | 0   |       |
| 98.99 | 265  | 225 | 197  | 0    | 46   | 0   |       |
| 98.99 | 266  | 225 | 197  | 0    | 47   | 0   |       |
| 98.99 | 267  | 225 | 197  | 0    | 48   | 0   |       |
| 98.99 | 268  | 225 | 197  | 0    | 49   | 0   |       |
| 98.99 | 164  | 209 | 297  | 197  | 49   | 0   |       |
| 98.99 | 165  | 209 | 297  | 197  | 49   | 0   |       |
| 98.99 | 166  | 209 | 297  | 197  | 49   | 0   |       |
| 98.99 | 167  | 209 | 297  | 197  | 49   | 0   |       |
| 98.99 | 169  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 170  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 171  | 211 | 297  | 197  | 49   | 0   |       |
| 1     |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|       | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 98.99 | 172  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 173  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 174  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 175  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 176  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 177  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 178  | 211 | 297  | 197  | 49   | 0   |       |
| 98.99 | 248  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 249  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 250  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 251  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 252  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 253  | 224 | 297  | 197  | 49   | 0   |       |
| 98.99 | 485  | 239 | 297  | 197  | 49   | 0   |       |
| 98.99 | 486  | 239 | 297  | 197  | 49   | 0   |       |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 98.99  | 487  | 239 | 297  | 197  | 49   | 0   |       |
| 99.00  | 494  | 269 | 298  | 198  | 49   | 0   |       |
| 99.00  | 495  | 269 | 298  | 198  | 49   | 0   |       |
| 99.00  | 496  | 269 | 298  | 198  | 49   | 0   |       |
| 100.87 | 198  | 215 | 198  | 0    | 50   | 0   |       |
| 100.88 | 190  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 191  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 192  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 193  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 194  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 195  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 196  | 214 | 298  | 198  | 50   | 0   |       |
| 100.88 | 197  | 214 | 298  | 198  | 50   | 0   |       |
| 102.84 | 1    | 201 | 198  | 0    | 51   | 0   |       |
| 102.84 | 2    | 201 | 198  | 0    | 52   | 0   |       |
| 102.84 | 3    | 201 | 198  | 0    | 53   | 0   |       |
| 102.84 | 4    | 201 | 198  | 0    | 54   | 0   |       |
| 102.84 | 5    | 201 | 198  | 0    | 55   | 0   |       |
| 102.84 | 6    | 201 | 198  | 0    | 56   | 0   |       |
| 102.84 | 7    | 201 | 198  | 0    | 57   | 0   |       |
| 102.84 | 8    | 201 | 198  | 0    | 58   | 0   |       |
| 102.84 | 9    | 201 | 198  | 0    | 59   | 0   |       |
| 102.84 | 10   | 201 | 198  | 0    | 60   | 0   |       |
| 102.84 | 11   | 201 | 198  | 0    | 61   | 0   |       |
| 103.56 | 23   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 24   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 25   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 26   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 27   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 28   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 29   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 30   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 31   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 32   | 203 | 299  | 199  | 61   | 0   |       |
| 103.56 | 33   | 203 | 299  | 199  | 61   | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 103.56 | 34   | 203 | 299  | 199  | 61   | 0   |       |
| 103.71 | 47   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 48   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 49   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 50   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 51   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 52   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 53   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 54   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 55   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 56   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 57   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 58   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 59   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 60   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 61   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 62   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 63   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 64   | 205 | 298  | 198  | 61   | 0   |       |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 103.71 | 65   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 66   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 67   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 68   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 69   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 70   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 71   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 72   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 73   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 74   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 75   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 76   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 77   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 78   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 79   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 80   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 81   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 82   | 205 | 298  | 198  | 61   | 0   |       |
| 103.71 | 83   | 205 | 298  | 198  | 61   | 0   |       |
| 105.27 | 84   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 85   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 86   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 87   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 88   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 89   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 90   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 91   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 92   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 93   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 94   | 206 | 296  | 196  | 61   | 0   |       |
| 105.27 | 95   | 206 | 296  | 196  | 61   | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 105.27 | 96   | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 97   | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 98   | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 99   | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 100  | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 101  | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 102  | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 103  | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 104  | 206 | 296  | 196  |      | 61  | 0     |
| 105.27 | 105  | 206 | 296  | 196  |      | 61  | 0     |
| 105.49 | 164  | 209 | 197  | 0    |      | 62  | 0     |
| 105.49 | 165  | 209 | 197  | 0    |      | 63  | 0     |
| 105.49 | 166  | 209 | 197  | 0    |      | 64  | 0     |
| 105.49 | 167  | 209 | 197  | 0    |      | 65  | 0     |
| 105.49 | 169  | 211 | 197  | 0    |      | 66  | 0     |
| 105.49 | 170  | 211 | 197  | 0    |      | 67  | 0     |
| 105.49 | 171  | 211 | 197  | 0    |      | 68  | 0     |
| 105.49 | 172  | 211 | 197  | 0    |      | 69  | 0     |
| 105.49 | 173  | 211 | 197  | 0    |      | 70  | 0     |
| 105.49 | 174  | 211 | 197  | 0    |      | 71  | 0     |
| 105.49 | 175  | 211 | 197  | 0    |      | 72  | 0     |
| 105.49 | 176  | 211 | 197  | 0    |      | 73  | 0     |
| 105.49 | 177  | 211 | 197  | 0    |      | 74  | 0     |



|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 105.49 | 178  | 211 | 197  | 0    | 75   | 0   |       |
| 105.49 | 248  | 224 | 197  | 0    | 76   | 0   |       |
| 105.49 | 249  | 224 | 197  | 0    | 77   | 0   |       |
| 105.49 | 250  | 224 | 197  | 0    | 78   | 0   |       |
| 105.49 | 251  | 224 | 197  | 0    | 79   | 0   |       |
| 105.49 | 252  | 224 | 197  | 0    | 80   | 0   |       |
| 105.49 | 253  | 224 | 197  | 0    | 81   | 0   |       |
| 105.49 | 485  | 239 | 197  | 0    | 82   | 0   |       |
| 105.49 | 486  | 239 | 197  | 0    | 83   | 0   |       |
| 105.49 | 487  | 239 | 197  | 0    | 84   | 0   |       |
| 105.49 | 242  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 243  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 244  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 245  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 246  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 247  | 223 | 297  | 197  | 84   | 0   |       |
| 105.49 | 483  | 266 | 197  | 0    | 85   | 0   |       |
| 105.49 | 484  | 266 | 197  | 0    | 86   | 0   |       |
| 107.18 | 227  | 220 | 299  | 199  | 86   | 0   |       |
| 108.64 | 12   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 13   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 14   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 15   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 16   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 17   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 18   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 19   | 202 | 299  | 199  | 86   | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 108.64 | 20   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 21   | 202 | 299  | 199  | 86   | 0   |       |
| 108.64 | 22   | 202 | 299  | 199  | 86   | 0   |       |
| 109.20 | 242  | 223 | 197  | 0    | 87   | 0   |       |
| 109.20 | 243  | 223 | 197  | 0    | 88   | 0   |       |
| 109.20 | 244  | 223 | 197  | 0    | 89   | 0   |       |
| 109.20 | 245  | 223 | 197  | 0    | 90   | 0   |       |
| 109.20 | 246  | 223 | 197  | 0    | 91   | 0   |       |
| 109.20 | 247  | 223 | 197  | 0    | 92   | 0   |       |
| 109.20 | 455  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 456  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 457  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 458  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 459  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 460  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 461  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 462  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 463  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 464  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 465  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 466  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 467  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 468  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 469  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 470  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 471  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 472  | 236 | 297  | 197  | 92   | 0   |       |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 109.20 | 473  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 474  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 475  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 476  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 477  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 478  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 479  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 480  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 481  | 236 | 297  | 197  | 92   | 0   |       |
| 109.20 | 482  | 236 | 297  | 197  | 92   | 0   |       |
| 111.14 | 269  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 270  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 271  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 272  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 273  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 274  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 275  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 276  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 277  | 254 | 297  | 197  | 92   | 0   |       |
| 111.14 | 179  | 212 | 297  | 197  | 92   | 0   |       |
| 111.14 | 180  | 212 | 297  | 197  | 92   | 0   |       |
| 111.14 | 181  | 212 | 297  | 197  | 92   | 0   |       |
| 111.14 | 278  | 227 | 297  | 197  | 92   | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 111.14 | 279  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 280  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 281  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 282  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 283  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 284  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 285  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 286  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 287  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 288  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 289  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 290  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 291  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 292  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 293  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 294  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 295  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 296  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 297  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 298  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 299  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 300  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 301  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 302  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 303  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 304  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 305  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 306  | 227 | 297  | 197  | 92   | 0   |       |
| 111.14 | 307  | 227 | 297  | 197  | 92   | 0   |       |
| 112.28 | 23   | 203 | 199  | 0    | 93   | 0   |       |
| 112.28 | 24   | 203 | 199  | 0    | 94   | 0   |       |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 112.28 | 25   | 203 | 199  | 0    | 95   | 0   |       |
| 112.28 | 26   | 203 | 199  | 0    | 96   | 0   |       |
| 112.28 | 27   | 203 | 199  | 0    | 97   | 0   |       |
| 112.28 | 28   | 203 | 199  | 0    | 98   | 0   |       |
| 112.28 | 29   | 203 | 199  | 0    | 99   | 0   |       |
| 112.28 | 30   | 203 | 199  | 0    | 100  | 0   |       |
| 112.28 | 31   | 203 | 199  | 0    | 101  | 0   |       |
| 112.28 | 32   | 203 | 199  | 0    | 102  | 0   |       |
| 112.28 | 33   | 203 | 199  | 0    | 103  | 0   |       |
| 112.28 | 34   | 203 | 199  | 0    | 104  | 0   |       |
| 112.28 | 228  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 229  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 230  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 231  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 232  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 233  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 234  | 221 | 299  | 199  | 104  | 0   |       |
| 112.28 | 503  | 273 | 299  | 199  | 104  | 0   |       |
| 112.28 | 504  | 273 | 299  | 199  | 104  | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 112.28 | 505  | 273 | 299  | 199  | 104  | 0   |       |
| 113.64 | 84   | 206 | 196  | 0    | 105  | 0   |       |
| 113.64 | 85   | 206 | 196  | 0    | 106  | 0   |       |
| 113.64 | 86   | 206 | 196  | 0    | 107  | 0   |       |
| 113.64 | 87   | 206 | 196  | 0    | 108  | 0   |       |
| 113.64 | 88   | 206 | 196  | 0    | 109  | 0   |       |
| 113.64 | 89   | 206 | 196  | 0    | 110  | 0   |       |
| 113.64 | 90   | 206 | 196  | 0    | 111  | 0   |       |
| 113.64 | 91   | 206 | 196  | 0    | 112  | 0   |       |
| 113.64 | 92   | 206 | 196  | 0    | 113  | 0   |       |
| 113.64 | 93   | 206 | 196  | 0    | 114  | 0   |       |
| 113.64 | 94   | 206 | 196  | 0    | 115  | 0   |       |
| 113.64 | 95   | 206 | 196  | 0    | 116  | 0   |       |
| 113.64 | 96   | 206 | 196  | 0    | 117  | 0   |       |
| 113.64 | 97   | 206 | 196  | 0    | 118  | 0   |       |
| 113.64 | 98   | 206 | 196  | 0    | 119  | 0   |       |
| 113.64 | 99   | 206 | 196  | 0    | 120  | 0   |       |
| 113.64 | 100  | 206 | 196  | 0    | 121  | 0   |       |
| 113.64 | 101  | 206 | 196  | 0    | 122  | 0   |       |
| 113.64 | 102  | 206 | 196  | 0    | 123  | 0   |       |
| 113.64 | 103  | 206 | 196  | 0    | 124  | 0   |       |
| 113.64 | 104  | 206 | 196  | 0    | 125  | 0   |       |
| 113.64 | 105  | 206 | 196  | 0    | 126  | 0   |       |
| 113.64 | 106  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 107  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 108  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 109  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 110  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 111  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 112  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 113  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 114  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 115  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 116  | 207 | 296  | 196  | 126  | 0   |       |
| 113.64 | 117  | 207 | 296  | 196  | 126  | 0   |       |

|        |      |      |      |      |     |       |
|--------|------|------|------|------|-----|-------|
| 113.64 | 118  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 119  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 120  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 121  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 122  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 123  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 124  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 125  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 126  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 127  | 207  | 296  | 196  | 126 | 0     |
| 113.64 | 199  | 216  | 296  | 196  | 126 | 0     |
| 113.64 | 200  | 216  | 296  | 196  | 126 | 0     |
| 113.64 | 201  | 216  | 296  | 196  | 126 | 0     |
| 113.64 | 202  | 216  | 296  | 196  | 126 | 0     |
| 113.64 | 203  | 216  | 296  | 196  | 126 | 0     |
| 1      | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 113.64 | 204  | 216  | 296  | 196  | 126 | 0     |
| 113.64 | 212  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 213  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 214  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 215  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 216  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 217  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 218  | 218  | 296  | 196  | 126 | 0     |
| 113.64 | 205  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 206  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 207  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 208  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 209  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 210  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 211  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 219  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 220  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 221  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 222  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 223  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 224  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 225  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 226  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 361  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 362  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 363  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 364  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 365  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 366  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 367  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 368  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 369  | 259  | 296  | 196  | 126 | 0     |
| 113.64 | 385  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 386  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 387  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 388  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 389  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 390  | 258  | 296  | 196  | 126 | 0     |
| 113.64 | 391  | 258  | 296  | 196  | 126 | 0     |

|   |        |     |      |      |      |     |       |
|---|--------|-----|------|------|------|-----|-------|
|   | 113.64 | 392 | 258  | 296  | 196  | 126 | 0     |
|   | 113.64 | 393 | 258  | 296  | 196  | 126 | 0     |
|   | 115.55 | 227 | 220  | 199  | 0    | 127 | 0     |
|   | 116.80 | 12  | 202  | 199  | 0    | 128 | 0     |
|   | 116.80 | 13  | 202  | 199  | 0    | 129 | 0     |
|   | 116.80 | 14  | 202  | 199  | 0    | 130 | 0     |
|   | 116.80 | 15  | 202  | 199  | 0    | 131 | 0     |
|   | 116.80 | 16  | 202  | 199  | 0    | 132 | 0     |
|   | 116.80 | 17  | 202  | 199  | 0    | 133 | 0     |
|   | 116.80 | 18  | 202  | 199  | 0    | 134 | 0     |
|   | 116.80 | 19  | 202  | 199  | 0    | 135 | 0     |
| 1 |        | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME   | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 116.80 | 20  | 202  | 199  | 0    | 136 | 0     |
|   | 116.80 | 21  | 202  | 199  | 0    | 137 | 0     |
|   | 116.80 | 22  | 202  | 199  | 0    | 138 | 0     |
|   | 116.80 | 128 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 129 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 130 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 131 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 132 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 133 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 134 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 135 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 136 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 137 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 138 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 139 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 140 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 141 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 142 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 143 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 144 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 145 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 146 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 147 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 148 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 149 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 150 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 151 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 152 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 153 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 154 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 155 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 156 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 157 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 158 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 159 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 160 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 161 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 162 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 163 | 208  | 299  | 199  | 138 | 0     |
|   | 116.80 | 228 | 221  | 199  | 0    | 139 | 0     |
|   | 116.80 | 229 | 221  | 199  | 0    | 140 | 0     |
|   | 116.80 | 230 | 221  | 199  | 0    | 141 | 0     |
|   | 116.80 | 231 | 221  | 199  | 0    | 142 | 0     |

|   |        |     |      |      |      |     |       |
|---|--------|-----|------|------|------|-----|-------|
|   | 116.80 | 232 | 221  | 199  | 0    | 143 | 0     |
|   | 116.80 | 233 | 221  | 199  | 0    | 144 | 0     |
|   | 116.80 | 234 | 221  | 199  | 0    | 145 | 0     |
|   | 116.80 | 394 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 395 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 396 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 397 | 233  | 299  | 199  | 145 | 0     |
| 1 |        | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME   | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 116.80 | 398 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 399 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 400 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 401 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 402 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 403 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 404 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 405 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 406 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 407 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 408 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 409 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 410 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 411 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 412 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 413 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 414 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 415 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 416 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 417 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 418 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 419 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 420 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 421 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 422 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 423 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 424 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 425 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 426 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 427 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 428 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 429 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 430 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 431 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 432 | 233  | 299  | 199  | 145 | 0     |
|   | 116.80 | 500 | 250  | 299  | 199  | 145 | 0     |
|   | 116.80 | 501 | 250  | 299  | 199  | 145 | 0     |
|   | 116.80 | 502 | 250  | 299  | 199  | 145 | 0     |
|   | 116.80 | 503 | 273  | 199  | 0    | 146 | 0     |
|   | 116.80 | 504 | 273  | 199  | 0    | 147 | 0     |
|   | 116.80 | 505 | 273  | 199  | 0    | 148 | 0     |
|   | 116.99 | 494 | 269  | 198  | 0    | 149 | 0     |
|   | 116.99 | 495 | 269  | 198  | 0    | 150 | 0     |
|   | 116.99 | 496 | 269  | 198  | 0    | 151 | 0     |
|   | 117.59 | 190 | 214  | 198  | 0    | 152 | 0     |
|   | 117.59 | 191 | 214  | 198  | 0    | 153 | 0     |
|   | 117.59 | 192 | 214  | 198  | 0    | 154 | 0     |

|   |        |     |      |      |      |     |       |
|---|--------|-----|------|------|------|-----|-------|
|   | 117.59 | 193 | 214  | 198  | 0    | 155 | 0     |
|   | 117.59 | 194 | 214  | 198  | 0    | 156 | 0     |
|   | 117.59 | 195 | 214  | 198  | 0    | 157 | 0     |
| 1 |        | OCC | ORIG | FROM | TO   | NUM | NUM   |
|   | TIME   | NUM | NODE | NODE | NODE | OUT | TRAPD |
|   | 117.59 | 196 | 214  | 198  | 0    | 158 | 0     |
|   | 117.59 | 197 | 214  | 198  | 0    | 159 | 0     |
|   | 117.59 | 47  | 205  | 198  | 0    | 160 | 0     |
|   | 117.59 | 48  | 205  | 198  | 0    | 161 | 0     |
|   | 117.59 | 49  | 205  | 198  | 0    | 162 | 0     |
|   | 117.59 | 50  | 205  | 198  | 0    | 163 | 0     |
|   | 117.59 | 51  | 205  | 198  | 0    | 164 | 0     |
|   | 117.59 | 52  | 205  | 198  | 0    | 165 | 0     |
|   | 117.59 | 53  | 205  | 198  | 0    | 166 | 0     |
|   | 117.59 | 54  | 205  | 198  | 0    | 167 | 0     |
|   | 117.59 | 55  | 205  | 198  | 0    | 168 | 0     |
|   | 117.59 | 56  | 205  | 198  | 0    | 169 | 0     |
|   | 117.59 | 57  | 205  | 198  | 0    | 170 | 0     |
|   | 117.59 | 58  | 205  | 198  | 0    | 171 | 0     |
|   | 117.59 | 59  | 205  | 198  | 0    | 172 | 0     |
|   | 117.59 | 60  | 205  | 198  | 0    | 173 | 0     |
|   | 117.59 | 61  | 205  | 198  | 0    | 174 | 0     |
|   | 117.59 | 62  | 205  | 198  | 0    | 175 | 0     |
|   | 117.59 | 63  | 205  | 198  | 0    | 176 | 0     |
|   | 117.59 | 64  | 205  | 198  | 0    | 177 | 0     |
|   | 117.59 | 65  | 205  | 198  | 0    | 178 | 0     |
|   | 117.59 | 66  | 205  | 198  | 0    | 179 | 0     |
|   | 117.59 | 67  | 205  | 198  | 0    | 180 | 0     |
|   | 117.59 | 68  | 205  | 198  | 0    | 181 | 0     |
|   | 117.59 | 69  | 205  | 198  | 0    | 182 | 0     |
|   | 117.59 | 70  | 205  | 198  | 0    | 183 | 0     |
|   | 117.59 | 71  | 205  | 198  | 0    | 184 | 0     |
|   | 117.59 | 72  | 205  | 198  | 0    | 185 | 0     |
|   | 117.59 | 73  | 205  | 198  | 0    | 186 | 0     |
|   | 117.59 | 74  | 205  | 198  | 0    | 187 | 0     |
|   | 117.59 | 75  | 205  | 198  | 0    | 188 | 0     |
|   | 117.59 | 76  | 205  | 198  | 0    | 189 | 0     |
|   | 117.59 | 77  | 205  | 198  | 0    | 190 | 0     |
|   | 117.59 | 78  | 205  | 198  | 0    | 191 | 0     |
|   | 117.59 | 79  | 205  | 198  | 0    | 192 | 0     |
|   | 117.59 | 80  | 205  | 198  | 0    | 193 | 0     |
|   | 117.59 | 81  | 205  | 198  | 0    | 194 | 0     |
|   | 117.59 | 82  | 205  | 198  | 0    | 195 | 0     |
|   | 117.59 | 83  | 205  | 198  | 0    | 196 | 0     |
|   | 117.59 | 182 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 183 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 184 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 185 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 186 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 187 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 188 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 189 | 213  | 298  | 198  | 196 | 0     |
|   | 117.59 | 308 | 228  | 298  | 198  | 196 | 0     |
|   | 117.59 | 309 | 228  | 298  | 198  | 196 | 0     |
|   | 117.59 | 310 | 228  | 298  | 198  | 196 | 0     |
| 1 |        | OCC | ORIG | FROM | TO   | NUM | NUM   |

| TIME   | NUM | NODE | NODE | NODE | OUT | TRAPD |
|--------|-----|------|------|------|-----|-------|
| 117.59 | 311 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 312 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 313 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 314 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 315 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 316 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 317 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 318 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 319 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 320 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 321 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 322 | 228  | 298  | 198  | 196 | 0     |
| 117.59 | 323 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 324 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 325 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 326 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 327 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 328 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 329 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 330 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 331 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 332 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 333 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 334 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 335 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 336 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 337 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 338 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 339 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 340 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 341 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 342 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 343 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 344 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 345 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 346 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 347 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 348 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 349 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 350 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 351 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 352 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 353 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 354 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 355 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 356 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 357 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 358 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 359 | 229  | 298  | 198  | 196 | 0     |
| 117.59 | 360 | 229  | 298  | 198  | 196 | 0     |

1

| TIME   | OCC<br>NUM | ORIG<br>NODE | FROM<br>NODE | TO<br>NODE | NUM<br>OUT | NUM<br>TRAPD |
|--------|------------|--------------|--------------|------------|------------|--------------|
| 117.59 | 491        | 268          | 298          | 198        | 196        | 0            |
| 117.59 | 492        | 268          | 298          | 198        | 196        | 0            |



|        |      |      |      |      |     |       |
|--------|------|------|------|------|-----|-------|
| 117.59 | 493  | 268  | 298  | 198  | 196 | 0     |
| 121.10 | 205  | 259  | 196  | 0    | 197 | 0     |
| 121.10 | 206  | 259  | 196  | 0    | 198 | 0     |
| 121.10 | 207  | 259  | 196  | 0    | 199 | 0     |
| 121.10 | 208  | 259  | 196  | 0    | 200 | 0     |
| 121.10 | 209  | 259  | 196  | 0    | 201 | 0     |
| 121.10 | 210  | 259  | 196  | 0    | 202 | 0     |
| 121.10 | 211  | 259  | 196  | 0    | 203 | 0     |
| 121.10 | 361  | 259  | 196  | 0    | 204 | 0     |
| 121.10 | 362  | 259  | 196  | 0    | 205 | 0     |
| 121.10 | 363  | 259  | 196  | 0    | 206 | 0     |
| 121.10 | 364  | 259  | 196  | 0    | 207 | 0     |
| 121.10 | 365  | 259  | 196  | 0    | 208 | 0     |
| 121.10 | 366  | 259  | 196  | 0    | 209 | 0     |
| 121.10 | 367  | 259  | 196  | 0    | 210 | 0     |
| 121.10 | 368  | 259  | 196  | 0    | 211 | 0     |
| 121.10 | 369  | 259  | 196  | 0    | 212 | 0     |
| 122.11 | 219  | 258  | 196  | 0    | 213 | 0     |
| 122.11 | 220  | 258  | 196  | 0    | 214 | 0     |
| 122.11 | 221  | 258  | 196  | 0    | 215 | 0     |
| 122.11 | 222  | 258  | 196  | 0    | 216 | 0     |
| 122.11 | 223  | 258  | 196  | 0    | 217 | 0     |
| 122.11 | 224  | 258  | 196  | 0    | 218 | 0     |
| 122.11 | 225  | 258  | 196  | 0    | 219 | 0     |
| 122.11 | 226  | 258  | 196  | 0    | 220 | 0     |
| 122.11 | 385  | 258  | 196  | 0    | 221 | 0     |
| 122.11 | 386  | 258  | 196  | 0    | 222 | 0     |
| 122.11 | 387  | 258  | 196  | 0    | 223 | 0     |
| 122.11 | 388  | 258  | 196  | 0    | 224 | 0     |
| 122.11 | 389  | 258  | 196  | 0    | 225 | 0     |
| 122.11 | 390  | 258  | 196  | 0    | 226 | 0     |
| 122.11 | 391  | 258  | 196  | 0    | 227 | 0     |
| 122.11 | 392  | 258  | 196  | 0    | 228 | 0     |
| 122.11 | 393  | 258  | 196  | 0    | 229 | 0     |
| 122.11 | 106  | 207  | 196  | 0    | 230 | 0     |
| 122.11 | 107  | 207  | 196  | 0    | 231 | 0     |
| 122.11 | 108  | 207  | 196  | 0    | 232 | 0     |
| 122.11 | 109  | 207  | 196  | 0    | 233 | 0     |
| 122.11 | 110  | 207  | 196  | 0    | 234 | 0     |
| 122.11 | 111  | 207  | 196  | 0    | 235 | 0     |
| 122.11 | 112  | 207  | 196  | 0    | 236 | 0     |
| 122.11 | 113  | 207  | 196  | 0    | 237 | 0     |
| 122.11 | 114  | 207  | 196  | 0    | 238 | 0     |
| 122.11 | 115  | 207  | 196  | 0    | 239 | 0     |
| 122.11 | 116  | 207  | 196  | 0    | 240 | 0     |
| 122.11 | 117  | 207  | 196  | 0    | 241 | 0     |
| 122.11 | 118  | 207  | 196  | 0    | 242 | 0     |
| 122.11 | 119  | 207  | 196  | 0    | 243 | 0     |
| 1      | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 122.11 | 120  | 207  | 196  | 0    | 244 | 0     |
| 122.11 | 121  | 207  | 196  | 0    | 245 | 0     |
| 122.11 | 122  | 207  | 196  | 0    | 246 | 0     |
| 122.11 | 123  | 207  | 196  | 0    | 247 | 0     |
| 122.11 | 124  | 207  | 196  | 0    | 248 | 0     |
| 122.11 | 125  | 207  | 196  | 0    | 249 | 0     |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 122.11 | 126  | 207 | 196  | 0    | 250  | 0   |       |
| 122.11 | 127  | 207 | 196  | 0    | 251  | 0   |       |
| 122.11 | 199  | 216 | 196  | 0    | 252  | 0   |       |
| 122.11 | 200  | 216 | 196  | 0    | 253  | 0   |       |
| 122.11 | 201  | 216 | 196  | 0    | 254  | 0   |       |
| 122.11 | 202  | 216 | 196  | 0    | 255  | 0   |       |
| 122.11 | 203  | 216 | 196  | 0    | 256  | 0   |       |
| 122.11 | 204  | 216 | 196  | 0    | 257  | 0   |       |
| 122.11 | 212  | 218 | 196  | 0    | 258  | 0   |       |
| 122.11 | 213  | 218 | 196  | 0    | 259  | 0   |       |
| 122.11 | 214  | 218 | 196  | 0    | 260  | 0   |       |
| 122.11 | 215  | 218 | 196  | 0    | 261  | 0   |       |
| 122.11 | 216  | 218 | 196  | 0    | 262  | 0   |       |
| 122.11 | 217  | 218 | 196  | 0    | 263  | 0   |       |
| 122.11 | 218  | 218 | 196  | 0    | 264  | 0   |       |
| 128.22 | 179  | 212 | 197  | 0    | 265  | 0   |       |
| 128.22 | 180  | 212 | 197  | 0    | 266  | 0   |       |
| 128.22 | 181  | 212 | 197  | 0    | 267  | 0   |       |
| 129.03 | 455  | 236 | 197  | 0    | 268  | 0   |       |
| 129.03 | 456  | 236 | 197  | 0    | 269  | 0   |       |
| 129.03 | 457  | 236 | 197  | 0    | 270  | 0   |       |
| 129.03 | 458  | 236 | 197  | 0    | 271  | 0   |       |
| 129.03 | 459  | 236 | 197  | 0    | 272  | 0   |       |
| 129.03 | 460  | 236 | 197  | 0    | 273  | 0   |       |
| 129.03 | 461  | 236 | 197  | 0    | 274  | 0   |       |
| 129.03 | 462  | 236 | 197  | 0    | 275  | 0   |       |
| 129.03 | 463  | 236 | 197  | 0    | 276  | 0   |       |
| 129.03 | 464  | 236 | 197  | 0    | 277  | 0   |       |
| 129.03 | 465  | 236 | 197  | 0    | 278  | 0   |       |
| 129.03 | 466  | 236 | 197  | 0    | 279  | 0   |       |
| 129.03 | 467  | 236 | 197  | 0    | 280  | 0   |       |
| 129.03 | 468  | 236 | 197  | 0    | 281  | 0   |       |
| 129.03 | 469  | 236 | 197  | 0    | 282  | 0   |       |
| 129.03 | 470  | 236 | 197  | 0    | 283  | 0   |       |
| 129.03 | 471  | 236 | 197  | 0    | 284  | 0   |       |
| 129.03 | 472  | 236 | 197  | 0    | 285  | 0   |       |
| 129.03 | 473  | 236 | 197  | 0    | 286  | 0   |       |
| 129.03 | 474  | 236 | 197  | 0    | 287  | 0   |       |
| 129.03 | 475  | 236 | 197  | 0    | 288  | 0   |       |
| 129.03 | 476  | 236 | 197  | 0    | 289  | 0   |       |
| 129.03 | 477  | 236 | 197  | 0    | 290  | 0   |       |
| 129.03 | 478  | 236 | 197  | 0    | 291  | 0   |       |
| 129.03 | 479  | 236 | 197  | 0    | 292  | 0   |       |
| 129.03 | 480  | 236 | 197  | 0    | 293  | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 129.03 | 481  | 236 | 197  | 0    | 294  | 0   |       |
| 129.03 | 482  | 236 | 197  | 0    | 295  | 0   |       |
| 129.03 | 269  | 254 | 197  | 0    | 296  | 0   |       |
| 129.03 | 270  | 254 | 197  | 0    | 297  | 0   |       |
| 129.03 | 271  | 254 | 197  | 0    | 298  | 0   |       |
| 129.03 | 272  | 254 | 197  | 0    | 299  | 0   |       |
| 129.03 | 273  | 254 | 197  | 0    | 300  | 0   |       |
| 129.03 | 274  | 254 | 197  | 0    | 301  | 0   |       |
| 129.03 | 275  | 254 | 197  | 0    | 302  | 0   |       |
| 129.03 | 276  | 254 | 197  | 0    | 303  | 0   |       |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 129.03 | 277  | 254 | 197  | 0    | 304  | 0   |       |
| 129.03 | 278  | 227 | 197  | 0    | 305  | 0   |       |
| 129.03 | 279  | 227 | 197  | 0    | 306  | 0   |       |
| 129.03 | 280  | 227 | 197  | 0    | 307  | 0   |       |
| 129.03 | 281  | 227 | 197  | 0    | 308  | 0   |       |
| 129.03 | 282  | 227 | 197  | 0    | 309  | 0   |       |
| 129.03 | 283  | 227 | 197  | 0    | 310  | 0   |       |
| 129.03 | 284  | 227 | 197  | 0    | 311  | 0   |       |
| 129.03 | 285  | 227 | 197  | 0    | 312  | 0   |       |
| 129.03 | 286  | 227 | 197  | 0    | 313  | 0   |       |
| 129.03 | 287  | 227 | 197  | 0    | 314  | 0   |       |
| 129.03 | 288  | 227 | 197  | 0    | 315  | 0   |       |
| 129.03 | 289  | 227 | 197  | 0    | 316  | 0   |       |
| 129.03 | 290  | 227 | 197  | 0    | 317  | 0   |       |
| 129.03 | 291  | 227 | 197  | 0    | 318  | 0   |       |
| 129.03 | 292  | 227 | 197  | 0    | 319  | 0   |       |
| 129.03 | 293  | 227 | 197  | 0    | 320  | 0   |       |
| 129.03 | 294  | 227 | 197  | 0    | 321  | 0   |       |
| 129.03 | 295  | 227 | 197  | 0    | 322  | 0   |       |
| 129.03 | 296  | 227 | 197  | 0    | 323  | 0   |       |
| 129.03 | 297  | 227 | 197  | 0    | 324  | 0   |       |
| 129.03 | 298  | 227 | 197  | 0    | 325  | 0   |       |
| 129.03 | 299  | 227 | 197  | 0    | 326  | 0   |       |
| 129.03 | 300  | 227 | 197  | 0    | 327  | 0   |       |
| 129.03 | 301  | 227 | 197  | 0    | 328  | 0   |       |
| 129.03 | 302  | 227 | 197  | 0    | 329  | 0   |       |
| 129.03 | 303  | 227 | 197  | 0    | 330  | 0   |       |
| 129.03 | 304  | 227 | 197  | 0    | 331  | 0   |       |
| 129.03 | 305  | 227 | 197  | 0    | 332  | 0   |       |
| 129.03 | 306  | 227 | 197  | 0    | 333  | 0   |       |
| 129.03 | 307  | 227 | 197  | 0    | 334  | 0   |       |
| 131.31 | 182  | 213 | 198  | 0    | 335  | 0   |       |
| 131.31 | 183  | 213 | 198  | 0    | 336  | 0   |       |
| 131.31 | 184  | 213 | 198  | 0    | 337  | 0   |       |
| 131.31 | 185  | 213 | 198  | 0    | 338  | 0   |       |
| 131.31 | 186  | 213 | 198  | 0    | 339  | 0   |       |
| 131.31 | 187  | 213 | 198  | 0    | 340  | 0   |       |
| 131.31 | 188  | 213 | 198  | 0    | 341  | 0   |       |
| 131.31 | 189  | 213 | 198  | 0    | 342  | 0   |       |
| 132.03 | 128  | 208 | 199  | 0    | 343  | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 132.03 | 129  | 208 | 199  | 0    | 344  | 0   |       |
| 132.03 | 130  | 208 | 199  | 0    | 345  | 0   |       |
| 132.03 | 131  | 208 | 199  | 0    | 346  | 0   |       |
| 132.03 | 132  | 208 | 199  | 0    | 347  | 0   |       |
| 132.03 | 133  | 208 | 199  | 0    | 348  | 0   |       |
| 132.03 | 134  | 208 | 199  | 0    | 349  | 0   |       |
| 132.03 | 135  | 208 | 199  | 0    | 350  | 0   |       |
| 132.03 | 136  | 208 | 199  | 0    | 351  | 0   |       |
| 132.03 | 137  | 208 | 199  | 0    | 352  | 0   |       |
| 132.03 | 138  | 208 | 199  | 0    | 353  | 0   |       |
| 132.03 | 139  | 208 | 199  | 0    | 354  | 0   |       |
| 132.03 | 140  | 208 | 199  | 0    | 355  | 0   |       |
| 132.03 | 141  | 208 | 199  | 0    | 356  | 0   |       |
| 132.03 | 142  | 208 | 199  | 0    | 357  | 0   |       |

|        |      |      |      |      |     |       |
|--------|------|------|------|------|-----|-------|
| 132.03 | 143  | 208  | 199  | 0    | 358 | 0     |
| 132.03 | 144  | 208  | 199  | 0    | 359 | 0     |
| 132.03 | 145  | 208  | 199  | 0    | 360 | 0     |
| 132.03 | 146  | 208  | 199  | 0    | 361 | 0     |
| 132.03 | 147  | 208  | 199  | 0    | 362 | 0     |
| 132.03 | 148  | 208  | 199  | 0    | 363 | 0     |
| 132.03 | 149  | 208  | 199  | 0    | 364 | 0     |
| 132.03 | 150  | 208  | 199  | 0    | 365 | 0     |
| 132.03 | 151  | 208  | 199  | 0    | 366 | 0     |
| 132.03 | 152  | 208  | 199  | 0    | 367 | 0     |
| 132.03 | 153  | 208  | 199  | 0    | 368 | 0     |
| 132.03 | 154  | 208  | 199  | 0    | 369 | 0     |
| 132.03 | 155  | 208  | 199  | 0    | 370 | 0     |
| 132.03 | 156  | 208  | 199  | 0    | 371 | 0     |
| 132.03 | 157  | 208  | 199  | 0    | 372 | 0     |
| 132.03 | 158  | 208  | 199  | 0    | 373 | 0     |
| 132.03 | 159  | 208  | 199  | 0    | 374 | 0     |
| 132.03 | 160  | 208  | 199  | 0    | 375 | 0     |
| 132.03 | 161  | 208  | 199  | 0    | 376 | 0     |
| 132.03 | 162  | 208  | 199  | 0    | 377 | 0     |
| 132.03 | 163  | 208  | 199  | 0    | 378 | 0     |
| 132.03 | 235  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 236  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 237  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 238  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 239  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 240  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 241  | 222  | 299  | 199  | 378 | 0     |
| 132.03 | 394  | 233  | 199  | 0    | 379 | 0     |
| 132.03 | 395  | 233  | 199  | 0    | 380 | 0     |
| 132.03 | 396  | 233  | 199  | 0    | 381 | 0     |
| 132.03 | 397  | 233  | 199  | 0    | 382 | 0     |
| 132.03 | 398  | 233  | 199  | 0    | 383 | 0     |
| 132.03 | 399  | 233  | 199  | 0    | 384 | 0     |
| 132.03 | 400  | 233  | 199  | 0    | 385 | 0     |
| 132.03 | 401  | 233  | 199  | 0    | 386 | 0     |
| 1      | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 132.03 | 402  | 233  | 199  | 0    | 387 | 0     |
| 132.03 | 403  | 233  | 199  | 0    | 388 | 0     |
| 132.03 | 404  | 233  | 199  | 0    | 389 | 0     |
| 132.03 | 405  | 233  | 199  | 0    | 390 | 0     |
| 132.03 | 406  | 233  | 199  | 0    | 391 | 0     |
| 132.03 | 407  | 233  | 199  | 0    | 392 | 0     |
| 132.03 | 408  | 233  | 199  | 0    | 393 | 0     |
| 132.03 | 409  | 233  | 199  | 0    | 394 | 0     |
| 132.03 | 410  | 233  | 199  | 0    | 395 | 0     |
| 132.03 | 411  | 233  | 199  | 0    | 396 | 0     |
| 132.03 | 412  | 233  | 199  | 0    | 397 | 0     |
| 132.03 | 413  | 233  | 199  | 0    | 398 | 0     |
| 132.03 | 414  | 233  | 199  | 0    | 399 | 0     |
| 132.03 | 415  | 233  | 199  | 0    | 400 | 0     |
| 132.03 | 416  | 233  | 199  | 0    | 401 | 0     |
| 132.03 | 417  | 233  | 199  | 0    | 402 | 0     |
| 132.03 | 418  | 233  | 199  | 0    | 403 | 0     |
| 132.03 | 419  | 233  | 199  | 0    | 404 | 0     |

|        |      |      |      |      |     |       |
|--------|------|------|------|------|-----|-------|
| 132.03 | 420  | 233  | 199  | 0    | 405 | 0     |
| 132.03 | 421  | 233  | 199  | 0    | 406 | 0     |
| 132.03 | 422  | 233  | 199  | 0    | 407 | 0     |
| 132.03 | 423  | 233  | 199  | 0    | 408 | 0     |
| 132.03 | 424  | 233  | 199  | 0    | 409 | 0     |
| 132.03 | 425  | 233  | 199  | 0    | 410 | 0     |
| 132.03 | 426  | 233  | 199  | 0    | 411 | 0     |
| 132.03 | 427  | 233  | 199  | 0    | 412 | 0     |
| 132.03 | 428  | 233  | 199  | 0    | 413 | 0     |
| 132.03 | 429  | 233  | 199  | 0    | 414 | 0     |
| 132.03 | 430  | 233  | 199  | 0    | 415 | 0     |
| 132.03 | 431  | 233  | 199  | 0    | 416 | 0     |
| 132.03 | 432  | 233  | 199  | 0    | 417 | 0     |
| 132.03 | 433  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 434  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 435  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 436  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 437  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 438  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 439  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 440  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 441  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 442  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 443  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 444  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 445  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 446  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 447  | 234  | 299  | 199  | 417 | 0     |
| 132.03 | 448  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 449  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 450  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 451  | 235  | 299  | 199  | 417 | 0     |
| 1      | OCC  | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM  | NODE | NODE | OUT | TRAPD |
| 132.03 | 452  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 453  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 454  | 235  | 299  | 199  | 417 | 0     |
| 132.03 | 500  | 250  | 199  | 0    | 418 | 0     |
| 132.03 | 501  | 250  | 199  | 0    | 419 | 0     |
| 132.03 | 502  | 250  | 199  | 0    | 420 | 0     |
| 132.03 | 506  | 274  | 299  | 199  | 420 | 0     |
| 132.03 | 235  | 222  | 199  | 0    | 421 | 0     |
| 132.03 | 236  | 222  | 199  | 0    | 422 | 0     |
| 132.03 | 237  | 222  | 199  | 0    | 423 | 0     |
| 132.03 | 238  | 222  | 199  | 0    | 424 | 0     |
| 132.03 | 239  | 222  | 199  | 0    | 425 | 0     |
| 132.03 | 240  | 222  | 199  | 0    | 426 | 0     |
| 132.03 | 241  | 222  | 199  | 0    | 427 | 0     |
| 132.03 | 433  | 234  | 199  | 0    | 428 | 0     |
| 132.03 | 434  | 234  | 199  | 0    | 429 | 0     |
| 132.03 | 435  | 234  | 199  | 0    | 430 | 0     |
| 132.03 | 436  | 234  | 199  | 0    | 431 | 0     |
| 132.03 | 437  | 234  | 199  | 0    | 432 | 0     |
| 132.03 | 438  | 234  | 199  | 0    | 433 | 0     |
| 132.03 | 439  | 234  | 199  | 0    | 434 | 0     |
| 132.03 | 440  | 234  | 199  | 0    | 435 | 0     |

|        |      |     |      |      |      |     |       |
|--------|------|-----|------|------|------|-----|-------|
| 132.03 | 441  | 234 | 199  | 0    | 436  | 0   |       |
| 132.03 | 442  | 234 | 199  | 0    | 437  | 0   |       |
| 132.03 | 443  | 234 | 199  | 0    | 438  | 0   |       |
| 132.03 | 444  | 234 | 199  | 0    | 439  | 0   |       |
| 132.03 | 445  | 234 | 199  | 0    | 440  | 0   |       |
| 132.03 | 446  | 234 | 199  | 0    | 441  | 0   |       |
| 132.03 | 447  | 234 | 199  | 0    | 442  | 0   |       |
| 132.03 | 448  | 235 | 199  | 0    | 443  | 0   |       |
| 132.03 | 449  | 235 | 199  | 0    | 444  | 0   |       |
| 132.03 | 450  | 235 | 199  | 0    | 445  | 0   |       |
| 132.03 | 451  | 235 | 199  | 0    | 446  | 0   |       |
| 132.03 | 452  | 235 | 199  | 0    | 447  | 0   |       |
| 132.03 | 453  | 235 | 199  | 0    | 448  | 0   |       |
| 132.03 | 454  | 235 | 199  | 0    | 449  | 0   |       |
| 132.03 | 506  | 274 | 199  | 0    | 450  | 0   |       |
| 132.26 | 308  | 228 | 198  | 0    | 451  | 0   |       |
| 132.26 | 309  | 228 | 198  | 0    | 452  | 0   |       |
| 132.26 | 310  | 228 | 198  | 0    | 453  | 0   |       |
| 132.26 | 311  | 228 | 198  | 0    | 454  | 0   |       |
| 132.26 | 312  | 228 | 198  | 0    | 455  | 0   |       |
| 132.26 | 313  | 228 | 198  | 0    | 456  | 0   |       |
| 132.26 | 314  | 228 | 198  | 0    | 457  | 0   |       |
| 132.26 | 315  | 228 | 198  | 0    | 458  | 0   |       |
| 132.26 | 316  | 228 | 198  | 0    | 459  | 0   |       |
| 132.26 | 317  | 228 | 198  | 0    | 460  | 0   |       |
| 132.26 | 318  | 228 | 198  | 0    | 461  | 0   |       |
| 132.26 | 319  | 228 | 198  | 0    | 462  | 0   |       |
| 132.26 | 320  | 228 | 198  | 0    | 463  | 0   |       |
| 1      |      | OCC | ORIG | FROM | TO   | NUM | NUM   |
|        | TIME | NUM | NODE | NODE | NODE | OUT | TRAPD |
| 132.26 | 321  | 228 | 198  | 0    | 464  | 0   |       |
| 132.26 | 322  | 228 | 198  | 0    | 465  | 0   |       |
| 132.26 | 323  | 229 | 198  | 0    | 466  | 0   |       |
| 132.26 | 324  | 229 | 198  | 0    | 467  | 0   |       |
| 132.26 | 325  | 229 | 198  | 0    | 468  | 0   |       |
| 132.26 | 326  | 229 | 198  | 0    | 469  | 0   |       |
| 132.26 | 327  | 229 | 198  | 0    | 470  | 0   |       |
| 132.26 | 328  | 229 | 198  | 0    | 471  | 0   |       |
| 132.26 | 329  | 229 | 198  | 0    | 472  | 0   |       |
| 132.26 | 330  | 229 | 198  | 0    | 473  | 0   |       |
| 132.26 | 331  | 229 | 198  | 0    | 474  | 0   |       |
| 132.26 | 332  | 229 | 198  | 0    | 475  | 0   |       |
| 132.26 | 333  | 229 | 198  | 0    | 476  | 0   |       |
| 132.26 | 334  | 229 | 198  | 0    | 477  | 0   |       |
| 132.26 | 335  | 229 | 198  | 0    | 478  | 0   |       |
| 132.26 | 336  | 229 | 198  | 0    | 479  | 0   |       |
| 132.26 | 337  | 229 | 198  | 0    | 480  | 0   |       |
| 132.26 | 338  | 229 | 198  | 0    | 481  | 0   |       |
| 132.26 | 339  | 229 | 198  | 0    | 482  | 0   |       |
| 132.26 | 340  | 229 | 198  | 0    | 483  | 0   |       |
| 132.26 | 341  | 229 | 198  | 0    | 484  | 0   |       |
| 132.26 | 342  | 229 | 198  | 0    | 485  | 0   |       |
| 132.26 | 343  | 229 | 198  | 0    | 486  | 0   |       |
| 132.26 | 344  | 229 | 198  | 0    | 487  | 0   |       |
| 132.26 | 345  | 229 | 198  | 0    | 488  | 0   |       |
| 132.26 | 346  | 229 | 198  | 0    | 489  | 0   |       |

|        |     |     |     |   |     |   |
|--------|-----|-----|-----|---|-----|---|
| 132.26 | 347 | 229 | 198 | 0 | 490 | 0 |
| 132.26 | 348 | 229 | 198 | 0 | 491 | 0 |
| 132.26 | 349 | 229 | 198 | 0 | 492 | 0 |
| 132.26 | 350 | 229 | 198 | 0 | 493 | 0 |
| 132.26 | 351 | 229 | 198 | 0 | 494 | 0 |
| 132.26 | 352 | 229 | 198 | 0 | 495 | 0 |
| 132.26 | 353 | 229 | 198 | 0 | 496 | 0 |
| 132.26 | 354 | 229 | 198 | 0 | 497 | 0 |
| 132.26 | 355 | 229 | 198 | 0 | 498 | 0 |
| 132.26 | 356 | 229 | 198 | 0 | 499 | 0 |
| 132.26 | 357 | 229 | 198 | 0 | 500 | 0 |
| 132.26 | 358 | 229 | 198 | 0 | 501 | 0 |
| 132.26 | 359 | 229 | 198 | 0 | 502 | 0 |
| 132.26 | 360 | 229 | 198 | 0 | 503 | 0 |
| 132.26 | 491 | 268 | 198 | 0 | 504 | 0 |
| 132.26 | 492 | 268 | 198 | 0 | 505 | 0 |
| 132.26 | 493 | 268 | 198 | 0 | 506 | 0 |

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Evacuation Statistics  
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506 Occupants escaped in 132.26 seconds  
0 occupants were trapped

---Floor clearing times---

Floor 1 at 132.26 seconds  
Floor 2 at 132.03 seconds

---Stair clearing times---

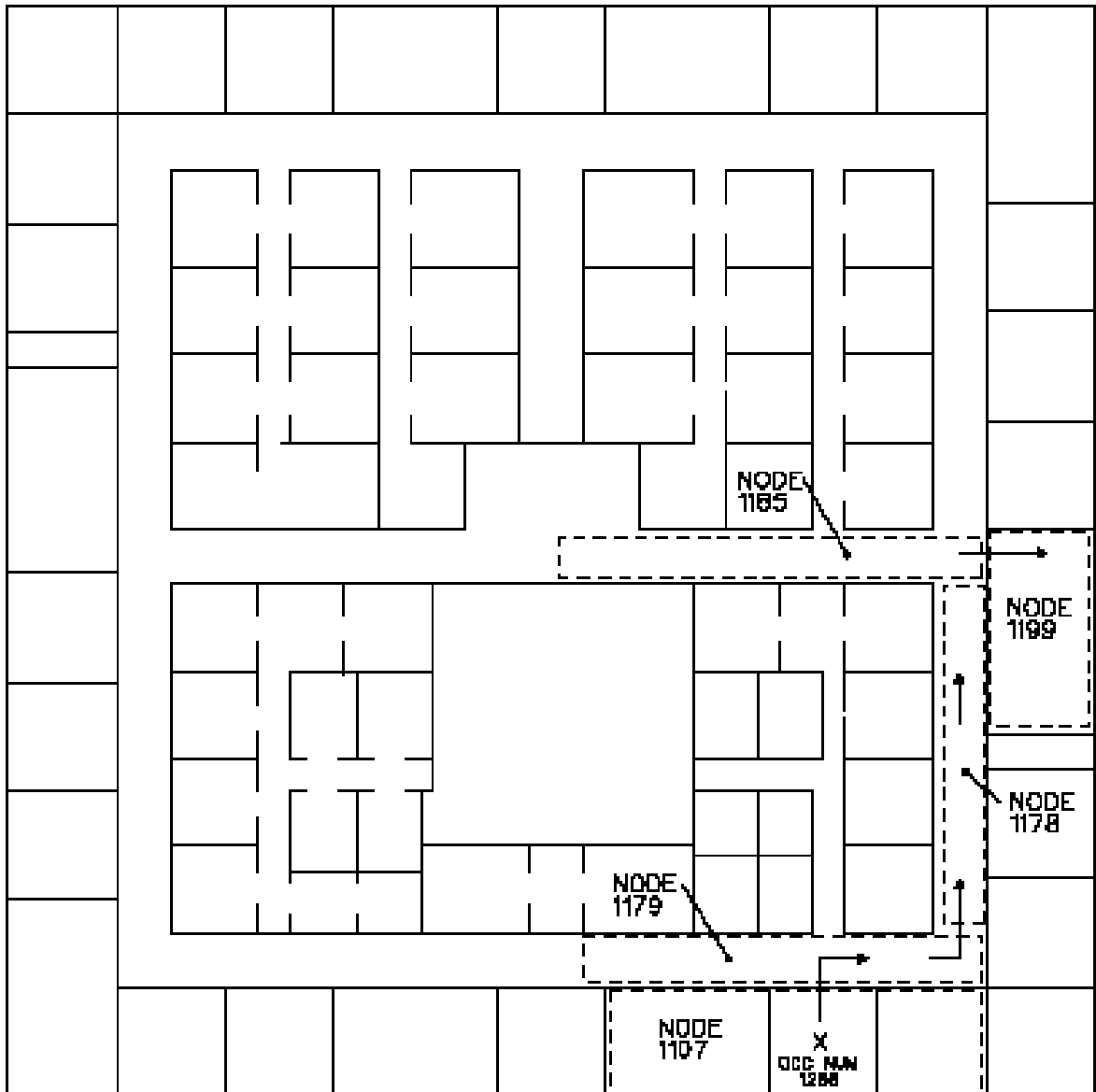
Stairway 99 at 132.03 seconds  
Stairway 98 at 132.26 seconds  
Stairway 97 at 129.03 seconds  
Stairway 96 at 122.11 seconds

---Exit clearing times---

108 People used exit at node 196 by 122. sec  
117 People used exit at node 197 by 129. sec  
139 People used exit at node 198 by 132. sec  
142 People used exit at node 199 by 132. sec

Appendix 10

100 Foot Square Building Floor Layout Illustrating the Travel Path for Occupant 1288





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