Kettler Capitals Iceplex

Megan Kohut

Structural Option

The Pennsylvania State University
Architectural Engineering
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Faculty Consultant: Dr. Linda Hanagan

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To all my friends and family, for all their support. I couldn't have made it this far without you!

Washington Capitals Iceplex

Arlington, Virginia

Team Roster

- Owners: Lincoln Holdings, Arlington County
- Architect: Architecture, Inc.
- Structural Engineer: Rathgeber/Goss Associates
- MEP Engineer: KTA Group
- Civil Engineer: VIKA
- Construction Manager: Sigal Construction Corporation

The Stats

- Project Cost: $42.7M
- Size: 137,000 SF
- Levels: 9
- Construction Dates: January 2005 - present
- Delivery Method: Design-Bid-Build

Architectural Line

- Highest ice rink above street level in the United States
- Built on top of existing seven story parking garage
- Designed to be LEED Certified
- Two NHL regulation size rinks with training facility and corporate offices

Structural Line

- Parking Structure
  - -Five levels cast-in-place concrete
  - -One level post-tentioned concrete
  - -One level composite steel
- Ice Rink/Training Facility
  - - Composite Steel
  - - Deep long-span roof joists providing clear space for rinks

Mechanical Line

- Desiccant based dehumidification system
- Refrigerant based cooling system
- Air space that contacts ice must remain 10-20 degrees above ice surface temperature
- CO_2 sensors regulate required 8000 cfm of outside air to ice rinks
- Network of ammonia refrigerant piping runs under rink to create and maintain ice

Electrical/Lighting Line

- 4000-ampere, 277/480 volt 3-phase, 4 wire switchboard located on garage level one
- Service extended to 8th and 9th level Iceplex to distribution switch board via bus duct
- 120/208 volt step-down transformer located in mechanical rooms if needed
- Lighting served at 277 volts
- Emergency power to support life safety systems and fire pump

Fire Protection Line

- Standard wet system complying with NFPA 13, 14, 24
- Meets requirements for high-rise building structures
- Fire pump maintains required 100 psi at top of standpipes
- Fully alarmed heat trace system

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EXECUTIVE SUMMARY

The Kettler Capitals Iceplex is the practice facility for the NHL franchise, Washington Capitals. It is located in Arlington, Virginia just outside Washington D.C. The Iceplex was constructed on top of the existing parking structure for the Ballston Mall in Arlington. The original parking structure consists of concrete two-way slabs and post-tensioned concrete. The Iceplex was constructed using a composite steel system.

When the Iceplex was constructed on top of the existing parking structure, the gravity system, the lateral system, and the foundation system all needed to be reinforced. This was proven to be the most complicated part of the design.

A solution to this problem would have been to tear down the parking structure and construct the new building from scratch. This thesis examines this possibility in order to determine if this is indeed a feasible solution. The Iceplex and parking structure will be completely redesigned. The two ice rinks will be moved to the first level on a slab-on-grade, which will help limit deflections of the ice surface. The parking structure will then be designed as a separate structure constructed of precast concrete and will span over the ice rinks. This will create the need for a large transfer system.

In addition to the complete structural redesign of the Iceplex and parking garage, three additional design changes are discussed. First, a civil/site design examines the most efficient way of laying out the building and includes any changes in the locations of entrances and exits. Second, an architectural redesign accounts for any changes in the architectural layout of the spaces. Finally, a construction management assessment compares the cost and schedule of the proposed design to the actual design.

Based on the structural redesign and the three breadth topics, it was found that the proposed design is *not* a feasible solution. Although it was possible, the design of the transfer system proved to be very complicated. Extremely large steel member sizes were required to take the large loads from the parking garage above. Also, the estimated cost of the proposed design was 24% more than the actual cost of the original design. Since cost is a very important factor to building owners, it should be considered in the final decision. Finally, the estimated project schedule was about twice as long as the original project.

INTRODUCTION

The Kettler Capitals Iceplex is the practice facility for the National Hockey League team, Washington Capitals. It is located at the Ballston Common Mall in Arlington, Virginia at the intersection of Glebe Road and Randolph Street. This 137,000 square foot facility was built on top an existing parking structure and houses two regulation sized ice rinks, corporate offices, a training facility, and a pro shop. At 60ft. above street level, the Kettler Capitals Iceplex is the home of the highest ice rink in the United States.

Design for the Iceplex began in 2000; however, this was the third time the Ballston parking garage had been expanded. The original facility, which dates back to the 1950s, was a five story cast-in-place concrete structure reinforced with mild steel. Then in the 1980s, the parking garage was expanded two more times. In 1981, a five story L-shaped addition was constructed of cast-in-place post-tensioned concrete. Then in 1986, the existing five level structure was topped with two more levels, one post-tensioned concrete and the other composite steel. See Figure 1 for a schematic phasing diagram of these additions.

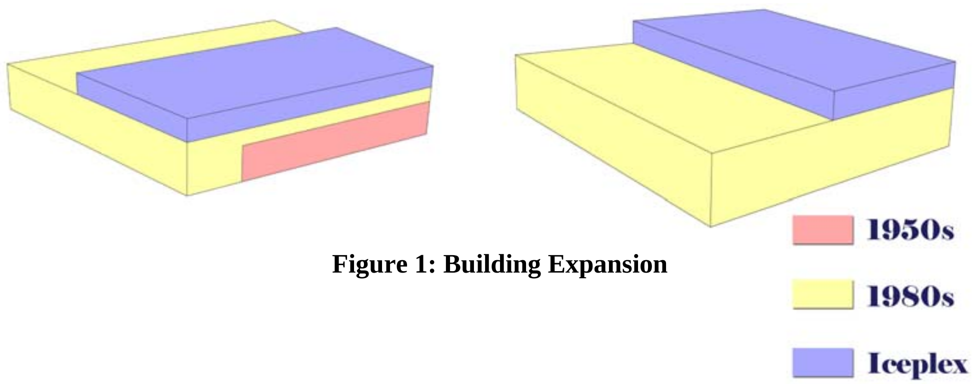


Figure 1: Building Expansion

There were several challenges when designing the Iceplex. The initial challenge was figuring out how to safely build an ice rink and roof weighing a total of 235 psf dead load plus 130 psf live load over an existing structure that was designed for a total expansion of 60 psf dead load and 50 psf live load. Another challenge was controlling deflection over the long 200ft. span of each ice rink. A consultant recommended that the deflection be as close to zero as possible in order to prevent the ice from cracking. Also, the need for large column-free spaces limited the locations where lateral members could be placed.

BUILDING BACKGROUND

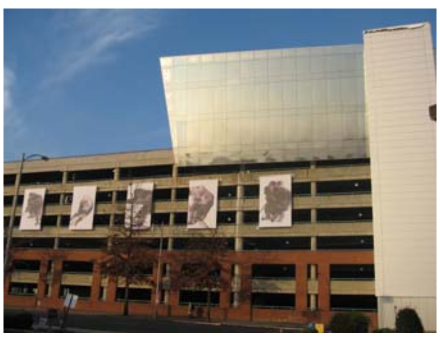
Architectural Design

The Kettler Capitals Iceplex is located on top of a parking structure at the Ballston Common Mall at the intersection of Glebe Road and Randolph Street in Arlington, Virginia. The Iceplex is connected to the mall through the parking structure and is directly linked to the Metro Orange Line.

The new rink building was constructed over the original 1951 parking garage. This garage was designed as five levels of cast-in-place concrete reinforced with mild steel with the additional capacity for two levels of vertical expansion. In the 1980s, two levels of additional parking were added. Finally in 2000, design for the eighth floor ice rinks and ninth floor corporate/training facility began. At 60ft. above grade, the Kettler Iceplex is proud to be the home of the highest rink above street level in the US.

The complex was designed to a LEED Certified level but never registered with the US Green Building Council (USGBC) in order to pursue the rating. Using a variety of recycled materials and having natural light penetrate into 90% of interior spaces are two features that make Kettler a green building.

Building Envelope



The façade of the parking structure consists of reinforced concrete and brick. Like typical parking garages, many openings in the façade are needed to ventilate the area from car exhaust. This means that the building envelope of this part of the building does not give any protection from the elements.

The building envelope of the rink and office space is made of metal paneling and glass curtain walls. The curtain wall is supported using metal studs and kickers. The wall uses 1” insulated glazing in order to obtain a sufficient thermal barrier.

The roof membrane consists of a concrete slab on metal deck using a fully adhered EPDM roof membrane. Long-span trusses were required to support the roof above the ice rinks.

Structural System

Since the Kettler Capitals Iceplex was constructed on top of an existing parking garage, there were many design challenges during the addition.

The actual load of the new Iceplex was about three and a half times that of the allowable expansion load. Consequently, reinforcing the existing structure was required. After testing the soils, it was determined that two footings needed to be expanded 3 ft. in one direction. The existing columns were analyzed for the additional load of the new structure. A total of 11 columns were wrapped in carbon fiber reinforcing. Also, all existing steel columns on levels 5 and 6 of the parking garage were encased in concrete.

Two expansion joints were used in the construction of the new Iceplex. One running in the north-south direction separates the 8th level of parking from the 8th level of the Iceplex which is where the ice rinks are located. The other expansion joint, running east-west, separates the ice rinks from the Capitals corporate offices and training facility.

It was important to limit deflection of the concrete slab supporting the rinks in order to prevent the ice from cracking. The structural engineer and the ice rink consultant compromised to limit the deflection to L/480. This slab was constructed from 3½" lightweight concrete over 3" 18 gage galvanized composite deck (total thickness = 6½") reinforced with #4 at 16"oc each way 2" below the slab. Supporting the slab are mostly composite W18x40s at 9'-0"oc spanning 30'-0". These W18s frame into larger steel composite beams which range from W21x50s to W36x150s. All shear studs are ¾" diameter by 4" long. Steel columns supporting the rinks range from W12x58s to W14x257s.

The need for long-span, column free spaces was critical in the design of the roof over the two ice rinks. The roof joists above the rinks are open web steel joists, 68DLH16. These joists have a depth of 68" and have the capacity to support large loads with extremely long spans. The span of these roof joists are 120ft. and are spaced at 5'-6"oc.

There is a mix of lateral resisting systems throughout the structure. The original parking structure that was built in the 1950s was constructed using a two-way slab system. During the 1980s expansions, moment frames were designed to resist lateral loads. Finally, during the construction of the new Iceplex, a mix of braced frames and moment connections were used.

Mechanical System

The mechanical system serving the main ice rinks consists of a desiccant based dehumidification system combined with a refrigerant based cooling system all packaged

in three separate roof mounted units. The purpose of these systems is to keep the air space that contacts the ice between 10 to 20 °F above the ice surface temperature. Since the ice surface does evaporate and contribute water vapor to the airspace, these units are also responsible for removing this moisture from the air.

A network of refrigerant piping running under the entire rink surface creates and maintains the temperature of the ice. The refrigerant used for this system is ammonia, which is cooled by industrial type chillers. The chiller room is located next to the ice melt pit in between the two ice rinks.

The locker rooms, bathrooms, and many of the utility rooms use various exhaust systems. The party rooms, faculty offices, and other remaining spaces are ventilated and air conditioned by four refrigerant based packaged constant volume rooftop units with extensive ductwork and air distribution systems.

The team offices, team locker rooms, coaches' rooms, and team training facilities are all ventilated and air conditioned by four refrigerant based packaged variable-air-volume (VAV) rooftop units. These units work in conjunction with VAV zone terminal units (VAV boxes) that vary the amount of cooling or heating into the zone they serve by varying the amount of air provided to these spaces. These VAV boxes act as a damper/valve and also include electric reheat. The VAV boxes operate based on a zone thermostat and the VAV rooftop unit is responsible for maintaining a constant supply air temperature and adequate airflow to the VAV boxes based on the demand.

Lighting/Electrical System

Electrical service consists of a 4000-ampere, 277/480 volt 3-phase, 4-wire, switchboard in the garage at level one. Service is extended to the Kettler Capitals Iceplex, at the new eighth level, through a distribution switchboard by bus ducts. Distribution throughout the facility is at 277/480 volts to several electric rooms located throughout the facility. If transformation is required to 120/208 volts, step-down transformers are provided at the electric rooms. The vast majority of lighting equipment is served at 277 volts. The majority of mechanical equipment is served at 277/480 volts. All other equipment that is not served at 277/480 volts is served at 120/208 volts. All branch circuit wiring is installed in conduit and Type AC cable was permitted when concealed. The facility has emergency power to support life safety systems and a fire pump. The majority of the lighting was required to be the same color temperature, 3500K. Although several manufacturers were used, most lighting fixtures were manufactured by Lithonia. Mounting types varied, but recessed and surface mounting were most widely used.

Construction Management

Sigal Construction Corporation was the project manager for the Iceplex. They acted as under a design-bid-build delivery method. The staging area for the new 8th and 9th levels was located on the 7th level of the existing parking garage.

Since the existing structure needed to be reinforced before constructing the new Iceplex, the architect prescribed a 6-phase plan starting in February 2005 and ending in June 2006.

- Phase 1: Expand footings
- Phase 2: Column Bolstering
- Phase 3: Underground utility work
- Phase 4: Crane installed on level 7 to erect steel for ice rinks
- Phase 5: Complete structural work for new stairs/elevators
- Phase 6: Complete construction within levels 8 and 9

Fire Protection System

The fire protection system is a standard wet system complying with NFPA sections 13, 14 and 24 and meets the requirements for high rise building structures. Based on the high rise requirements, and those of Arlington County, Virginia, 100psi must be maintained at the top of the standpipes. Thus a fire pump was required and is located at the ground level of the structure. Water was distributed to the standpipes using a fully charged wet system in unconditioned space and is protected from freezing by means of heat trace and insulation. The fire pump and heat trace are fed from an emergency generator. The heat trace system is fully alarmed to notify building engineers of failure in any portion of the system.

Project Team

Owner/Developer: Lincoln Holdings, Arlington County / Jones Lang Lasalle

Architect: Architecture, Inc.

Civil Engineer: VIKA

Structural Engineer: Rathgeber Goss Assoc.

MEP Engineer: KTA Group

Construction Manager: Sigal Construction

THE EXISTING STRUCTURAL DESIGN

Reinforcing the Existing Parking Structure

As previously mentioned, the actual load of the new Iceplex was about three and a half times that of the allowable expansion load of the existing parking structure. Inevitably, the existing parking structure needed to be reinforced before constructing the new addition.

Foundation

The structural engineer of record, Rathgeber/Goss Associates of Rockville, MD, recommended testing the soil as a first step in the reinforcing process. Engineering Consulting Services, Ltd. was hired to complete the testing. Test results showed that the allowable bearing pressure of the soil was 10,000 psf which was significantly higher than the 6,000 psf used in the original construction. Based on this information and the column loads from the new construction, it was concluded that only two footings needed to be expanded. These footings, along column line 9 (see Figure 2), were expanded 3'-0" in one direction. No increase in footing depth was necessary.

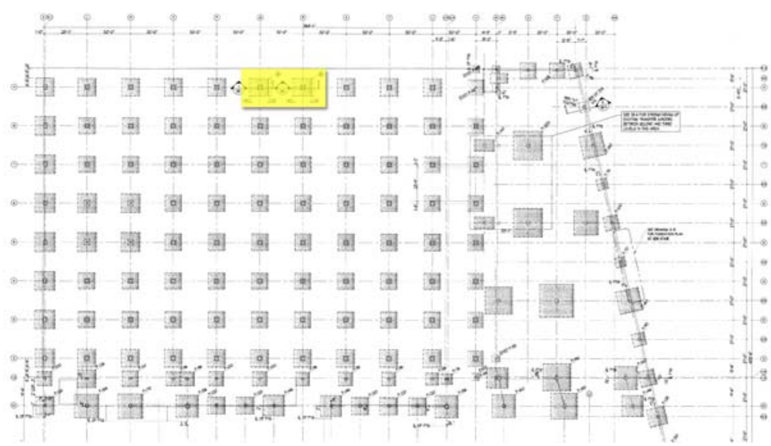


Figure 2: Footing Expansion Locations

Columns

It was also recommended by Rathgeber/Goss that the existing concrete columns be core tested in order to analyze their compressive strength. Engineering Consulting Services, Ltd. was hired to perform these tests as well. However, due to the high density of reinforcing steel in the columns, testable cores were unobtainable. Therefore, a series of Windsor Probe tests were performed throughout the structure in lieu of the originally proposed concrete coring.

A total of nine Windsor Probe tests were performed throughout the existing parking structure. Five tests were located on the first floor, four on the fourth floor, and two on the sixth floor. ECS attempted to concentrate these tests primarily in locations where column loads would increase the greatest with the vertical expansion. After completing the tests, it was recommended that a compressive strength of 5,000 psi be assumed for the existing concrete columns. Since the original concrete strength was assumed to be 3,000 psi, this showed that the concrete had gained significant strength over time.

Based on these results, the columns needing additional reinforcement were determined. A total of 11 columns on levels 3, 4, 5, and 6 were wrapped in carbon fiber reinforcing. These columns are shown in red in Figure 3. Gardner James Engineering, Inc. was commissioned to design this additional reinforcement. GJ chose a product called Aquawrap from Structural Composites, Inc. for the carbon fiber reinforcing. This allowed the ultimate axial load in the columns to be greater than the nominal capacity by a factor of 1.2.

In addition to the carbon fiber reinforcement, all existing steel columns in the parking structure (levels 5 and 6) were encased in concrete in order to provide the additional required capacity. All columns shaded in blue in Figure 3 were reinforced. See Figure 4 for a bolstering detail.

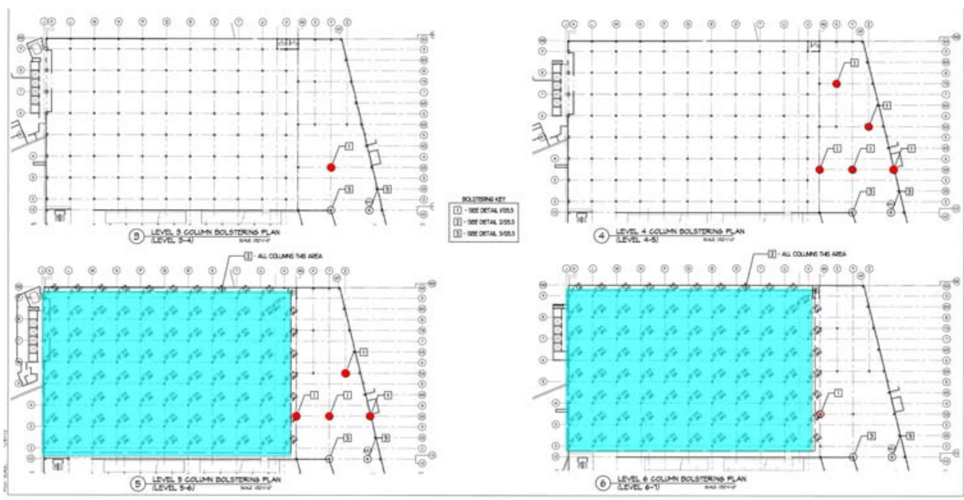


Figure 3: Column Reinforcing Locations

Figure 4: Column Bolstering Detail

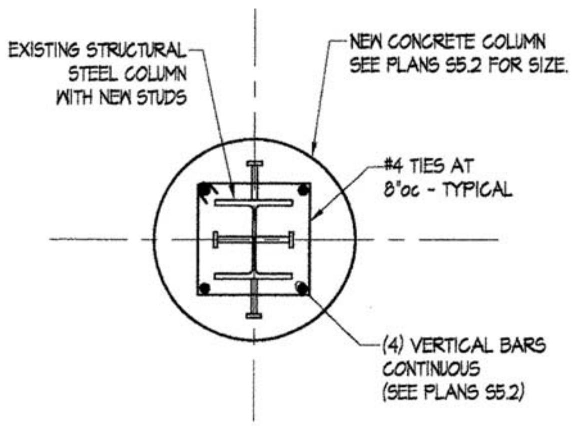


Figure 5: Column Bolstering. ***Courtesy: RGA***

The Gravity Framing System

There were two expansion joints used in the construction of the new Iceplex, one running in the north-south direction and the other in the east-west direction. See Figure 6 for the locations of these joints. Expansion joint A, running north-south, separates the 8th floor parking structure from the 8th floor of the Iceplex. Expansion Joint B, running east-west, separates the ice rinks from team facility including the team offices and locker rooms. Both these joints span vertically the entire height of the building.

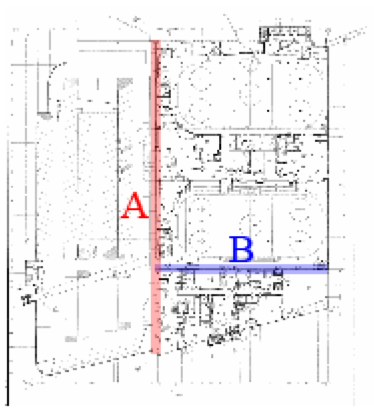
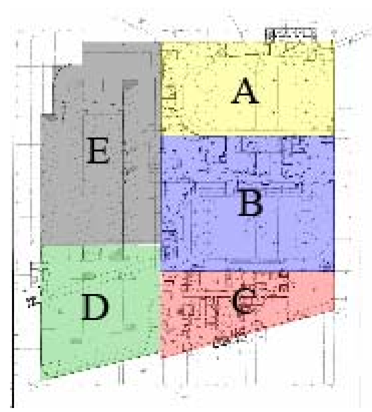


Figure 6: Location of Expansion Joints



Keyplan

The first five levels of Areas A and B are constructed of mildly reinforced cast-in-place concrete consisting of 26"-28" diameter columns. The two-way slab is 10½" thick with 5¼ " drop panels and column capitals. Levels six and seven are constructed of 27'-0" x 30'-0" composite steel bays with W16x26s spanning the 27' direction and W24x55s spanning the 30' direction. Levels eight and nine of the Iceplex also consist of composite steel framing with the same 27'-0" x 30'-0" bay. Figure 7 shows a typical bay framing of level eight supporting the ice rinks.

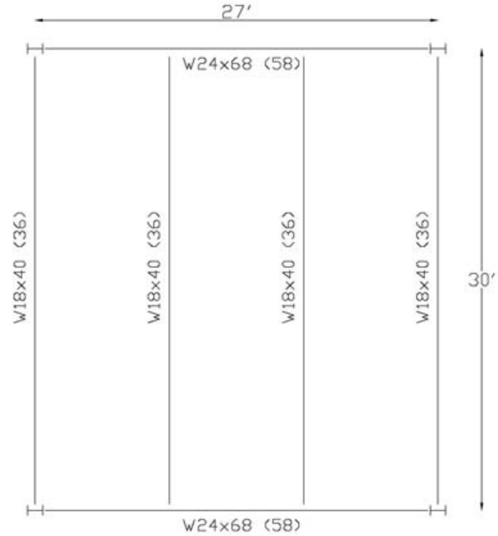


Figure 7: Enlarged Typical Framing Plan

The Lateral Framing System

The lateral system of Areas A and B is somewhat complicated due to the several expansions the structure has encountered over the years and the various materials that were used.

The first five levels of concrete were cast monolithically creating continuous concrete moment frames in each direction throughout the building footprint. In general, this lateral system has proven very stiff and efficient for resisting lateral loads but creates potential problems in seismic regions because of its heavy weight.

When the structure was expanded both horizontally and vertically in the 1980s, reinforcement of the lateral system was needed. The original lateral system is shown in yellow in Figure 8. Areas A and B on levels 7 and 8 were framed using composite steel with moment connections. There are ten moment frames spanning the east-west direction along the exterior of the building. Two frames spanning the north-south direction run the entire width of the building at both sides of the structure.

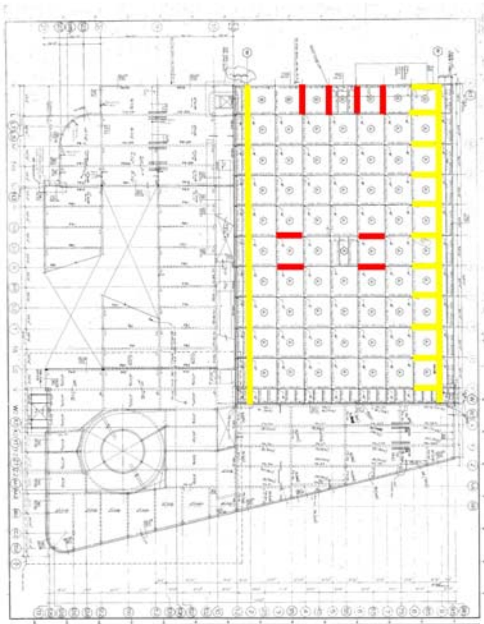


Figure 8: Level 7 Lateral System

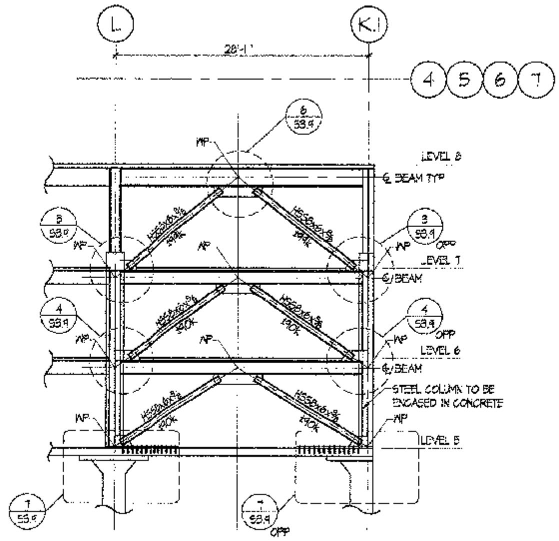


Figure 9: Braced Frame Detail

Finally, when the Iceplex was added onto the parking structure, a mix of braced frames and moment connections were used. Eight braced frames were constructed on the 7th level reinforcing the existing structure for additional lateral forces. HSS8x6x3/8 tubes were used for all cross bracing. These frames are shown in red in Figure 8 and a detail of these braced frames is shown in Figure 9. On the 8th level, there are a total of eight braced frames, four in each direction. These frames use the same tube sections and are shown in blue in Figure 10. Eight moment frames were constructed and were spaced evenly throughout with the exception of the voided areas from the ice rinks. These are shown in green in Figure 10.

All lateral resisting members on the 9th level in this area are located in Area 9B. Seven moment frames span the north-south direction and four span the east-west direction. W24s and W33s are typical of the moment frames on the 9th level. Figure 11 shows the location of all lateral resisting frames in Area 9B.

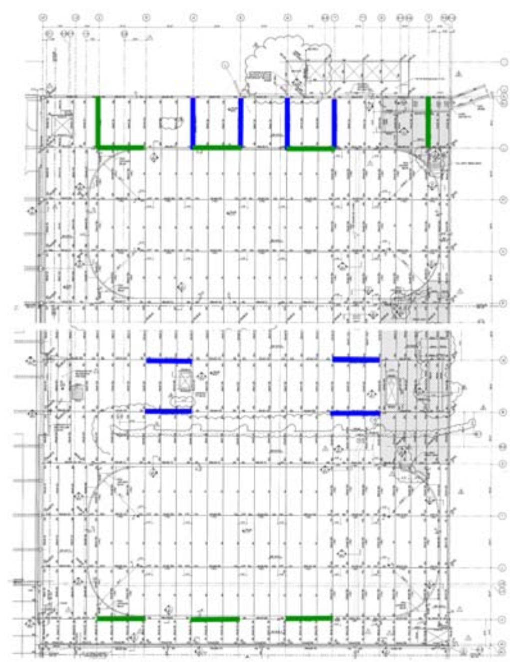


Figure 10: Level 8 Lateral System

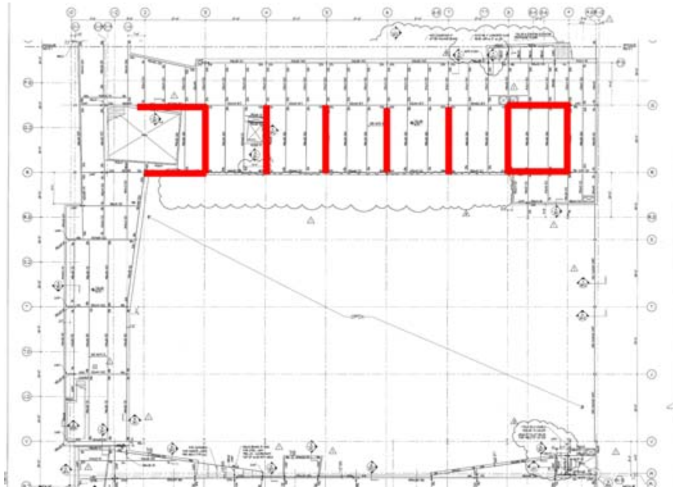


Figure 11: Level 9 Lateral System

The lateral resisting system of Areas A and B may be difficult to understand in 2-dimensions. Figure 12 shows the entire lateral system in 3D which may help to explain how the various systems work together to resist wind and seismic loads.

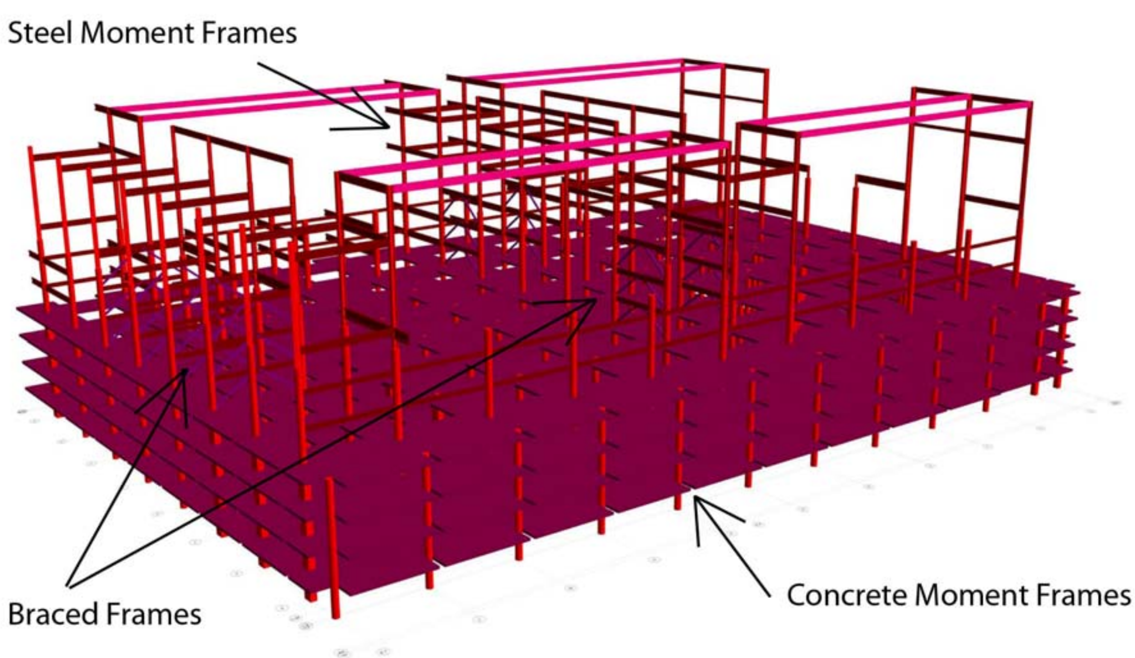


Figure 12: 3D Lateral Resisting System

PROBLEM STATEMENT AND PROPOSED SOLUTION

As previously stated, when the Iceplex was added onto the existing Ballston Mall parking garage, reinforcing the structure was required. Two footings were expanded, most columns were strengthened, and the lateral system needed to be reinforced in order to resist increased lateral loads. This proved to be the most complex part of the design. Also, minimizing deflection was crucial for the ice rinks which are located over 60ft. above grade.

There is a possibility that reinforcing the existing structure was not the most efficient and economical solution to the expansion. Instead, demolishing the existing parking garage and constructing the Iceplex from scratch may have simplified the project. This would eliminate the need for reinforcement and would simplify the lateral framing system.

Redesigning the Iceplex and parking structure would allow the two ice rinks to be relocated to the first floor. The rinks could then be supported using a slab-on-grade, therefore minimizing deflection issues. The parking garage will be built as a separate structure above the Iceplex creating the need for a large transfer system. These trusses will be used to support the parking structure and span above the rinks. The garage will be framed using a precast concrete system. The lateral system will mainly consist of shear walls.

Since the building will be built from scratch, a civil/site study will be completed. This will analyze the site and nearby vehicular traffic in order to chose the most efficient locations for garage entrances and exits. The architectural layout will also be examined and any needed changes will be designed in order to accommodate any adjustments made to the site layout. An in-depth project cost will be calculated for this proposed design and a corresponding schedule will be completed. Taking all this into consideration, a final recommendation can be made about whether or not the proposed design is in fact a feasible and economic solution.

CIVIL/SITE DESIGN

Since the entire building is to be redesigned from the ground up, the locations of existing garage entrances and exits should be evaluated for their efficiency. Currently, the parking structure, servicing both the Iceplex and the Ballston Common Mall, has two entrances and two exits. The main access point, from N. Glebe Rd., has two entrance lanes and three exit lanes. A secondary access point, from N. Randolph St., has two entrance lanes and two exit lanes.

According to *The Dimensions of Parking*, a publication from the Urban Land Institute and the National Parking Association, entrances should be located on high-volume streets in order to provide easy site access from nearby interstates and other major vehicular flow patterns. Exists should be located on low-volume streets to minimize street traffic conflicts with vehicles existing the parking garage. In order to effectively analyze the proper locations of garage entrances and exits, traffic count data was obtained from the Virginia Department of Transportation website. North Glebe Rd. has an AADT (Annual Average Daily Traffic) of 33,000 with a directional factor of 57%. This means that every day approximately 33,000 vehicles travel this stretch of road, 57% of which occur during rush hours. North Randolph St. has an AADT of 11,000 and a directional factor of 64%. Based on this information, N. Glebe Rd. has a much higher vehicular flow volume than that of N. Randolph St. From this data, it was concluded that vehicles should enter the garage from N. Glebe Rd. and exit from N. Randolph St.

It can be seen from the aerial map shown below that there is a major intersection at the existing main entrance to the garage. *The Dimensions of Parking* states that all entrances should be located at least 75 to 100ft. from any corner intersection; therefore the entrance must remain directly across from N. Carlin Springs Rd. This will allow the existing traffic signal light to continue to control vehicles entering the garage.

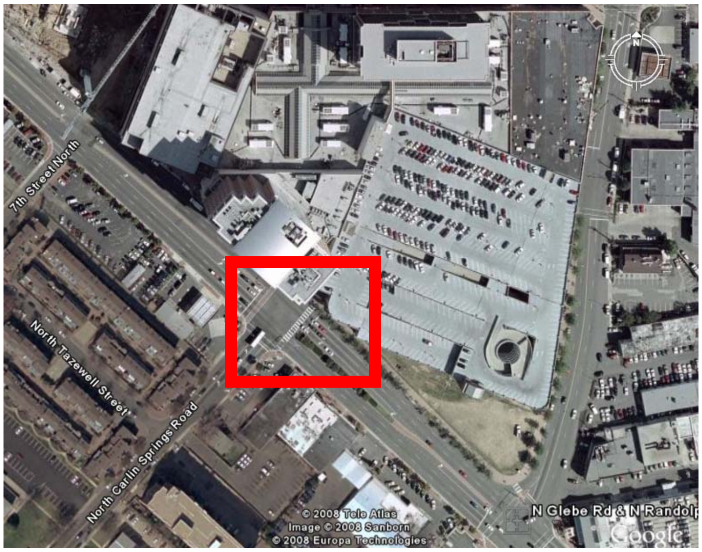


Figure 13: Aerial View Showing Existing Entrance Location

Based on this research combined with recommendations from professional engineers at The Pennsylvania State University, it was concluded that the existing entrances and exits were properly located during the original design. The garage entrance should be located at the intersection of N. Glebe Rd. and N. Carlin Springs Rd. and the garage exit should remain at the existing location on N. Randolph St.

Although *The Dimensions of Parking* recommends having more than one entrance for garages holding more than 500 vehicles, Ryan Seacrist, civil engineer at Penn State, advised that one entrance location will be sufficient as long as an adequate number of entry lanes and gates are provided. The redesign calls for three entry lanes and three gates which should be adequate.

Vehicle stacking must also be considered when designing a large parking structure. It is recommended that entry gates be located at least two car lengths, or 20ft. from the roadway. This will prevent roadway traffic from backing up while vehicles entering the garage receive their parking ticket at the gate. The proposed design has a minimum stacking distance of 101ft. and utilizes a deceleration lane for traffic entering the garage from northbound Glebe Rd. This will considerably reduce the possibility of traffic backing up onto the roadway, thus, decreasing the risks of traffic hazards. To avoid traffic congestion while exiting the parking garage, the cashier's booths are located 97ft. from the nearest parking aisle and 145ft. from Randolph St.

Finalized parking garage entrance and exit designs are shown in the enlarged plans shown below.

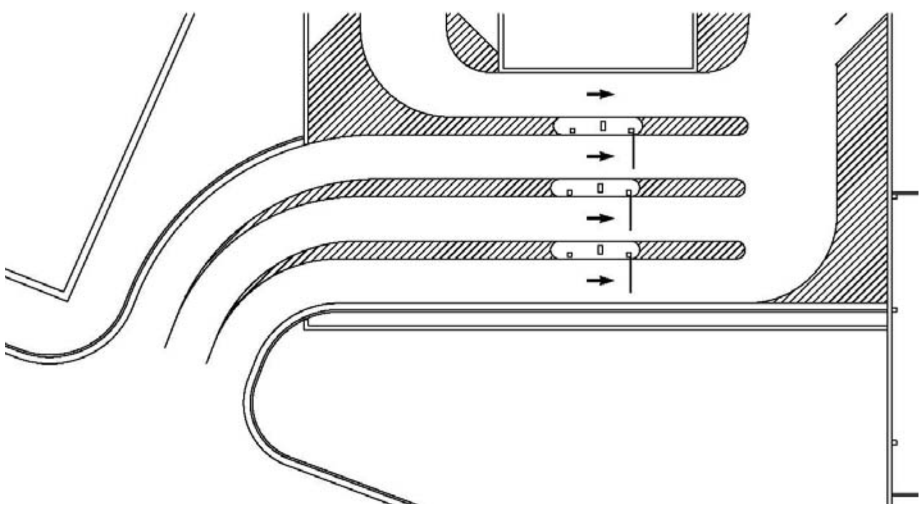


Figure 14: Garage Entrance Detail

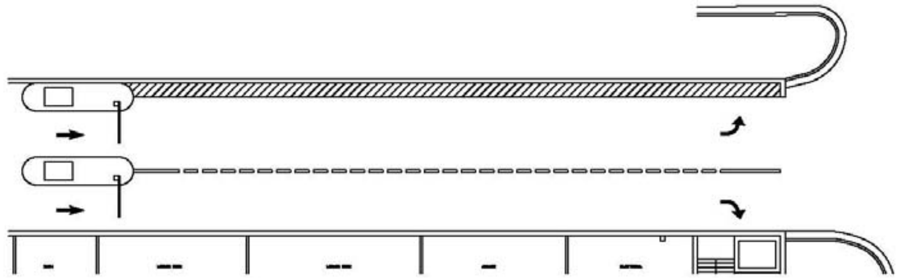


Figure 15: Garage Exit Detail

Another consideration from a civil site perspective is the building's main entrance and logistically accessing this location. An entry location for occupants not using the parking garage was determined to be both necessary and convenient. Based on the traffic count data, it was concluded that this entrance should be located off Randolph St. This will allow a drop off and pick up loop to be located off a low-volume roadway. This entrance will prove convenient for parents dropping off their children for events such as hockey practice and birthday parties. This roadway can also serve as an emergency fire lane if needed. This loop can be seen in architectural site plan shown below.

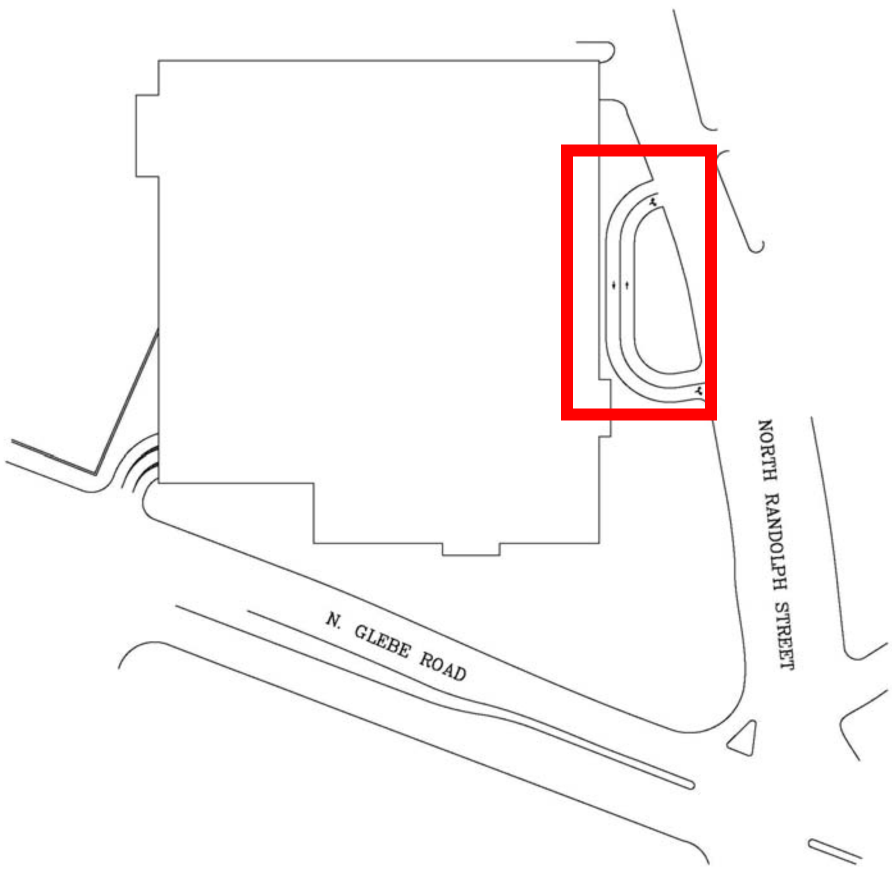


Figure 16: Architectural Site Plan

Green design is becoming more and more prominent in today's society. The amount of impervious area on a site should be minimized in order to have as little environmental impact as possible. Also, better storm water management is created on green sites. With the proposed design, the building footprint was reduced by 14.6% from the original design. This can be seen in Figure 17. This undeveloped land can serve as a large staging area for the contractor during construction. Then once construction is complete, it can be transformed into an attractively landscaped area. This corner has potential to become a prominent landmark in Arlington County. One design possibility could be to install a fountain surrounded by a park-like seating area. A large showpiece of the Capitals logo could be placed in the center of the fountain to symbolize the hockey team's unity with the county.

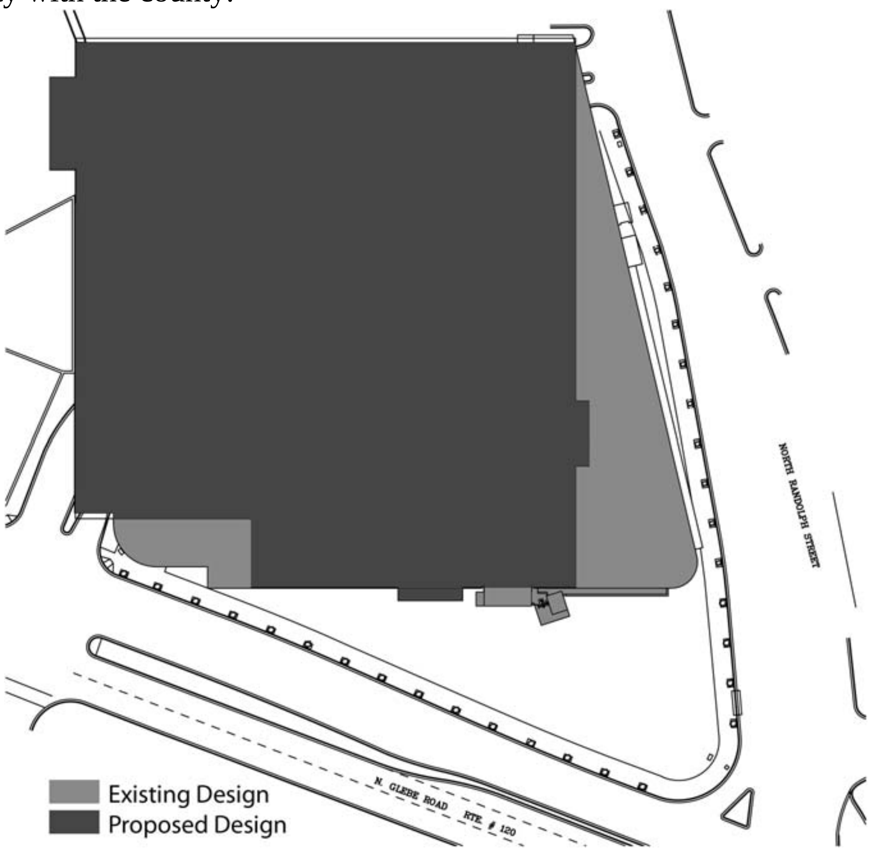


Figure 17: Impervious Area

ARCHITECTURAL DESIGN

The major architectural design change made to the Capitals' practice facility was to move the Iceplex from where it exists today on the 8th level down to ground level. Instead of the Iceplex being located on top of the parking garage, it will be relocated beneath the parking structure creating easy access from the street.

The Iceplex

The first step in the architectural redesign was to create a square footage program of the existing spaces. This will ensure that all rooms and facilities remain close to the same size as required by the owner in the original design. The Iceplex was divided into four distinct areas based on who will occupy the space: general admission/community areas, Capitals team access, visiting team access, and Capitals private offices. These areas are color coded in Figure 18.

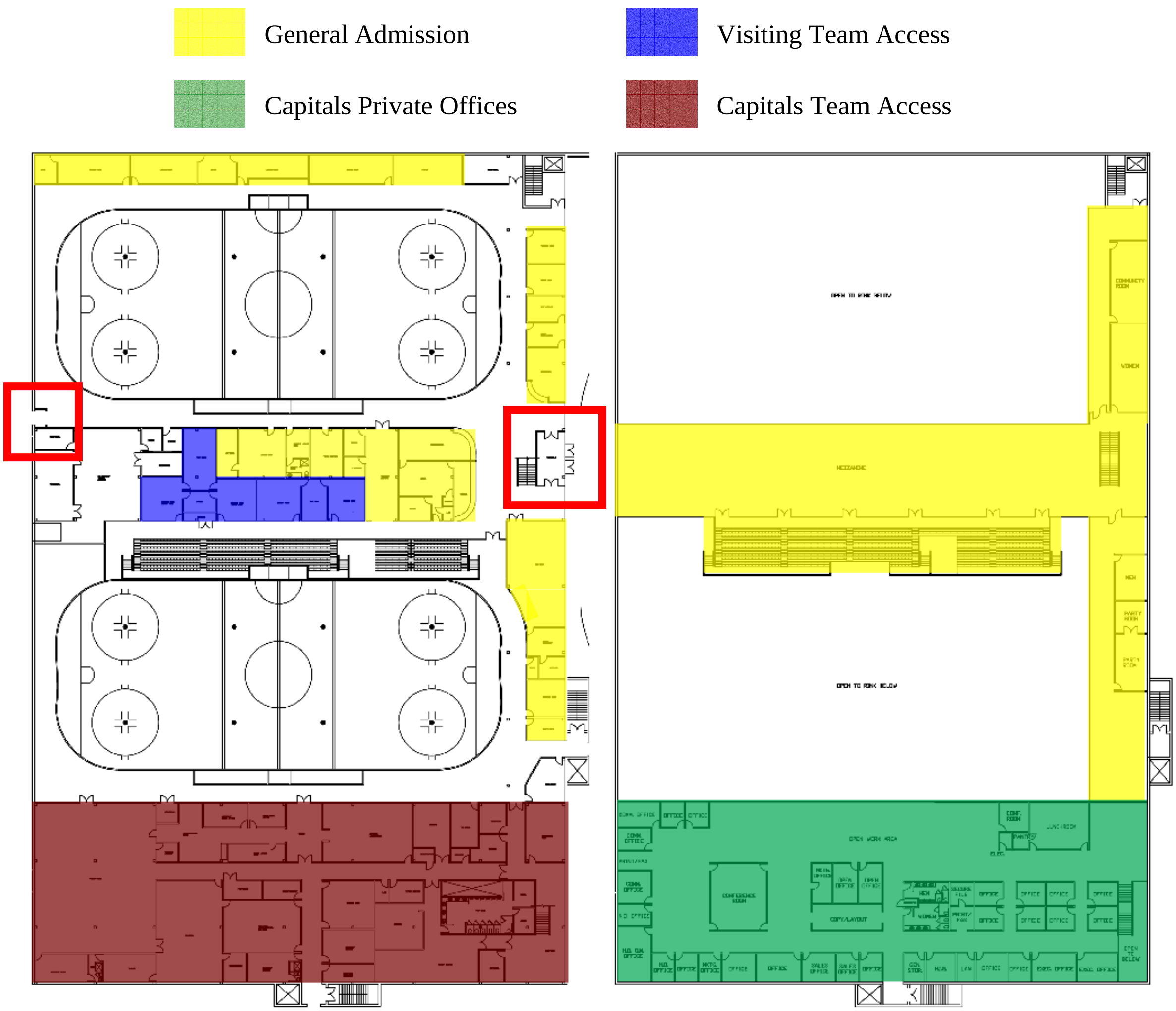


Figure 18: Iceplex Areas

Based on the garage access locations discussed previously in the civil/site section, the best orientation of the Iceplex was determined for the new design. Since the parking entrance and exit were already established, the southwest and northeast corners of the building must be reserved for the parking garage.

The main building entrance was located along the east side of the Iceplex creating easy access from N. Randolph St. This entrance will integrate with the drop off loop discussed previously. Based on these predetermined designs, the ice rinks were ideally located as shown in Figure 18. This figure also shows the proposed layout of the four main occupancy uses of the Iceplex.

A secondary entrance was located to access the parking garage. Since this is not a main entrance, a large greeting area was not provided. It was noted that this is not the most convenient situation for Capitals fans coming to watch pre-season practice and entering through the parking garage. However, for the majority of the year the main entrance will be more utilized with little league hockey practice and birthday parties. The two building entrances are outlined in red in Figure 18.

This conceptual layout and existing square footage program were then used to layout the individual rooms. As mentioned earlier, all spaces should be approximately the same size as in the original design. The spreadsheets below show the square footage areas of all spaces for both the existing and proposed designs. The difference in area size was calculated for comparison. As anticipated, room sizes were not exact, however most spaces are within a reasonable margin. The only major differences were in the visiting team locker rooms. With more time, these areas could be reanalyzed to account for the additional required space.

Table 1: Capitals Team Square Footage Program

Capitals Team Square Footage Program			
Room	**Original Area**	**Proposed Area**	**Difference**
Weight Room	3402	3678	276
Strength Coach's Office	180	297	117
Trainer's Office	224	294	70
Trainer's Bath	108	78	30
Training	1400	1350	50
Exam/Message	150	137	13
Equipment Manager	250	260	10
EM's Bath	104	44	60
Hydro Therapy	875	814	61
Stick Workshop	160	145	15
Pump Room	140	148	8
Training Storage	80	85	5

Weight Storage	110	82	28
Video Room	392	379	13
Asst. Coaches	216	215	1
Head Coach	180	175	5
Coach's Locker Room	300	212	88
Sticks	350	424	74
Capital's Locker Room	1204	1060	144
Lecture Room	486	495	9
Equipment Storage	288	345	57
Equipment Workroom	180	184	4
Player Lounge	1025	837	188
Changing	416	430	14
Office Storage	160	150	10
Player Locker Room	625	752	127
Steam Room	96	109	13
Sauna	130	117	13
Laundry	340	372	32
Housekeeping	54	57	3
Electric Room	60	51	9
Copy/Mail	189	160	29
Conference Room	484	464	20
Reception	300	574	274
Video Editing	156	162	6
Closing	156	174	18
TV Studio	210	250	40

Table 2: General Admission Square Footage Program

General Admission Square Footage Program			
Room	**Original Area**	**Proposed Area**	**Difference**
Office	130	119	11
Electric	90	93	3
Vending/Lockers	540	591	51
Skate Rental	665	450	215
Administration	345	380	35
Office	168	156	12
Tickets	280	232	48
Storage	25	18	7
Main Lobby	1500	1475	25
Snack Bar	440	400	40
Dry Storage	210	196	14
Food Preparation	200	187	13

Mech/Zamboni/ Ice Machine/ Ice Melt Pit/Elec	2304	2102	202
Mechanical	209	192	17
Office	90	90	0
Upper Concourse	10000	9919	81
Storage	90	92	2
Locker Room	418	456	38
Wet Room	198	211	13
Referee Locker Room	140	139	1
Referee Bath	80	89	9
Figure Skating	308	323	15
Ice Machine/Rink Storage	510	0	510
Lobby/Elevator Lobby	1000	0	1000
Bathroom	198	130	68
Locker Room	486	423	63
Electric	297	351	54
Arcade	342	419	77
Woman Bath	270	255	15
Men Bath	225	230	5
Woman Bath	680	660	20
Mezzanine	1100	1228	128
Community Room	629	602	27
Media Room	300	308	8
Men Bath	176	170	6
Woman Bath	400	281	119
Music	50	50	0
Storage	130	115	15
Skate Workshop	220	214	6
Pro-Shop	1320	1145	175
Mezzanine	1512	2358	846
Party Room	390	370	20
Party Room	225	210	15
Men Bath	300	297	3
Bleachers	4867	3993	874

Table 3: Visiting Team Square Footage Program

Visiting Team Square Footage Program			
Room	**Original Area**	**Proposed Area**	**Difference**
Locker Room	608	360	248
Office	165	134	31
Locker Room	510	366	144
Storage	75	51	24
Locker Room	540	366	174
Wet Room	360	216	144
Locker Room	400	314	86

Table 4: Capitals Private Offices Square Footage Program

Capitals Private Offices Square Footage Program			
Room	**Original Area**	**Proposed Area**	**Difference**
Balcony	144	0	144
Overlooking Area	2808	3503	695
General Offices	3207	3540	333
Print/Fax	110	136	26
NO Office	150	152	2
GM Office	400	400	0
HO Office	130	130	0
Marketing	130	130	0
Sales Office	195	195	0
G. Sales Office	117	130	13
MIG	169	176	7
LAN	130	104	26
Executive Office	260	260	0
Executive Office	260	234	26
Lunch Room	567	557	10
Waiting Room	260	930	670
Conference Room	169	169	0
Storage	32	52	20
Electric	45	41	4
Secure File	143	110	33
Print/Fax	110	110	0
Men Bath	156	167	11

Women Bath	234	227	7
Housekeeping	24	21	3
Copy/Layout	390	351	39
Marketing Office	162	162	0
Conference Room	740	750	10

In any sporting venue, floor to ceiling height is very important in the design. The distance from the ice rink surface to the bottom of the overhead truss supporting the parking structure is 26ft. This should allow for enough room to hang the "jumbo-tron" from the above structure and to avoid a claustrophobic feeling for skaters on the ice. This will give a floor to floor height of 15ft. for level one and 11ft. for level two of the two-story section of the Iceplex.

A unique feature of the new floorplan will now be pointed out. The zamboni storage area, which services both ice rinks, has direct access to the parking garage through a large sectional overhead door. This will allow easy transportation of the zamboni if it ever needs to leave the Iceplex facility for any maintenance issues. This feature was not available in the existing design and is shown in detail in Figure 19.

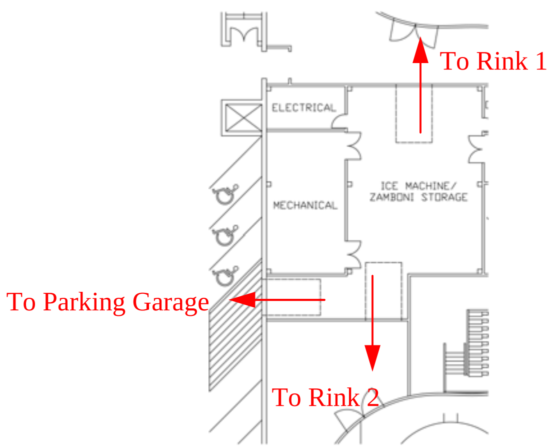


Figure 19: Zamboni Storage and Access

The Parking Garage

The International Building Code 2006 states that the minimum clear distance in a parking structure is 7'-0". However, *The Dimensions of Parking* recommends that a clear distance of 7'-6" provides a more spacious feeling. The proposed design calls for a floor to floor height of 11ft. Assuming a 2'-6" depth for structure, this leaves a clear distance of 8'-6" which is more than the recommended distance.

Deciding on an appropriate vertical transportation route proved to be the most complicated part of the parking garage architectural design. There are many options for laying out ramps and flat parking aisles. After careful consideration, a three-bay double helix ramp with one-way traffic was chosen. A diagram showing this vertical route is shown below in Figure 20. The only logical location for these ramps was at the western side of the building. This will allow for flat parking levels above the Iceplex. Per IBC 2006, vehicle ramps that are used for vertical circulation *and* parking shall not exceed a slope of 1:15 (6.67%). The ramps used in this design run a vertical distance of 15ft. on the first tier and 11ft. on the every other tier. They all run a horizontal distance of 250ft. creating a 6% or 4.4% slope. The proposed design of the parking garage calls for a total of nine levels of parking including the three partial levels on the ramps located adjacent to the Iceplex.

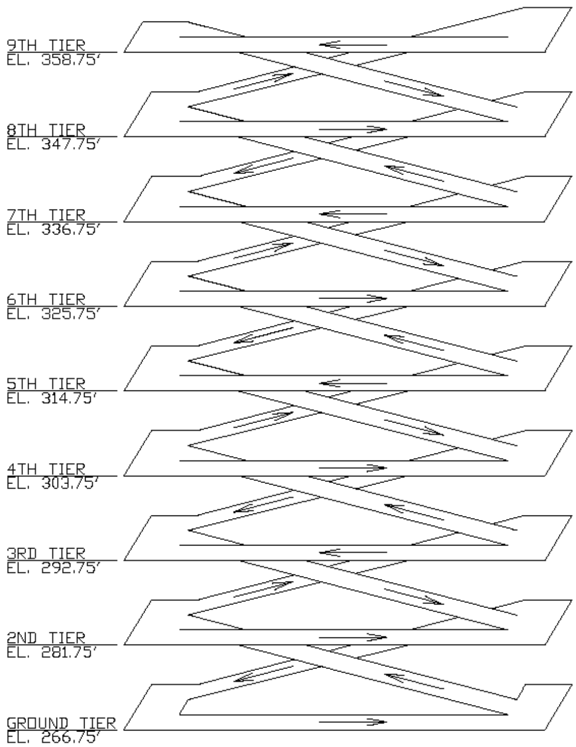


Figure 20: Vertical Transportation Isometric

One possible concern with this design is the recognizable availability of spaces. A car coming up the ramp may not know if there are any available parking spots located in the far rows of the garage. To eliminate this problem, a Smart Parking Garage System could be used. This system uses occupancy sensors to know where available parking spaces are located. The system can then inform drivers of the number of available stalls and direct them to the appropriate area. This kind of system should avoid driver's frustration in trying endlessly to find a parking space in a crowded parking garage. The two images shown below illustrate this Smart System. Figure 21 shows the proposed locations of the directional signage for the Smart System.

Beaver Ave. Parking Garage. State College, PA

BWI Airport. ***Courtesy IEEE.org***

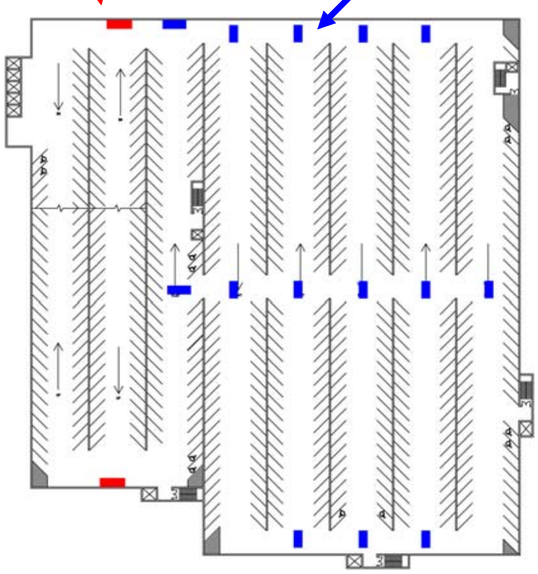


Figure 21: Directional Signage Locations

One necessary thing taken into consideration when designing the new parking garage was the number of parking stalls. Since this parking structure also services a large mall, it was important not to decrease the capacity of the garage. The structure currently carries approximately 2800 vehicles. With the new design, the parking garage has over 3800 stalls, which is a 37% increase over the existing design. Depending on mall management, these additional stalls could either be utilized, or one level of the garage could be removed creating about 3300 stalls.

The number of accessible parking spaces is regulated by the building code. According to IBC 2006 Section 1106, there must be 20 ADA spaces plus one for each 100 over 1000 total spaces. This means that for the parking garage holding 3800 vehicles, there must be 20 + (3800-1000)/100 = 48 ADA spaces. These spaces must be located along the shortest accessible route of travel from adjacent parking to an accessible building entrance or exit. Therefore, the ADA spaces in the proposed design will be located near all elevators and the Iceplex entrance.

Means of Egress

When designing a building with a large footprint, it is important to consider means of egress for building occupants. According to IBC 2006 Section 1019.1, for a building with an occupancy load of more than 1000, at least four exits per story must be provided. It also states that parking structures must have a minimum of two exits per parking tier excluding the vehicle ramps. It can be seen from Figure 22 that each level has at least six exits, including the elevator lobby connecting to the mall.

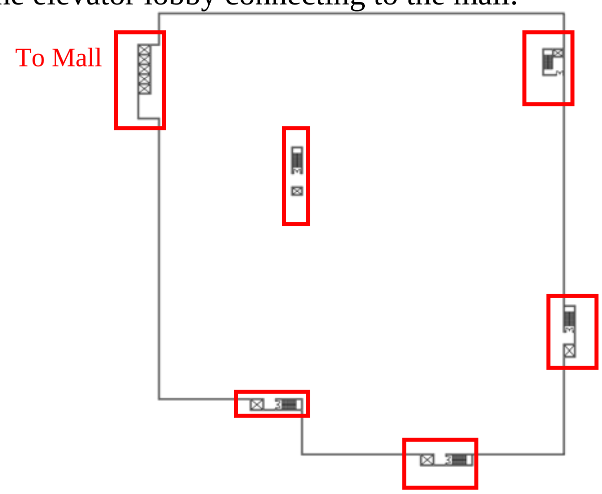


Figure 22: Exit Locations

IBC 2006 also sets limitations on exit access travel distance. According to Table 1016.1, the maximum length of exit access travel is as follows: 250ft. for ice rinks and bleachers (Occupancy Group A); 300ft. for offices (Occupancy Group B); and 300ft. for the parking garage (Occupancy Group S-2). These distances assume that the interior spaces of the Iceplex are sprinklered and the parking garage is not. Figure 23 shows the maximum travel distance for the most remote locations of the building.

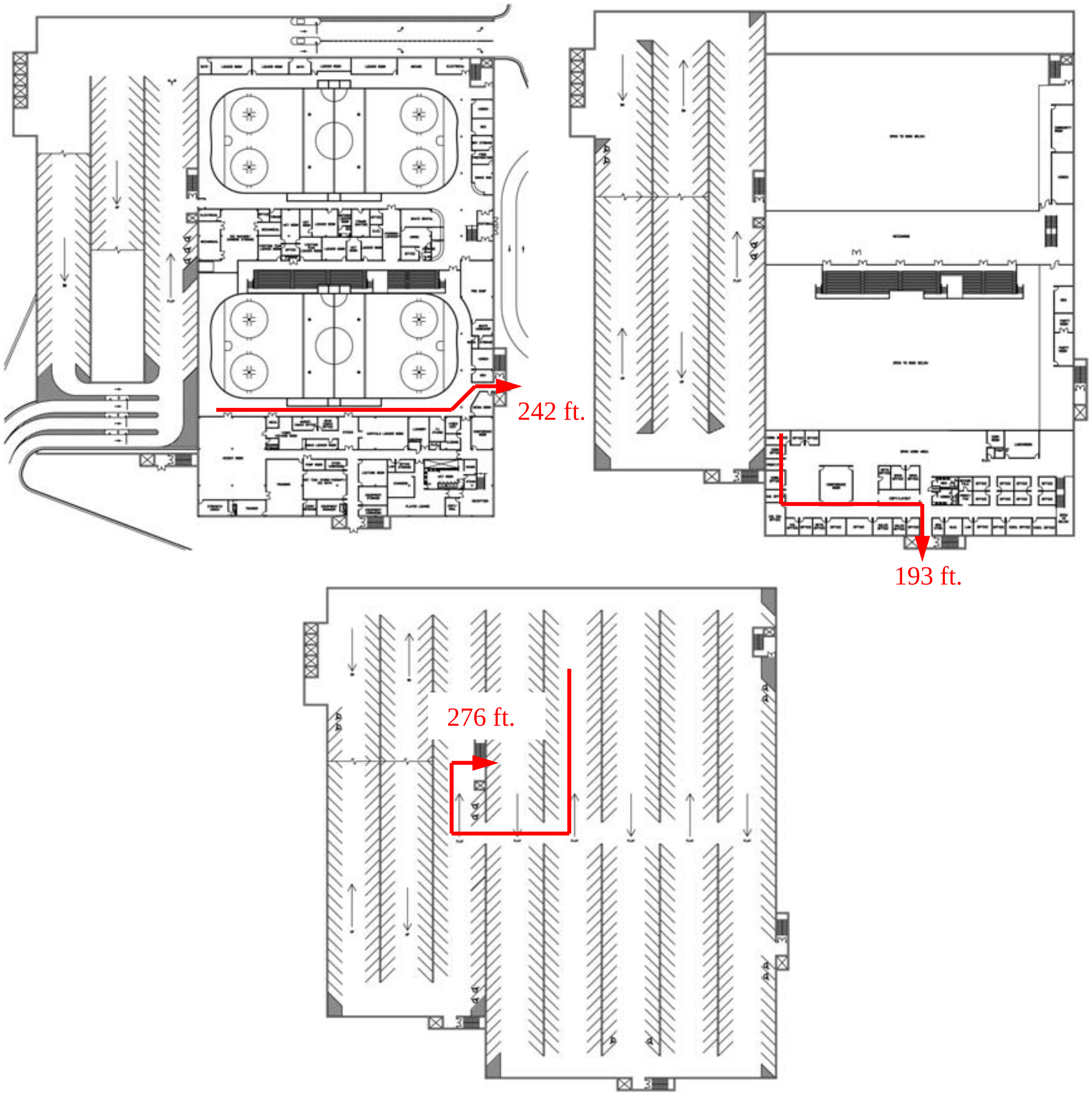


Figure 23: Maximum Egress Distances

Final Design

The finalized floorplans for the first two levels of the Iceplex and the parking garage layout are shown below. The maximum building dimensions are 372ft. x 408ft.

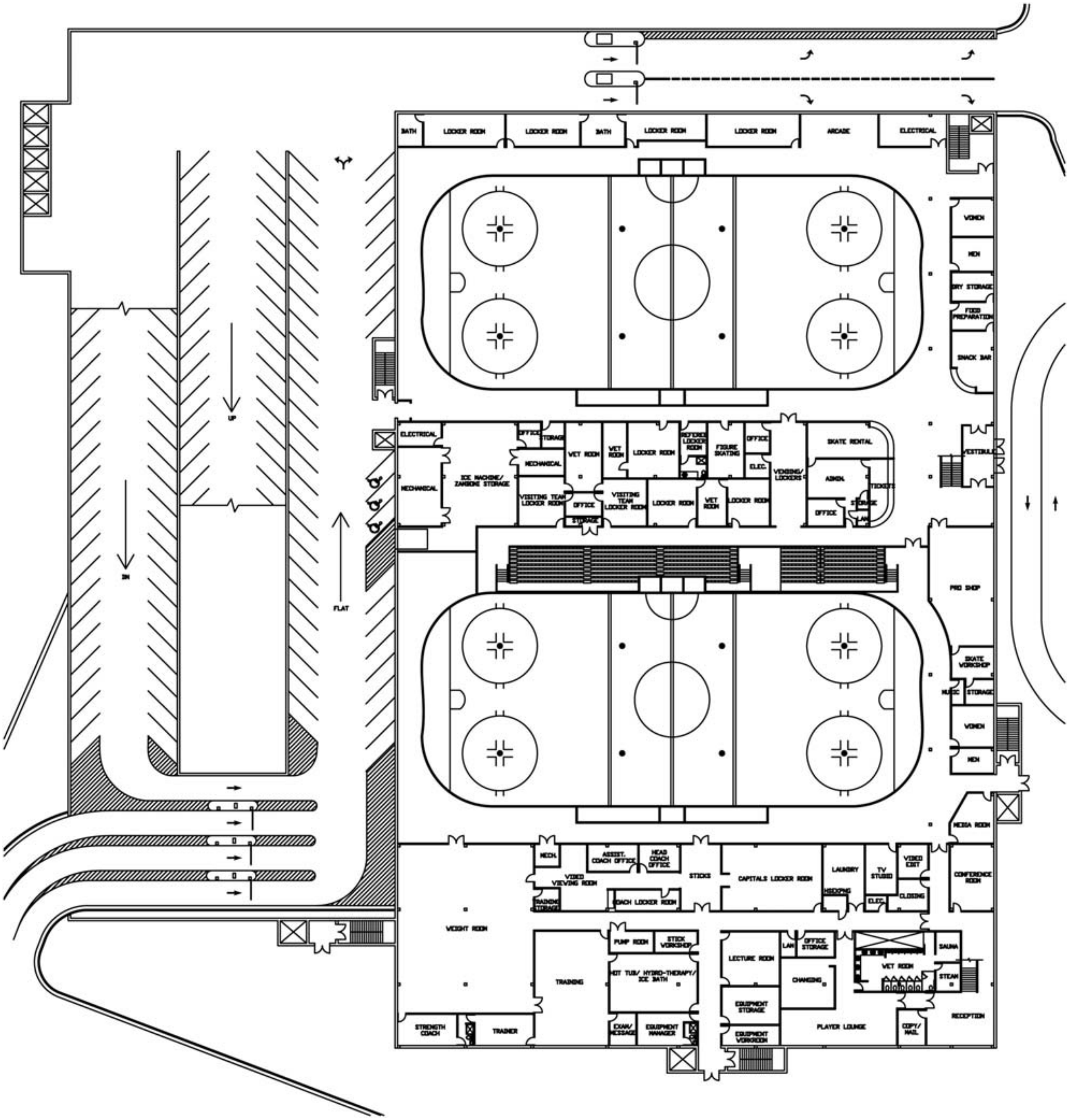


Figure 24: First Floorplan

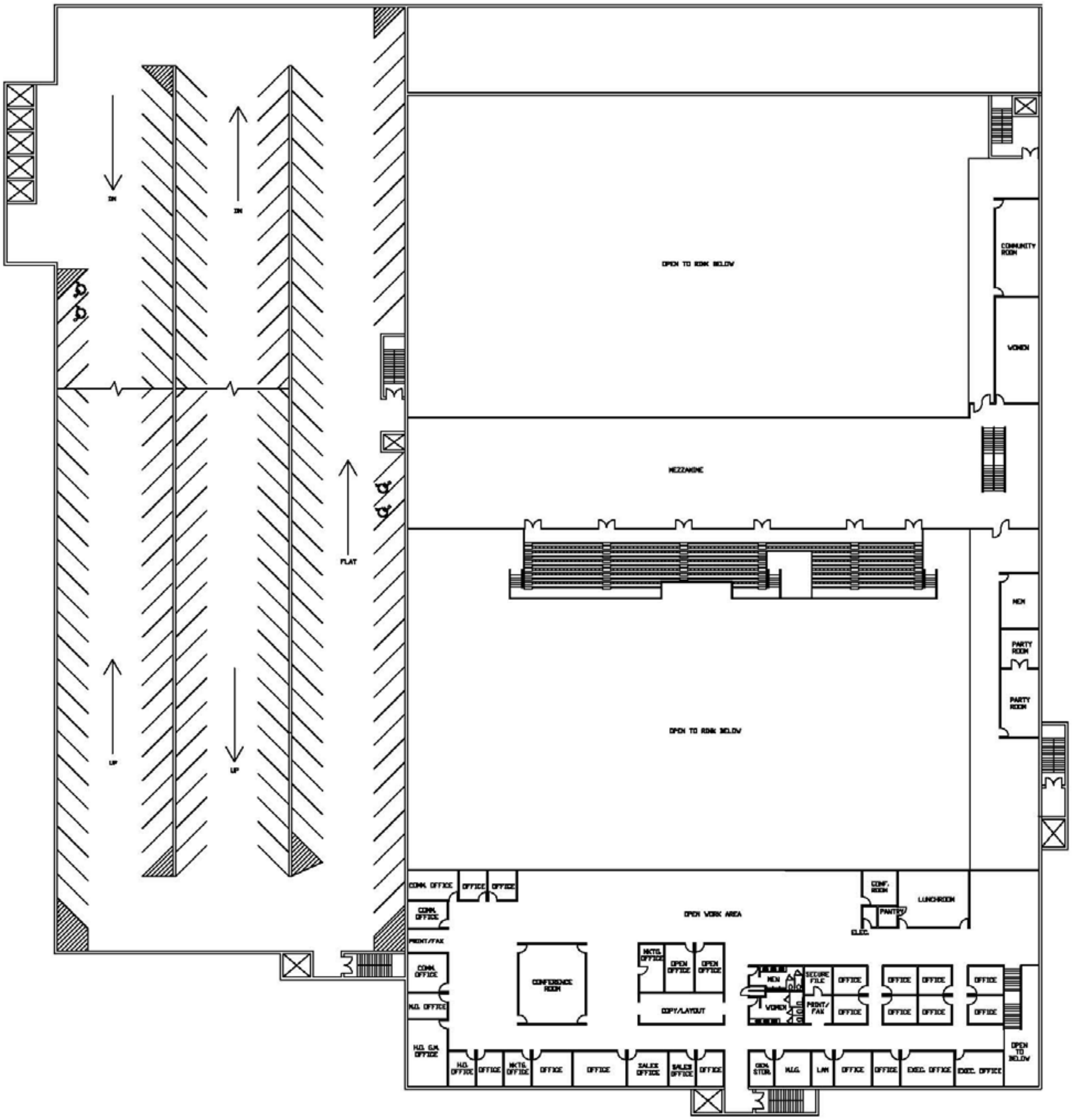


Figure 25: Second Floorplan

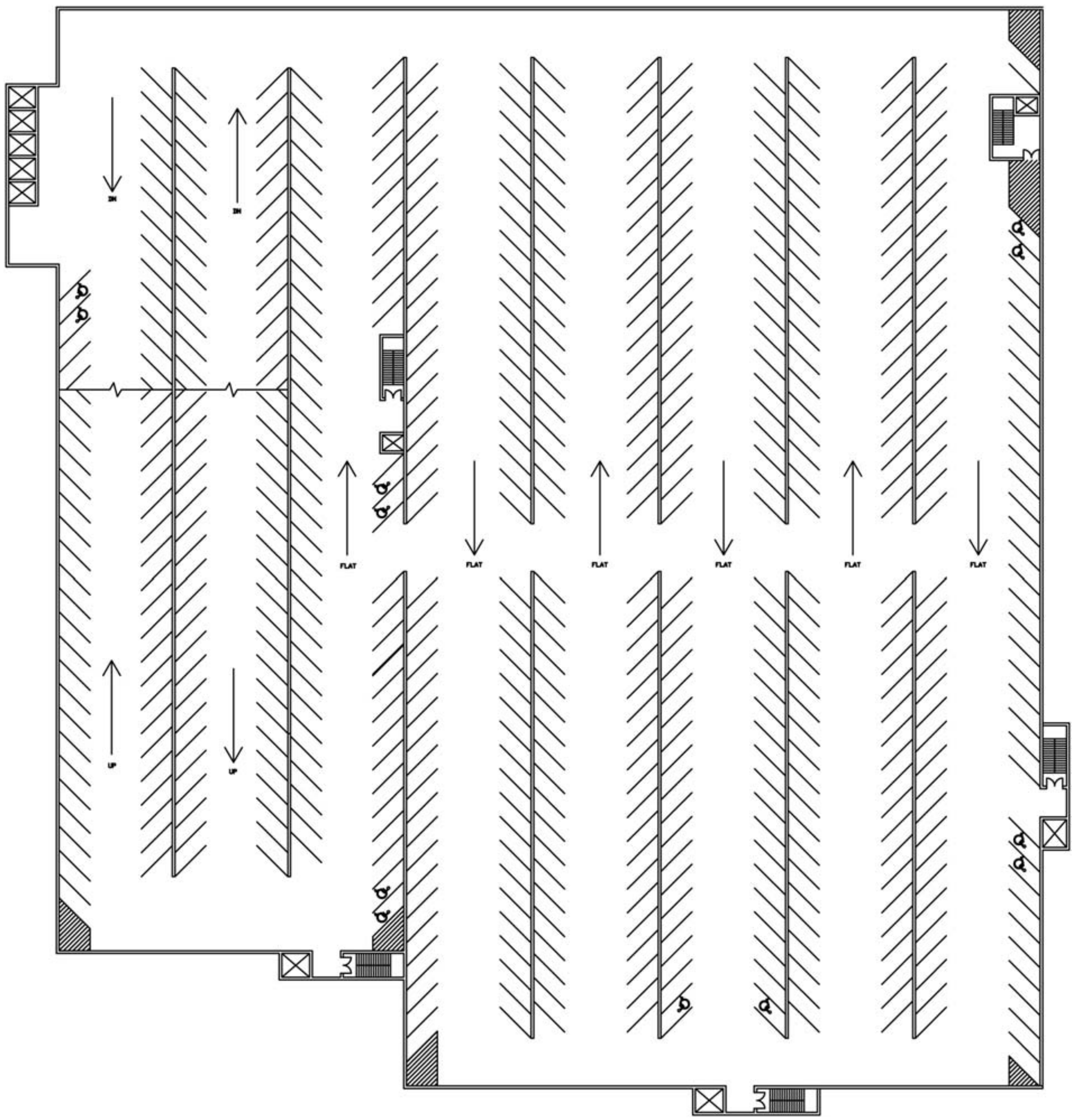


Figure 26: Typical Parking Floorplan

Below are sketches of building sections which explain how the parking garage will span over the Iceplex. It can be seen that an 11ft. clearance was allowed for any structure needed to support this section of the parking garage. A building rendering is provided to illustrate the architectural impact on the exterior. It can be seen that the main building materials include precast concrete, brick, metal paneling, and glass. It is very obvious which part of the building is the Iceplex and which part is the parking garage by the use of the various materials.

Since the Iceplex is now located on the ground and second floors, privacy must be considered. It is important to note that no private areas, such as bathrooms, are enclosed by glass. However, for other areas such as the training facility, that need to remain private only when in use, window shades are suggested. Another consideration for the final design was the openness of the parking garage. According to IBC 406.3.3.1, the openings of exterior walls in any parking garage must be at least 20% of the total perimeter wall area on any given tier. The proposed design calls for approximately 27% openness, therefore meeting this criterion.

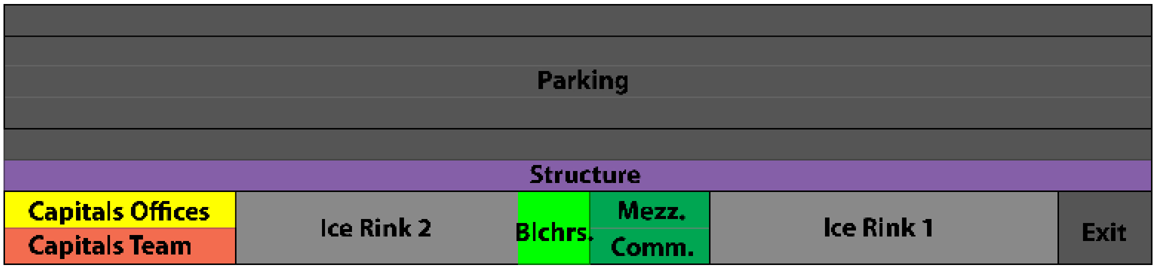


Figure 27: N-S Building Section

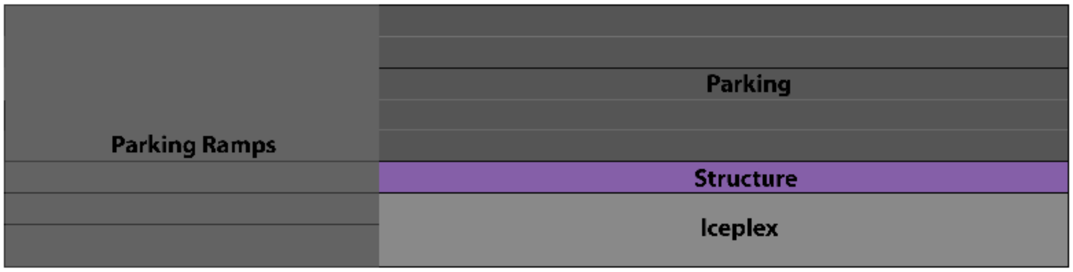


Figure 28: E-W Building Section

Figure 29: Rendering

STRUCTURAL DESIGN

The Parking Garage Structural System

Since the Ballston Common Mall will be without any parking for the duration of this proposed project, it was very important to frame the structural system with materials that can be erected quickly and efficiently. There were several options considered for the structural framing of the parking garage: cast-in-place concrete, steel, and precast concrete. Cast-in-place concrete takes time to cure, which will slow down erection time. Using CIP concrete will also push back the occupancy date, which needs to be avoided with this specific project. Steel framing has somewhat of a quick erection time, but is not typical of a large parking structure. Precast concrete was chosen to be the best building material to structure the parking garage because of its fast erection. Precast parking structures are erected one bay at a time, different from that of typical construction which erects one level at a time.

Another reason precast concrete is the ideal building material for this parking garage is its maintenance schedule. Precast parking structures that receive periodic maintenance and care can be used for decades with only moderate cost. If an owner follows a very simple schedule of maintenance, he will be protecting his investment avoiding increased repair costs down the road. There are three categories for this maintenance: housekeeping, preventative maintenance, and repairs. Housekeeping items include sweeping, trash pickup, and parking space restriping. Preventative maintenance items include floor wash down and repairing joint sealant. If an owner keeps up with these housekeeping and preventative maintenance tasks, major issues like corrosion that need serious repair may be eliminated.

Several options of precast concrete systems were researched. It was concluded that the MEGA-SPAN system from High Concrete was the best choice. This system introduces the 15ft. "MEGA-TEE" which is 5ft. wider than the typical double T. This allows for wider bays and longer spans. This system's primary benefits include faster construction time and reduced costs. In fact, this system can reduce construction time by 20-30% which will decrease the amount of time the Ballston Common Mall goes without parking. The MEGA-SPAN system is becoming more and more popular with large parking structures. Parking decks, such as East Parking Deck and Eisenhower Parking Deck on Penn State University's main campus, use this framing system. A copy of the MEGA-SPAN Precast Building System Design Guide has been provided in the appendix.

According to PCI's *Parking Structures: Recommended Practice for Design and Construction*, expansion joints are rarely used in precast parking structures unless the structure is more than 300ft. in length. The proposed design has maximum dimensions of 372'x408', which means that there should be at least on expansion joint in each direction. However, upon close examination it was very difficult to locate these needed joints because of the architectural layout of the building and the structural requirements of the ice rinks. Jim Pudleiner of Walker Parking Consultants in Wayne, PA stated that this large structure is pushing the limits, but it is possible to go without expansion joints. He stated that this may cause some issues with diaphragm cracking.

The Iceplex Structural System

The first level of the Iceplex, including both ice rinks, locker rooms, and the pro-shop, are located on ground level framed using a slab-on-grade. Although this slab was not designed in detail in this report, it is believed that locating the ice rinks on SOG will drastically improve the deflection problems that were experienced in the original design.

The second level of the Iceplex, including the Capitals corporate offices and mezzanine overlooking the rinks, was framed out of composite steel. The typical bay measures approximately 30'x30' varying slightly depending on architectural layout. The exact member sizes were not designed in detail in this report.

Gravity Loads

Gravity loads were taken from ASCE7-05 and are listed in Table 5. Even though the framing systems for the offices, mezzanine, and bleachers were not designed in detail in this report, their live loads are listed to show what would be used during this design.

Table 5: Gravity Loads

Area	LL (psf)	SDL (psf)
Parking Garage	40	3(mech) + 8 (Double T stem)
Offices	50	15 (corridors)
Mezzanine	60	
Bleachers	60	

The superimposed dead loads for the parking garage include 3psf for mechanical equipment and 8psf which accounts for the double T stems. This is in addition to a 5" slab thickness used during analysis.

Column takedowns were performed in order to determine column loads for the parking structure. Live load reduction was taken into consideration with these takedowns. The column takedown spreadsheets are provided in Appendix C. Figure 30 shows the proposed locations of gravity precast columns.

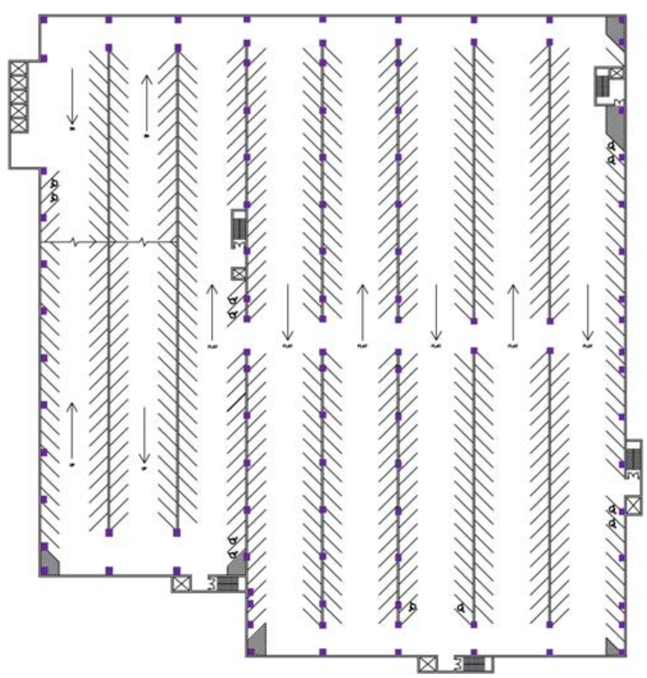


Figure 30: Column Locations

The Lateral Framing System

The main lateral force resisting system for the proposed design consists of precast concrete shear walls and lite walls. Lite walls are typically used in concrete parking structures. They are like shear walls but with openings in order to allow air flow and ventilation through the parking garage. These walls resist lateral forces as well as act as girders picking up the gravity loads from the double Ts. A photo of a lite wall used in Penn State's East Parking Deck in shown in Figure 31.

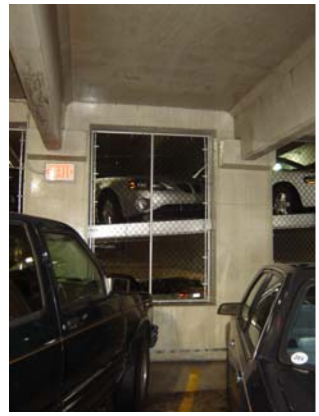
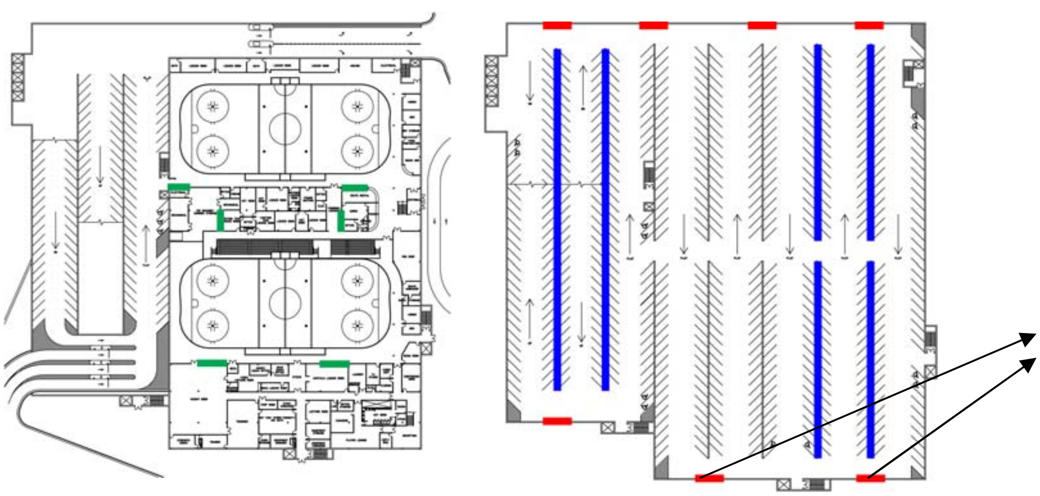


Figure 31: PSU East Parking Deck Lite Wall

One design consideration that took a great deal of thinking was the load path for lateral loads. Since the ice rinks require large open spaces, shear walls not located along the building perimeter cannot run the entire height of the building. There were also issues with the shear walls located along the exterior of the Capitals office spaces and locker rooms. The exterior walls of these spaces needed to remain glass and metal paneling for architectural reasons; therefore these walls were cut back at the first two levels of the Iceplex. After a great deal of thinking and comparing options, a final lateral resisting system was determined and is show in Figure 32. Lite walls are shown in blue, shear walls in red, and braced frames in green. Figure 33 shows how two of the shear walls will be cut back at Iceplex levels.

Figure 32: LFRS Location



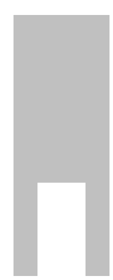


Figure 33: Shear Wall Cutback

Although this LFRS was determined to be the best solution, the location of these members may raise some other design issues. It can be seen that walls in both directions are located a reasonable distance from the center of rigidity. It is anticipated that this may cause some problems. When the building contracts, due to volume changes such as thermal expansion, the shear walls along the perimeter will want to resist this contraction resulting in serious cracking in the diaphragm. In order to avoid this problem, lateral resisting members should be relocated near the center of rigidity. Consequently, this will cause some design issues with the large open spaces needed for the ice rinks. With further consideration, there may be a solution to this problem but one was not determined in this report.

Determining Wind Loads

Wind loads were generated using ASCE7-05 Chapter 6. Much of the structure exterior on the north and east sides is blocked by adjacent buildings, therefore no windward or leeward pressure would result. This was taken into account when generating wind loads. The spreadsheets used to generate wind pressures can be found in Appendix C. Here is a list of input parameters used when calculating wind pressures:

- Basic Wind Speed, V 90mph
- Wind Directionality Factor, K_d 0.85
- Importance Factor, I 1.15
- Exposure Category B
- Internal Pressure Coefficient, C_{pi} 0.18
- Topographic Factor, K_{zt} 1.0
- External Pressure Coefficient, $C_{p,w}$ 0.8
- External Pressure Coefficient, $C_{p,l}$ -0.5
- External Pressure Coefficient, $C_{p,s}$ -0.7

The tables below show how the wind forces will be distributed for the four different wind directions. The grayed out areas represent where there will be no windward/leeward pressures. It can be seen that wind traveling from east to west and wind traveling from south to north will control.

Table 6: North-South Wind Distribution

N-S Wind Distribution							
Level	Leeward Pressure (psf)	Windward Pressure (psf)	Wall Area-Leeward (SF)	Wall Area-Windward (SF)	Total Leeward Load (kips)	Total Windward Load (kips)	Total Load to be Applied (kips)
Mezz.	3.0		4836		14.51		14.51
Truss	3.0		4092		12.28		12.28
P1	3.0		4092		12.28		12.28
P2	3.0		4092		12.28		12.28
P3	3.0		4092		12.28		12.28
P4	3.0		4092		12.28		12.28
P5	3.0	19.70	4092	2880	12.28	56.74	69.01
Roof	3.0	20.10	2046	3720	6.14	74.77	80.91
					Base Shear =		225.81

Table 7: South-North Wind Distribution

S-N Wind Distribution							
Level	Leeward Pressure (psf)	Windward Pressure (psf)	Wall Area-Leeward (SF)	Wall Area-Windward (SF)	Total Leeward Load (kips)	Total Windward Load (kips)	Total Load to be Applied (kips)
Mezz.		15.1		4836		73.0	73.0
Truss		16.4		4092		67.1	67.1
P1		17.3		4092		70.8	70.8
P2		18.0		4092		73.7	73.7
P3		18.6		4092		76.1	76.1
P4		19.2		4092		78.6	78.6
P5	3.0	19.7	2880	4092	8.6	80.6	89.3
Roof	3.0	20.1	3720	2046	11.2	41.1	52.3
					Base Shear =		580.8

Table 8: East-West Wind Distibution

E-W Wind Distribution							
Level	Leeward Pressure (psf)	Windward Pressure (psf)	Wall Area-Leeward (SF)	Wall Area-Windward (SF)	Total Leeward Load (kips)	Total Windward Load (kips)	Total Load to be Applied (kips)
Mezz.		15.00		5304		79.56	79.56
Truss		16.30		4488		73.15	73.15
P1		17.20		4488		77.19	77.19
P2		17.90		4488		80.34	80.34
P3		18.50		4488		83.03	83.03
P4		19.10		4488		85.72	85.72
P5		19.60		4488		87.96	87.96
Roof		20.00		2244		44.88	44.88
					Base Shear =		611.84

Table 9: West-East Wind Distribution

W-E Wind Distribution							
Level	Leeward Pressure (psf)	Windward Pressure (psf)	Wall Area-Leeward (SF)	Wall Area-Windward (SF)	Total Leeward Load (kips)	Total Windward Load (kips)	Total Load to be Applied (kips)
Mezz.	3.1		5304		16.44		16.44
Truss	3.1		4448		13.79		13.79
P1	3.1		4448		13.79		13.79
P2	3.1		4448		13.79		13.79
P3	3.1		4448		13.79		13.79
P4	3.1		4448		13.79		13.79
P5	3.1		4448		13.79		13.79
Roof	3.1		2244		6.96		6.96
					Base Shear =		106.13

Determining Seismic Loads

Seismic story forces were calculated using ASCE7-05. First, the weight of each story was calculated. To view these calculations and the material loads that went into them, see Appendix C. The table below summarizes the weights of each level.

Table 10: Story Weights

Level	Weight (kip)
Base	1,976
Mezz.	6,731
Truss*	6,152
P1	16,573
P2	16,573
P3	16,573
P4	16,573
P5	16,573
Roof	15,653
Total	**113,377**

* Assuming steel trusses = 3psf

Once the weights of every level were calculated, they were used to determine to seismic story forces. The table on the following page summarizes these loads. See Appendix C for the calculations. Here is a list of input parameters used during seismic analysis:

- S_s 0.154
- S_1 0.051
- Site Class Unknown, assume D
- Occupancy Category III
- F_a 1.6
- F_v 2.4
- Importance Factor, I 1.25
- Response Modification Coefficient, R 4 (precast shear walls)
- Approximate Period, T_a 0.59

Table 11: Seismic Story Forces and Shears

Level (x)	Fx (kips)	Vx (kips)	Mx (ft-kips)
Roof	156.5		
P5	165.7	165.7	14401
P4	165.7	331.5	27825
P3	165.7	497.2	39426
P2	165.7	662.9	49204
P1	165.7	828.7	57159
Truss	61.5	890.2	63291
Mezz.	67.3	957.5	64891
Base	19.8	**977.2**	**65900**

Analyzing Lateral Force Resisting System

Comparing the story forces and base shears for wind and seismic loading, it can be seen that seismic controls over wind. Now that the controlling lateral force was known, a computer model was ready to be built. Through previous experience with several modeling softwares, ETABS was chosen to be the best program to use to analyze the LFRS of the proposed design. Figure 34 shows the finalized ETABS model. It can be seen how the three types of lateral members are distributed throughout the building. It should be noted that parking ramps were ignored in the model in order to avoid meshing problems.

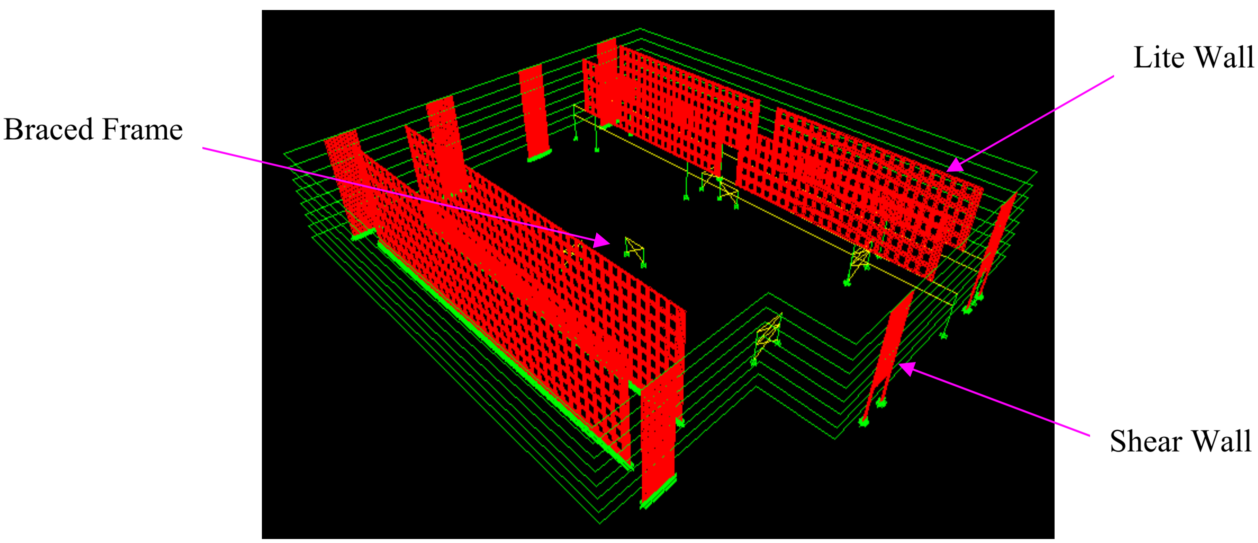


Figure 34: 3D LFRS ETABS Model

Here is a list of input parameters that were used when building this computer model:

- Manual meshing of all walls 1'x1'
- Each level assigned to its own diaphragm
- Seismic forces applied at center of rigidity with +5% eccentricity
- Diaphragm mass = DL (slab + double T stem + mech.)ksf / 32.2 / 12^3
- All members fixed at base
- P-Δ effects accounted for

Once the computer model was analyzed, the loads taken by each member were tabulated. Designing the lateral members is beyond the scope of this report, however the loads at the base of the four lite walls will be needed in order to design the transfer trusses. That is discussed later in this report. See the tables below for these forces.

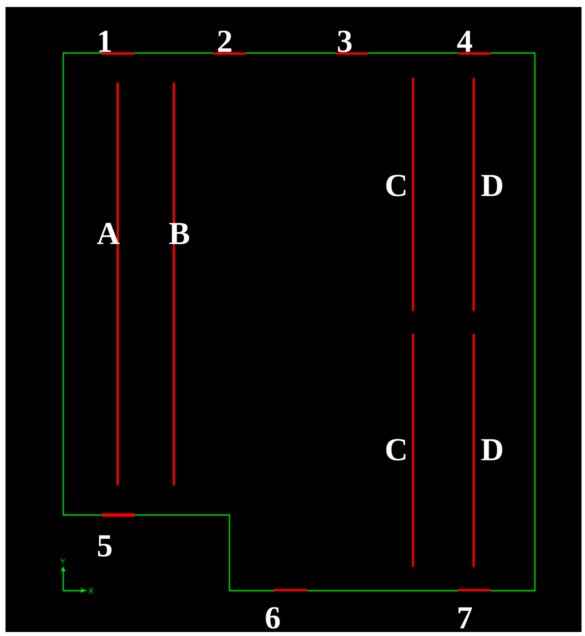


Figure 35: LFRS Labels

Table 12: Shear Wall Forces

Member	Floor (x)	Vx (kip)	Mx (kip-in)
Wall 1	Roof	9.5	71
	P5	22.9	1,238
	P4	48	6,742
	P3	71	12,705
	P2	97.3	26,976
	P1	126	46,486
	Truss	137	65,475
	Mezz.	131	82,459
	Base	129	106,644

Member	Floor (x)	Vx (kip)	Mx (kip-in)
Wall 5	Roof	3.9	17
	P5	17.7	1,230
	P4	40	4,057
	P3	62	11,075
	P2	80.2	18,804
	P1	94.2	32,402
	Truss	93.1	51,373
	Mezz.	324	89,863
	Base	360	156,868

Wall 2	Roof	5.3	13	Wall 6	Roof	3.8	14
	P5	23.7	1,546		P5	18.3	1,244
	P4	46.4	5,595		P4	39.3	3,737
	P3	72.6	15,972		P3	62.5	9,232
	P2	97.3	25,796		P2	88.2	22,534
	P1	126	47,412		P1	111	40,069
	Truss	137	65,138		Truss	169	60,094
	Mezz.	131	83,103		Mezz.	13.3	66,893
	Base	129	106,485		Base	9.4	68,665
Wall 3	Roof	12.6	109	Wall 7	Roof	4.8	29
	P5	23.7	1,727		P5	16.7	946
	P4	46.4	5,185		P4	40.4	4,473
	P3	65.1	13,749		P3	63.4	10,242
	P2	98.3	31,718		P2	87.9	23,400
	P1	126	47,412		P1	103	42,487
	Truss	137	65,307		Truss	170	63,081
	Mezz.	131	83,103		Mezz.	13.8	66,967
	Base	130	106,803		Base	10.3	68,896
Wall 4	Roof	6.6	41				
	P5	23.6	1,612				
	P4	45.6	5,318				
	P3	71.5	13,896				
	P2	97.9	31,748				
	P1	109	48,356				
	Truss	139	66,140				
	Mezz.	132	82,929				
	Base	132	107,316				

Table 13: Lite Wall Forces

Member	Floor (x)	Vx (kip)	Mx (kip-in)		Member	Floor (x)	Vx (kip)	Mx (kip-in)
Lite Wall A	Roof	11.2	55		Lite Wall C	Roof	92	385
	P5	22.8	2,830			P5	93.7	12,065
	P4	28.7	4,689			P4	134	27,640
	P3	35.3	7,208			P3	157	46,416
	P2	57.4	9,421			P2	203	68,970
	P1	49.6	16,141			P1	211	63,224
	Truss	416	66,810			Truss		
	Mezz.	417	12,216			Mezz.		
	Base	415	192,912			Base		
Lite Wall B	Roof	31.6	93		Lite Wall D	Roof	67	61
	P5	49.8	6,327			P5	127	18,436
	P4	83.3	16,997			P4	156	34,104
	P3	114	31,661			P3	183	59,122
	P2	142	49,719			P2	210	82,562
	P1	137	67,572			P1	232	93,361
	Truss	629	147,556			Truss		
	Mezz.	609	228,750			Mezz.		
	Base	609	321,953			Base		

Designing Transfer Trusses

Since the proposed design calls for six levels of parking to be constructed over top the two ice rinks, a large transfer system is required to transfer the large gravity and lateral loads from above. Based on these large loads, especially dead loads, it was determined that a truss system was the best system to use. Vertical web members were located at points of column loads and were spaced evenly under conditions of uniformly distributed loads. This should allow for the most effective transfer of axial forces throughout the truss.

Design Overview

The truss and column locations are shown in the figure below in red and blue, respectively. Trusses A, B, and E take only gravity load, whereas trusses C and D take both gravity and lateral load. The applied forces on trusses A, B, and E are point loads from the precast columns supporting the parking garage. The column takedowns were used in order determine each of these loads. The gravity loads on trusses C and D are uniformly distributed loads transferred from the lite walls above. These trusses were modeled individually using the structural design software, SAP2000.

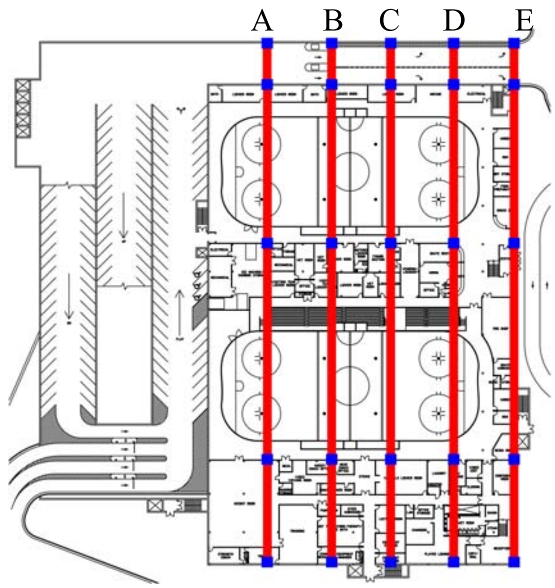


Figure 36: Design 1 Truss and Column Locations

Design 1

The first design attempt used a planar truss with a depth of 11ft. An elevation of this truss is shown in Figure 37. To test this configuration, a truss taking only gravity loads was examined.

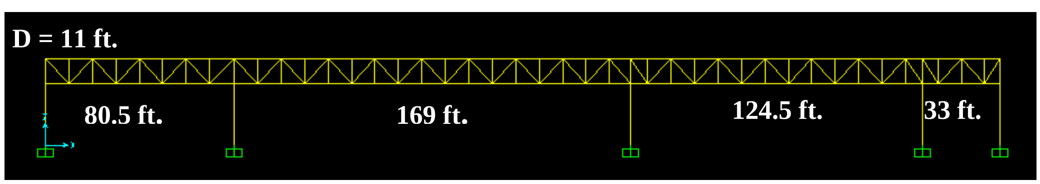


Figure 37: Planar Truss Model (Design 1)

The figure below shows the axial compressive and tensile forces in the truss members. Red indicates compression whereas yellow indicates tension. It can be seen that there are extremely high forces in several members, especially the top chords. A combined loading analysis was performed using the AISC Steel Construction Manual Chapter 6. Interaction equations H1-1a and H1-1b were used to determine what member size, if any, was adequate to carry these loads. Since the top chord spanning 169ft. carries the largest axial load, it was checked first. Using the axial and flexural loads provided by SAP, a stress level of 2.283>>1.0 was calculated using even the largest wide flange shape, the W36x800. This concludes that this truss configuration will fail. The calculations for this member can be found in Appendix C.

Figure 38: Planar Truss Axial DL

Design 2

Since the first design attempt failed by a large margin, several changes were made during the second attempt. First, the depth of the truss was increased from 11ft. to 22ft. The configuration of this truss was made into a space truss instead of a planar truss. This will provide two bottom chords with additional web members to better spread out the load from the top chord. An additional column was added in order to decrease the spans as much as the architectural layout would allow. The new longest span is still in the second bay but is now 126ft. instead of the original 169ft. This can be seen in Figure 39 with the additional columns shown in yellow. Figure 40 shows a view of this new truss configuration.

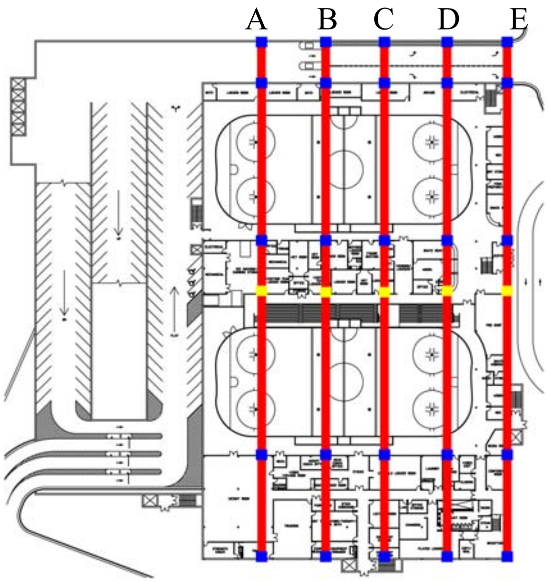


Figure 39: Design 2 Truss and Column Locations

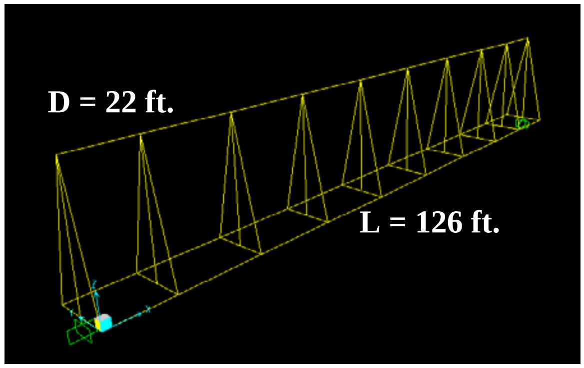


Figure 40: Space Truss Model (Design 2)

Once again, the axial and flexural loads were taken from SAP and used to check the member stresses. With this new design, the top chord still fails with a stress level of 1.18. This calculation can also be found in Appendix C.

Design 3

One last truss configuration was analyzed. With this third attempt, more diagonal members were added to even better distribute the load from the top chord. The truss depth and span remained 22ft. and 126ft. respectively. This can be seen in Figure 41 below. AISC equations H1-1a and H1-1b were again analyzed. This time, the stress levels in all members was found to be acceptable. The controlling load combination was 1.2D + 1.6L. The top chord final design for trusses A and B (taking only gravity load) uses a W40x503 (93% stressed). The bottom chords for this design are both W36x150 (also 93% stressed). The calculations for these members can be found in Appendix C. Web members range from HSS3x3x3/8 to HSS12x12x5/8. Two W14x193 members were used as vertical web members on either side of the truss. A spreadsheet showing the design and forces in each web member from the controlling bay is provided in Appendix C.

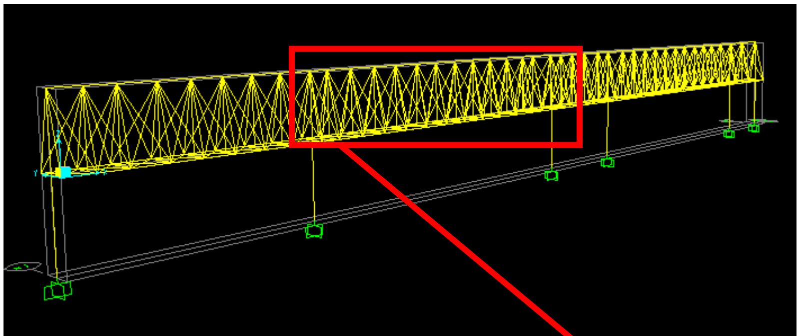
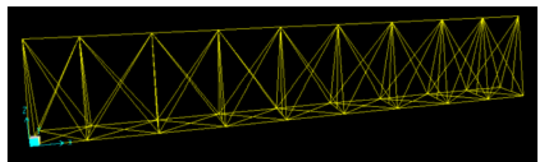


Figure 41: Space Truss Model (Design 3)



Design 3 (continued)

Now that a possible truss design configuration was determined, trusses C and D transferring both gravity and lateral load were examined. Uniformly distributed gravity loads were applied to the top chords of the truss. These loads were calculated the same way as the column takedowns and can be found in Appendix C. The moments determined from the ETABS lateral model were taken and applied to the top chords as well. These moments were applied using the truss bay's relative spans. For instance, the total moment at the base of a 176ft. lite wall is 5269 kip-ft. The truss bay spanning 126ft. will take 126' x 5269 / 176' = 3772 kip-ft. The corresponding moments were calculated this way for all truss spans and were applied at the center of the top chords. The shear in each lite wall was also applied to the edge of the truss. The model was finally analyzed in order to obtain the forces in each member. The load combination 1.2D + 1.0E + L controlled in this case.

The combined loading equations were once again used to design the top and bottom chords of the lateral trusses. The top chord of the second bay was designed as a W36x441 (82% stressed) and the bottom chords a W36x135 (76% stressed). Web members slightly increased in size and ranged from HSS3x3x3/8 to HSS14x14x5/8.

Since these trusses take lateral loads, it was assumed that the columns supporting these trusses will control over those of the gravity only trusses. These columns were then designed using the combined loading equations. It was important to use columns with as small of depth and width possible because they will be located in corridors as well as office spaces. The smallest column, Column 1, was designed as a W30x261 (96% stressed). The largest column, Columns 2 and 5, were designed as W36x441. Figure 42 shows the column designs.

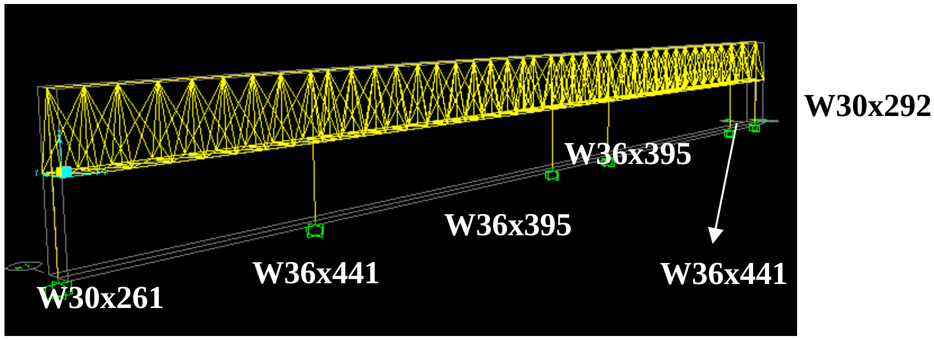


Figure 42: Column Designs

Design 4

Since the column sizes required by Design 3 were extremely large in dimension, a fourth design was analyzed. This design calls for two columns at each supporting location instead of the original one. This can be seen in Figure 43. It was thought that by adding additional columns, the dimensions would decrease to sizes that can be used without interfering with the architectural layout. After this SAP model was analyzed, the columns with the largest load, columns 3 and 5, were once again designed. Although they were able to decrease to a W30x261 and a W30x292 respectively, their 30" depth is still not ideal to use in architectural spaces. Since the depth only decrease by 3", it was assumed that this minimal change does not make up for the additional steel members. Therefore, one column at each support will be used as the final design. All column calculations can be found in Appendix C.

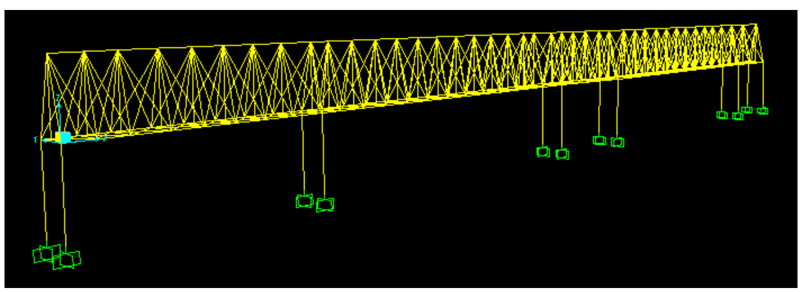


Figure 43: Space Truss with 2-Column Option

Final Design

The final design of the lateral trusses is shown below. Now that this has been determined, deflections can now be analyzed. Deflections in the top chords of these transfer trusses needed to be as small as possible because too much deflection can lead to sagging of the parking garage above. This can cause many problems from disturbing the drainage system of the garage to major issues while erecting the precast structure.

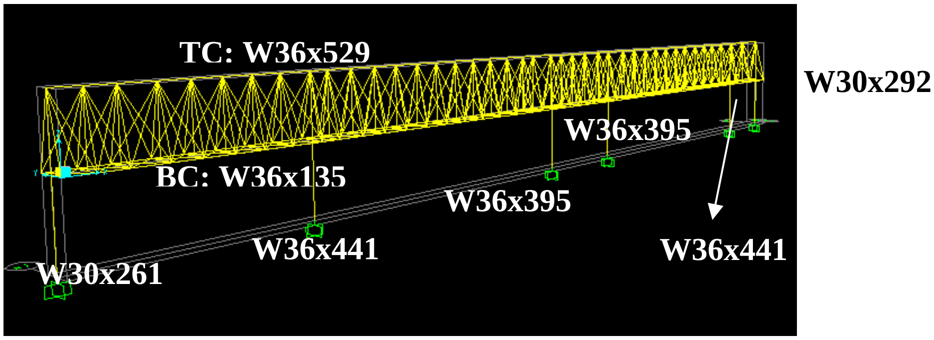


Figure 44: Final Truss Design

In order to determine how deflections will affect the structure, SAP was used to determine these deflections. Once all members were assigned there appropriate size, the model was analyzed one last time. The deflections of the top chords were as follows:

- Δ_{DL} = 2.33" in Bay 4 = L/641
- Δ_{LL} = 0.82" in Bay 4 = L/1822
- $\Delta_{Total,\ Factored}$ = 3.61" in Bay 4 = L/414

It should be noted that the live load deflection above is for the total code load of 40psf for parking garages. Whereas in reality the actual live load for a garage with cars bumper to bumper is more in the magnitude of 20psf. Therefore, it can be concluded that live load deflections should not be an issue with this truss design.

The biggest concern with these trusses is the dead load deflection. Since the deflection is relatively small, the top chords can be cambered in order to account for this deflection. It was recommended by a practicing engineer to camber about 80% of the total dead load. That would mean using a camber of about 1.9".

One major concern that must be addressed with the construction manager and precast engineer is how to properly erect the parking structure on top of these trusses. As the parking structure is erected, the trusses will deflect more and more as each piece is laid into place. One must ask the question, will the connections of the precast structure allow for such movement? Due to time constraints, this issue is not addressed thoroughly in this report, however it should be noted that it was indeed considered.

Truss Design Affects on Architecture

There were several things that changed during the many design attempts of the transfer trusses. First, the truss depth was increased from 11ft. to 22ft. This will affect both the parking layout and the architectural façade of the building. Since one level of parking must be removed to account for this larger truss, 341 parking stalls were lost. However, the new parking capacity is still greater than that of the existing parking structure. Also, the fourth level on the building exterior must now become another 11ft. of metal paneling. This is shown in Figure 45 outlined in red. Recall that the columns supporting

Figure 45: Facade Changes

these trusses are located in corridors and in office spaces. Their required 36" depth will have to either be blocked out using gypsum board or given an architectural layer of paint. Either way, these columns are taking up usable working space and will be inconvenient for building occupants.

CONSTRUCTION MANAGEMENT

Project Cost

Project cost is extremely important in the construction industry. Owners always want to get the best end result at the lowest possible price. Estimating the cost of the proposed design and comparing it to the actual design is essential in determining whether or not this is an economical solution.

The actual cost of the original design was $42.7M, but this number cannot be legally confirmed. Sigal Construction, the construction manager, is currently in litigation with the owner arguing about price. This means that the exact numbers could not legally be made public. However, a Certification for Payment document was obtained from Micheal Shevitz, project manager of the Iceplex project. It dates back to March 2005 and only addresses early estimated prices. According to this document, the total project cost is $30.4M. This document can be reviewed in Appendix D. For the sake of this report, the unconfirmed, yet more accurate, cost of $42.7M will be used.

Three RS Means 2007 publications were used to estimate the cost of the proposed design: Assemblies, Heavy Construction, and Site Work & Landscape. Unit prices of various activities were obtained from these books and applied to estimated quantities to arrive at cost data. It should be noted that all numbers include installation, overhead, and profit. Several soft costs were also estimated including contingencies and an estimated loss in mall revenue for the roughly 300 days the mall will be without the parking garage. Some numbers were taken from the cost data provided by Sigal Construction, adjusted for inflation. These numbers are noted with an * in the cost spreadsheet. The final project estimate is shown in the spreadsheet on the following pages.

Table 14: Cost Estimate

Activity		Unit	Cost/Unit	No. Units	Cost
Existing Building Demolition					
Demolition-Building		CF	$0.40	12,124,000	$4,849,600
Demolition-Foundation		CF	$5.00	102,900	$514,500
	Reinforcement: +10%				$51,450
Disposal (Assume no hazardous material)		CY	$12.00	157,500	$1,890,000
					$7,305,550
Foundation / Slab-on-Grade					
Strip Footings (Litewalls)		LF	$450.00	618	$278,100
	Estimate for 60klf, soil capacity 3ksf				
Spread Footings (Truss Columns)		EA	$61,500.00	36	$2,214,000
	Estimate for 3000k, soil capacity 3ksf				
Spread Footings		EA	$437.00	83	$36,271
	75k, soil capacity 3ksf				
Slab-on-Grade		SF	$5.45	145,000	$790,250
	6" thick, reinforced, non-industrial				
					$3,318,621
Precast Parking Garage					
Double Ts		SF	$15.00	632,000	$9,480,000
Columns		LF	$225.00	5,600	$1,260,000
Girders		LF	$200.00	9,700	$1,940,000
Shearwalls		SF	$40.00	25,000	$1,000,000
Litewalls		SF	$30.00	95,000	$2,850,000
Exterior Spandrels with Brick		SF	$50.00	48,500	$2,425,000
Exterior Spandrels		SF	$36.00	68,800	$2,476,800
Ramps		SF	$30.00	37,400	$1,122,000
Stairwells		EA	$4,500.00	40	$180,000
					$22,733,800
Iceplex Structure					
Steel Beams and Girders (Mezz./Offices)		SF	$14.40	34,500	$496,800
	25x30 Bay				
	125 psf Total Load				
Metal Deck / Concrete Fill (Mezz./Offices)		SF	$5.47	34,500	$188,715
	10' span				
	4" thickness				
Steel Columns (Mezz./Offices)		LF	$50.00	1,245	$62,250
Precast Wall Separating Garage and Iceplex		SF	$28.80	8,424	$242,611
	8" thick with 2" insulation				
	20x10 units				
					$990,376
Transfer Trusses					
Wide Flange		TON	$880.00	1,195	$1,051,600
HSS		TON	$980.00	685	$671,300
Connections (33% of bare steel)					$568,557
Erection (Assume +30%)					$516,870
					$2,808,327

Activity			Unit	Cost/Unit	No. Units	Cost
Finishes						
Curtain Wall Panels without Structure			SF	$20.50	6,500	$133,250
	Glazing Panel 5/8" thick					
Glazed Doors			EA	$3,800.00	5	$19,000
	Aluminum/Glass w/o transom					
	6'x7'					
Drywall Partitions on Metal Stud Framing			SF	$5.41	36,000	$194,760
	5/8" FR Drywall Both Faces					
	Framing 16" oc					
Steel Doors (Exits)			EA	$3,985.00	42	$167,370
	18 gage steel, 2-door with frame; 6'x7'					
	B label = A label + $600 (approx.)					
Interior Glazed Opening (Capitals Offices/Mezz)			EA	$4,500.00	45	$202,500
	Concealed Frame, 1/2" float, 16'x5'					$0
Interior Doors			EA	$394.00	125	$49,250
	Wood Door/Frame, Hollow Core					
	Luann, 2'-8"x6'-8", 3-5/8" Deep					
Wall Finishes			SF	$0.73	36,000	$26,280
	Painting Primer + 1 Coat					
Floor Finishes			SF	$7.00	81,000	$567,000
	Avg. Carpet and Tile					
Drywall Ceilings						
	5/8" FR Drywall on Metal Studs		SF	$3.32	57,300	$190,236
Ice Rink Dasher Boards			EA	$157,500.00	2	$315,000
Bleachers			EA	$138.00	675	$93,150
Miscellaneous (scoreboard, fire extinguishers, projection screens, sauna, etc.)*						$635,000
						$2,592,796
MEP						
Community Centers (Comm./Party Rooms)						
	Total Mechanical/Electrical		SF	$34.50	28,000	$966,000
Offices						
	Plumbing		SF	$4.59	19,300	$88,587
	HVAC		SF	$9.15	19,300	$176,595
	Electrical		SF	$9.65	19,300	$186,245
Parking Garage						
	Plumbing		SF	$1.36	632,000	$859,520
	Electrical		SF	$2.09	632,000	$1,320,880
Ice Skating Rinks						
	Total Mechanical/Electrical		SF	$14.75	32,700	$482,325
Clubs: YMCA (Locker Rooms/Training/etc.)						
	Total Mechanical/Electrical		SF	$33.00	19,300	$636,900
Elevators: Hydrolic			EA	$110,000.00	5	$550,000
Ice Rink Maintanence (Refrig., Plumb., Cooling)						
	55°, 5 mos., 100 ton		EA	$545,500.00	2	$1,091,000
Fire Protection*						$486,000
Smart Parking Garage Counting System						$75,000
						$6,919,052
Landscaping and Site Work						
Site Utilities*						$150,000
Chain Link Fences*						$6,850
Concrete Sidewalks			LF	$24.70	1,000	$24,700
Bituminous Roadway			LF	$91.00	232	$21,112
Lawn			1000SF	$1,105.00	67	$74,035
						$119,847
						$46,788,369
Soft Costs						
Design Fees			8.5%			$3,977,011
Permitting						$150,000
Contingency*		gen + adjustment				$1,720,000
Mobilization/Demobilization*						$172,000
Bond*						$217,500
Estimated Loss in Mall Revenue			DAY	$72,000.00	300	$21,600,000
						$74,624,881

*Numbers taken from original price estimate, adjusted for inflation

The estimated mall loss of revenue was obtained by using the 2002 revenue for total retail trade stores in Arlington, VA from the Census Bureau. The annual revenue for all retail stores in the county totaled $2.1B in 2002. It was assumed that 5% of this revenue comes from the Ballston Common Mall and that the mall would lose 25% of its customers without a parking garage. Based on these numbers, it was estimated that the mall would lose approximately $72,000 each day without the parking garage. It should be noted that this number is based on rough assumptions and cannot be labeled accurate without more information. However, when asked about its daily revenue, mall management stated that they could not release that information, therefore these assumptions must be made.

For this estimate, the foundation system was assumed to be spread footings. It was recommended that a deep foundation system, such as piles, could be used in Arlington in order to decrease any structure settlement. However, this system only works efficiently with certain soil types. According to an interactive map from the U.S. Department of Agriculture NRCS, the corner of N. Glebe Rd. and N. Randolph St. is composed mainly of construction fill material. A deep foundation system would not work properly under these soil conditions.

The estimate for the precast parking garage was taken from unit price numbers given by a salesman from High Concrete. This salesman had access to dimensions, plans, and elevations for the proposed design. The email with these numbers can be found in Appendix F.

The steel cost numbers were calculated based on a recommendation by Charlie Carter of AISC. He stated that wide flange shapes cost approximately $0.44 per pound and HSS tubes cost about $0.49 per pound. The email with these numbers can be found in Appendix F.

Without taking into consideration a loss in mall revenue, the total construction cost of the proposed design is $53M, about $10M more than the original design, a 24% increase.

Project Schedule

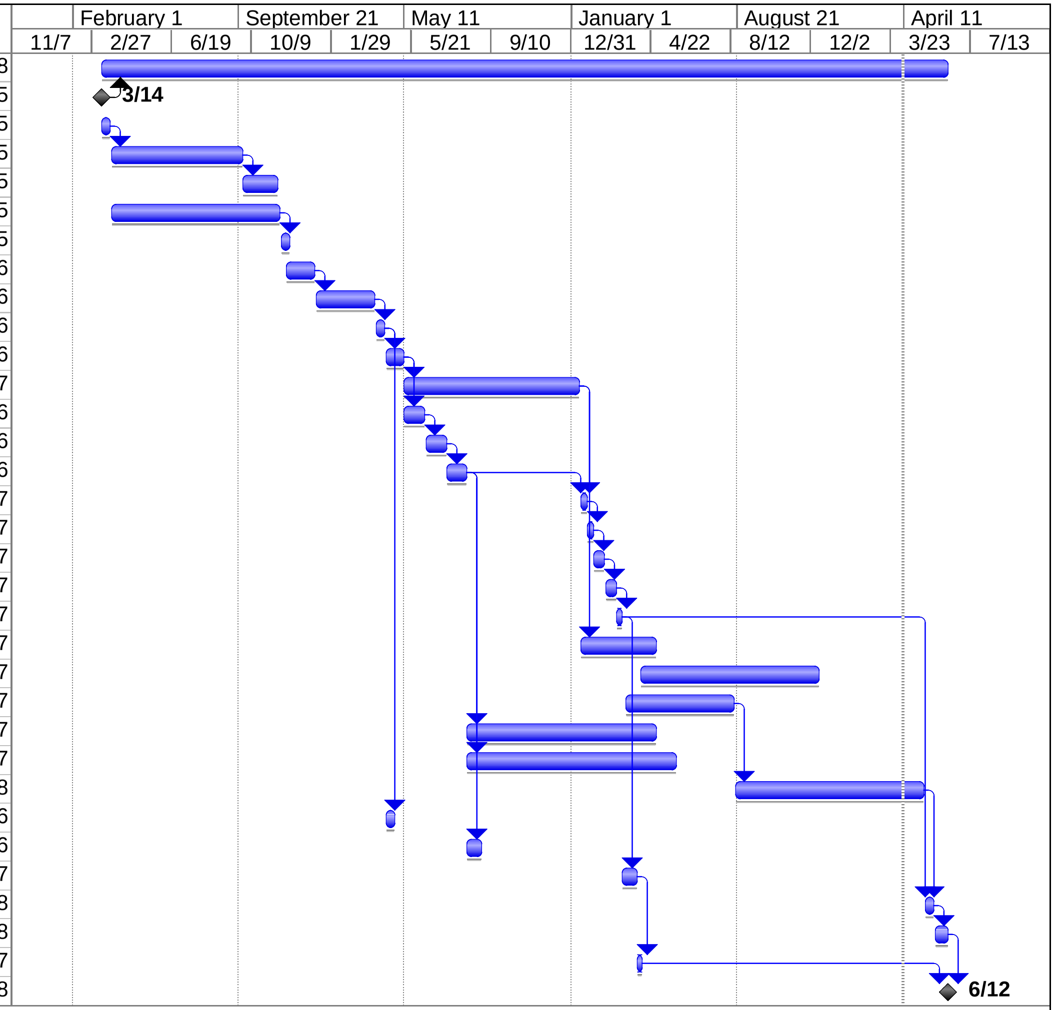
Another determining factor in the feasibility of the proposed design is the project schedule, how long construction will take. The original design called for a total duration of 360 working days, which came out to be approximately 495 days total. A detailed Gantt Chart for the original project is provided in Appendix D.

The schedule for the proposed design was created based on RS Means daily output numbers, data from the original schedule, and input from professional engineers in the industry. For instance, Ken Bauer, Director of Research and Development & Technical Sales Support at High Concrete, provided information on how their MEGA-SPAN system is erected and how long it takes to construct. This information can be found in an email in Appendix F.

The schedule for the proposed design calls for a duration of 848 working days, or a total of 1170 days. Based on engineering judgment and input from professional engineers in the industry, this does not seem accurate. One engineer stated that this project seems like a 30 month project, not a 39. Most likely there is a lot of activity overlap that was missed in this schedule.

The approximate 30 month project schedule is about twice as lengthy as the original schedule. The most likely cause of this big difference is the demolition time, which runs approximately one year in length. Also, erecting the large steel trusses makes up a large portion of the schedule. The precast parking garage, however, is erected extremely fast compared to its large size. One crew can erect an average of 22 pieces per day. The proposed schedule can be found on the following page.

ID		Task Name	Duration	Start	Finish
1		TOTAL PROJECT DURATION	848 days	Mon 3/14/05	Thu 6/12/08
2		Notice to Proceed	0 days	Mon 3/14/05	Mon 3/14/05
3		Mobilization	10 days	Mon 3/14/05	Fri 3/25/05
4		Building Demolition	132 days	Mon 3/28/05	Tue 9/27/05
5		Foundation Demolition	35 days	Wed 9/28/05	Tue 11/15/05
6		Disposal	170 days	Mon 3/28/05	Fri 11/18/05
7		Excavation	10 days	Mon 11/21/05	Fri 12/2/05
8		Site Utilities	30 days	Mon 11/28/05	Fri 1/6/06
9		Form and Pour Foundation	60 days	Mon 1/9/06	Fri 3/31/06
10		Backfill	10 days	Mon 4/3/06	Fri 4/14/06
11		Pour SOG	19 days	Mon 4/17/06	Thu 5/11/06
12		Steel Erection	175 days	Fri 5/12/06	Fri 1/12/07
13		Precast Parking Bay 1	21 days	Fri 5/12/06	Fri 6/9/06
14		Precast Parking Bay 2	20 days	Mon 6/12/06	Mon 7/10/06
15		Precast Parking Bay 3	20 days	Tue 7/11/06	Mon 8/7/06
16		Precast Parking Bay 4	7 days	Mon 1/15/07	Tue 1/23/07
17		Precast Parking Bay 5	7 days	Wed 1/24/07	Thu 2/1/07
18		Precast Parking Bay 6	11 days	Fri 2/2/07	Fri 2/16/07
19		Precast Parking Bay 7	11 days	Mon 2/19/07	Mon 3/5/07
20		Precast Parking Bay 8	6 days	Tue 3/6/07	Tue 3/13/07
21		Perimeter Framing	76 days	Mon 1/15/07	Mon 4/30/07
22		Exterior Metal Panels	180 days	Mon 4/9/07	Fri 12/14/07
23		Exterior Glass Systems	110 days	Mon 3/19/07	Fri 8/17/07
24		Stairs	190 days	Tue 8/8/06	Mon 4/30/07
25		Elevators	210 days	Tue 8/8/06	Mon 5/28/07
26		Interiors	190 days	Mon 8/20/07	Fri 5/9/08
27		Roadway	10 days	Mon 4/17/06	Fri 4/28/06
28		Sidewalks	15 days	Tue 8/8/06	Mon 8/28/06
29		Landscaping	15 days	Wed 3/14/07	Tue 4/3/07
30		Final Inspections	10 days	Mon 5/12/08	Fri 5/23/08
31		Punchlist	14 days	Mon 5/26/08	Thu 6/12/08
32		Site Punchlist	5 days	Wed 4/4/07	Tue 4/10/07
33		Substantial Completion	0 days	Thu 6/12/08	Thu 6/12/08



Project: Project1
Date: Wed 4/9/08

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

CONCLUSION

When the Iceplex was built on top of an existing parking garage, much of the existing structure had to be reinforced for the additional gravity and lateral loads. This proved to be the most complicated part of the project. A proposed solution, to demolish the parking garage and build from the ground up, was analyzed for its feasibility. First a civil/site analysis was completed to determine the best site access points. Then, the architectural layout and façade of the building were redesigned. Next, large transfer trusses were designed in order to take the loads from the parking garage above when the Iceplex was relocated to ground level. Finally, a construction management analysis was completed comparing the cost and schedule of the proposed design to the original.

Based on the civil/site analysis, the proposed solution seems to be very feasible. In fact, the building footprint can be reduced by almost 15%. The traffic analysis proved that the existing garage entrance and exit locations could remain. This would eliminate any additional traffic signal issues.

The architectural redesign of the Iceplex also concluded that the proposed design was a definite possibility to the problem. When the ice rinks were relocated to ground level, entering and exiting the Iceplex became very convenient. A drop-off loop was designed to allow occupants to be dropped off without parking their vehicle or without going to the 8th level of the parking garage. The layout of the spaces remained somewhat consistent with the original design. This should assist in obtaining the owner's approval of the proposed project. Also, the square footages of most spaces were within reasonable margins of the original design.

Based on the structural design of the transfer system, the proposed design cannot be recommended. Designing the trusses was extremely difficult and took three attempts before working. If this system were to actually be used, a large design fee would be charged by the structural engineer to effectively design the members and the complicated connections. Also, the columns needed to support these trusses were extremely large. Since these columns are located in common corridors as well as office spaces, their size will be extremely inconvenient to both building occupants and the architectural layout.

The construction management analysis also proved the proposed design not feasible. The project cost was increased by $10M and the schedule was twice as long as the original design. Both play an important role to the building owner.

In conclusion, the proposed design cannot be recommended as a possible solution. The disadvantages of a complicated design and an increased cost and construction duration outweigh the advantages. However, if the owner did indeed want to relocate the Iceplex to ground level, other structural and architectural possibilities could be examined. For instance, the Iceplex could be constructed independently of the parking garage. The garage could then become an adjacent tower to the Iceplex. Of course, this all depends on whether or not the site size allows for such architecture. This would then eliminate the need to transfer out extremely high gravity and lateral loads.

APPENDIX A

Virginia Department of Transportation
Traffic Engineering Division
2006
Annual Average Daily Traffic Volume Estimates By Section of Route
Arlington Maintenance Area

Route	Jurisdiction	From	To	Length	**AADT**	**QA**	4Tire	Bus	Truck 2Axle	Truck 3+Axle	Truck 1Trail	Truck 2Trail	QC	K Factor	QK	Dir Factor	AAWDT	QW
110 Jefferson Davis Hwy	Arlington County	Arlington Ridge Rd	SR 27	1.29	**65000**	**G**	99%	1%	0%	0%	0%	0%	F	0.075	F	0.609	68000	G
110 Jefferson Davis Hwy	Arlington County	SR 27	US 1; 4US 01-P SR110 EAST & BEGI	1.00	**61000**	**G**	99%	1%	0%	0%	0%	0%	C	0.072	F	0.689	63000	G
120 Glebe Rd	Arlington County	SR 123 Chain Bridge Rd	SR 309 Old Dominion Drive	2.49	**14000**	**G**								0.095	F	0.578	15000	G
120 Glebe Rd	Arlington County	SR 309 Old Dominion Drive	US 29 Lee Highway	0.55	**17000**	**G**								0.086	F	0.509	18000	G
120 Glebe Rd	Arlington County	US 29 Lee Highway	SR 237 Washington Blvd	0.93	**23000**	**G**								0.082	F	0.540	24000	G
120 237 Glebe Rd	Arlington County	SR 237 Washington Blvd	SR 237 Fairfax Dr	0.25	**30000**	**G**								0.081	F	0.579	31000	G
120 Glebe Rd	Arlington County	SR 237 Fairfax Dr	US 50	1.13	**33000**	**A**								0.082	A	0.569	34000	A
120 Glebe Rd	Arlington County	US 50	SR 244 Columbia Pike	0.86	**32000**	**G**								0.074	F	0.555	33000	G
120 Glebe Rd	Arlington County	SR 244 Columbia Pike	I-395	1.24	**28000**	**G**								0.077	F	0.616	29000	G
120 Glebe Rd	Arlington County	I-395	Arlington Ridge Rd	0.92	**28000**	**G**								0.075	F	0.575	29000	G
120 Glebe Rd	Arlington County	Arlington Ridge Rd	US 1	0.73	**23000**	**G**								0.077	F	0.794	24000	G
123 Chain Bridge Rd	Arlington County	Fairfax County Line	DC Line, Chain Bridge	0.40	**15000**	**G**	99%	0%	0%	0%	0%	0%	F	0.102	F	0.570	18000	G
124	Arlington County	US 29 Lee Hwy	Spout Run Parkway	0.17	**14000**	**G**	100%	0%	0%	0%	0%	0%	C	0.087	F	0.581	16000	G
233	Arlington County	US 1 Jefferson Davis Hwy	Reagan National Airport	0.36	**17000**	**G**	97%	1%	1%	0%	1%	0%	C	0.076	F	0.72	19000	G
236 Duke Street	City of Alexandria (Maint: 29)	Fairfax County Line	WCL Alexandria	0.06	**38000**	**N**	99%	1%	0%	0%	0%	0%	N	0.083	N	0.534	40000	N
236 Duke St	City of Alexandria (Maint: 29)	WCL Alexandria	I-395	0.34	**54000**	**F**	99%	1%	0%	0%	0%	0%	F	0.070	F	0.515	58000	F
236 Duke St	City of Alexandria	I-395	SR 401 Van Dorn St	0.32	**64000**	**F**	97%	1%	1%	0%	0%	0%	F	0.073	F	0.517	69000	F

Arlington County

No.	Route	From	To	Length	AADT	QA	4Tire	Bus	Truck 2Axle	Truck 3+Axle	Truck 1Trail	Truck 2Trail	QC	K Factor	QK	Dir Factor	AAWDT	QW	Year
4	Clarendon Blvd	00-6700 Washington Blvd	00-6812 Courthouse Road	0.78	**13000**	G	97%	1%	1%	1%	1%	0%	C	0.093	F		14000	G	2006
5	Courthouse Rd	SR 244 Columbia Pike	FR-703; Walter Reed Dr	0.58	**5800**	G	95%	2%	2%	0%	0%	0%	C	0.086	F	0.681	6400	G	2006
7	Columbus Street	30th St	31st St	0.12	**1200**	G	98%	0%	1%	0%	0%	0%	C	0.1	F	0.763	1300	G	2006
8	Fairfax Dr	I-66	SR 120; SR 237 Fairfax Dr E	0.38	**31000**	G	99%	1%	1%	0%	0%	0%	C	0.065	F	0.557	34000	G	2006
9	Harrison St	00-6809 Patrick Henry Dr	US 29 Lee Hwy	0.30	**7000**	G	99%	0%	0%	0%	0%	0%	F	0.096	F	0.516	7600	G	2006
9	Harrison St	US 29 Lee Hwy	27th St	0.30	**8900**	G	99%	0%	0%	0%	0%	0%	F	0.098	F	0.516	9700	G	2006
9	Harrison St	27th St	Williamsburg Blvd	0.62	**5900**	G	99%	0%	0%	0%	0%	0%	C	0.099	F	0.517	6500	G	2006
10	Little Falls Rd	00-6771 Yorktown Blvd	00-6626, N George Mason Dr	0.25	**3400**	G	99%	0%	1%	0%	0%	0%	C	0.120	F	0.504	3700	G	2006
11	S Manchester St	Fairfax County Line	US 50 Arlington Blvd	0.15	**8400**	G	98%	0%	1%	0%	0%	0%	C	0.093	F	0.698	9200	G	2006
12	Memorial Dr	SR 110 Overpass	District of Columbia Line	0.17	**14000**	G	99%	0%	1%	0%	0%	0%	F	0.123	F	0.826	15000	G	2006
13	Nash Street	00-6608 Wilson Blvd	00-6744 Key Blvd	0.11	**6800**	G	98%	1%	1%	0%	0%	0%	F	0.084	F	0.565	7500	G	2006
13	Nash Street	00-6744 Key Blvd	US 29	0.14	**2800**	G	98%	1%	1%	0%	0%	0%	C	0.117	F	0.854	3100	G	2006
14	Pierce Street	00-6812 Clarendon Blvd	00-6608 Wilson Blvd	0.07	**5400**	G	97%	1%	1%	0%	0%	0%	F	0.084	F	0.589	6000	G	2006
15	Quinn Street	00-6608 Wilson Blvd	Key Blvd	0.25	**4400**	G	98%	1%	1%	0%	0%	0%	F	0.095	F	0.612	4900	G	2006
16	Randolph Street	SR 120, N Glebe Rd	00-6608 Wilson Blvd	0.19	**11000**	G	95%	3%	1%	0%	0%	0%	C	0.086	F	0.637	12000	G	2006
16	Randolph Street	00-6608 Wilson Blvd	SR 237 Fairfax Dr	0.18	**5800**	G	95%	3%	1%	0%	0%	0%	F	0.097	F	0.532	6400	G	2006
17	Stuart Street	00-6608 Wilson Blvd	00-6753, 9 th Street	0.07	**5300**	G	98%	1%	1%	0%	0%	0%	F	0.09	F	0.527	5900	G	2006
19	Washington Blvd	00-6780 Westmoreland St	SR 237 P; US 29 Lee Hwy	0.42	**2200**	G	98%	1%	1%	0%	0%	0%	C	0.139	F		2400	G	2006
20	Monroe Street	00-6608 Wilson Blvd	SR 237 Fairfax Dr	0.10	**2900**	G	98%	0%	1%	0%	0%	0%	C	0.101	F	0.582	3200	G	2006
20	Monroe Street	SR 237	00-6700 Washington Blvd	0.20	**3000**	G	99%	0%	0%	0%	0%	0%	C	0.092	F	0.559	3200	G	2006

70

Glossary of Terms:

Route: The Route Number assigned to this segment of roadway with the master inventory route number if this is an overlapping route, with official street or highway name if available.

Length: Length of the traffic segment in miles.

AADT: Annual Average Daily Traffic. The estimate of typical daily traffic on a road segment for all days of the week, Sunday through Saturday, over the period of one year.

QA: Quality of AADT:

- A Average of Complete Continuous Count Data
- B Average of Selected Continuous Count Data
- F Factored Short Term Traffic Count Data
- G Factored Short Term Traffic Count Data with Growth Element
- H Historical Estimate
- M Manual Uncounted Estimate
- N AADT of Similar Neighboring Traffic Link
- O Provided By External Source
- R Raw Traffic Count, Unfactored

4Tire: Percentage of the traffic volume made up of motorcycles, passenger cars, vans and pickup trucks.

Bus: Percentage of the traffic volume made up of busses.

2Axle Truck: Percentage of the traffic volume made up of 2 axle single unit trucks (not including pickups and vans).

3+Axle Truck: Percentage of the traffic volume made up of single unit trucks with three or more axles.

1Trail Truck: Percentage of the traffic volume made up of units with a single trailer.

2Trail Truck: Percentage of the traffic volume made up of units with more than one trailer.

QC: Quality of Classification Data:

- A Average of Complete Continuous Count Data
- B Average of Selected Continuous Count Data
- C Short Term Classified Traffic Count Data
- F Factored Short Term Traffic Count Data
- H Historical Estimate
- M Mass Collective Average
- N Classification Estimates of Similar Neighboring Traffic Link

K Factor: The estimate of the portion of the traffic volume traveling during the peak hour or design hour.

QK: Quality of the K Factor estimate:

- A Factor based on 30th Highest Hour Observed During at least 250 days of Continuous Traffic Data
- B Factor based on other Hour Observed During Less than 250 days of Continuous Traffic Data
- F Factor based on Highest Hour Collected at in a 48 Hour Weekday Period
- M Factor based on Manual Estimate of design hour
- N Design Hour Factor (K Factor) of Similar Neighboring Traffic Link
- O Provided by External Source

Dir Factor: The estimate of the portion of the traffic volume traveling in the peak direction during the peak hour..

AAWDT: Average Annual Weekday Traffic. The estimate of typical traffic over the period of one year for the days between Monday through Thursday inclusive.

QW: Quality of AAWDT:

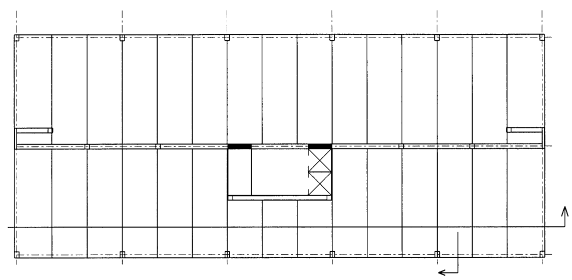
- A Average of Complete Continuous Count Data
- B Average of Selected Continuous Count Data
- F Factored Short Term Traffic Count Data
- G Factored Short Term Traffic Count Data with Growth Element
- M Manual Uncounted Estimate
- N AAWDT of Similar Neighboring Traffic Link
- O Provided by External Source

Year: Year for which the published values are appropriate. If the Quality of AADT (QA) is “R”, the year is the year that the raw traffic count was collected, and if available,

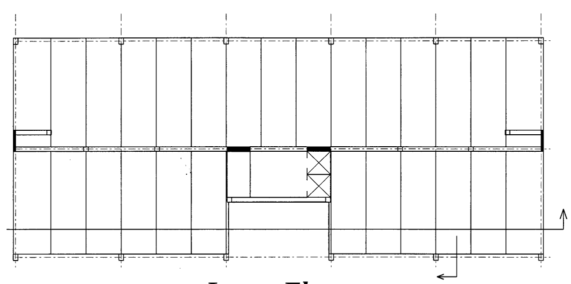
APPENDIX B

MEGA-SPAN™ Precast Building System

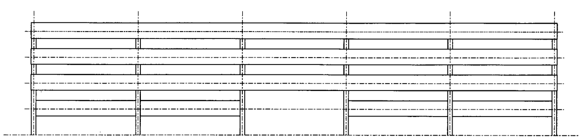
DESIGN GUIDE



Upper Floors



Lower Floor



Front Elevation

HIGH CONCRETE STRUCTURES, INC.

A Division of High Industries, Inc.

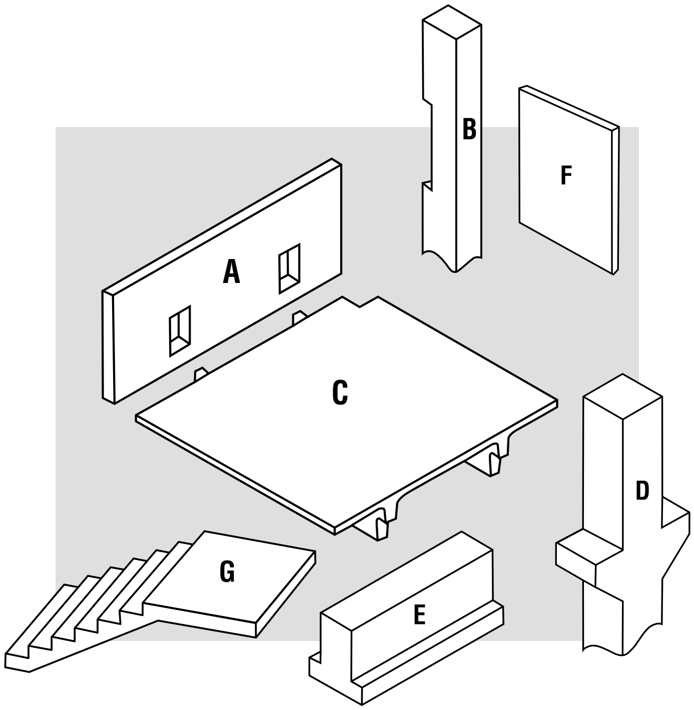
www.highconcrete.com

Table of Contents

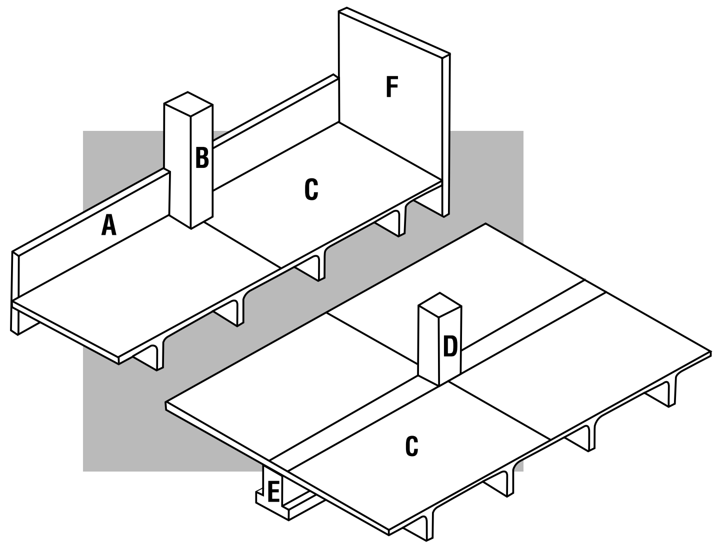
Description

MEGA-SPAN™ Design Guide

A. Exterior Spandrel
B. Exterior Column
C. 15′ MEGA TEE™
D. Interior Column
E. Girder
F. Shear Wall
G. Stair System



It's easy to design with MEGA-SPAN™—your imagination—and technical assistance from High Concrete Structures' team of experienced building professionals.

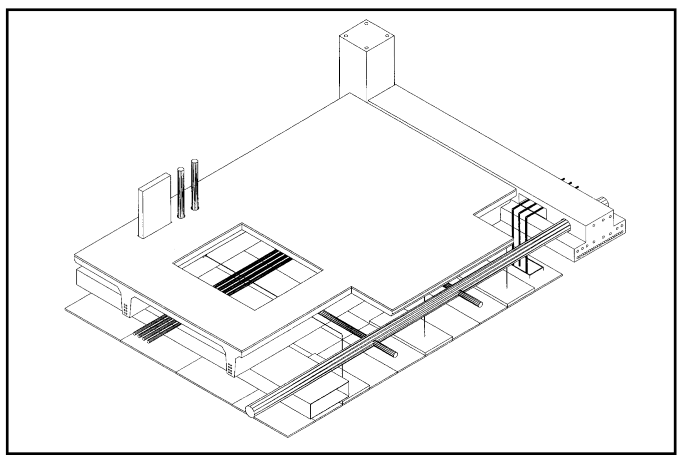


A few simple, easy-to-use parts provide almost unlimited design freedom—and great building solutions.

About the MEGA-SPAN™ Design Guide

This guide shows how to apply the MEGA-SPAN™ Building System to develop preliminary design or early stage design development drawings for buildings that are four stories, 40 stories—or more—in height.

The all precast MEGA-SPAN™ building system conforms to all national building codes.



The ample MEGA-SPAN™ Dual-Depth Plenum—with dedicated space for plumbing, electrical and communications runs—easily accommodates all mechanical, plumbing, electrical, security and communications infrastructure.

How To Design Using The MEGA-SPAN™ Building System

Step 1. Building Footprint—

rough out your building footprint.

Step 2. Bay Sizing and Core Layout—

overlay MEGA-SPAN™ bays (45′ wide × 45′–55′ deep) onto your building footprint and select the largest bays possible*. Then:

a) Determine approximate floor-to-floor heights by using the MEGA TEE™ and Girder tables and determining the clearances needed in the Dual-Depth Plenum (see pages 5 and 7).

b) Size Columns for four to eight story buildings using the Column tables in this design guide (see page 7). For taller buildings, call 1-800-PRECAST to get approximate Column sizes for preliminary designs.

c) Layout cores, stairs, floor openings and shear walls.

* Narrower, less cost-effective 10,′ 12,′ 15′, 20′, 24′, 30′, 36′, 40′ or 42′ bays can be used if required for intermediate or end bays.

Step 3. Sections, Elevations and Finishes—

develop preliminary elevations and sections using the Guidelines for Exterior Spandrels (see page 9). Then, select your preferred exterior finish(es).

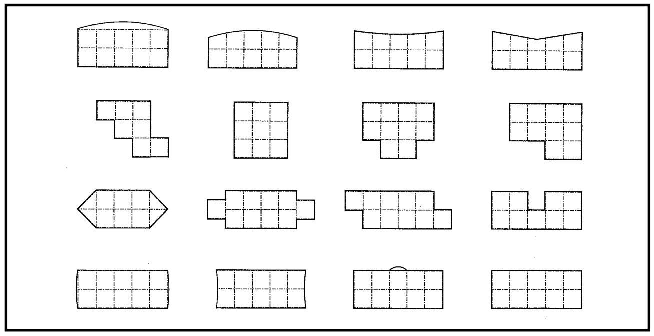
Step 4. Details—

select appropriate detail sections for reveals, joints and connections from the *MEGA-SPAN™ Building System Technical Details* manual (see page 10 for example details).

Step 5. Ask for FREE Technical Design and Engineering Assistance or Preliminary Costs Estimates—

call High Concrete Structures, Inc. at 1-800-PRECAST.

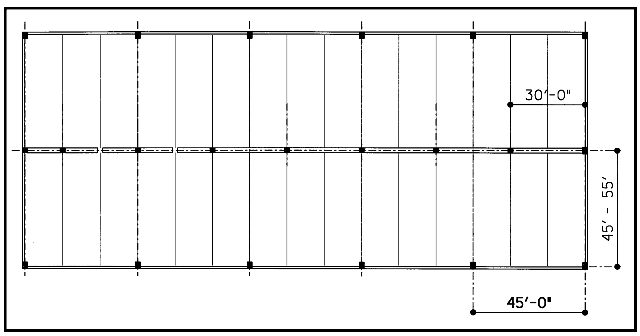
Step 1. Building Footprint



A few of the many footprints that are possible with MEGA-SPAN™.

Rough out your building footprint. The MEGA-SPAN™ precast building system is flexible and will accommodate nearly any footprint or interior design feature including atriums, mezzanines and auditoriums.

Step 2. Bay Sizing and Core Layout



Plan showing cost efficient 45′ × 55′ bay spacing.

Overlay MEGA-SPAN™ bays (45′ wide × 45′–55′ deep) onto your building footprint and select the largest bays possible. 15′ wide MEGA TEEs™ with Columns arranged in 45′ wide × 55′ deep bays create the most cost efficient, open plans.

Conventional double tees in 10′ and 12′ widths can be combined with MEGA TEEs™ to create smaller intermediate or end bays that are 20′, 24′, 30′, 36′, 40′ or 42′ wide. Custom bay lengths of any dimension from 5′–45′ can also be created.

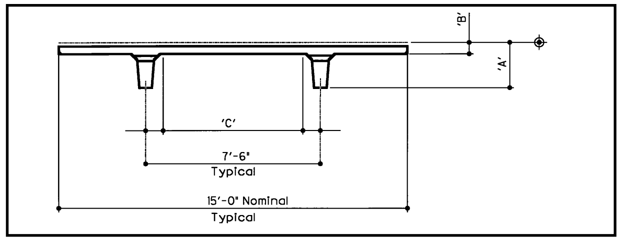
Set Column bay centerlines based on the width of MEGA TEEs™. Core and Shear Walls can be integrated with Columns placed along the centerline of a Girder.

In buildings two or more bays deep, Column spacing along the Girder centerline is recommended at efficient, 30′ intervals so that the depth of Girder* does not exceed the depth of MEGA TEEs™ and a 2′-2″ clearance below structural members is maintained across the entire Dual-Depth Plenum for HVAC, suspended ceilings and lighting.

*In buildings where MEGA TEE™ spans are 45′ or less and penetrations greater than 4″ in diameter are not required in Girders, a 22″ Girder depth can be used. In buildings where ductwork or other plenum systems pass through a Girder, or where MEGA TEE™ spans exceed 45' in length, a minimum 27″ Girder depth is required.

Crane lifting MEGA TEE™ into position

Penetrations of up to 30″ wide × 9″ high—placed at 5′-0″ on-center intervals—can be specified in 27″ deep Girders to provide a high degree of plenum flexibility for HVAC, mechanical or electrical system cross-overs. In buildings with 22″ deep Girders, 4″ diameter penetrations for piping, conduit, etc., can be made at 5′-0″ on-center intervals.



Section through super-efficient, low camber MEGA TEE™

A = Depth
B = Flange Thickness
C = Clearance Between Legs

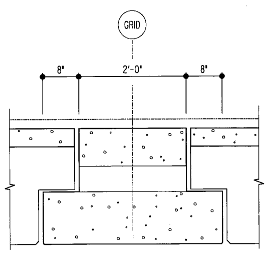
MEGA TEE™ and DOUBLE TEE DIMENSIONS
125 psf Live Load and Dead Load

WIDTH	LENGTH	A - Depth	B - Flange*	C - Clearance
15′ TEE	45′	24″	5″	6′ - 0″
15′ TEE	55′	29 1/2″	5 1/2″	6′ - 0″

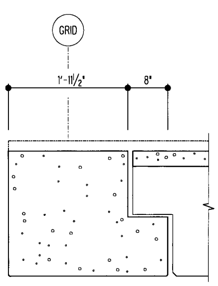
*Includes 3″ flange + lightweight topping

GIRDER DIMENSIONS - for MEGA TEE™
@ 125 psf Live Load and Dead Load

GIRDER SPAN	MEGA TEE™ LENGTH	GIRDER DEPTH	MAXIMUM OPENING	OPENING INTERVAL
30′	45′	22″	4″ dia.	5' - 0" o.c
30′	55′	27″	30″ × 9″ dia.	5' - 0" o.c

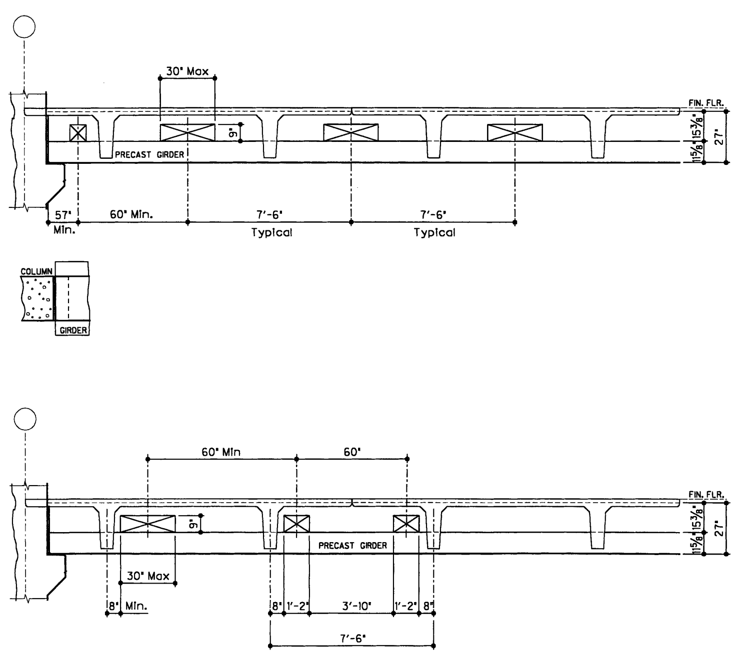


Inverted "T" Girder



"L" Girder

Section of low profile Girder—"L" Girders accommodate special end conditions such as atrium spaces, etc.



Elevation of low profile Girder for 55′ span

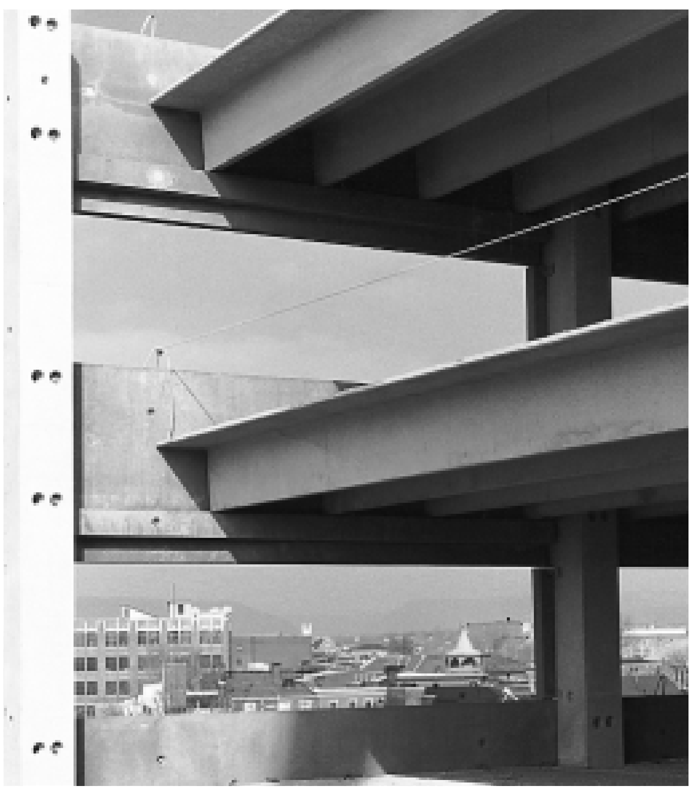
Standard Floor and Roof Loading

Standard MEGA TEEs™ with 3″ flanges accommodate uniformly distributed floor loads of 125 psf (100 psf Live Load + 25 psf Dead Load). MEGA TEEs™ designed for rooftop use typically carry uniform loads of 50 psf (30 psf Snow Load + 20 psf Roofing Material Load).

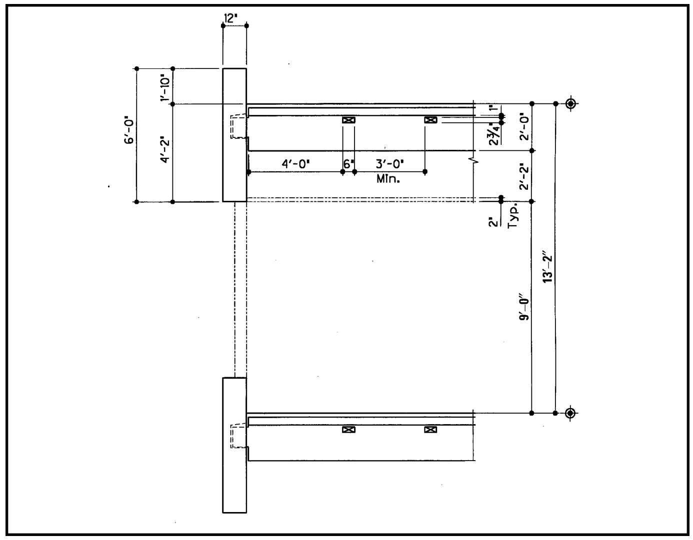
MEGA TEEs™ used in roof construction can be pitched to a slope of ¼″ per foot toward a Girder centerline. Rooftop equipment can be placed almost anywhere on the roof if it is arranged so openings for ductwork pass between MEGA TEE™ legs.

Using live load reduction, live loads on floors can be increased by 25%—up to a maximum of 125 psf—anywhere along the length of the MEGA TEE™. Additionally, if a 2″ composite deck is applied to the 3″ standard MEGA TEE™ flange, or if a MEGA TEE™ with a 4″ flange is used, live loads of up to 225 psf can be achieved anywhere along the length of the MEGA TEE™.

Even heavier floor or roof loads can be accommodated with MEGA TEEs™. To learn more, call 1-800-PRECAST for assistance with your requirements.



MEGA TEE™ bearing on Spandrel



Typical floor-to-floor section for 45′ deep bays

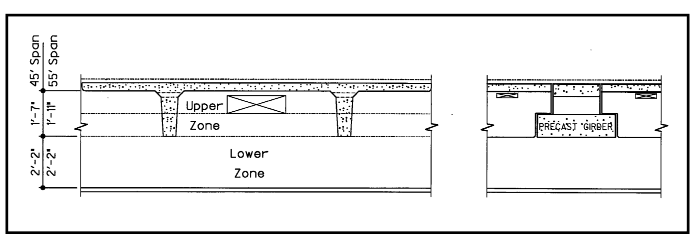
Step 2a. Floor-to-Floor Heights

Determine approximate floor-to-floor heights by using the MEGA TEE™ and Girder tables (see page 5) and allowing for clearances needed in the Dual-Depth Plenum.

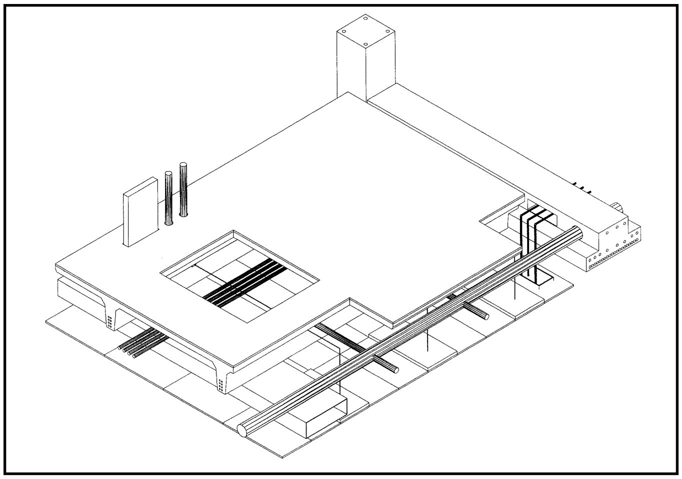
The depth of MEGA-TEEs™ and supporting Girders will determine minimum floor-to-floor heights. For buildings with suspended ceilings, a minimum clearance of 11′-2″ below the bottom of 22″ or 27″ MEGA TEEs™ and Girders is recommended to accommodate HVAC ductwork, the ceiling suspension system and lighting.

Dual-Depth Plenum

The two-zone MEGA-SPAN™ Dual-Depth Plenum is 3′-7″ deep. The 2′-2″ lower zone—below the bottom of the MEGA TEEs™—accommodates HVAC ductwork, suspended ceiling systems and lighting. The height of the upper zone—between MEGA TEE™ legs—varies from 1′-7″ to 1′-11″ depending on the depth of the MEGA TEEs™ or Girders used. The Dual-Depth Plenum easily accommodates electrical conduit, plumbing, fire protection, alarm, security and communication systems and additional ducting or air handling equipment.



Section through two-zone Dual-Depth Plenum



The Dual-Depth Plenum easily accommodates independent and bypassing mechanical, electrical, communications and plumbing systems.

In buildings where MEGA TEEs™ span 45′ or less, the upper plenum zone is 1′-7″. Where MEGA TEEs™ span more than 45′, the upper zone is 1′-11″. Blockouts for conduit, piping, cabling and miscellaneous wiring—made with High Concrete's patented molds— can be specified in the top of MEGA TEE™ leg stems at minimum intervals of 3′-0″ on center.

To make even better use of the Dual-Depth Plenum, penetrations of up to 30″ wide × 9″ high—placed at 5′-0″ on-center intervals*—can be specified to provide even greater plenum flexibility for HVAC, mechanical or electrical system cross-overs in 27″ deep Girders. In buildings with 22″ deep Girders, 4″ diameter penetrations for piping, conduit, etc. can be made at 5′-0″ on-center intervals*.

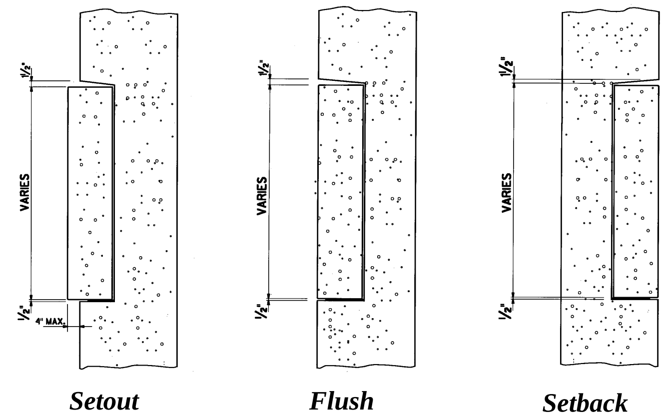
*Girder penetrations may not be closer than 42″ to the end of the Girder.

Step 2b. Column Sizes

Determine approximate Column sizes for four to eight story buildings using the Column tables to the right. For heavier loads or taller buildings, call 1-800-PRECAST to get approximate Column sizes for preliminary designs.

Column sizes are regulated by the load they carry and their unbraced length, i.e., floor-to-floor height. Exterior Columns supporting 45′ Exterior Spandrels are larger, while interior Columns—supporting shorter 30′ Girders—are smaller.

Columns are usually rectangular but can be made square or round. Exterior Column dimensions are increased if setback spandrel treatments are used to develop façade depth.



Spandrel placement on Columns

EXTERIOR COLUMNS* for 4″ "SETOUT"

HEIGHT	SPAN		HEIGHT	SHAPE	
Stories	Spandrel	Tee	Floor-to-Floor	Rectangular	Round
4	45′	45′	13′-2″±	24″ × 36″	25″ dia.
4	45′	55′	13′-8″±	28″ × 36″	27″ dia.
8	45′	45′	13′-2″±	36″ × 40″	33″ dia.
8	45′	55′	13′-8″±	36″ × 44″	36″ dia.

EXTERIOR COLUMNS* for "FLUSH" or "SETBACK" SPANDRELS**

HEIGHT	SPAN		HEIGHT	SHAPE	
Stories	Spandrel	Tee	Floor-to-Floor	Rectangular	Round
4	45′	45′	13′-2″±	24″ × 36″	25″ dia.
4	45′	55′	13′-8″±	28″ × 36″	27″ dia.
8	45′	45′	13′-2″±	36″ × 40″	33″ dia.
8	45′	55′	13′-8″±	36″ × 44″	36″ dia.

INTERIOR COLUMNS* for GIRDERS**

HEIGHT	SPAN		HEIGHT	SHAPE	
Stories	Tee	Girder	Floor-to-Floor	Rectangular	Round
4	45′	30′	13′-2″±	20″ × 24″	25″ dia.
4	55′	30′	13′-8″±	20″ × 24″	25″ dia.
8	45′	30′	13′-2″±	20″ × 24″	25″ dia.
8	55′	30′	13′-8″±	20″ × 24″	25″ dia.

*Spandrels cannot be pocketed into round Columns.

**100psf LL/125psf Total Load. For square Columns, use the round Column diameter for the dimension of each size.

MEGA-SPAN™ components are easy to erect. Columns and Girders are installed first.

Step 2c. Cores, Stairs, Openings and Shear Walls

Layout cores, Stairs, openings and Shear Walls.

Custom Cores

Structural framing and Slabs for building cores—to accommodate Stairs, elevators, mechanical shafts, toilet rooms and utility closets—are built to your plans using custom-sized Columns, Girders and precast Slabs. For maximum economy and flexibility, except where precast Shear Walls are required, core or Stair Walls should be made of concrete block or gypsum shaftwall.

Exit Stairs

The MEGA-SPAN™ precast building system uses economical steel pan sections with pipe railings, although more durable pre-finished, precast concrete Stair systems can also be specified.

MEGA-SPAN™ Columns are delivered as single units up to 75′ long.

Floor Openings for Elevators, HVAC, Mechanical, Electrical and Communications Work

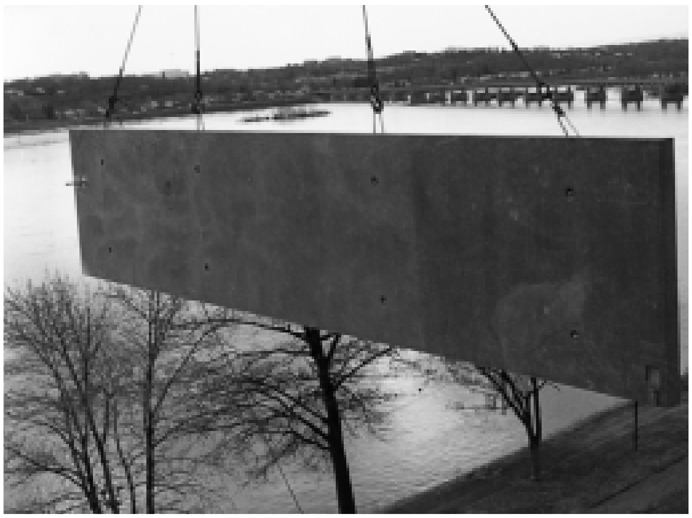
MEGA TEEs™ have sufficient clearance between leg stems to accommodate most standard hydraulic and cable-operated passenger elevators and virtually any kind of mechanical chase or shaft. Larger elevators may require special structural framing (see diagrams on page 5 for standard clearances between MEGA TEE™ leg stems).

Shear Walls

Precast Shear Walls provide code-required wind and seismic bracing and are more cost-effective than moment bracing. For the most cost efficient and open plan, Shear Walls should be incorporated into Stair, elevator and core wall designs. Shear Walls are generally 12″ thick, up to 45′ long and will be required parallel to both the short and long dimensions of the building. Shear Walls can be designed to accommodate openings for exit, passage and service doors.

In preliminary designs, Shear Walls parallel to the short dimension should be placed at the ends of the building and their length should be 10–15% of the width of the building. Shear Walls parallel to the long dimension should be placed along the Girder centerline, and their length should be 15–20% of the length of the building*.

*The exact dimension of the Shear Walls required for your building must be determined by your structural engineer or the engineers at High Concrete Structures, Inc.



Shear Wall sections are installed as monolithic units of up to 13′-8″ × 45′.

MEGA TEEs™ are placed into pockets in Exterior Spandrels.

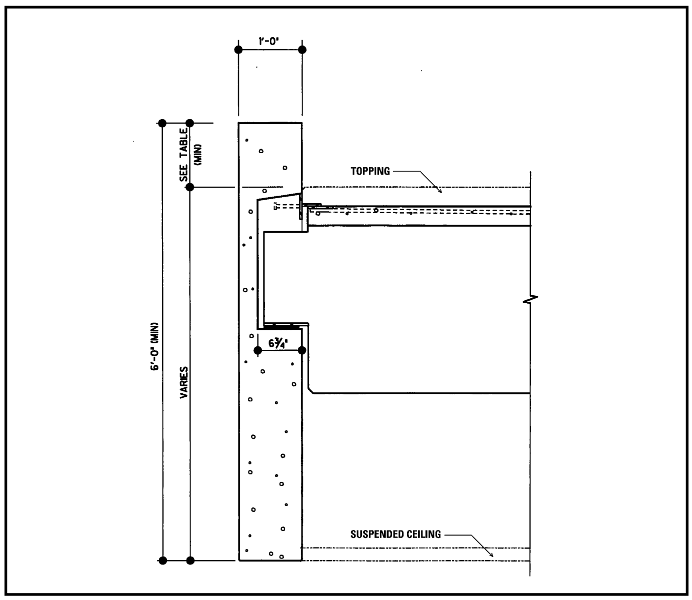
Step 3. Sections, Elevations and Finishes

Develop preliminary elevations and sections using the Guidelines for Exterior Spandrels (this page). Then, select your preferred exterior finish(es).

Size, Shape and Placement

Load-bearing Exterior Spandrels are generally 12″ thick and span the 45′ distance between Columns. Non load-bearing Spandrels are also 12″ thick. Exterior Spandrel depths can vary based on span width, MEGA TEE™ span length, floor loading, Column heights and the depth of reveals required for façade treatments. Generally Exterior Spandrels must be at least 6′- 0″deep.

A minimum of 4′-2″ of Exterior Spandrel depth is required *below the top of the finished floor* to support MEGA TEEs™ and enclose the Dual-Depth Plenum. 45′ straight or gently curved Exterior Spandrels can be set in front of, flush with, or behind exterior Columns (see page 7).



Section at exterior wall showing Exterior Spandrel.

GUIDELINES FOR EXTERIOR SPANDRELS

MEGA TEEs™ BAY SIZE			Exterior Spandrels	
Length	Width	MINIMUM Total Load*	MINIMUM Overall Height	Height Above MEGA TEE™**
45′	45′	125 psf	6′-0″	22″
55′	45′	125 psf	6′-0″	16″

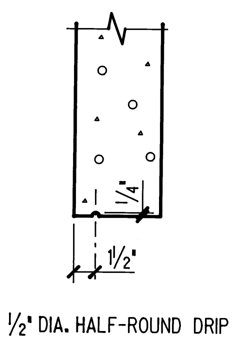
*Total Load = Live Load + Dead Load
**Includes Lightweight Topping

Finishes, Textures and Veneers

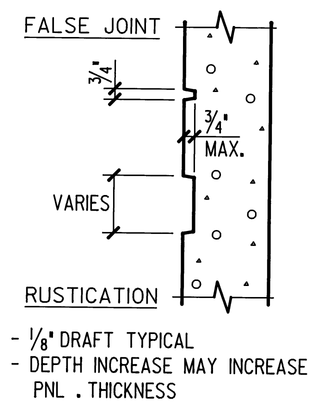
Exterior Spandrels can be specified to have any aggregate, color, finish or veneer available in precast concrete. Finishes include acid washed, sandblasted, exposed aggregate, formed stone, honed or polished—as well as brick or stone veneers. For more information on available precast colors and finishes call 1-800-PRECAST.

Step 4. Details

Select appropriate detail sections for reveals, joints and connections from the *MEGA-SPAN™ Building System Technical Details* manual.



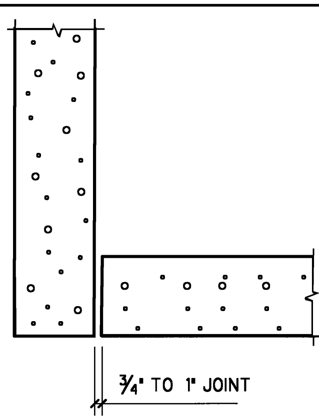
Exterior Spandrel Drip



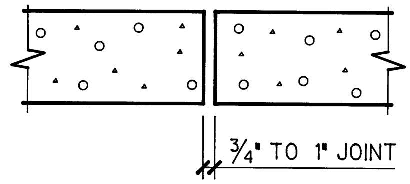
Exterior Spandrel Shallow Reveal

Preferred Reveals

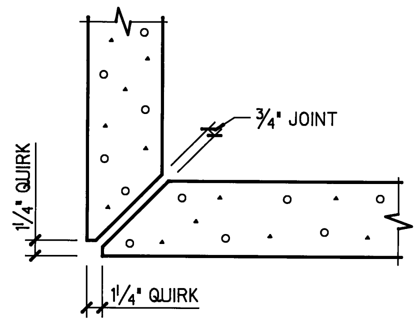
Note: For reveals greater than ¾″ deep, the Panel thickness increases proportionately.



Exterior Spandrel to Exterior Spandrel—butt corner



Exterior Spandrel to Exterior Spandrel—butt joint



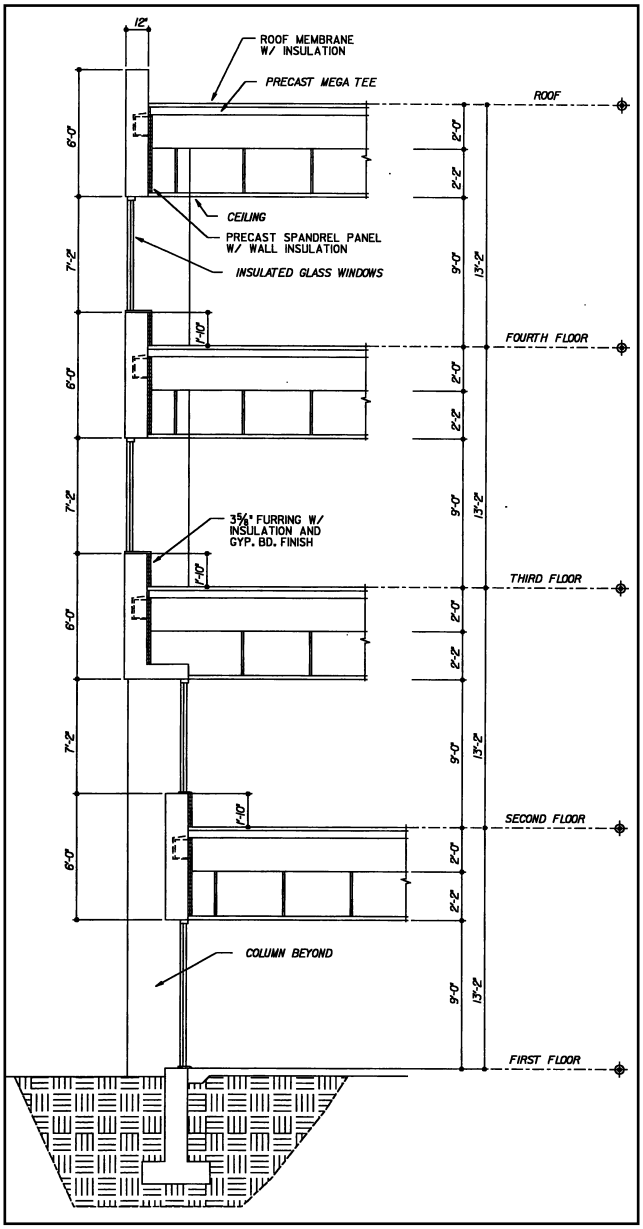
Exterior Spandrel to Exterior Spandrel—mitered corner

Exterior Spandrels can be detailed and finished in an unlimited variety of ways.

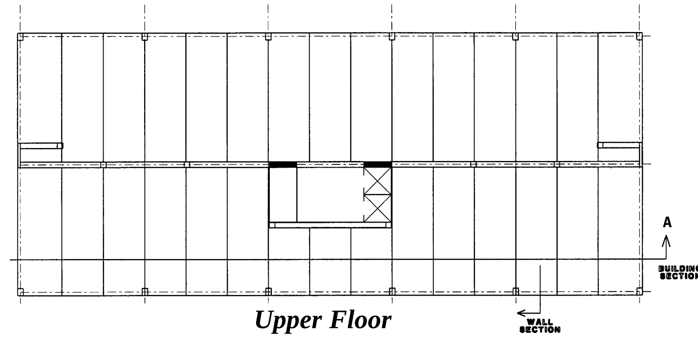
Exterior Spandrels can be cast to any standard precast joint and surface design. For MEGA-SPAN™ precast building system construction details, consult the *MEGA-SPAN™ Precast Building System Technical Details* manual or visit www.highconcrete.com.

Step 5. Technical Design and Cost Estimating Assistance

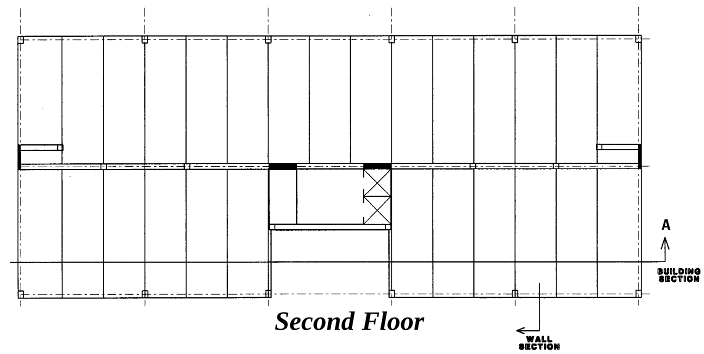
To take advantage of FREE technical design, engineering or cost estimating services, call High Concrete at 1-800-PRECAST.



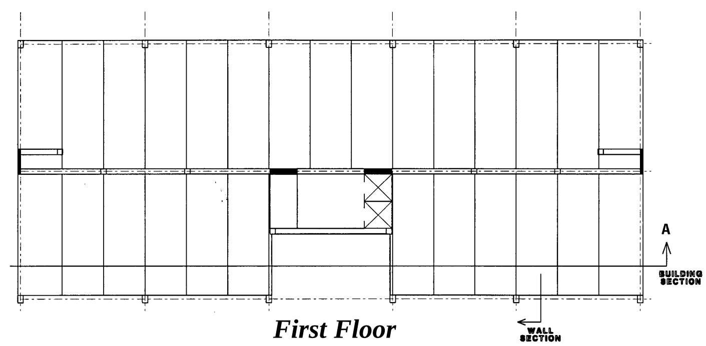
Dual-Depth Plenum/Exterior Wall Section (45′ span)



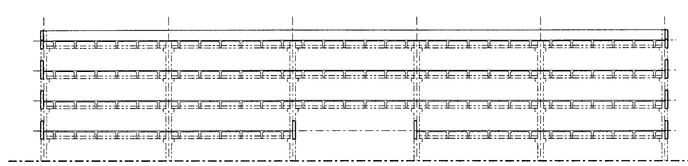
Upper Floor



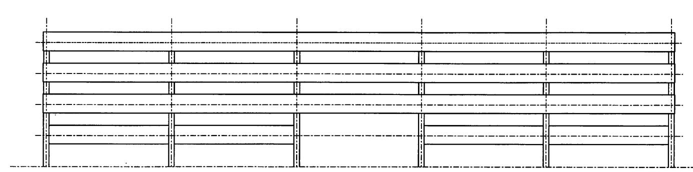
Second Floor



First Floor



Building Section A



Front Elevation

A simple building using the MEGA-SPAN™ building system.

High Standards. High Concrete.

High Quality. Innovation. First-rate Service. Design Support.
Innovation in product development combined with quality and service has earned High Concrete Structures, Inc. the position of industry leader, setting the highest standards.

High Quality

- member of Precast/Prestressed Concrete Institute (PCI), American Concrete Institute (ACI) and Mid-Atlantic Precast Association (MAPA)
- over 25 years of PCI quality certification
- winner of national awards from organizations such as PCI, ACI and ABC (Associated Builders and Contractors)
- proprietary Quality Management Program and on-going training for co-workers

Innovation

- producer of nation's first fifteen-foot wide double tee
- inventor of the Tilt-frame Transporter for economical shipping of wider double tees
- first to design and produce plastic embedments
- first to produce QualiTEE System™ of double tees for parking structures

First-rate Service

- full service precast concrete producer with a complete line of architectural and structural products
- on-site representative during the erection process for every project
- year-round construction
- guaranteed product availability

Design Support

- initial, up-front design assistance
- most extensive in-house engineering and drafting staff
- fully experienced in the design/build process
- computerized estimating and project budgeting

High Concrete Structures, Inc. was founded in 1956 as Kurtz Precast Corporation. In 1977, the original firm became a part of High Industries, Inc. Since then, High Concrete Structures, Inc. has become a nationally recognized leader in the design, manufacture and installation of precast/prestressed concrete products. With over 45 years of experience, we set the highest standards for quality, innovation, service and design support.

We Set the Highest Standards.

HIGH CONCRETE STRUCTURES, INC.

A Division of High Industries, Inc.

125 Denver Road
Denver, PA 17517
(717) 336-9300
FAX (717) 336-9301
1-800-PRECAST
1-800-773-2278
www.highconcrete.com

APPENDIX C

PROJECT	Iceplex Redsign		
CLIENT	Penn State University - AE		
JOB NO.		*DATE*	8-Apr-08
ENGINEER	Megan Kohut	*PAGE*	1 OF 1

Main Windforce Resisting System

CODE:

International Building Code 2006 / ASCE 7-05

INPUT:

Building Height (H):	92 ft		
Building Depth (L):	408 ft		
Building Width (B):	372 ft	Wind on Narrow Face of Building	
Number of Stories (N):	8		
Basic Wind Speed (V):	90 MPH	Figure 6-1 (pg 33)	
Wind Directionality Factor (K_d):	0.85	Table 6-4 (pg 80)	
Building Category:	III	Table 1-1 (pg 3)	
Importance Factor (I):	1.15	Table 6-1 (pg 77)	
Exposure Category:	B	6.5.6.3 (pg 25)	
Topographic Factor (K_{zt}):	1.00	6.5.7 (pg 26)	
Gust Effect Factor (G or Gf): Use Calculated?	Yes	6.5.8 (pg 26)	Frequency (Hz) = 1.25
Internal Pressure Coefficients (+/-GC_{pi}):	0.55	Table 6-5 (pg 47)	
External Pressure Coefficient (C_p windward):	0.8	Figure 6-6 (pg 49)	
External Pressure Coefficient (C_p leeward):	-0.5	Figure 6-6 (pg 49)	L/B = 1.10
External Pressure Coefficient (C_p sidewall):	-0.7	Figure 6-6 (pg 49)	

FORMULAS:

$p = qGC_p - q_i(GC_{pi})$ Equation 6-17 (6.5.12.2 pg 28)

$q_z = 0.00256(K_z)(K_{zt})(K_d)(V^2)(I)$ Equation 6-15 (6.5.10 pg 27)

CALCULATIONS:

Gust Effect Factor: frequency (n_1) = 1.25 Hz ***Rigid*** $g_Q = g_v = 3.4$

$z = 55.2$ ft $I_z = 0.275$ $L_z = 379.9$ $Q = 0.764$

Rigid Structures: $G = 0.925[(1+1.7g_QI_zQ)/(1+1.7g_vI_z)]$ Equation 6-4 (6.5.8.1 pg 26)

Flexible Structures: $G_f = 0.925[(1+1.7I_z*sqrt(g_Q\text{^}2Q\text{^}2+g_R\text{^}2(R\text{^}2)))/(1+1.7g_vI_z)]$ Equation 6-8 (6.5.8.2 pg 26)

$g_R = 4.242$	$b = 0.45$	$\alpha = 0.25$	$V_z = 67.55$
$N_1 = 7.029$	$R_n = 0.041$	$\eta_h = 7.83$	$R_h = 0.120$
$\eta_B = 31.66$	$R_B = 0.031$	$\eta_L = 116.26$	$R_L = 0.009$
$R = 0.090$			

Velocity Pressure and Wind Force Summary

Location	Height (ft)	K_z	q_z	G	Ext. Pres. qGC_p	Internal Pressure q_i	Internal Pressure $q_i(GC_{pi})$	Combined Pressure (+GC_{pi})	Combined Pressure (-GC_{pi})	Design Load Ww + Lw Height (ft)	Design Load Ww + Lw Load (psf)
Windward	15	0.575	11.65	0.791	7.37	19.56	10.76	-3.39	18.13	15	15.10
	26	0.673	13.63	0.791	8.62	19.56	10.76	-2.13	19.38	26	16.36
	37	0.744	15.08	0.791	9.54	19.56	10.76	-1.22	20.30	37	17.27
	48	0.801	16.24	0.791	10.27	19.56	10.76	-0.48	21.03	48	18.01
	59	0.850	17.23	0.791	10.90	19.56	10.76	0.14	21.66	59	18.63
	70	0.892	18.09	0.791	11.44	19.56	10.76	0.69	22.20	70	19.18
	81	0.930	18.86	0.791	11.93	19.56	10.76	1.17	22.69	81	19.66
	92	0.965	19.56	0.791	12.37	19.56	10.76	1.62	23.13	92	20.11
Leeward	ALL	0.965	19.56	0.791	-7.73	19.56	10.76	-18.49	3.02		
Side Walls	ALL	0.965	19.56	0.791	-10.83	19.56	10.76	-21.58	-0.07		

Note: Per 6.5.12.3 (pg 32) the wind loads calculated above need to be applied using the four load cases in Figure 6-9 (pg 54)

PROJECT	Iceplex Redsign		
CLIENT	Penn State University - AE		
JOB NO.		*DATE*	8-Apr-08
ENGINEER	Megan Kohut	*PAGE*	1 OF 1

Main Windforce Resisting System

CODE:

International Building Code 2000 / ASCE 7-98

INPUT:

Building Height (H):	92 ft		
Building Depth (L):	372 ft		
Building Width (B):	408 ft	Wind on Broad Face of Building	
Number of Stories (N):	8		
Basic Wind Speed (V):	90 MPH	Figure 6-1 (pg 33)	
Wind Directionality Factor (K_d):	0.85	Table 6-4 (pg 80)	
Building Category:	III	Table 1-1 (pg 3)	
Importance Factor (I):	1.15	Table 6-1 (pg 77)	
Exposure Category:	B	6.5.6.3 (pg 25)	
Topographic Factor (K_{zt}):	1.00	6.5.7 (pg 26)	
Gust Effect Factor (G or Gf): Use Calculated?	Yes	6.5.8 (pg 26)	Frequency (Hz) = 1.25
Internal Pressure Coefficients (+/-GC_{pi}):	0.55	Table 6-5 (pg 47)	
External Pressure Coefficient (C_p windward):	0.8	Figure 6-6 (pg 49)	
External Pressure Coefficient (C_p leeward):	-0.5	Figure 6-6 (pg 49)	L/B = 0.91
External Pressure Coefficient (C_p sidewall):	-0.7	Figure 6-6 (pg 49)	

FORMULAS:

$p = qGC_p - q_i(GC_{pi})$ Equation 6-17 (6.5.12.2 pg 28)

$q_z = 0.00256(K_z)(K_{zt})(K_d)(V^2)(I)$ Equation 6-15 (6.5.10 pg 27)

CALCULATIONS:

Gust Effect Factor: frequency (n_1) = 1.25 Hz ***Rigid*** $g_Q = g_V = 3.4$

$z = 55.2$ ft $I_z = 0.275$ $L_z = 379.9$ $Q = 0.756$

Rigid Structures: $G = 0.925[(1+1.7g_Q I_z Q)/(1+1.7g_v I_z)]$ Equation 6-4 (6.5.8.1 pg 26)

Flexible Structures: $G_f = 0.925[(1+1.7I_z*sqrt(g_Q\char`^2Q\char`^2+g_R\char`^2(R\char`^2)))/(1+1.7g_v I_z)]$ Equation 6-8 (6.5.8.2 pg 26)

$g_R = 4.242$	$b = 0.45$	$\alpha = 0.25$	$V_z = 67.55$
$N_1 = 7.029$	$R_n = 0.041$	$\eta_h = 7.83$	$R_h = 0.120$
$\eta_B = 34.73$	$R_B = 0.028$	$\eta_L = 106.01$	$R_L = 0.009$
$R = 0.086$			

Velocity Pressure and Wind Force Summary

Location	Height (ft)	K_z	q_z	G	Ext. Pres. qGC_p	Internal Pressure q_i	Internal Pressure $q_i(GC_{pi})$	Combined Pressure (+GC_{pi})	Combined Pressure (-GC_{pi})	Design Load Ww + Lw Height (ft)	Design Load Ww + Lw Load (psf)
Windward	15	0.575	11.65	0.786	7.33	19.56	10.76	-3.43	18.09	15	15.02
	26	0.673	13.63	0.786	8.58	19.56	10.76	-2.18	19.33	26	16.27
	37	0.744	15.08	0.786	9.49	19.56	10.76	-1.27	20.24	37	17.18
	48	0.801	16.24	0.786	10.22	19.56	10.76	-0.54	20.98	48	17.91
	59	0.850	17.23	0.786	10.84	19.56	10.76	0.08	21.60	59	18.53
	70	0.892	18.09	0.786	11.38	19.56	10.76	0.62	22.14	70	19.07
	81	0.930	18.86	0.786	11.87	19.56	10.76	1.11	22.62	81	19.56
	92	0.965	19.56	0.786	12.31	19.56	10.76	1.55	23.06	92	20.00
Leeward	ALL	0.965	19.56	0.786	-7.69	19.56	10.76	-18.45	3.07		
Side Walls	ALL	0.965	19.56	0.786	-10.77	19.56	10.76	-21.53	-0.01		

Note: Per 6.5.12.3 (pg 32) the wind loads calculated above need to be applied using the four load cases in Figure 6-9 (pg 54)

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SEISMIC LOADING CALCULATIONS

REF: ASCE7-05

General Information

S_S= 0.154 Fa= 1.6 S_{DS}= 0.164
S_1= 0.051 Fv= 2.4 S_{D1}= 0.082
Site Class: D
Occ. Cat. III Seismic Design Category: A

Seismic Response Coefficient

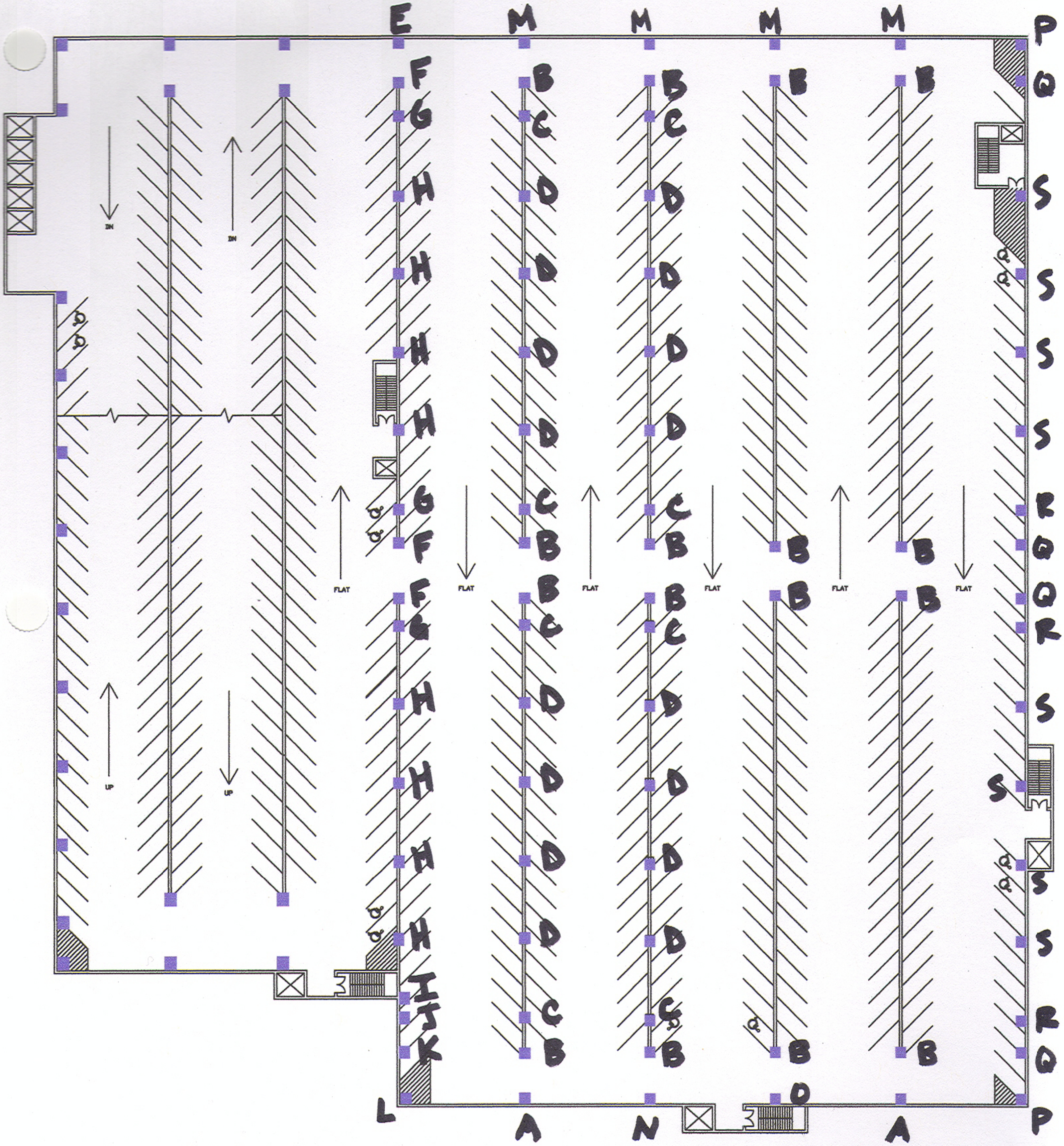
I= 1.25 C_{Sa}= 0.051 C_S= 0.043
R= 4.00 C_{Smax}= 0.043
Ta= 0.59 C_{Smin}= 0.010

Equivalent Lateral Force Calculation

Fx = 0.01Wx (SDC A)
Fx = story forces

Vx = story shear
W = 113377.0
$V=C_S*W$ 4867.2

Floor(x)	Height(ft.)	Wx(kips)	Fx(kips)	Vx(kips)	Mx (ft.-kips)
Roof	92.00	15653.0	156.5		
P5	81.00	16573.0	165.7	165.7	14400.8
P4	70.00	16573.0	165.7	331.5	27824.9
P3	59.00	16573.0	165.7	497.2	39426.0
P2	48.00	16573.0	165.7	662.9	49204.1
P1	37.00	16573.0	165.7	828.7	57159.1
TRUSS	26.00	6152.0	61.5	890.2	63291.1
MEZZ	15.00	6731.0	67.3	957.5	64890.6
BASE	0.00	1976.0	19.8	977.2	65900.3
total		113377.0			


E M M M M P
F B B B B Q
G C C
H D D S
H D D S
H D D S
H D D S
G C C R
F B B B B Q
IN
IN
FLAT FLAT FLAT FLAT FLAT FLAT
F B B B B Q
G C C R
H D D S
H D D S
H D D S
H D D S
I
J C C R
K B B B B Q
UP
UP
O
L A N A P

COLUMN LOAD TAKEDOWN - Summary

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COLUMN A

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	432	4	1728	NA	63	-	26880		0			53.9		53.9		53.9	64.7		64.7		64.7
P5	11.00	N	432	4	3456	1.00	63	16500	73920	11		40	40	122.2	17.3	176.1	17.3	193.3	146.6	27.6	211.3	27.6	238.9
P4	11.00	Y	432	4	5184	0.80	63	16500	73920	11		40	32	122.2	13.8	298.2	31.1	329.3	146.6	22.1	357.9	49.8	407.6
P3	11.00	Y	432	4	6912	0.80	63	16500	73920	11		40	32	122.2	13.8	420.4	44.9	465.3	146.6	22.1	504.5	71.9	576.4
P2	11.00	Y	432	4	8640	0.80	63	16500	73920	11		40	32	122.2	13.8	542.6	58.8	601.3	146.6	22.1	651.1	94.0	745.1
P1								16500						16.5		559.1	58.8	617.8	19.8		670.9	94.0	764.9
TRUSS																559.1	58.8	617.8			670.9	94.0	764.9
MEZZ																559.1	58.8	617.8			670.9	94.0	764.9
GROUND																559.1	58.8	617.8			670.9	94.0	764.9

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	559.1	DL =	670.9
LL =	58.8	LL =	94.0
TL =	617.8	TL =	764.9

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	17.58	19.83
3	14.35	16.19
4	12.43	14.02
6	10.15	11.45
8	8.79	9.92
3	14.35	16.19

COLUMN LOAD TAKEDOWN - input

PROJECT	Iceplex Redesign
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COLUMN ID:	A	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT**:	110	PSF
CURTAIN WALL WEIGHT:	21	PSF
BRICK WEIGHT**:	30	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	432	4	36	40	4	48			4	48				
P5	11.00	5	N	432	4	36	40	11	48			11	48		11	0	40
P4	11.00	5	Y	432	4	36	40	11	48			11	48		11	0	40
P3	11.00	5	Y	432	4	36	40	11	48			11	48		11	0	40
P2	11.00	5	Y	432	4	36	40	11	48			11	48		11	0	40
P1	0.00	5	Y	432	4	36	40	11	48			11	48		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN B

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	744	4	2976	NA	63	-			0			46.5		46.5		46.5	55.8		55.8		55.8
P5	11.00	N	744	4	5952	1.00	63	5500		11		40	40	60.2	29.8	106.7	29.8	136.4	72.2	47.6	128.0	47.6	175.6
P4	11.00	Y	744	4	8928	0.80	63	5500		11		40	32	60.2	23.8	166.9	53.6	220.4	72.2	38.1	200.2	85.7	286.0
P3	11.00	Y	744	4	11904	0.80	63	5500		11		40	32	60.2	23.8	227.1	77.4	304.4	72.2	38.1	272.5	123.8	396.3
P2	11.00	Y	744	4	14880	0.80	63	5500		11		40	32	60.2	23.8	287.2	101.2	388.4	72.2	38.1	344.7	161.9	506.6
P1								5500						5.5		292.7	101.2	393.9	6.6		351.3	161.9	513.2
TRUSS																292.7	101.2	393.9			351.3	161.9	513.2
MEZZ																292.7	101.2	393.9			351.3	161.9	513.2
GROUND																292.7	101.2	393.9			351.3	161.9	513.2

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	292.7	DL =	351.3
LL =	101.2	LL =	161.9
TL =	393.9	TL =	513.2

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	14.03	15.84
3	11.46	12.93
4	9.92	11.20
6	8.10	9.14
8	7.02	7.92
3	11.46	12.93

COLUMN LOAD TAKEDOWN - input

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COLUMN ID:	B	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT:	150	PSF
CURTAIN WALL WEIGHT:	100	PSF
BRICK WEIGHT:	40	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	744	4	20	24										
P5	11.00	5	N	744	4	20	24								11	0	40
P4	11.00	5	Y	744	4	20	24								11	0	40
P3	11.00	5	Y	744	4	20	24								11	0	40
P2	11.00	5	Y	744	4	20	24								11	0	40
P1	0.00	5	Y	744	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN C

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	1032	4	4128	NA	63	-			0			64.5		64.5		64.5	77.4		77.4		77.4
P5	11.00	N	1032	4	8256	1.00	63	5500		11		40	40	81.4	41.3	145.9	41.3	187.1	97.6	66.0	175.0	66.0	241.1
P4	11.00	Y	1032	4	12384	0.80	63	5500		11		40	32	81.4	33.0	227.2	74.3	301.5	97.6	52.8	272.6	118.9	391.5
P3	11.00	Y	1032	4	16512	0.80	63	5500		11		40	32	81.4	33.0	308.6	107.3	415.9	97.6	52.8	370.3	171.7	542.0
P2	11.00	Y	1032	4	20640	0.80	63	5500		11		40	32	81.4	33.0	389.9	140.4	530.3	97.6	52.8	467.9	224.6	692.5
P1								5500						5.5		395.4	140.4	535.8	6.6		474.5	224.6	699.1
TRUSS																395.4	140.4	535.8			474.5	224.6	699.1
MEZZ																395.4	140.4	535.8			474.5	224.6	699.1
GROUND																395.4	140.4	535.8			474.5	224.6	699.1

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	395.4	DL =	474.5
LL =	140.4	LL =	224.6
TL =	535.8	TL =	699.1

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	16.37	18.47
3	13.36	15.08
4	11.57	13.06
6	9.45	10.66
8	8.18	9.23
3	13.36	15.08

COLUMN LOAD TAKEDOWN - input

PROJECT	Iceplex Redesign
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COLUMN ID:	C	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT:	150	PSF
CURTAIN WALL WEIGHT:	100	PSF
BRICK WEIGHT:	40	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	1032	4	20	24										
P5	11.00	5	N	1032	4	20	24								11	0	40
P4	11.00	5	Y	1032	4	20	24								11	0	40
P3	11.00	5	Y	1032	4	20	24								11	0	40
P2	11.00	5	Y	1032	4	20	24								11	0	40
P1	0.00	5	Y	1032	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT	Portico
CLIENT	AR Meyers
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ENGINEER	bsh
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COLUMN D

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	1440	4	5760	NA	63	-			0			90.0		90.0		90.0	108.0		108.0		108.0
P5	11.00	N	1440	4	11520	1.00	63	5500		11		40	40	111.3	57.6	201.3	57.6	258.9	133.6	92.2	241.6	92.2	333.8
P4	11.00	Y	1440	4	17280	0.80	63	5500		11		40	32	111.3	46.1	312.7	103.7	416.4	133.6	73.7	375.2	165.9	541.1
P3	11.00	Y	1440	4	23040	0.80	63	5500		11		40	32	111.3	46.1	424.0	149.8	573.8	133.6	73.7	508.8	239.6	748.4
P2	11.00	Y	1440	4	28800	0.80	63	5500		11		40	32	111.3	46.1	535.4	195.8	731.2	133.6	73.7	642.4	313.3	955.8
P1								5500						5.5		540.9	195.8	736.7	6.6		649.0	313.3	962.4
TRUSS																540.9	195.8	736.7			649.0	313.3	962.4
MEZZ																540.9	195.8	736.7			649.0	313.3	962.4
GROUND																540.9	195.8	736.7			649.0	313.3	962.4

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	540.9	DL =	649.0
LL =	195.8	LL =	313.3
TL =	736.7	TL =	962.4

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	19.19	21.66
3	15.67	17.68
4	13.57	15.31
6	11.08	12.50
8	9.60	10.83
3	15.67	17.68

COLUMN LOAD TAKEDOWN - input

PROJECT	Portico		
CLIENT	AR Meyers		
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COLUMN ID:	D	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT:	150	PSF
CURTAIN WALL WEIGHT:	100	PSF
BRICK WEIGHT:	40	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	1440	4	20	24										
P5	11.00	5	N	1440	4	20	24								11	0	40
P4	11.00	5	Y	1440	4	20	24								11	0	40
P3	11.00	5	Y	1440	4	20	24								11	0	40
P2	11.00	5	Y	1440	4	20	24								11	0	40
P1	0.00	5	Y	1440	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT	Portico		
CLIENT	AR Meyers		
JOB NO.	4035.00	*DATE*	8-Apr-08
ENGINEER	bsh	*PAGE*	1 OF 2

COLUMN E

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	828	4	3312	NA	63	-	27600		0			79.4		79.4		79.4	95.2		95.2		95.2
P5	11.00	N	828	4	6624	1.00	63	16500	75900	11		40	40	153.3	33.1	232.6	33.1	265.7	183.9	53.0	279.1	53.0	332.1
P4	11.00	Y	828	4	9936	0.80	63	16500	75900	11		40	32	153.3	26.5	385.9	59.6	445.5	183.9	42.4	463.0	95.4	558.4
P3	11.00	Y	828	4	13248	0.80	63	16500	75900	11		40	32	153.3	26.5	539.1	86.1	625.2	183.9	42.4	646.9	137.8	784.7
P2	11.00	Y	828	4	16560	0.80	63	16500	75900	11		40	32	153.3	26.5	692.4	112.6	805.0	183.9	42.4	830.9	180.2	1011.0
P1								16500						16.5		708.9	112.6	821.5	19.8		850.7	180.2	1030.8
TRUSS																708.9	112.6	821.5			850.7	180.2	1030.8
MEZZ																708.9	112.6	821.5			850.7	180.2	1030.8
GROUND																708.9	112.6	821.5			850.7	180.2	1030.8

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	708.9	DL =	850.7
LL =	112.6	LL =	180.2
TL =	821.5	TL =	1030.8

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	20.27	22.87
3	16.55	18.67
4	14.33	16.17
6	11.70	13.20
8	10.13	11.43
3	16.55	18.67

COLUMN LOAD TAKEDOWN - input

PROJECT Portico
CLIENT AR Meyers
JOB NO. 4035.00 DATE 8-Apr-08
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COLUMN ID: E
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT: 150 PSF
CURTAIN WALL WEIGHT: 100 PSF
BRICK WEIGHT: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	828	4	36	40	4	46								
P5	11.00	5	N	828	4	36	40	11	46						11	0	40
P4	11.00	5	Y	828	4	36	40	11	46						11	0	40
P3	11.00	5	Y	828	4	36	40	11	46						11	0	40
P2	11.00	5	Y	828	4	36	40	11	46						11	0	40
P1	0.00	5	Y	828	4	36	40	11	46						11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT	Iceplex Redesign
CLIENT	Penn State University AE
ENGINEER	Megan Kohut
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COLUMN F

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	713	4	2852	NA	63	-			0			44.6		44.6		44.6	53.5		53.5		53.5
P5	11.00	N	713	4	5704	1.00	63	5500		11		40	40	57.9	28.5	102.5	28.5	131.0	69.5	45.6	123.0	45.6	168.6
P4	11.00	Y	713	4	8556	0.80	63	5500		11		40	32	57.9	22.8	160.4	51.3	211.7	69.5	36.5	192.4	82.1	274.6
P3	11.00	Y	713	4	11408	0.80	63	5500		11		40	32	57.9	22.8	218.3	74.2	292.4	69.5	36.5	261.9	118.6	380.6
P2	11.00	Y	713	4	14260	0.80	63	5500		11		40	32	57.9	22.8	276.2	97.0	373.2	69.5	36.5	331.4	155.1	486.6
P1								5500						5.5		281.7	97.0	378.7	6.6		338.0	155.1	493.2
TRUSS																281.7	97.0	378.7			338.0	155.1	493.2
MEZZ																281.7	97.0	378.7			338.0	155.1	493.2
GROUND																281.7	97.0	378.7			338.0	155.1	493.2

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	281.7	DL =	338.0
LL =	97.0	LL =	155.1
TL =	378.7	TL =	493.2

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	13.76	15.53
3	11.23	12.68
4	9.73	10.98
6	7.94	8.96
8	6.88	7.76
3	11.23	12.68

COLUMN LOAD TAKEDOWN - input

PROJECT: Iceplex Redesign
CLIENT: Penn State University AE
ENGINEER: Megan Kohut
DATE: 8-Apr-08
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COLUMN ID: F
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT: 150 PSF
CURTAIN WALL WEIGHT: 100 PSF
BRICK WEIGHT: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	713	4	20	24										
P5	11.00	5	N	713	4	20	24								11	0	40
P4	11.00	5	Y	713	4	20	24								11	0	40
P3	11.00	5	Y	713	4	20	24								11	0	40
P2	11.00	5	Y	713	4	20	24								11	0	40
P1	0.00	5	Y	713	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT Iceplex Redesign
CLIENT Penn State University AE
ENGINEER Megan Kohut
DATE 8-Apr-08
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COLUMN G

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	989	4	3956	NA	63	-			0			61.8		61.8		61.8	74.2		74.2		74.2
P5	11.00	N	989	4	7912	1.00	63	5500		11		40	40	78.2	39.6	140.0	39.6	179.6	93.8	63.3	168.0	63.3	231.3
P4	11.00	Y	989	4	11868	0.80	63	5500		11		40	32	78.2	31.6	218.2	71.2	289.4	93.8	50.6	261.8	113.9	375.8
P3	11.00	Y	989	4	15824	0.80	63	5500		11		40	32	78.2	31.6	296.4	102.9	399.2	93.8	50.6	355.7	164.6	520.2
P2	11.00	Y	989	4	19780	0.80	63	5500		11		40	32	78.2	31.6	374.6	134.5	509.1	93.8	50.6	449.5	215.2	664.7
P1								5500						5.5		380.1	134.5	514.6	6.6		456.1	215.2	671.3
TRUSS																380.1	134.5	514.6			456.1	215.2	671.3
MEZZ																380.1	134.5	514.6			456.1	215.2	671.3
GROUND																380.1	134.5	514.6			456.1	215.2	671.3

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	380.1	DL =	456.1
LL =	134.5	LL =	215.2
TL =	514.6	TL =	671.3

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	16.04	18.10
3	13.10	14.78
4	11.34	12.80
6	9.26	10.45
8	8.02	9.05
3	13.10	14.78

COLUMN LOAD TAKEDOWN - input

PROJECT Iceplex Redesign
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COLUMN ID:	G	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT:	150	PSF
CURTAIN WALL WEIGHT:	100	PSF
BRICK WEIGHT:	40	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	989	4	20	24										
P5	11.00	5	N	989	4	20	24								11	0	40
P4	11.00	5	Y	989	4	20	24								11	0	40
P3	11.00	5	Y	989	4	20	24								11	0	40
P2	11.00	5	Y	989	4	20	24								11	0	40
P1	0.00	5	Y	989	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT	Portico
CLIENT	AR Meyers
JOB NO.	4035.00
ENGINEER	bsh
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COLUMN H

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	1380	4	5520	NA	63	-			0			86.3		86.3		86.3	103.5		103.5		103.5
P5	11.00	N	1380	4	11040	1.00	63	5500		11		40	40	106.9	55.2	193.2	55.2	248.4	128.3	88.3	231.8	88.3	320.1
P4	11.00	Y	1380	4	16560	0.80	63	5500		11		40	32	106.9	44.2	300.1	99.4	399.5	128.3	70.7	360.1	159.0	519.1
P3	11.00	Y	1380	4	22080	0.80	63	5500		11		40	32	106.9	44.2	407.0	143.5	550.6	128.3	70.7	488.4	229.6	718.1
P2	11.00	Y	1380	4	27600	0.80	63	5500		11		40	32	106.9	44.2	514.0	187.7	701.7	128.3	70.7	616.8	300.3	917.1
P1								5500						5.5		519.5	187.7	707.2	6.6		623.4	300.3	923.7
TRUSS																519.5	187.7	707.2			623.4	300.3	923.7
MEZZ																519.5	187.7	707.2			623.4	300.3	923.7
GROUND																519.5	187.7	707.2			623.4	300.3	923.7

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	519.5	DL =	623.4
LL =	187.7	LL =	300.3
TL =	707.2	TL =	923.7

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	18.80	21.22
3	15.35	17.32
4	13.30	15.00
6	10.86	12.25
8	9.40	10.61
3	15.35	17.32

COLUMN LOAD TAKEDOWN - input

PROJECT: Portico
CLIENT: AR Meyers
JOB NO.: 4035.00
ENGINEER: bsh
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COLUMN ID: H
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT: 150 PSF
CURTAIN WALL WEIGHT: 100 PSF
BRICK WEIGHT: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	1380	4	20	24										
P5	11.00	5	N	1380	4	20	24								11	0	40
P4	11.00	5	Y	1380	4	20	24								11	0	40
P3	11.00	5	Y	1380	4	20	24								11	0	40
P2	11.00	5	Y	1380	4	20	24								11	0	40
P1	0.00	5	Y	1380	4	20	24								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

PROJECT	Iceplex Redesign
CLIENT	Penn State University AE
ENGINEER	Megan Kohut
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COLUMN
I

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	686	4	2744	NA	63	-	21480		0			64.4		64.4		64.4	77.2		77.2		77.2
P5	11.00	N	686	4	5488	1.00	63	16500	59070	11		40	40	126.0	27.4	190.3	27.4	217.8	151.2	43.9	228.4	43.9	272.3
P4	11.00	Y	686	4	8232	0.80	63	16500	59070	11		40	32	126.0	22.0	316.3	49.4	365.7	151.2	35.1	379.6	79.0	458.6
P3	11.00	Y	686	4	10976	0.80	63	16500	59070	11		40	32	126.0	22.0	442.3	71.3	513.7	151.2	35.1	530.8	114.2	644.9
P2	11.00	Y	686	4	13720	0.80	63	16500	59070	11		40	32	126.0	22.0	568.3	93.3	661.6	151.2	35.1	682.0	149.3	831.3
P1								16500						16.5		584.8	93.3	678.1	19.8		701.8	149.3	851.1
TRUSS																584.8	93.3	678.1			701.8	149.3	851.1
MEZZ																584.8	93.3	678.1			701.8	149.3	851.1
GROUND																584.8	93.3	678.1			701.8	149.3	851.1

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	584.8	DL =	701.8
LL =	93.3	LL =	149.3
TL =	678.1	TL =	851.1

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	18.41	20.78
3	15.03	16.96
4	13.02	14.69
6	10.63	12.00
8	9.21	10.39
3	15.03	16.96

COLUMN LOAD TAKEDOWN - input

PROJECT	Iceplex Redesign
CLIENT	Penn State University AE
ENGINEER	Megan Kohut
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COLUMN ID:	I	
FLOOR LEVELS:	7	(max 25)
PARKING LEVELS:	0	(max 7)
BEARING PRESSURE:	3	KSF

CONCRETE WEIGHT:	150	PCF
PRECAST WEIGHT**:	150	PSF
CURTAIN WALL WEIGHT:	21	PSF
BRICK WEIGHT**:	40	PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR:	1.2
ACI LL FACTOR:	1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	686	4	36	40	4	35			4	3				
P5	11.00	5	N	686	4	36	40	11	35			11	3		11	0	40
P4	11.00	5	Y	686	4	36	40	11	35			11	3		11	0	40
P3	11.00	5	Y	686	4	36	40	11	35			11	3		11	0	40
P2	11.00	5	Y	686	4	36	40	11	35			11	3		11	0	40
P1	0.00	5	Y	686	4	36	40	11	35			11	3		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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CLIENT Penn State University AE
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ENGINEER Megan Kohut
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COLUMN J

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	462	4	1848	NA	63	-	15680		0			44.6		44.6		44.6	53.5		53.5		53.5
P5	11.00	N	462	4	3696	1.00	63	16500	43120	11		40	40	93.6	18.5	138.1	18.5	156.6	112.3	29.6	165.8	29.6	195.3
P4	11.00	Y	462	4	5544	0.80	63	16500	43120	11		40	32	93.6	14.8	231.7	33.3	265.0	112.3	23.7	278.1	53.2	331.3
P3	11.00	Y	462	4	7392	0.80	63	16500	43120	11		40	32	93.6	14.8	325.3	48.0	373.3	112.3	23.7	390.3	76.9	467.2
P2	11.00	Y	462	4	9240	0.80	63	16500	43120	11		40	32	93.6	14.8	418.9	62.8	481.7	112.3	23.7	502.6	100.5	603.2
P1								16500						16.5		435.4	62.8	498.2	19.8		522.4	100.5	623.0
TRUSS																435.4	62.8	498.2			522.4	100.5	623.0
MEZZ																435.4	62.8	498.2			522.4	100.5	623.0
GROUND																435.4	62.8	498.2			522.4	100.5	623.0

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	435.4	DL =	522.4
LL =	62.8	LL =	100.5
TL =	498.2	TL =	623.0

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	15.78	17.81
3	12.89	14.54
4	11.16	12.59
6	9.11	10.28
8	7.89	8.90
3	12.89	14.54

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: J
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 150 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	462	4	36	40	4	20			4	23				
P5	11.00	5	N	462	4	36	40	11	20			11	23		11	0	40
P4	11.00	5	Y	462	4	36	40	11	20			11	23		11	0	40
P3	11.00	5	Y	462	4	36	40	11	20			11	23		11	0	40
P2	11.00	5	Y	462	4	36	40	11	20			11	23		11	0	40
P1	0.00	5	Y	462	4	36	40	11	20			11	23		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN K

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	372	4	1488	NA	63	-	12160		0			35.4		35.4		35.4	42.5		42.5		42.5
P5	11.00	N	372	4	2976	1.00	63	16500	33440	11		40	40	77.3	14.9	112.7	14.9	127.6	92.7	23.8	135.2	23.8	159.0
P4	11.00	Y	372	4	4464	0.80	63	16500	33440	11		40	32	77.3	11.9	190.0	26.8	216.8	92.7	19.0	228.0	42.9	270.8
P3	11.00	Y	372	4	5952	0.80	63	16500	33440	11		40	32	77.3	11.9	267.3	38.7	305.9	92.7	19.0	320.7	61.9	382.6
P2	11.00	Y	372	4	7440	0.80	63	16500	33440	11		40	32	77.3	11.9	344.5	50.6	395.1	92.7	19.0	413.4	80.9	494.4
P1								16500						16.5		361.0	50.6	411.6	19.8		433.2	80.9	514.2
TRUSS																361.0	50.6	411.6			433.2	80.9	514.2
MEZZ																361.0	50.6	411.6			433.2	80.9	514.2
GROUND																361.0	50.6	411.6			433.2	80.9	514.2

FOUNDATION LOAD SUMMARY	
SERVICE LOAD	ULTIMATE LOAD
DL = 361.0	DL = 433.2
LL = 50.6	LL = 80.9
TL = 411.6	TL = 514.2

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	14.35	16.19
3	11.71	13.22
4	10.14	11.45
6	8.28	9.35
8	7.17	8.09
3	11.71	13.22

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: K
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 150 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	372	4	36	40	4	16			4	16				
P5	11.00	5	N	372	4	36	40	11	16			11	16		11	0	40
P4	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P3	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P2	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P1	0.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN L

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	216	2	432	NA	63	-	23520		0			37.0		37.0		37.0	44.4		44.4		44.4
P5	11.00	N	216	2	864	1.00	63	16500	64680	11		40	40	97.1	8.6	134.1	8.6	142.7	116.5	13.8	160.9	13.8	174.7
P4	11.00	Y	216	2	1296	0.97	63	16500	64680	11		40	39	97.1	8.4	231.1	17.0	248.2	116.5	13.4	277.4	27.3	304.6
P3	11.00	Y	216	2	1728	0.97	63	16500	64680	11		40	39	97.1	8.4	328.2	25.4	353.6	116.5	13.4	393.8	40.7	434.5
P2	11.00	Y	216	2	2160	0.97	63	16500	64680	11		40	39	97.1	8.4	425.2	33.8	459.1	116.5	13.4	510.3	54.1	564.4
P1								16500						16.5		441.7	33.8	475.6	19.8		530.1	54.1	584.2
TRUSS																441.7	33.8	475.6			530.1	54.1	584.2
MEZZ																441.7	33.8	475.6			530.1	54.1	584.2
GROUND																441.7	33.8	475.6			530.1	54.1	584.2

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	441.7	DL =	530.1
LL =	33.8	LL =	54.1
TL =	475.6	TL =	584.2

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	15.42	17.40
3	12.59	14.21
4	10.90	12.30
6	8.90	10.05
8	7.71	8.70
3	12.59	14.21

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: L
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	216	2	36	40	4	42			4	42				
P5	11.00	5	N	216	2	36	40	11	42			11	42		11	0	40
P4	11.00	5	Y	216	2	36	40	11	42			11	42		11	0	40
P3	11.00	5	Y	216	2	36	40	11	42			11	42		11	0	40
P2	11.00	5	Y	216	2	36	40	11	42			11	42		11	0	40
P1	0.00	5	Y	216	2	36	40	11	42			11	42		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	432	4	1728	NA	63	-	28800		0			55.8		55.8		55.8	67.0		67.0		67.0
P5	11.00	N	432	4	3456	1.00	63	16500	79200	11		40	40	127.5	17.3	183.3	17.3	200.5	152.9	27.6	219.9	27.6	247.6
P4	11.00	Y	432	4	5184	0.80	63	16500	79200	11		40	32	127.5	13.8	310.7	31.1	341.8	152.9	22.1	372.8	49.8	422.6
P3	11.00	Y	432	4	6912	0.80	63	16500	79200	11		40	32	127.5	13.8	438.2	44.9	483.1	152.9	22.1	525.8	71.9	597.7
P2	11.00	Y	432	4	8640	0.80	63	16500	79200	11		40	32	127.5	13.8	565.6	58.8	624.4	152.9	22.1	678.7	94.0	772.7
P1								16500						16.5		582.1	58.8	640.9	19.8		698.5	94.0	792.5
TRUSS																582.1	58.8	640.9			698.5	94.0	792.5
MEZZ																582.1	58.8	640.9			698.5	94.0	792.5
GROUND																582.1	58.8	640.9			698.5	94.0	792.5

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	582.1	DL =	698.5
LL =	58.8	LL =	94.0
TL =	640.9	TL =	792.5

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	17.90	20.20
3	14.62	16.49
4	12.66	14.28
6	10.33	11.66
8	8.95	10.10
3	14.62	16.49

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: M
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT: 150 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT: 40 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	432	4	36	40	4	48								
P5	11.00	5	N	432	4	36	40	11	48						11	0	40
P4	11.00	5	Y	432	4	36	40	11	48						11	0	40
P3	11.00	5	Y	432	4	36	40	11	48						11	0	40
P2	11.00	5	Y	432	4	36	40	11	48						11	0	40
P1	0.00	5	Y	432	4	36	40	11	48						11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN N

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	432	4	1728	NA	63	-	25560		0			52.6		52.6		52.6	63.1		63.1		63.1
P5	11.00	N	432	4	3456	1.00	63	16500	70290	11		40	40	118.5	17.3	171.1	17.3	188.4	142.3	27.6	205.3	27.6	233.0
P4	11.00	Y	432	4	5184	0.80	63	16500	70290	11		40	32	118.5	13.8	289.6	31.1	320.7	142.3	22.1	347.6	49.8	397.3
P3	11.00	Y	432	4	6912	0.80	63	16500	70290	11		40	32	118.5	13.8	408.2	44.9	453.1	142.3	22.1	489.8	71.9	561.7
P2	11.00	Y	432	4	8640	0.80	63	16500	70290	11		40	32	118.5	13.8	526.7	58.8	585.5	142.3	22.1	632.1	94.0	726.1
P1								16500						16.5		543.2	58.8	602.0	19.8		651.9	94.0	745.9
TRUSS																543.2	58.8	602.0			651.9	94.0	745.9
MEZZ																543.2	58.8	602.0			651.9	94.0	745.9
GROUND																543.2	58.8	602.0			651.9	94.0	745.9

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	543.2	DL =	651.9
LL =	58.8	LL =	94.0
TL =	602.0	TL =	745.9

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	17.35	19.58
3	14.17	15.98
4	12.27	13.84
6	10.02	11.30
8	8.67	9.79
3	14.17	15.98

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: N
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	432	4	36	40	4	48			4	37				
P5	11.00	5	N	432	4	36	40	11	48			11	37		11	0	40
P4	11.00	5	Y	432	4	36	40	11	48			11	37		11	0	40
P3	11.00	5	Y	432	4	36	40	11	48			11	37		11	0	40
P2	11.00	5	Y	432	4	36	40	11	48			11	37		11	0	40
P1	0.00	5	Y	432	4	36	40	11	48			11	37		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	432	4	1728	NA	63	-	22560		0			49.6		49.6		49.6	59.5		59.5		59.5
P5	11.00	N	432	4	3456	1.00	63	16500	62040	11		40	40	110.3	17.3	159.9	17.3	177.1	132.4	27.6	191.8	27.6	219.5
P4	11.00	Y	432	4	5184	0.80	63	16500	62040	11		40	32	110.3	13.8	270.1	31.1	301.2	132.4	22.1	324.2	49.8	373.9
P3	11.00	Y	432	4	6912	0.80	63	16500	62040	11		40	32	110.3	13.8	380.4	44.9	425.4	132.4	22.1	456.5	71.9	528.4
P2	11.00	Y	432	4	8640	0.80	63	16500	62040	11		40	32	110.3	13.8	490.7	58.8	549.5	132.4	22.1	588.9	94.0	682.9
P1								16500						16.5		507.2	58.8	566.0	19.8		608.7	94.0	702.7
TRUSS																507.2	58.8	566.0			608.7	94.0	702.7
MEZZ																507.2	58.8	566.0			608.7	94.0	702.7
GROUND																507.2	58.8	566.0			608.7	94.0	702.7

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	507.2	DL =	608.7
LL =	58.8	LL =	94.0
TL =	566.0	TL =	702.7

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	16.82	18.98
3	13.74	15.50
4	11.90	13.42
6	9.71	10.96
8	8.41	9.49
3	13.74	15.50

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: O
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	432	4	36	40	4	48			4	12				
P5	11.00	5	N	432	4	36	40	11	48			11	12		11	0	40
P4	11.00	5	Y	432	4	36	40	11	48			11	12		11	0	40
P3	11.00	5	Y	432	4	36	40	11	48			11	12		11	0	40
P2	11.00	5	Y	432	4	36	40	11	48			11	12		11	0	40
P1	0.00	5	Y	432	4	36	40	11	48			11	12		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN P

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	216	2	432	NA	63	-	15600		0			29.1		29.1		29.1	34.9		34.9		34.9
P5	11.00	N	216	2	864	1.00	63	16500	42900	11		40	40	75.3	8.6	104.4	8.6	113.0	90.3	13.8	125.3	13.8	139.1
P4	11.00	Y	216	2	1296	0.97	63	16500	42900	11		40	39	75.3	8.4	179.7	17.0	196.7	90.3	13.4	215.6	27.3	242.8
P3	11.00	Y	216	2	1728	0.97	63	16500	42900	11		40	39	75.3	8.4	254.9	25.4	280.4	90.3	13.4	305.9	40.7	346.6
P2	11.00	Y	216	2	2160	0.97	63	16500	42900	11		40	39	75.3	8.4	330.2	33.8	364.0	90.3	13.4	396.2	54.1	450.4
P1								16500						16.5		346.7	33.8	380.5	19.8		416.0	54.1	470.2
TRUSS																346.7	33.8	380.5			416.0	54.1	470.2
MEZZ																346.7	33.8	380.5			416.0	54.1	470.2
GROUND																346.7	33.8	380.5			416.0	54.1	470.2

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	346.7	DL =	416.0
LL =	33.8	LL =	54.1
TL =	380.5	TL =	470.2

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	13.79	15.56
3	11.26	12.71
4	9.75	11.01
6	7.96	8.99
8	6.90	7.78
3	11.26	12.71

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: P
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	216	2	36	40	4	33			4	9				
P5	11.00	5	N	216	2	36	40	11	33			11	9		11	0	40
P4	11.00	5	Y	216	2	36	40	11	33			11	9		11	0	40
P3	11.00	5	Y	216	2	36	40	11	33			11	9		11	0	40
P2	11.00	5	Y	216	2	36	40	11	33			11	9		11	0	40
P1	0.00	5	Y	216	2	36	40	11	33			11	9		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN Q

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	372	4	1488	NA	63	-	8960		0			32.2		32.2		32.2	38.7		38.7		38.7
P5	11.00	N	372	4	2976	1.00	63	16500	24640	11		40	40	68.5	14.9	100.7	14.9	115.6	82.2	23.8	120.8	23.8	144.6
P4	11.00	Y	372	4	4464	0.80	63	16500	24640	11		40	32	68.5	11.9	169.2	26.8	196.0	82.2	19.0	203.0	42.9	245.9
P3	11.00	Y	372	4	5952	0.80	63	16500	24640	11		40	32	68.5	11.9	237.7	38.7	276.3	82.2	19.0	285.2	61.9	347.1
P2	11.00	Y	372	4	7440	0.80	63	16500	24640	11		40	32	68.5	11.9	306.1	50.6	356.7	82.2	19.0	367.4	80.9	448.3
P1								16500						16.5		322.6	50.6	373.2	19.8		387.2	80.9	468.1
TRUSS																322.6	50.6	373.2			387.2	80.9	468.1
MEZZ																322.6	50.6	373.2			387.2	80.9	468.1
GROUND																322.6	50.6	373.2			387.2	80.9	468.1

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	322.6	DL =	387.2
LL =	50.6	LL =	80.9
TL =	373.2	TL =	468.1

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	13.66	15.41
3	11.15	12.59
4	9.66	10.90
6	7.89	8.90
8	6.83	7.71
3	11.15	12.59

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: Q
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	372	4	36	40	4	16			4	16				
P5	11.00	5	N	372	4	36	40	11	16			11	16		11	0	40
P4	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P3	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P2	11.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
P1	0.00	5	Y	372	4	36	40	11	16			11	16		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN R

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	516	4	2064	NA	63	-	12320		0			44.6		44.6		44.6	53.5		53.5		53.5
P5	11.00	N	516	4	4128	1.00	63	16500	33880	11		40	40	88.3	20.6	132.9	20.6	153.5	106.0	33.0	159.5	33.0	192.5
P4	11.00	Y	516	4	6192	0.80	63	16500	33880	11		40	32	88.3	16.5	221.2	37.2	258.3	106.0	26.4	265.4	59.4	324.9
P3	11.00	Y	516	4	8256	0.80	63	16500	33880	11		40	32	88.3	16.5	309.5	53.7	363.2	106.0	26.4	371.4	85.9	457.2
P2	11.00	Y	516	4	10320	0.80	63	16500	33880	11		40	32	88.3	16.5	397.8	70.2	468.0	106.0	26.4	477.4	112.3	589.6
P1								16500						16.5		414.3	70.2	484.5	19.8		497.2	112.3	609.4
TRUSS																414.3	70.2	484.5			497.2	112.3	609.4
MEZZ																414.3	70.2	484.5			497.2	112.3	609.4
GROUND																414.3	70.2	484.5			497.2	112.3	609.4

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	414.3	DL =	497.2
LL =	70.2	LL =	112.3
TL =	484.5	TL =	609.4

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	15.56	17.56
3	12.71	14.34
4	11.01	12.42
6	8.99	10.14
8	7.78	8.78
3	12.71	14.34

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: R
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	516	4	36	40	4	22			4	22				
P5	11.00	5	N	516	4	36	40	11	22			11	22		11	0	40
P4	11.00	5	Y	516	4	36	40	11	22			11	22		11	0	40
P3	11.00	5	Y	516	4	36	40	11	22			11	22		11	0	40
P2	11.00	5	Y	516	4	36	40	11	22			11	22		11	0	40
P1	0.00	5	Y	516	4	36	40	11	22			11	22		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN S

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)	DEAD LOAD (kips)	LIVE LOAD (kips)	TOTAL DL (kips)	TOTAL LL (kips)	TOTAL LOAD (kips)
Roof	11.00	N	720	4	2880	NA	63	-	16800		0			61.8		61.8		61.8	74.2		74.2		74.2
P5	11.00	N	720	4	5760	1.00	63	16500	46200	11		40	40	115.6	28.8	177.4	28.8	206.2	138.7	46.1	212.9	46.1	259.0
P4	11.00	Y	720	4	8640	0.80	63	16500	46200	11		40	32	115.6	23.0	293.0	51.8	344.9	138.7	36.9	351.6	82.9	434.6
P3	11.00	Y	720	4	11520	0.80	63	16500	46200	11		40	32	115.6	23.0	408.7	74.9	483.5	138.7	36.9	490.4	119.8	610.2
P2	11.00	Y	720	4	14400	0.80	63	16500	46200	11		40	32	115.6	23.0	524.3	97.9	622.2	138.7	36.9	629.1	156.7	785.8
P1								16500						16.5		540.8	97.9	638.7	19.8		648.9	156.7	805.6
TRUSS																540.8	97.9	638.7			648.9	156.7	805.6
MEZZ																540.8	97.9	638.7			648.9	156.7	805.6
GROUND																540.8	97.9	638.7			648.9	156.7	805.6

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	540.8	DL =	648.9
LL =	97.9	LL =	156.7
TL =	638.7	TL =	805.6

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	17.87	20.16
3	14.59	16.46
4	12.64	14.26
6	10.32	11.64
8	8.94	10.08
3	14.59	16.46

COLUMN LOAD TAKEDOWN - input

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COLUMN ID: S
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			COLUMN INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Area (sf)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	720	4	36	40	4	30			4	30				
P5	11.00	5	N	720	4	36	40	11	30			11	30		11	0	40
P4	11.00	5	Y	720	4	36	40	11	30			11	30		11	0	40
P3	11.00	5	Y	720	4	36	40	11	30			11	30		11	0	40
P2	11.00	5	Y	720	4	36	40	11	30			11	30		11	0	40
P1	0.00	5	Y	720	4	36	40	11	30			11	30		11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

COLUMN LOAD TAKEDOWN - Summary

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COLUMN
LITEWALL

FLOOR INFO		LIVE LOAD REDUCTION					FLOOR LOADING INFO							SERVICE LOADS					ULTIMATE LOADS				
LEVEL	FLOOR HEIGHT (ft)	LLR	TRIB AREA (sf)	K_{LL} FACTOR	INFLUENCE AREA (sf)	LLR (%)	SLAB SW (psf)	COL SW (lb)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)	TYP LL_{RED} (psf)	DEAD LOAD (klf)	LIVE LOAD (klf)	TOTAL DL (klf)	TOTAL LL (klf)	TOTAL LOAD (klf)	DEAD LOAD (klf)	LIVE LOAD (klf)	TOTAL DL (klf)	TOTAL LL (klf)	TOTAL LOAD (klf)
Roof	11.00	N	43	4	172	NA	63	-		11	0			3.2		3.2		3.2	3.8		3.8		3.8
P5	11.00	N	43	4	344	1.00	63	1650		11		40	40	4.8	1.7	8.0	1.7	9.7	5.8	2.8	9.6	2.8	12.3
P4	11.00	Y	43	4	516	1.39	63	1650		11		40	56	4.8	2.4	12.8	4.1	16.9	5.8	3.8	15.3	6.6	21.9
P3	11.00	Y	43	4	688	1.39	63	1650		11		40	56	4.8	2.4	17.6	6.5	24.1	5.8	3.8	21.1	10.4	31.5
P2	11.00	Y	43	4	860	1.39	63	1650		11		40	56	4.8	2.4	22.4	8.9	31.3	5.8	3.8	26.9	14.3	41.1
P1								1650						1.7		24.1	8.9	33.0	2.0		28.9	14.3	43.1
TRUSS																24.1	8.9	33.0			28.9	14.3	43.1
MEZZ																24.1	8.9	33.0			28.9	14.3	43.1
GROUND																24.1	8.9	33.0			28.9	14.3	43.1

FOUNDATION LOAD SUMMARY			
SERVICE LOAD		ULTIMATE LOAD	
DL =	24.1	DL =	28.9
LL =	8.9	LL =	14.3
TL =	33.0	TL =	43.1

FOOTING SIZE		
Q	SQUARE (X x X)	ROUND (diameter)
2	4.06	4.58
3	3.31	3.74
4	2.87	3.24
6	2.34	2.64
8	2.03	2.29
3	3.31	3.74

COLUMN LOAD TAKEDOWN - input

PROJECT Iceplex Redesign
CLIENT Penn State University AE
ENGINEER Megan Kohut
DATE 8-Apr-08
PAGE 2 OF 2

COLUMN ID: ITEWALL
FLOOR LEVELS: 7 (max 25)
PARKING LEVELS: 0 (max 7)
BEARING PRESSURE: 3 KSF

CONCRETE WEIGHT: 150 PCF
PRECAST WEIGHT**: 110 PSF
CURTAIN WALL WEIGHT: 21 PSF
BRICK WEIGHT**: 30 PSF

IBC TABLE 1607.9.2
LIVE LOAD ELEMENT FACTOR K_{LL}

ELEMENT	KLL
Interior columns	4
Exterior columns without cant slabs	4
Edge columns with cant slabs	3
Corner columns with cant slabs	2

ACI DL FACTOR: 1.2
ACI LL FACTOR: 1.6

** TAKES INTO ACCOUNT 27% OPENINGS

FLOOR INFO			LIVE LOAD REDUCTION			WALL INFO		SPANDREL DEAD LOAD						DEAD LOAD		LIVE LOAD	
								PRECAST		CURTAIN WALL		BRICK					
LEVEL	FLOOR HEIGHT (ft)	SLAB THICK (in)	LLR	Tributary Width (ft)	K_{LL} FACTOR	WIDTH (in)	LENGTH (in)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	HEIGHT (ft)	LENGTH (ft)	MISC ADL (lb)	TYP ADL (psf)	MISC LL (lb)	TYP LL (psf)
Roof	11.00	5	N	43	4	12	12								11		
P5	11.00	5	N	43	4	12	12								11	0	40
P4	11.00	5	Y	43	4	12	12								11	0	40
P3	11.00	5	Y	43	4	12	12								11	0	40
P2	11.00	5	Y	43	4	12	12								11	0	40
P1	0.00	5	Y	43	4	12	12								11	0	40
TRUSS	0.00																
MEZZ	0.00																
GROUND	0.00																
	-																

	Truss Member	Trial Size per SAP	Lb	KL	r	Ag	KL/r	E	Fe	Fy	0.44Fy	Fcr	φPn	φMn	Pu	Mu	Pu/φPn	Interaction Equation	Mu/φMn	Interaction Value
Failed Design Attempts	Top Chord (Design 1)	W36x800	0	15	16.6	236	0.90	29000	350535	50	22	50.0	10619	13700	22529	2210	2.1215	H1-1a	0.1613	2.283 No Good
	Top Chord (Design 2)	W36x800	0	15	16.6	236	0.90	29002	350559	50	22	50.0	10619	13700	8074	5718	0.7603	H1-1a	0.4174	1.178 No Good

	Truss Member	Trial Size per SAP	Lb	KL	r	Ag	KL/r	E	Fe	Fy	0.44Fy	Fcr	φPn	φMn	Pu	Mu	Pu/φPn	Interaction Equation	Mu/φMn	Interaction Value
Final Truss Design	TC-B (Gravity)	W40x503	0'	15	16.8	148	0.89	29000	359033	50	22	50.0	6660	8660	2610	4687	0.3919	H1-1a	0.5412	0.933 OK
	BC-B (Gravity)	W36x150	15'	15	14.3	44.2	1.05	29000	260128	50	22	50.0	1989	2180	1343	549	0.6753	H1-1a	0.2518	0.927 OK
	TC-B (Lateral)	W36x441	0'	10	15.7	130	0.64	29000	705500	50	22	50.0	5850	7160	1903	3521	0.3253	H1-1a	0.4918	0.817 OK
	TC-C (Lateral)	W36x529	0'	10	16	156	0.63	29000	732719	50	22	50.0	7020	8740	2452	3851	0.3493	H1-1a	0.4406	0.790 OK
	BC-B (Lateral)	W36x135	10'	10	14	39.7	0.71	29000	560988	50	22	50.0	1786	1834	752	613	0.4210	H1-1a	0.3342	0.755 OK
	BC-C (Lateral)	W36x135	10'	10	14	39.7	0.71	29000	560988	50	22	50.0	1786	1834	1121	282	0.6275	H1-1a	0.1538	0.781 OK
	Col 1 (Lateral)	W27x539	26'	26	12.7	32.5	2.05	29000	68290	50	22	50.0	1462	6570	1732	1336	1.1846	H1-1a	0.2033	1.388 No Good
		W36x487	26'	26	15.8	143	1.65	29000	105698	50	22	50.0	6434	7150	1732	1336	0.2692	H1-1a	0.1869	0.456 OK
		W30x391	26'	26	13.4	115	1.94	29000	76026	50	22	50.0	5174	4830	1732	1336	0.3348	H1-1a	0.2766	0.611 OK
		W30x326	26'	26	13.2	95.8	1.97	29000	73773	50	22	50.0	4310	3855	1732	1336	0.4019	H1-1a	0.3466	0.748 OK
		W30x261	26'	26	13.1	76.9	1.98	29000	72660	50	22	50.0	3460	2916	1732	1336	0.5006	H1-1a	0.4582	0.959 OK
	Col 2 (Lateral)	W30x391	26'	26	13.4	115	1.94	29000	76026	50	22	50.0	5174	4830	4224	1491	0.8165	H1-1a	0.3087	1.125 No Good
		W33x387	26'	26	14.6	114	1.78	29000	90252	50	22	50.0	5129	5120	4224	1491	0.8236	H1-1a	0.2912	1.115 No Good
		W36x395	26'	26	15.7	116	1.66	29000	104364	50	22	50.0	5219	5580	4224	1491	0.8094	H1-1a	0.2672	1.077 No Good
		W36x441	26'	26	15.7	130	1.66	29000	104364	50	22	50.0	5849	6330	4224	1491	0.7222	H1-1a	0.2355	0.958 OK
	Col 3 (Lateral)	W36x441	26'	26	15.7	130	1.66	29000	104364	50	22	50.0	5849	6330	3099	2145	0.5298	H1-1a	0.3389	0.869 OK
		W36x395	26'	26	15.7	116	1.66	29000	104364	50	22	50.0	5219	5580	3099	2145	0.5938	H1-1a	0.3844	0.978 OK
	Col 4 (Lateral)	W36x395	26'	26	15.7	116	1.66	29000	104364	50	22	50.0	5219	5580	3281	1600	0.6287	H1-1a	0.2867	0.915 OK
	Col 5 (Lateral)	W36x395	26'	26	15.7	116	1.66	29000	104364	50	22	50.0	5219	5580	3197	2838	0.6126	H1-1a	0.5086	1.121 No Good
		W36x441	26'	26	15.7	130	1.66	29000	104364	50	22	50.0	5849	6330	3197	2838	0.5466	H1-1a	0.4483	0.995 OK
	Col 6 (Lateral)	W30x261	26'	26	13.1	76.9	1.98	29000	72660	50	22	50.0	3460	2916	662	2522	0.1914	H1-1b	0.8649	1.069 No Good
		W30x292	26'	26	13.2	85.9	1.97	29000	73773	50	22	50.0	3864	3384	662	2522	0.1713	H1-1b	0.7453	0.924 OK
	Col 5x2 (Lateral)	W27x539	26'	26	12.7	32.5	2.05	29000	68290	50	22	50.0	1462	6570	1735	1766	1.1867	H1-1a	0.2688	1.455 No Good
		W30x261	26'	26	13.1	76.9	1.98	29000	72660	50	22	50.0	3460	2916	1735	1766	0.5015	H1-1a	0.6056	1.107 No Good
		W30x391	26	26	13.4	115	1.94	29000	76026	50	22	50.0	5174	4830	1735	1766	0.3354	H1-1a	0.3656	0.701 OK
		W36x395	26	26	15.7	116	1.66	29000	104364	50	22	50.0	5219	5580	1735	1766	0.3324	H1-1a	0.3165	0.649 OK
		W30x292	26	26	13.2	85.9	1.97	29000	73773	50	22	50.0	3864	3384	1735	1766	0.4490	H1-1a	0.5219	0.971 OK
	Col 3x2 (Lateral)	W30x292	26	26	13.2	85.9	1.97	29000	73773	50	22	50.0	3864	3384	1386	1216	0.3587	H1-1a	0.3593	0.718 OK
		W30x261	26	26	13.1	76.9	1.98	29000	72660	50	22	50.0	3460	2916	1386	1216	0.4006	H1-1a	0.4170	0.818 OK
		W27x539	26	26	12.7	32.5	2.05	29000	68290	50	22	50.0	1462	6570	1386	1216	0.9480	H1-1a	0.1851	1.133 No Good

Truss Member	Size	KL	Pu		Truss Member	Size	KL	Pu
3	HSS3x3x3/8	18	9.8		75	HSS5x5x1/2	22.6	-30.3
4	HSS3x3x3/8	18	9.8		76	HSS5x5x1/2	22	-0.6
7	HSS3x3x3/8	10	38.1		77	HSS5x5x1/2	22.6	-76.4
31	HSS3x3x3/8	18	8.6		78	HSS5x5x1/2	10	-13.6
32	HSS3x3x3/8	18	8.6		79	HSS5x5x1/2	22.6	-76.4
33	HSS3x3x3/8	18	6.9		80	HSS5x5x1/2	22	-1.6
34	HSS3x3x3/8	18	6.9		81	HSS5x5x1/2	22.6	192.3
35	HSS3x3x3/8	18	10.5		82	HSS10x10x5/8	26.6	-407.8
36	HSS3x3x3/8	18	10.5		83	HSS5x5x1/2	22.6	192.3
37	HSS3x3x3/8	18	11.1		84	W14x193	22	-1739.5
38	HSS3x3x3/8	18	11.1		85	HSS3x3x3/8	22.6	33.5
39	HSS3x3x3/8	18	10.4		86	HSS5x5x1/2	10	-9.3
40	HSS3x3x3/8	18	10.4		87	HSS3x3x3/8	22.6	33.5
41	HSS3x3x3/8	18	9.4		88	HSS3x3x3/8	22	0.3
42	HSS3x3x3/8	18	9.4		89	HSS5x5x1/2	22.6	-9.0
43	HSS3x3x3/8	18	7.4		90	HSS5x5x1/2	10	-7.4
44	HSS3x3x3/8	18	6.3		91	HSS5x5x1/2	22.6	-9.0
45	HSS3x3x3/8	18	6.3		92	HSS5x5x1/2	22	-0.2
46	HSS3x3x3/8	26.6	7.4		93	HSS3x3x3/8	22.6	53.7
47	HSS10x10x5/8	26.6	627.9		94	HSS5x5x1/2	10	-3.2
48	HSS10x10x5/8	26.6	-442.3		95	HSS3x3x3/8	22.6	53.7
49	HSS10x10x5/8	26.6	627.9		96	HSS3x3x3/8	22	0.5
50	HSS10x10x5/8	26.6	-442.3		97	HSS10x10x5/8	26.6	-407.8
51	HSS6x6x1/2	26.6	298.9		98	HSS3x3x3/8	26.6	27.2
52	HSS6x6x1/2	26.6	298.9		99	HSS8x8x1/2	26.6	-138.6
53	HSS12x12x5/8	26.6	-548.8		100	HSS8x8x1/2	26.6	-138.6
54	HSS12x12x5/8	26.6	-548.8		101	HSS3x3x3/8	26.6	27.2
55	HSS5x5x1/2	26.6	208.1		102	HSS5x5x1/2	26.6	-43.6
56	HSS5x5x1/2	26.6	208.1		103	HSS5x5x1/2	26.6	-43.6
57	HSS5x5x1/2	22.6	187.6		104	HSS5x5x1/2	26.6	-8.7
58	HSS3x3x3/8	10	35.8		105	HSS5x5x1/2	26.6	-8.7
59	HSS5x5x1/2	22.6	187.6		106	HSS3x3x3/8	26.6	85.9
60	W14x193	22	-1594.7		107	HSS3x3x3/8	26.6	85.9
61	HSS5x5x1/2	22.6	-35.6		108	HSS8x8x1/2	26.6	-234.1
62	HSS5x5x1/2	10	-10.6		109	HSS8x8x1/2	26.6	-234.1
63	HSS5x5x1/2	22.6	-35.6		110	HSS5x5x1/2	26.6	185.3
64	HSS5x5x1/2	22	-0.6		111	HSS5x5x1/2	26.6	185.3
65	HSS3x3x3/8	22.6	10.9		112	HSS10x10x5/8	26.6	-313.7
66	HSS5x5x1/2	10	-9.5		113	HSS10x10x5/8	26.6	-313.7
67	HSS3x3x3/8	22.6	10.9		114	HSS6x6x1/2	26.6	280.9
68	HSS3x3x3/8	26.6	0.2		115	HSS6x6x1/2	26.6	280.9
69	HSS5x5x1/2	26.6	-66.0		116	HSS12x12x5/8	26.6	-586.8
70	HSS5x5x1/2	10	-11.5		117	HSS12x12x5/8	26.6	-586.8
71	HSS5x5x1/2	26.6	-66.0		118	HSS10x10x5/8	26.6	641.1
72	HSS5x5x1/2	22	-1.4		119	HSS10x10x5/8	26.6	641.1
73	HSS5x5x1/2	22.6	-30.3		120	HSS10x10x5/8	26.6	-431.0
74	HSS5x5x1/2	10	-16.8		121	HSS10x10x5/8	26.6	-431.0

SEAR·BROWN

Project: ______ Project No. ______

By: ______ Checked: ______

Date: ______ Sheet ____ of ____

LOADS

Garage LL: 40 psf	All levels
Garage Mech SDL: 3psf	All levels
Garage Double T stem SDL: 8psf	All levels
Office LL: 50psf	MEZZ
Office Corridor SDL: 15 psf	MEZZ
Mezz. LL: 60 psf	Mezz
Bleachers LL: 60psf (attached to floor)	Mezz
Ext. Spandrel DL:	Perimeter - Levels P1 - ROOF where applicable
(8" concrete + 4" brick) -	
(8" concrete) -	
Steel SDL: 3 psf	Truss
Mech. SDL: 3psf	Truss, All parking levels

SEAR·BROWN

Project: ____________ Project No. ____________

By: ____________ Checked: ____________

Date: ____________ Sheet ______ of ______

Spandrel loads

Trib Height: Roof: $\frac{11'}{2}$ + 4' parapet = 9.5'

P5 – P2 : 11'

P1 : $\frac{11'}{2}$ = 5.5'

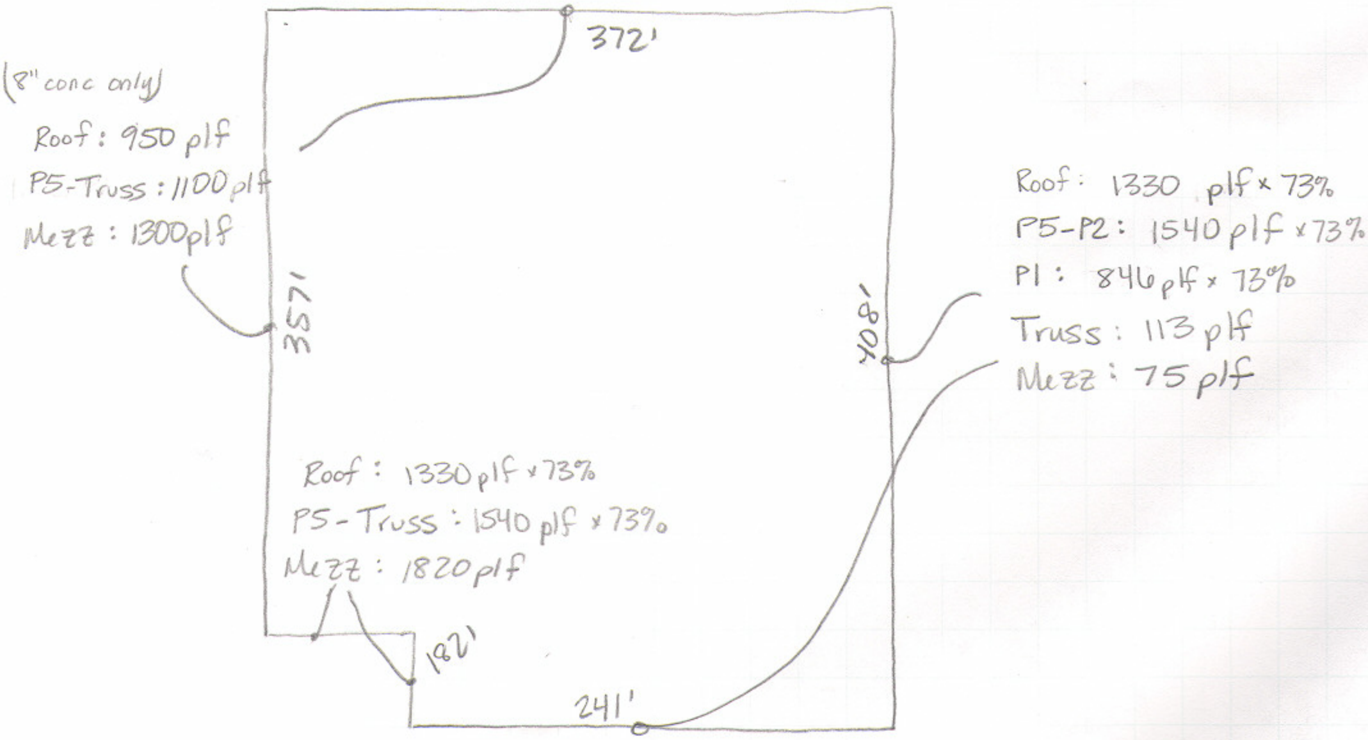
L side only:

- P1: 11'
- Truss : 11'
- Mezz : $\frac{11'}{2} + \frac{15'}{2}$ = 13'

Conc. + Brick : 8" concrete : 150 pcf × thickness × trib. height

4" brick : 120 pcf × " × "

Openings : ~ 27% > 20% required OK ✓



Metal (Al) paneling : 165 pcf × $\frac{1''}{12}$ thickness × trib. height

Glass : 161 pcf × $\frac{0.5''}{12}$ thickness × trib. height

SEAR·BROWN

Project: ____________ Project No. ____________

By: ____________ Checked: ____________

Date: ____________ Sheet ______ of ______

Story Wts.

Roof:

Slab – $150\text{ pcf} \times \frac{5}{12} = 62.5\text{ psf}$ Double T

8 psf stem

3 psf Mech

$73.5\text{ psf} \times 145{,}095\text{ SF} = 10664^K$

parapet – $150\text{pcf} \times \frac{8''}{12} \times 4' \times 1560'$ (perimeter) $= 624^K$

spandrel: 1586^K

columns: $150\text{ pcf} \times 2' \times 2' \times 5.5' \times 94\text{ col} = 310^K$

shear walls: $150\text{pcf} \times 1' \times 5.5' \times 176' \times 4\text{ walls} \times 75\%$
$= 436^K$

$150\text{pcf} \times 1' \times 5.5' \times 25' \times 7\text{walls} = 144^K$

$150\text{pcf} \times 1' \times 5.5' \times 305' \times 2\text{ walls} = 503^K$

beams: $150\text{pcf} \times 2' \times 2' \times 30' \times 77\text{ beams} = 1386^K$

$\boxed{\text{Roof wt} = 15653^K}$

SEAR·BROWN

Project:

Project No.

By:

Checked:

Date:

Sheet of

P5 - P1 :

slab = 10664 K
spandrel = 1737 K

columns : 150pcf × 2' × 2' × 11' × 94 col = 620 K

shear walls : 872 K
288 K
1006 K

beams : 1386 K

$\boxed{\text{P5-P1 Wt.} = 16573\ ^{K}}$

Truss :

slab : 73.5 psf × 46767 SF = 3437 K
spandrel : 1080 K
steel : 3psf × 98328 SF = 295 K
beams : 150pcf × 2' × 2' × 11' × 17 bms = 112 K
columns : 150pcf × 2' × 2' × 11' × 22 col = 145 K
shear walls : 436 + 144 + 503 = 1083 K

$\boxed{\text{Truss Wt.} = 6152\ ^{K}}$

SEAR·BROWN

Project:	Project No.
By:	Checked:
Date:	Sheet of

Mezz: steel: 3psf × 98328 SF = 295^K

spandrel: 948 + 47 + 331 = 1326^K

slab: 3437^K
beams: 112^K
col: 145^K
shear walls: 150pcf × 1' × 13' × 8' × 2walls = 31^K
150pcf × 1' × 13' × 305' × 2walls = 1190^K
150pcf × 1' × 25' × 13' × 4walls = 195^K

$\boxed{\text{Mezz Wt.} = 6731^K}$

Base: Steel: 295^K

shear walls: 150 × 1' × 7.5' × 8' × 2 walls = 18^K
150 × 1' × 7.5' × 305' × 2 walls = 686^K
150 × 1' × 25' × 7.5' × 4 walls = 113^K

spandrel: $\frac{7.5}{13}$ × Mezz = 765^K
cols: 150 × 2 × 2 × 7.5 × 22col = 99^K

$\boxed{\text{Base Wt.} = 1976^K}$

APPENDIX D

CONTINUATION SHEET

AIA DOCUMENT G703

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing
Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: **001**
PERIOD FROM: **1-Mar-05**
PERIOD TO: **31-Mar-05**
PROJECT NO: **#03150**
PROJECT NAME: **Wash Caps A**
CONTRACTOR: **SIGAL Const**

A	B	C	D	E	F	G	
			WORK COMPLETED				
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION	THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)
00001	Mobilization	150,000	0	75,000	0	75,000	50
00002	Demolition	944,090	0	68,190	0	68,190	7
00003	Earthwork/Sheeting/Shoring/Underpinning	80,415	0	0	0	0	0
00004	Pavement Markings	43,971	0	0	0	0	0
00005	Site Utilities	113,150	0	0	0	0	0
00006	Asphalt	37,875	0	0	0	0	0
00007	Site Concrete/Brick Paving	26,100	0	0	0	0	0
00008	Chain Link Fences	5,980	0	0	0	0	0
00009	Site Furnishings	14,600	0	0	0	0	0
00010	Concrete and Post Tension Concrete	3,420,000	0	25,000	0	25,000	1
00011	Masonry	664,300	0	0	0	0	0
00012	Structural Steel	5,080,655	0	40,000	0	40,000	1
00013	Miscellaneous Metals	667,245	0	0	0	0	0
00014	Architectural Joint Systems	24,300	0	0	0	0	0
00015	Rough Carpentry	102,698	0	0	0	0	0
00016	Interior Architectural Woodwork	474,358	0	0	0	0	0
00017	Waterproofing	333,490	0	0	0	0	0
00018	Corrugated & Insulation Metal Panels	1,326,640	0	0	0	0	0
00019	Roofing	807,600	0	0	0	0	0
00020	Spray Fireproofing	580,000	0	0	0	0	0
00021	Sealants & Firestopping	34,612	0	0	0	0	0
00022	Doors and Frames (and Access Doors)	243,170	0	0	0	0	0
00023	Overhead Coiling Doors & Folding Doors	20,447	0	0	0	0	0
00024	Structural Curtainwall & Alum Storefronts	1,896,960	0	0	0	0	0
00025	Drywall/Acoustical	1,700,450	0	0	0	0	0
00026	Ceramic Tile	76,335	0	0	0	0	0
00027	Wood Athletic Flooring	5,500	0	0	0	0	0
	SUBTOTAL	**18,874,941**	**0**	**208,190**	**0**	**208,190**	**1**

CONTINUATION SHEET

AIA DOCUMENT G703

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing
Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: **001**
PERIOD FROM: **1-Mar-05**
PERIOD TO: **31-Mar-05**
PROJECT NO: **#03150**
PROJECT NAME: **Wash Caps A**
CONTRACTOR: **SIGAL Const**

A	B	C	D	E	F	G	
			WORK COMPLETED				
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION	THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)
00028	Resilient/Carpet/VCT	435,657	0	0	0	0	0
00029	Resinous Flooring	30,620	0	0	0	0	0
00030	Painting	288,500	0	0	0	0	0
00031	Visual Display Surfaces	3,950	0	0	0	0	0
00032	Toilet Compartments	36,200	0	0	0	0	0
00033	Louvers & Vents	2,142	0	0	0	0	0
00034	Signs	185,344	0	0	0	0	0
00035	Fire Extinguishers, Cabinets & Accessories	2,929	0	0	0	0	0
00036	Wire Mesh Partitions	2,926	0	0	0	0	0
00037	Toilet & Bath Accessories	9,718	0	0	0	0	0
00038	Projection Screens	3,150	0	0	0	0	0
00039	TV & VCR Mounting Systems	6,351	0	0	0	0	0
00040	Food Service Equipment	58,465	0	0	0	0	0
00041	Appliances	119,112	0	0	0	0	0
00042	Scoreboard	27,928	0	0	0	0	0
00043	Sauna	7,000	0	0	0	0	0
00044	Foot Grilles (Walk Off Mats)	4,708	0	0	0	0	0
00045	Roller Shades	17,735	0	0	0	0	0
00046	Horizontal Louver Blinds	4,100	0	0	0	0	0
00047	Aluminum Bleachers	165,645	0	0	0	0	0
00048	Therapeutic Treatment Pools	93,885	0	0	0	0	0
00049	Elevators	487,994	0	0	0	0	0
00050	Mechanical	2,418,000	0	0	0	0	0
00051	Fire Protection	424,226	0	0	0	0	0
00052	Electrical	2,432,748	0	0	0	0	0
00053	Allowances	1,695,674	0	0	0	0	0
	SUBTOTAL	**27,839,648**	**0**	**208,190**	**0**	**208,190**	**1**

CONTINUATION SHEET

AIA DOCUMENT G703

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing
Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: **001**
PERIOD FROM: **1-Mar-05**
PERIOD TO: **31-Mar-05**
PROJECT NO: **#03150**
PROJECT NAME: **Wash Caps A**
CONTRACTOR: **SIGAL Const**

A	B	C	D	E	F	G	
			WORK COMPLETED				
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION	THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)
00054	General Conditions	1,500,000	0	21,286	0	21,286	1
00055	Fee	880,190	0	12,490	0	12,490	1
00056	Bond	189,558	0	189,558	0	189,558	100
00057		0	0	0	0	0	0
00058		0	0	0	0	0	0
00059		0	0	0	0	0	0
00060		0	0	0	0	0	0
00061		0	0	0	0	0	0
00062		0	0	0	0	0	0
00063		0	0	0	0	0	0
00064		0	0	0	0	0	0
00065		0	0	0	0	0	0
00066		0	0	0	0	0	0
00067		0	0	0	0	0	0
00068		0	0	0	0	0	0
00069		0	0	0	0	0	0
00070		0	0	0	0	0	0
00071		0	0	0	0	0	0
00072		0	0	0	0	0	0
00073		0	0	0	0	0	0
00074		0	0	0	0	0	0
00075		0	0	0	0	0	0
00076		0	0	0	0	0	0
00077		0	0	0	0	0	0
00078		0	0	0	0	0	0
00079		0	0	0	0	0	0
00080		0	0	0	0	0	0
	TOTAL ORIGINAL CONTRACT	**30,409,396**	**0**	**431,524**	**0**	**431,524**	**1**

APPLICATION AND CERTIFICATION FOR PAYMENT

AIA DOCUMENT G702

TO OWNER:
Arlington County Board & IDA
2100 Clarendon Blvd., Ste. 900
Arlington VA 22201
x

PROJECT:
Wash Caps Arlington Ice Skating Ctr.
627 North Glebe Road
Arlington, VA 22203

APPLICATION NO: **001**
PERIOD FROM: **1-Mar-**
PERIOD TO: **31-Mar**

FROM CONTRACTOR:
SIGAL Construction Corporation
3299 K Street, NW
Washington, DC 20007

VIA ARCHITECT:
Architecture, Inc.
1801 Alexander Bell Drive, Ste. 640
Reston, VA 20191

PROJECT NO: **#0315**

Agreement No. 461-03/ Purchase Order No. 502108

CONTRACT DATE: **7-Mar-**

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM $ **30,409,396**
2. Net change by Change Orders $ **0**
3. CONTRACT SUM TO DATE (Line 1 ± 2) $ **30,409,396**
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) $ **431,524**
5. RETAINAGE:
   a. ____ % of Completed Work (Column D + E on G703) $ **20,819**
   b. ____ % of Stored Material (Column F on G703) $ **0**
   Total Retainage (Lines 5a + 5b or Total in Column I of G703) $ **20,819**
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total) $ **410,705**
7. LESS PREVIOUS PAYMENT $ **0**
8. CURRENT PAYMENT DUE **15-Apr-05** $ **410,705**
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6) $ **29,998,691**

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner		
Total approved this Month	SEE ATTACHED BREAKDOWN	
TOTALS		
NET CHANGES by Change Order		

The undersigned Contractor certifies that to the best of t
information and belief the Work covered by this Applic
completed in accordance with the Contract Documents,
the Contractor for Work for which previous Certificates
payments received from the Owner, and that current pa

CONTRACTOR: **SIGAL Construction**

By: ______________________

State of: **District of Columbia** County of:
Subscribed and sworn to before me this day o
Notary Public:
My Commission expires:

ARCHITECT'S CERTIFICATE F

In accordance with the Contract Documents, based on c
comprising the application, the Architect certifies to the
Architect's knowledge, information and belief the Work
the quality of the Work is in accordance with the Contra
is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED . . . . $ ________

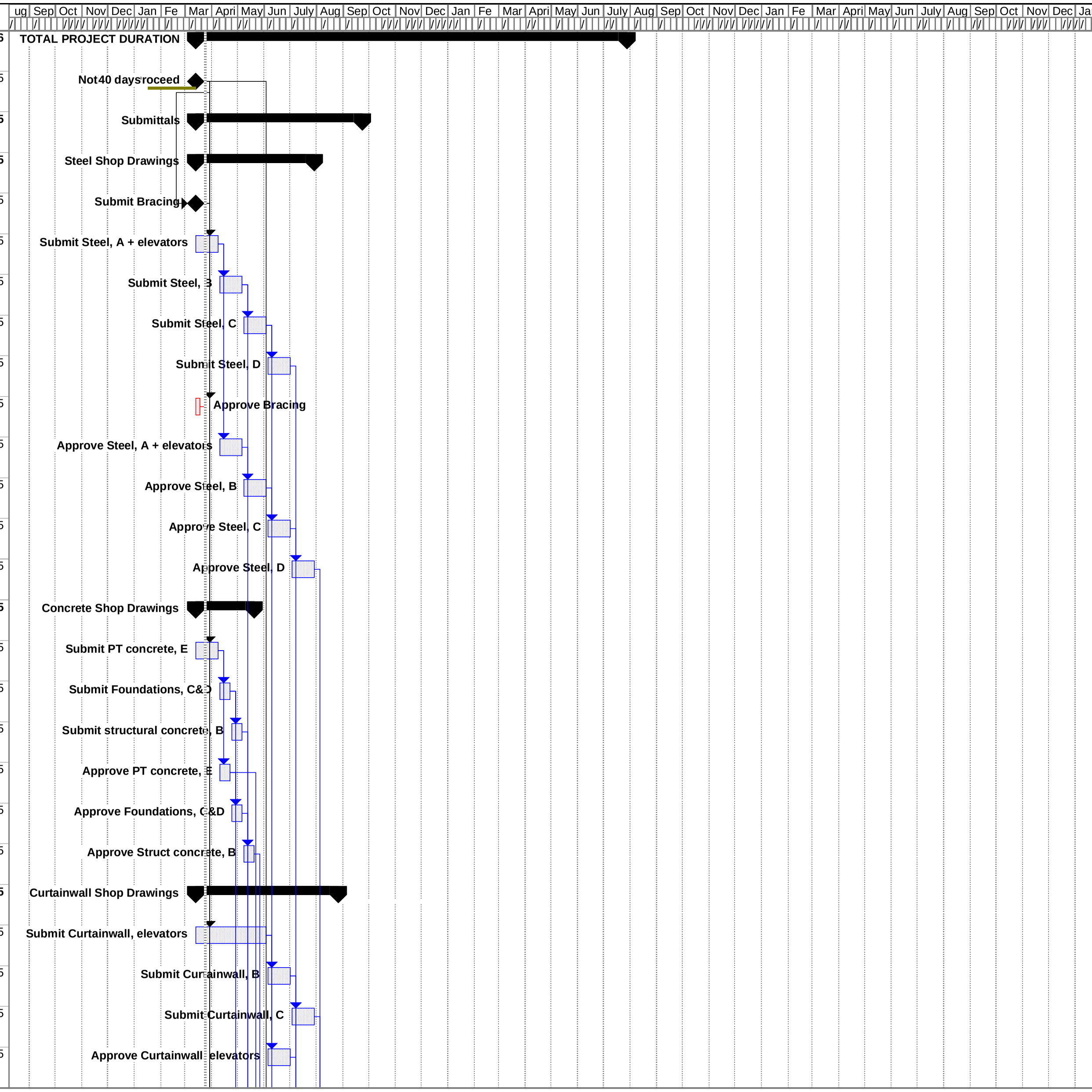
(Attach explanation if amount certified differs from the Application and on the Continuation Sheet that are cha
ARCHITECT:

By: ______________________

This Certificate is not negotiable. The AMOUNT CER
Contractor named herein. Issuance, payment and accept
prejudice to any rights of the Owner or Contractor unde

Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
1	**TOTAL PROJECT DURATION**	**360 days**	**Mon 3/14/05**	**Fri 7/28/06**
2	Notice To Proceed	0 days	Mon 3/14/05	Mon 3/14/05
3	**Submittals**	**140 days**	**Mon 3/14/05**	**Fri 9/23/05**
4	**Steel Shop Drawings**	**100 days**	**Mon 3/14/05**	**Fri 7/29/05**
5	Submit Bracing	0 days	Mon 3/14/05	Mon 3/14/05
6	Submit Steel, A + elevators	20 days	Mon 3/14/05	Fri 4/8/05
7	Submit Steel, B	20 days	Mon 4/11/05	Fri 5/6/05
8	Submit Steel, C	20 days	Mon 5/9/05	Fri 6/3/05
9	Submit Steel, D	20 days	Mon 6/6/05	Fri 7/1/05
10	Approve Bracing	5 days	Mon 3/14/05	Fri 3/18/05
11	Approve Steel, A + elevators	20 days	Mon 4/11/05	Fri 5/6/05
12	Approve Steel, B	20 days	Mon 5/9/05	Fri 6/3/05
13	Approve Steel, C	20 days	Mon 6/6/05	Fri 7/1/05
14	Approve Steel, D	20 days	Mon 7/4/05	Fri 7/29/05
15	**Concrete Shop Drawings**	**50 days**	**Mon 3/14/05**	**Fri 5/20/05**
16	Submit PT concrete, E	20 days	Mon 3/14/05	Fri 4/8/05
17	Submit Foundations, C&D	10 days	Mon 4/11/05	Fri 4/22/05
18	Submit structural concrete, B	10 days	Mon 4/25/05	Fri 5/6/05
19	Approve PT concrete, E	10 days	Mon 4/11/05	Fri 4/22/05
20	Approve Foundations, C&D	10 days	Mon 4/25/05	Fri 5/6/05
21	Approve Struct concrete, B	10 days	Mon 5/9/05	Fri 5/20/05
22	**Curtainwall Shop Drawings**	**120 days**	**Mon 3/14/05**	**Fri 8/26/05**
23	Submit Curtainwall, elevators	60 days	Mon 3/14/05	Fri 6/3/05
24	Submit Curtainwall, B	20 days	Mon 6/6/05	Fri 7/1/05
25	Submit Curtainwall, C	20 days	Mon 7/4/05	Fri 7/29/05
26	Approve Curtainwall, elevators	20 days	Mon 6/6/05	Fri 7/1/05



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical	Split	Slack	Project Summary	External Tasks
Critical Split	Progress	Slippage	Rolled Up Critical	External Milestone
Task	Milestone	Summary	Rolled Up Critical Split	Deadline

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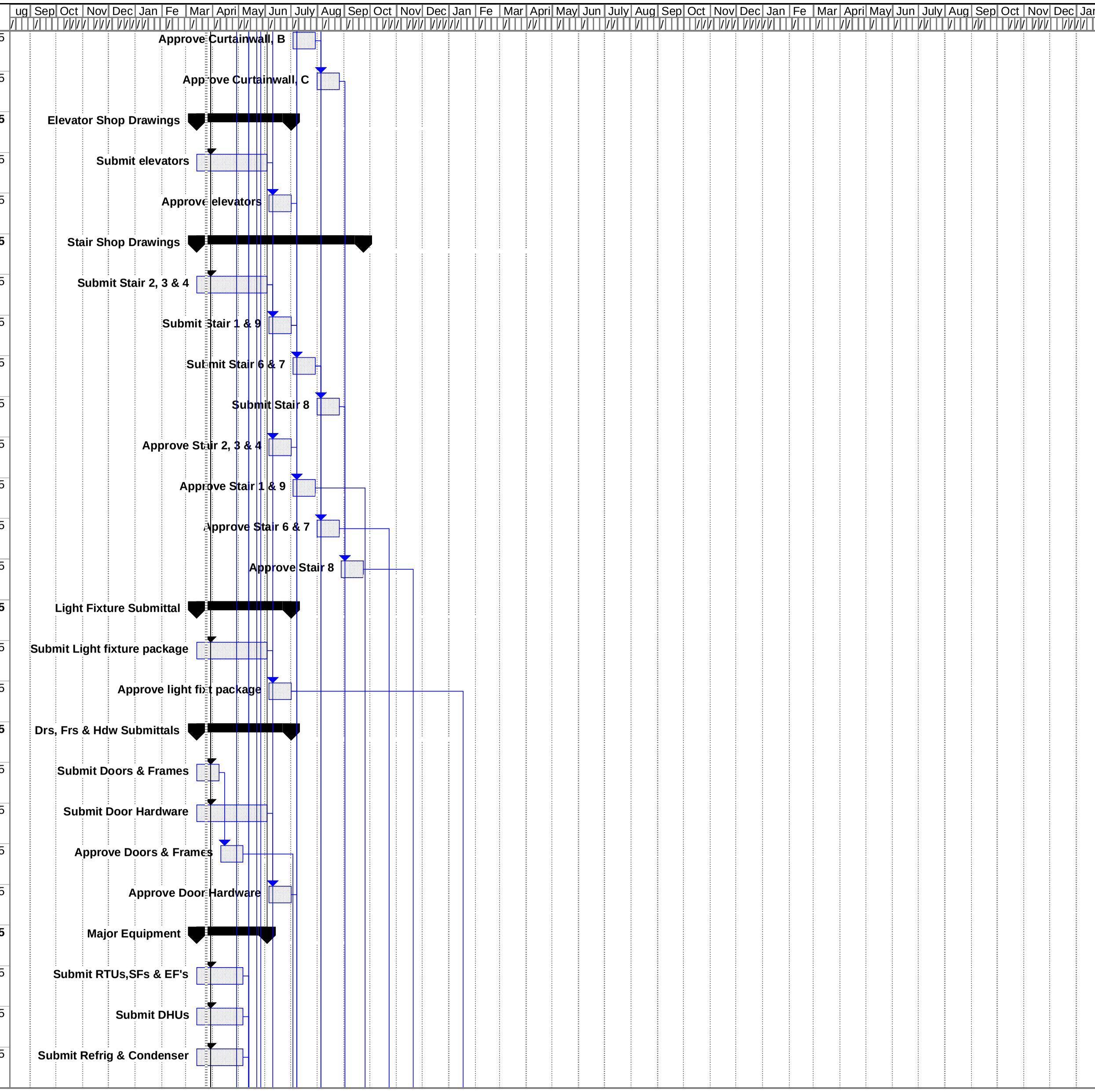
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
27	Approve Curtainwall, B	20 days	Mon 7/4/05	Fri 7/29/05
28	Approve Curtainwall, C	20 days	Mon 8/1/05	Fri 8/26/05
29	**Elevator Shop Drawings**	**80 days**	**Mon 3/14/05**	**Fri 7/1/05**
30	Submit elevators	60 days	Mon 3/14/05	Fri 6/3/05
31	Approve elevators	20 days	Mon 6/6/05	Fri 7/1/05
32	**Stair Shop Drawings**	**140 days**	**Mon 3/14/05**	**Fri 9/23/05**
33	Submit Stair 2, 3 & 4	60 days	Mon 3/14/05	Fri 6/3/05
34	Submit Stair 1 & 9	20 days	Mon 6/6/05	Fri 7/1/05
35	Submit Stair 6 & 7	20 days	Mon 7/4/05	Fri 7/29/05
36	Submit Stair 8	20 days	Mon 8/1/05	Fri 8/26/05
37	Approve Stair 2, 3 & 4	20 days	Mon 6/6/05	Fri 7/1/05
38	Approve Stair 1 & 9	20 days	Mon 7/4/05	Fri 7/29/05
39	Approve Stair 6 & 7	20 days	Mon 8/1/05	Fri 8/26/05
40	Approve Stair 8	20 days	Mon 8/29/05	Fri 9/23/05
41	**Light Fixture Submittal**	**80 days**	**Mon 3/14/05**	**Fri 7/1/05**
42	Submit Light fixture package	60 days	Mon 3/14/05	Fri 6/3/05
43	Approve light fixt package	20 days	Mon 6/6/05	Fri 7/1/05
44	**Drs, Frs & Hdw Submittals**	**80 days**	**Mon 3/14/05**	**Fri 7/1/05**
45	Submit Doors & Frames	20 days	Mon 3/14/05	Fri 4/8/05
46	Submit Door Hardware	60 days	Mon 3/14/05	Fri 6/3/05
47	Approve Doors & Frames	20 days	Mon 4/11/05	Fri 5/6/05
48	Approve Door Hardware	20 days	Mon 6/6/05	Fri 7/1/05
49	**Major Equipment**	**60 days**	**Mon 3/14/05**	**Fri 6/3/05**
50	Submit RTUs,SFs & EF's	40 days	Mon 3/14/05	Fri 5/6/05
51	Submit DHUs	40 days	Mon 3/14/05	Fri 5/6/05
52	Submit Refrig & Condenser	40 days	Mon 3/14/05	Fri 5/6/05



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical	Split	Slack	Project Summary	External Tasks
Critical Split	Progress	Slippage	Rolled Up Critical	External Milestone
Task	Milestone	Summary	Rolled Up Critical Split	Deadline

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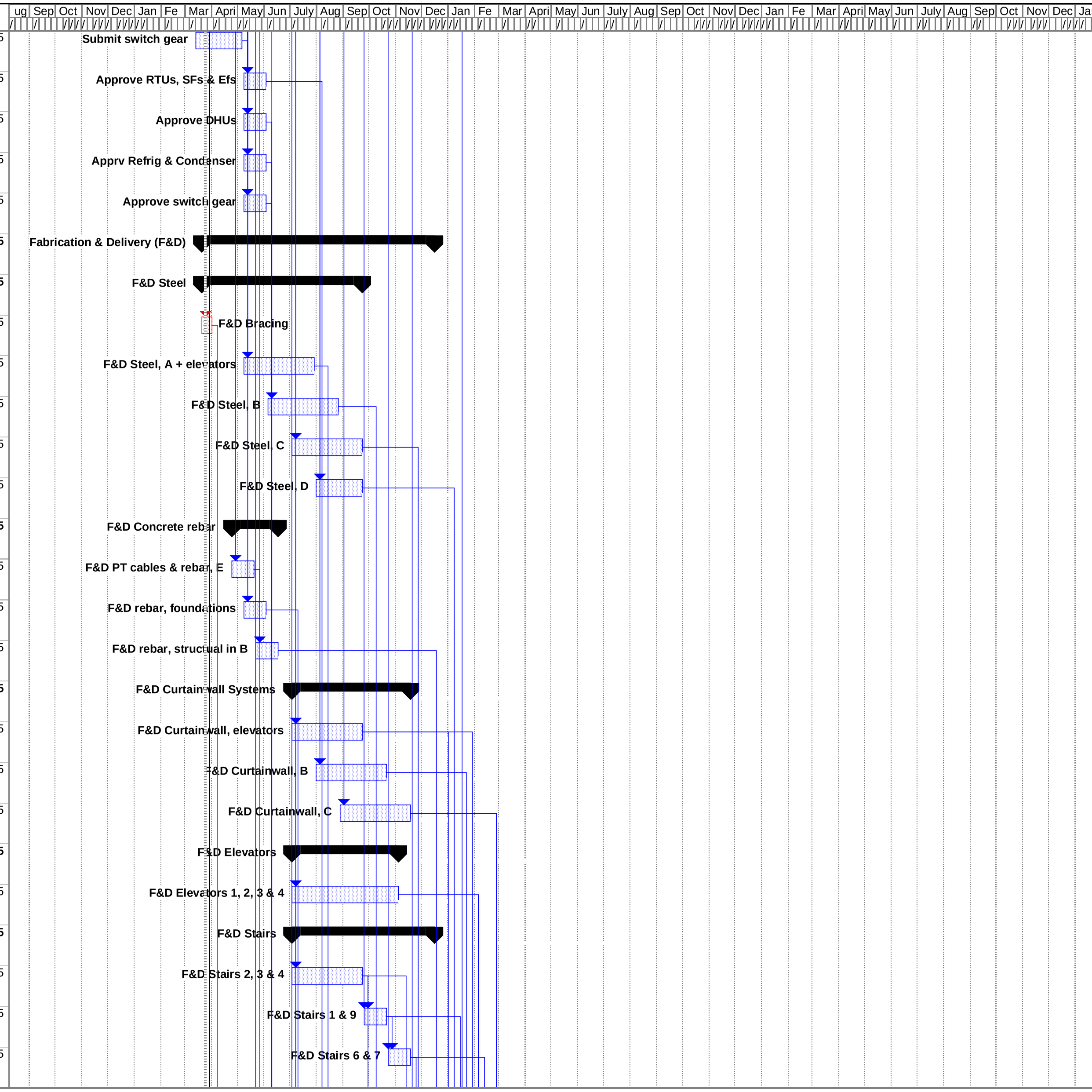
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
53	Submit switch gear	40 days	Mon 3/14/05	Fri 5/6/05
54	Approve RTUs, SFs & Efs	20 days	Mon 5/9/05	Fri 6/3/05
55	Approve DHUs	20 days	Mon 5/9/05	Fri 6/3/05
56	Apprv Refrig & Condenser	20 days	Mon 5/9/05	Fri 6/3/05
57	Approve switch gear	20 days	Mon 5/9/05	Fri 6/3/05
58	**Fabrication & Delivery (F&D)**	**195 days**	**Mon 3/21/05**	**Fri 12/16/05**
59	**F&D Steel**	**135 days**	**Mon 3/21/05**	**Fri 9/23/05**
60	F&D Bracing	10 days	Mon 3/21/05	Fri 4/1/05
61	F&D Steel, A + elevators	60 days	Mon 5/9/05	Fri 7/29/05
62	F&D Steel, B	60 days	Mon 6/6/05	Fri 8/26/05
63	F&D Steel, C	60 days	Mon 7/4/05	Fri 9/23/05
64	F&D Steel, D	40 days	Mon 8/1/05	Fri 9/23/05
65	**F&D Concrete rebar**	**40 days**	**Mon 4/25/05**	**Fri 6/17/05**
66	F&D PT cables & rebar, E	20 days	Mon 4/25/05	Fri 5/20/05
67	F&D rebar, foundations	20 days	Mon 5/9/05	Fri 6/3/05
68	F&D rebar, structual in B	20 days	Mon 5/23/05	Fri 6/17/05
69	**F&D Curtainwall Systems**	**100 days**	**Mon 7/4/05**	**Fri 11/18/05**
70	F&D Curtainwall, elevators	60 days	Mon 7/4/05	Fri 9/23/05
71	F&D Curtainwall, B	60 days	Mon 8/1/05	Fri 10/21/05
72	F&D Curtainwall, C	60 days	Mon 8/29/05	Fri 11/18/05
73	**F&D Elevators**	**90 days**	**Mon 7/4/05**	**Fri 11/4/05**
74	F&D Elevators 1, 2, 3 & 4	90 days	Mon 7/4/05	Fri 11/4/05
75	**F&D Stairs**	**120 days**	**Mon 7/4/05**	**Fri 12/16/05**
76	F&D Stairs 2, 3 & 4	60 days	Mon 7/4/05	Fri 9/23/05
77	F&D Stairs 1 & 9	20 days	Mon 9/26/05	Fri 10/21/05
78	F&D Stairs 6 & 7	20 days	Mon 10/24/05	Fri 11/18/05



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical		Split		Slack		Project Summary		External Tasks	
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

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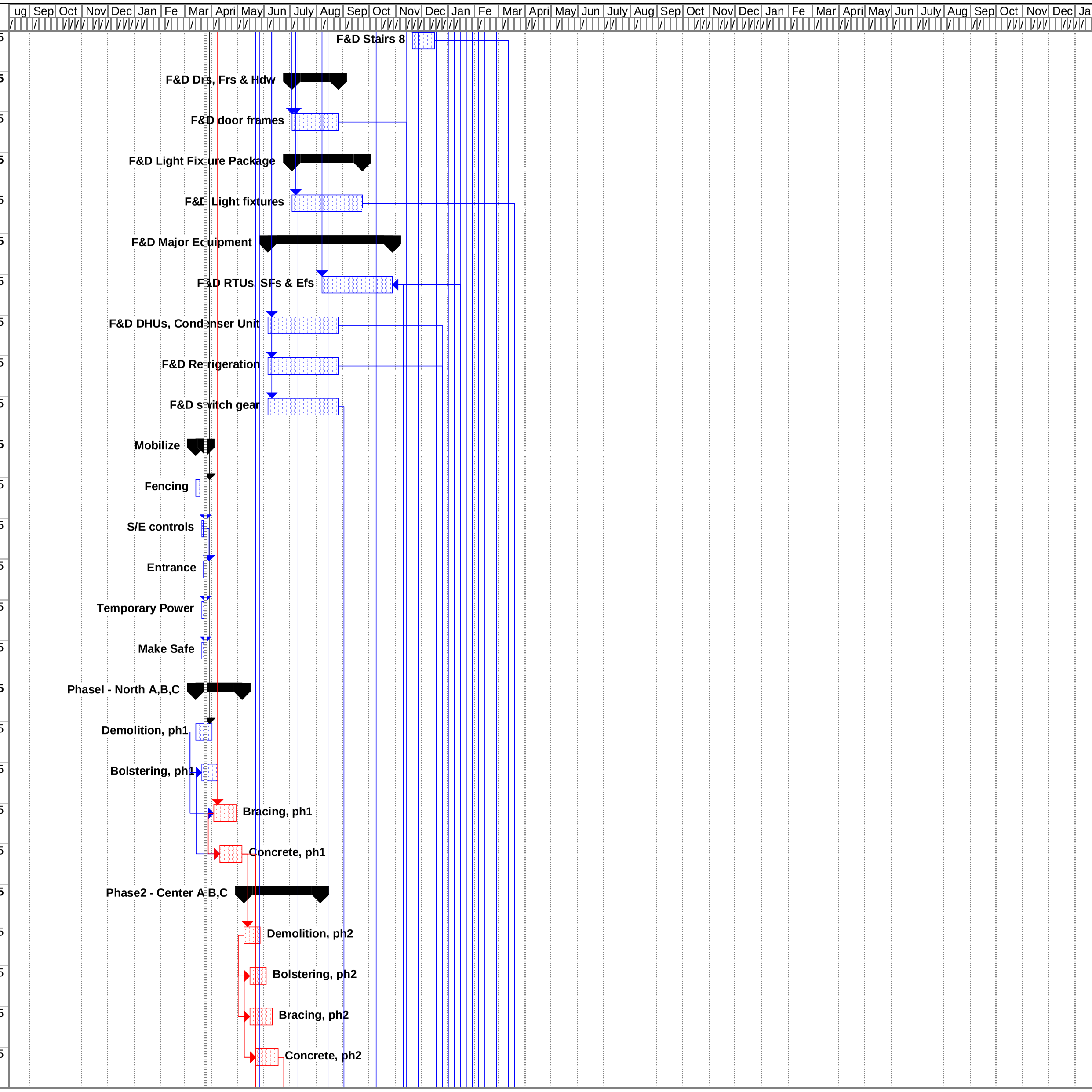
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
79	F&D Stairs 8	20 days	Mon 11/21/05	Fri 12/16/05
80	**F&D Drs, Frs & Hdw**	**40 days**	**Mon 7/4/05**	**Fri 8/26/05**
81	F&D door frames	40 days	Mon 7/4/05	Fri 8/26/05
82	**F&D Light Fixture Package**	**60 days**	**Mon 7/4/05**	**Fri 9/23/05**
83	F&D Light fixtures	60 days	Mon 7/4/05	Fri 9/23/05
84	**F&D Major Equipment**	**105 days**	**Mon 6/6/05**	**Fri 10/28/05**
85	F&D RTUs, SFs & Efs	60 days	Mon 8/8/05	Fri 10/28/05
86	F&D DHUs, Condenser Unit	60 days	Mon 6/6/05	Fri 8/26/05
87	F&D Refrigeration	60 days	Mon 6/6/05	Fri 8/26/05
88	F&D switch gear	60 days	Mon 6/6/05	Fri 8/26/05
89	**Mobilize**	**10 days**	**Mon 3/14/05**	**Fri 3/25/05**
90	Fencing	5 days	Mon 3/14/05	Fri 3/18/05
91	S/E controls	2 days	Mon 3/21/05	Tue 3/22/05
92	Entrance	2 days	Wed 3/23/05	Thu 3/24/05
93	Temporary Power	5 days	Mon 3/21/05	Fri 3/25/05
94	Make Safe	5 days	Mon 3/21/05	Fri 3/25/05
95	**PhaseI - North A,B,C**	**40 days**	**Mon 3/14/05**	**Fri 5/6/05**
96	Demolition, ph1	15 days	Mon 3/14/05	Fri 4/1/05
97	Bolstering, ph1	15 days	Mon 3/21/05	Fri 4/8/05
98	Bracing, ph1	20 days	Mon 4/4/05	Fri 4/29/05
99	Concrete, ph1	20 days	Mon 4/11/05	Fri 5/6/05
100	**Phase2 - Center A,B,C**	**65 days**	**Mon 5/9/05**	**Fri 8/5/05**
101	Demolition, ph2	15 days	Mon 5/9/05	Fri 5/27/05
102	Bolstering, ph2	15 days	Mon 5/16/05	Fri 6/3/05
103	Bracing, ph2	20 days	Mon 5/16/05	Fri 6/10/05
104	Concrete, ph2	20 days	Mon 5/23/05	Fri 6/17/05



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical	Split	Slack	Project Summary	External Tasks
Critical Split	Progress	Slippage	Rolled Up Critical	External Milestone
Task	Milestone	Summary	Rolled Up Critical Split	Deadline

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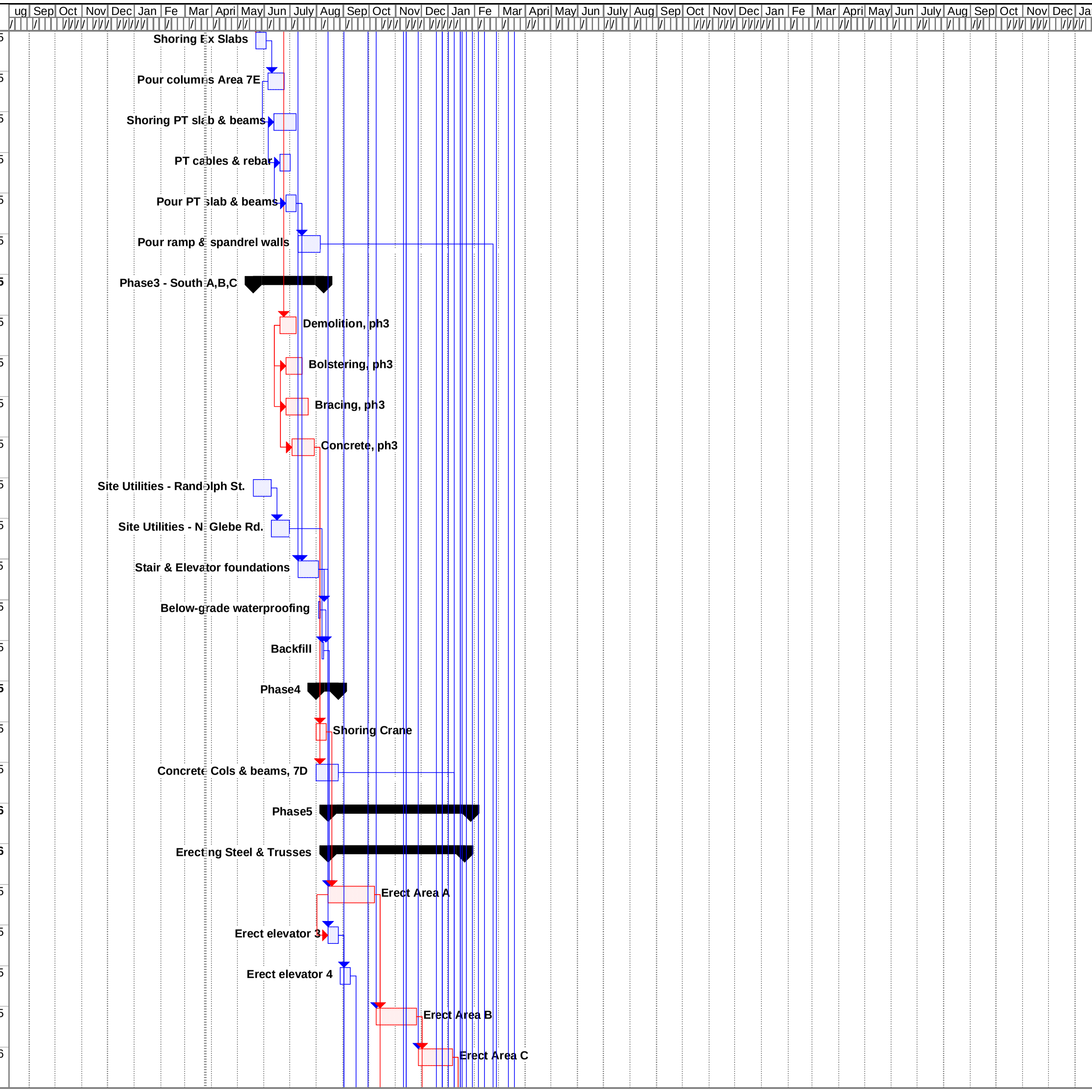
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
105	Shoring Ex Slabs	10 days	Mon 5/23/05	Fri 6/3/05
106	Pour columns Area 7E	15 days	Mon 6/6/05	Fri 6/24/05
107	Shoring PT slab & beams	20 days	Mon 6/13/05	Fri 7/8/05
108	PT cables & rebar	10 days	Mon 6/20/05	Fri 7/1/05
109	Pour PT slab & beams	10 days	Mon 6/27/05	Fri 7/8/05
110	Pour ramp & spandrel walls	20 days	Mon 7/11/05	Fri 8/5/05
111	**Phase3 - South A,B,C**	**58 days**	**Fri 5/20/05**	**Tue 8/9/05**
112	Demolition, ph3	15 days	Mon 6/20/05	Fri 7/8/05
113	Bolstering, ph3	15 days	Mon 6/27/05	Fri 7/15/05
114	Bracing, ph3	20 days	Mon 6/27/05	Fri 7/22/05
115	Concrete, ph3	20 days	Mon 7/4/05	Fri 7/29/05
116	Site Utilities - Randolph St.	15 days	Fri 5/20/05	Thu 6/9/05
117	Site Utilities - N. Glebe Rd.	15 days	Fri 6/10/05	Thu 6/30/05
118	Stair & Elevator foundations	18 days	Mon 7/11/05	Wed 8/3/05
119	Below-grade waterproofing	2 days	Thu 8/4/05	Fri 8/5/05
120	Backfill	2 days	Mon 8/8/05	Tue 8/9/05
121	**Phase4**	**20 days**	**Mon 8/1/05**	**Fri 8/26/05**
122	Shoring Crane	10 days	Mon 8/1/05	Fri 8/12/05
123	Concrete Cols & beams, 7D	20 days	Mon 8/1/05	Fri 8/26/05
124	**Phase5**	**120 days**	**Mon 8/15/05**	**Fri 1/27/06**
125	**Erecting Steel & Trusses**	**115 days**	**Mon 8/15/05**	**Fri 1/20/06**
126	Erect Area A	40 days	Mon 8/15/05	Fri 10/7/05
127	Erect elevator 3	10 days	Mon 8/15/05	Fri 8/26/05
128	Erect elevator 4	10 days	Mon 8/29/05	Fri 9/9/05
129	Erect Area B	35 days	Mon 10/10/05	Fri 11/25/05
130	Erect Area C	30 days	Mon 11/28/05	Fri 1/6/06



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical	Split	Slack	Project Summary	External Tasks	
Critical Split	Progress	Slippage	Rolled Up Critical	External Milestone	
Task	Milestone	Summary	Rolled Up Critical Split	Deadline	

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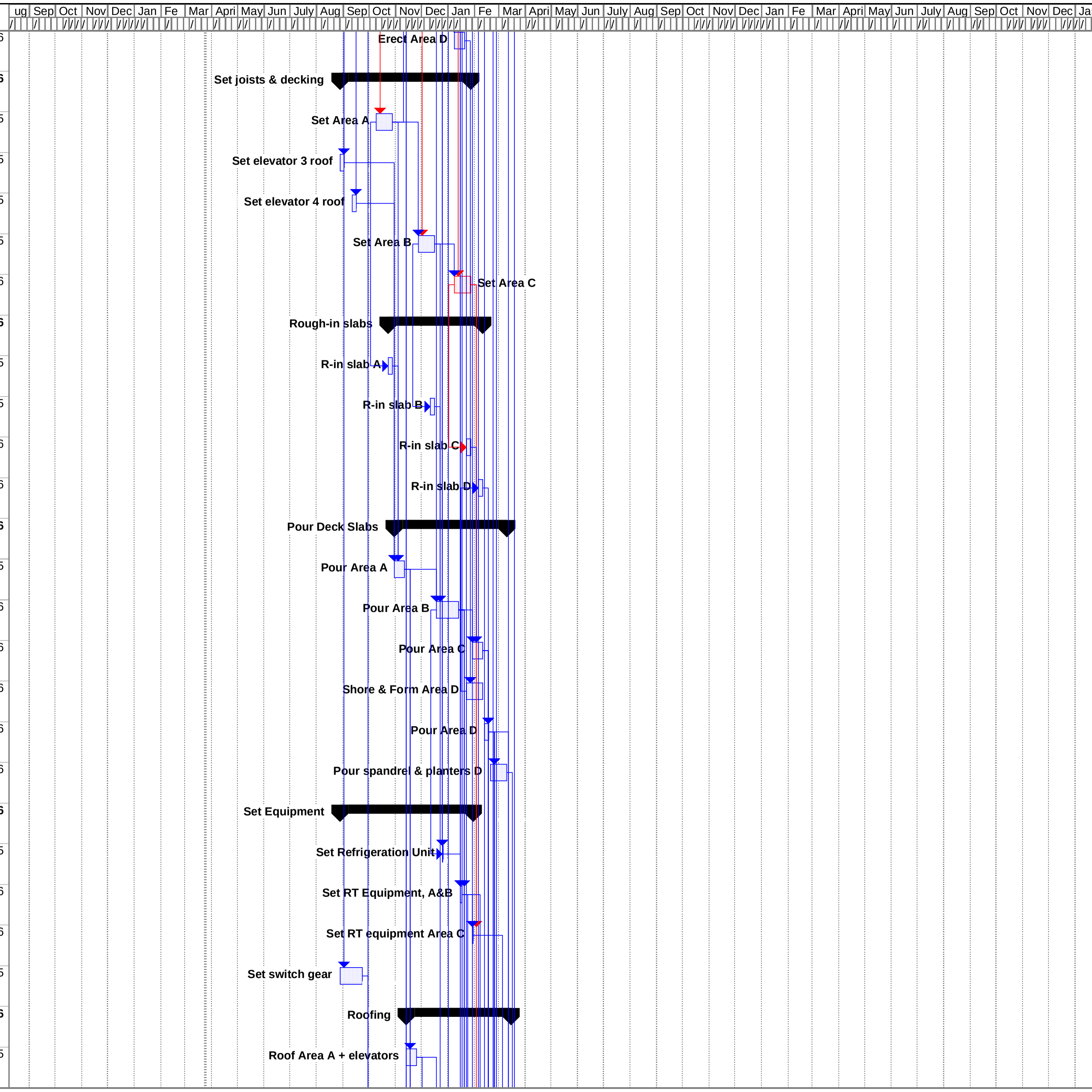
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
131	Erect Area D	10 days	Mon 1/9/06	Fri 1/20/06
132	**Set joists & decking**	**110 days**	**Mon 8/29/05**	**Fri 1/27/06**
133	Set Area A	15 days	Mon 10/10/05	Fri 10/28/05
134	Set elevator 3 roof	5 days	Mon 8/29/05	Fri 9/2/05
135	Set elevator 4 roof	5 days	Mon 9/12/05	Fri 9/16/05
136	Set Area B	15 days	Mon 11/28/05	Fri 12/16/05
137	Set Area C	15 days	Mon 1/9/06	Fri 1/27/06
138	**Rough-in slabs**	**80 days**	**Mon 10/24/05**	**Fri 2/10/06**
139	R-in slab A	5 days	Mon 10/24/05	Fri 10/28/05
140	R-in slab B	5 days	Mon 12/12/05	Fri 12/16/05
141	R-in slab C	5 days	Mon 1/23/06	Fri 1/27/06
142	R-in slab D	5 days	Mon 2/6/06	Fri 2/10/06
143	**Pour Deck Slabs**	**95 days**	**Mon 10/31/05**	**Fri 3/10/06**
144	Pour Area A	10 days	Mon 10/31/05	Fri 11/11/05
145	Pour Area B	20 days	Mon 12/19/05	Fri 1/13/06
146	Pour Area C	10 days	Mon 1/30/06	Fri 2/10/06
147	Shore & Form Area D	15 days	Mon 1/23/06	Fri 2/10/06
148	Pour Area D	5 days	Mon 2/13/06	Fri 2/17/06
149	Pour spandrel & planters D	15 days	Mon 2/20/06	Fri 3/10/06
150	**Set Equipment**	**111 days**	**Mon 8/29/05**	**Mon 1/30/06**
151	Set Refrigeration Unit	1 day	Mon 12/26/05	Mon 12/26/05
152	Set RT Equipment, A&B	2 days	Mon 1/16/06	Tue 1/17/06
153	Set RT equipment Area C	1 day	Mon 1/30/06	Mon 1/30/06
154	Set switch gear	20 days	Mon 8/29/05	Fri 9/23/05
155	**Roofing**	**88 days**	**Mon 11/14/05**	**Wed 3/15/06**
156	Roof Area A + elevators	10 days	Mon 11/14/05	Fri 11/25/05



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Critical		Split		Slack		Project Summary		External Tasks	
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

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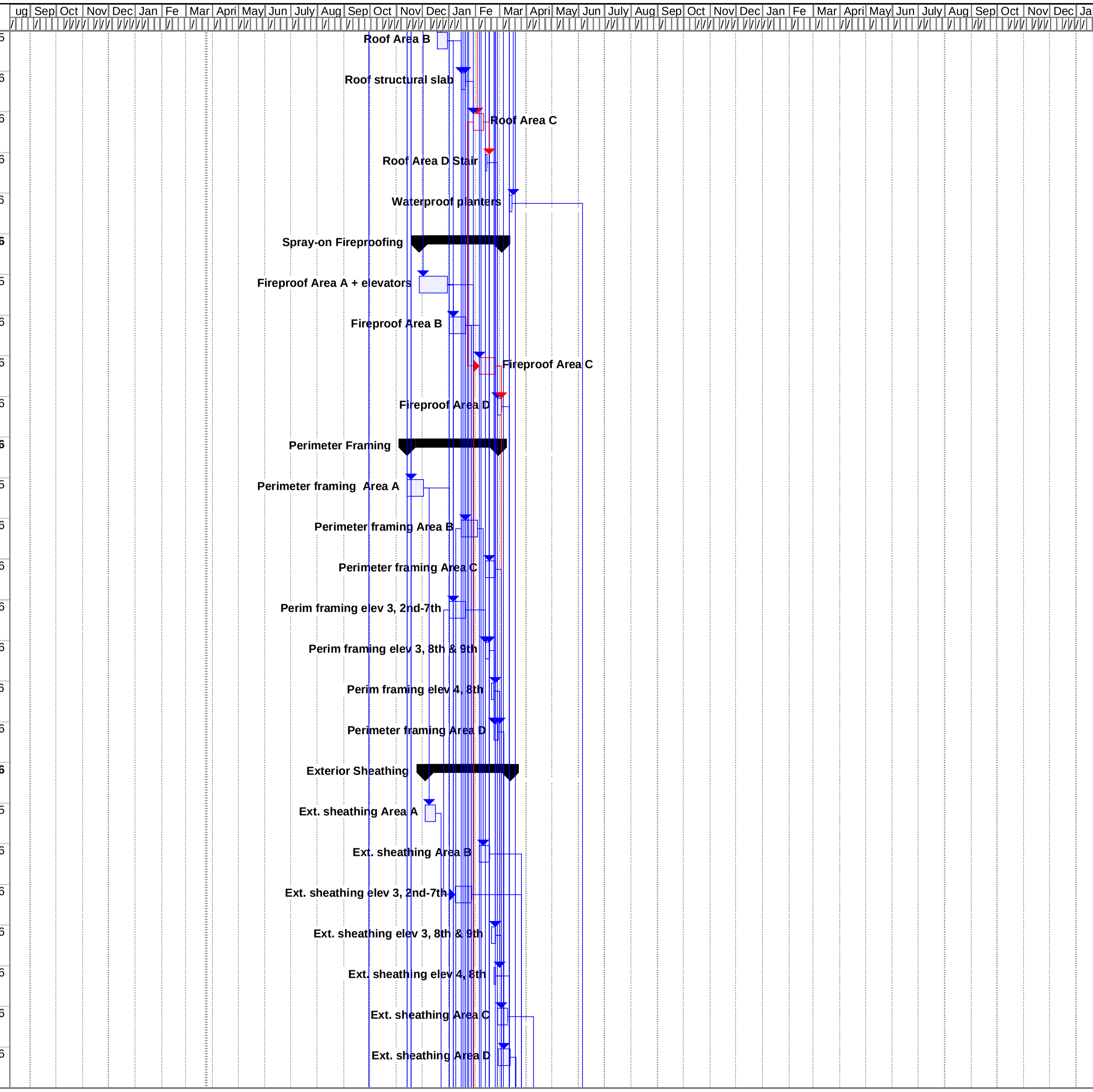
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
157	Roof Area B	10 days	Mon 12/19/05	Fri 12/30/05
158	Roof structural slab	5 days	Mon 1/16/06	Fri 1/20/06
159	Roof Area C	10 days	Mon 1/30/06	Fri 2/10/06
160	Roof Area D Stair	2 days	Mon 2/13/06	Tue 2/14/06
161	Waterproof planters	3 days	Mon 3/13/06	Wed 3/15/06
162	**Spray-on Fireproofing**	**70 days**	**Mon 11/28/05**	**Fri 3/3/06**
163	Fireproof Area A + elevators	25 days	Mon 11/28/05	Fri 12/30/05
164	Fireproof Area B	15 days	Mon 1/2/06	Fri 1/20/06
165	Fireproof Area C	15 days	Mon 2/6/06	Fri 2/24/06
166	Fireproof Area D	5 days	Mon 2/27/06	Fri 3/3/06
167	**Perimeter Framing**	**76 days**	**Mon 11/14/05**	**Mon 2/27/06**
168	Perimeter framing Area A	15 days	Mon 11/14/05	Fri 12/2/05
169	Perimeter framing Area B	15 days	Mon 1/16/06	Fri 2/3/06
170	Perimeter framing Area C	10 days	Mon 2/13/06	Fri 2/24/06
171	Perim framing elev 3, 2nd-7th	15 days	Mon 1/2/06	Fri 1/20/06
172	Perim framing elev 3, 8th & 9th	5 days	Mon 2/13/06	Fri 2/17/06
173	Perim framing elev 4, 8th	3 days	Mon 2/20/06	Wed 2/22/06
174	Perimeter framing Area D	3 days	Thu 2/23/06	Mon 2/27/06
175	**Exterior Sheathing**	**71 days**	**Mon 12/5/05**	**Mon 3/13/06**
176	Ext. sheathing Area A	10 days	Mon 12/5/05	Fri 12/16/05
177	Ext. sheathing Area B	10 days	Mon 2/6/06	Fri 2/17/06
178	Ext. sheathing elev 3, 2nd-7th	15 days	Mon 1/9/06	Fri 1/27/06
179	Ext. sheathing elev 3, 8th & 9th	5 days	Mon 2/20/06	Fri 2/24/06
180	Ext. sheathing elev 4, 8th	2 days	Thu 2/23/06	Fri 2/24/06
181	Ext. sheathing Area C	10 days	Mon 2/27/06	Fri 3/10/06
182	Ext. sheathing Area D	10 days	Tue 2/28/06	Mon 3/13/06



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Critical	Split	Slack	Project Summary
Critical Split	Progress	Slippage	Rolled Up Critical
Task	Milestone	Summary	Rolled Up Critical Split

External Tasks
External Milestone
Deadline

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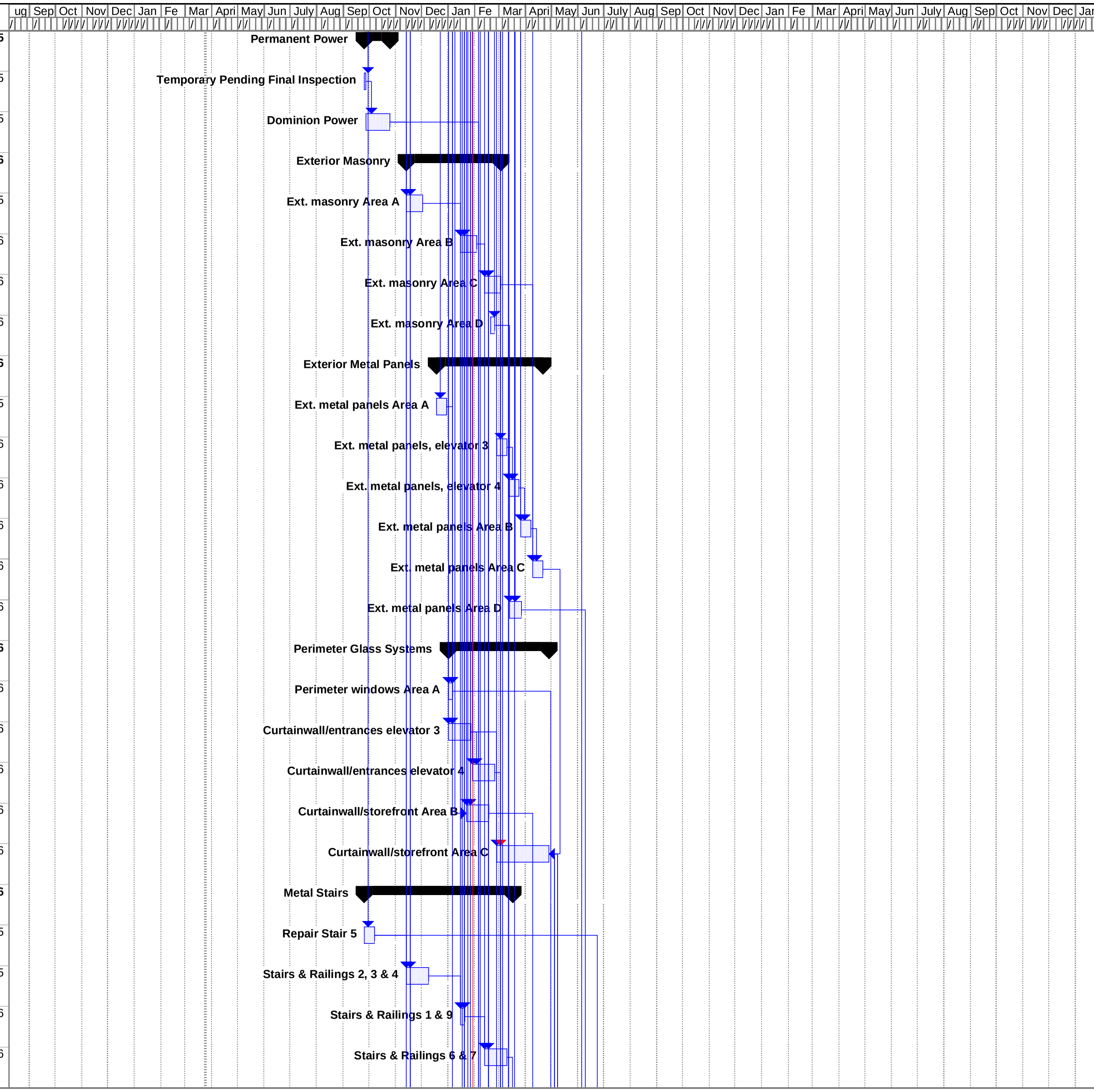
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
183	**Permanent Power**	**22 days**	**Mon 9/26/05**	**Tue 10/25/05**
184	Temporary Pending Final Inspection	2 days	Mon 9/26/05	Tue 9/27/05
185	Dominion Power	20 days	Wed 9/28/05	Tue 10/25/05
186	**Exterior Masonry**	**80 days**	**Mon 11/14/05**	**Fri 3/3/06**
187	Ext. masonry Area A	15 days	Mon 11/14/05	Fri 12/2/05
188	Ext. masonry Area B	15 days	Mon 1/16/06	Fri 2/3/06
189	Ext. masonry Area C	15 days	Mon 2/13/06	Fri 3/3/06
190	Ext. masonry Area D	5 days	Mon 2/20/06	Fri 2/24/06
191	**Exterior Metal Panels**	**90 days**	**Mon 12/19/05**	**Fri 4/21/06**
192	Ext. metal panels Area A	10 days	Mon 12/19/05	Fri 12/30/05
193	Ext. metal panels, elevator 3	10 days	Mon 2/27/06	Fri 3/10/06
194	Ext. metal panels, elevator 4	10 days	Mon 3/13/06	Fri 3/24/06
195	Ext. metal panels Area B	10 days	Mon 3/27/06	Fri 4/7/06
196	Ext. metal panels Area C	10 days	Mon 4/10/06	Fri 4/21/06
197	Ext. metal panels Area D	10 days	Tue 3/14/06	Mon 3/27/06
198	**Perimeter Glass Systems**	**85 days**	**Mon 1/2/06**	**Fri 4/28/06**
199	Perimeter windows Area A	5 days	Mon 1/2/06	Fri 1/6/06
200	Curtainwall/entrances elevator 3	20 days	Mon 1/2/06	Fri 1/27/06
201	Curtainwall/entrances elevator 4	20 days	Mon 1/30/06	Fri 2/24/06
202	Curtainwall/storefront Area B	20 days	Mon 1/23/06	Fri 2/17/06
203	Curtainwall/storefront Area C	45 days	Mon 2/27/06	Fri 4/28/06
204	**Metal Stairs**	**125 days**	**Mon 9/26/05**	**Fri 3/17/06**
205	Repair Stair 5	10 days	Mon 9/26/05	Fri 10/7/05
206	Stairs & Railings 2, 3 & 4	20 days	Mon 11/14/05	Fri 12/9/05
207	Stairs & Railings 1 & 9	5 days	Mon 1/16/06	Fri 1/20/06
208	Stairs & Railings 6 & 7	20 days	Mon 2/13/06	Fri 3/10/06



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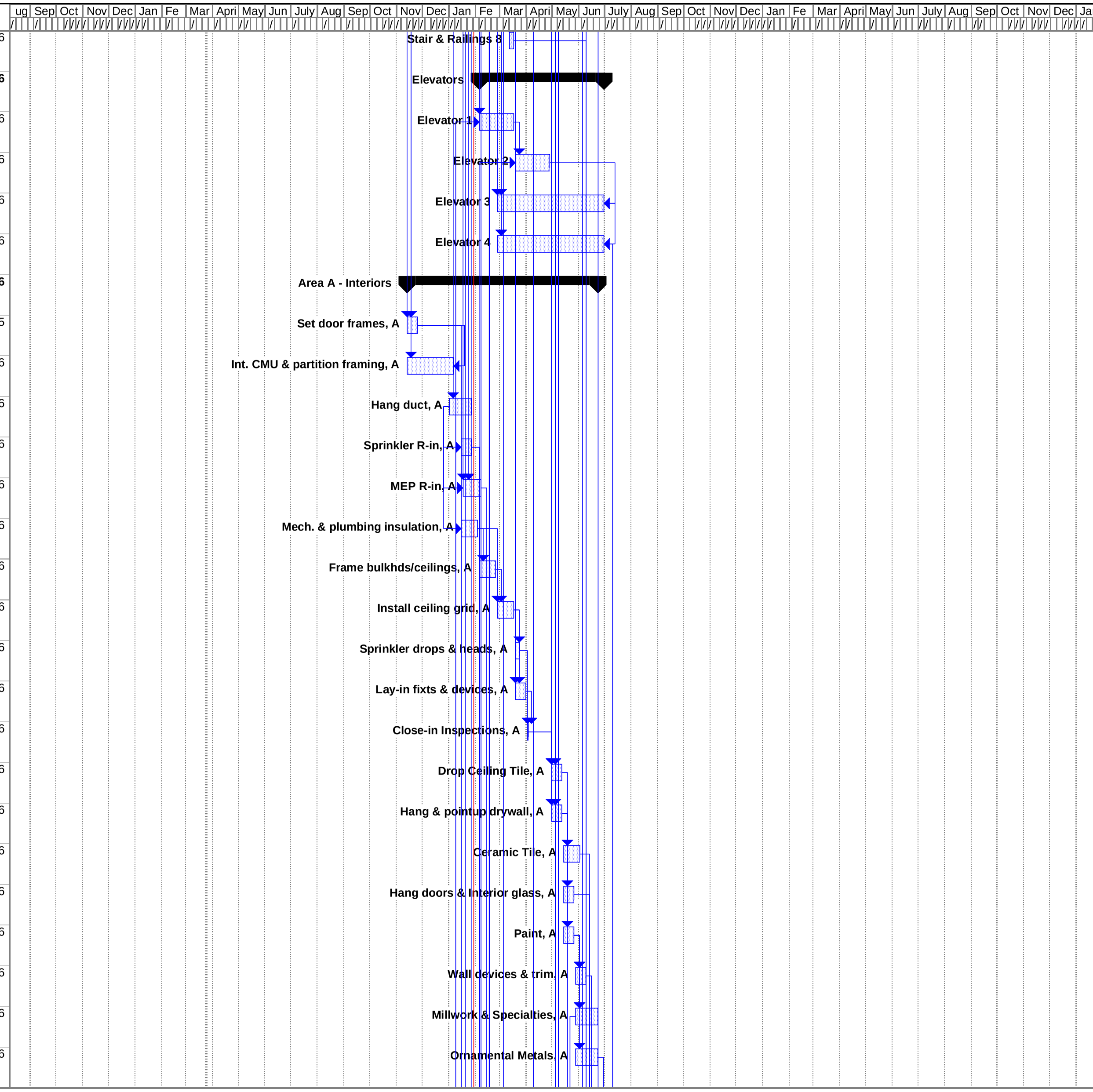
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
209	Stair & Railings 8	5 days	Mon 3/13/06	Fri 3/17/06
210	**Elevators**	**105 days**	**Mon 2/6/06**	**Fri 6/30/06**
211	Elevator 1	30 days	Mon 2/6/06	Fri 3/17/06
212	Elevator 2	30 days	Mon 3/20/06	Fri 4/28/06
213	Elevator 3	90 days	Mon 2/27/06	Fri 6/30/06
214	Elevator 4	90 days	Mon 2/27/06	Fri 6/30/06
215	**Area A - Interiors**	**160 days**	**Mon 11/14/05**	**Fri 6/23/06**
216	Set door frames, A	10 days	Mon 11/14/05	Fri 11/25/05
217	Int. CMU & partition framing, A	40 days	Mon 11/14/05	Fri 1/6/06
218	Hang duct, A	20 days	Mon 1/2/06	Fri 1/27/06
219	Sprinkler R-in, A	10 days	Mon 1/16/06	Fri 1/27/06
220	MEP R-in, A	15 days	Wed 1/18/06	Tue 2/7/06
221	Mech. & plumbing insulation, A	15 days	Mon 1/16/06	Fri 2/3/06
222	Frame bulkhds/ceilings, A	15 days	Mon 2/6/06	Fri 2/24/06
223	Install ceiling grid, A	15 days	Mon 2/27/06	Fri 3/17/06
224	Sprinkler drops & heads, A	5 days	Mon 3/20/06	Fri 3/24/06
225	Lay-in fixts & devices, A	10 days	Mon 3/20/06	Fri 3/31/06
226	Close-in Inspections, A	1 day	Mon 4/3/06	Mon 4/3/06
227	Drop Ceiling Tile, A	10 days	Mon 5/1/06	Fri 5/12/06
228	Hang & pointup drywall, A	10 days	Mon 5/1/06	Fri 5/12/06
229	Ceramic Tile, A	15 days	Mon 5/15/06	Fri 6/2/06
230	Hang doors & Interior glass, A	10 days	Mon 5/15/06	Fri 5/26/06
231	Paint, A	10 days	Mon 5/15/06	Fri 5/26/06
232	Wall devices & trim, A	10 days	Mon 5/29/06	Fri 6/9/06
233	Millwork & Specialties, A	20 days	Mon 5/29/06	Fri 6/23/06
234	Ornamental Metals, A	20 days	Mon 5/29/06	Fri 6/23/06



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Project: ACIR-Preliminary
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Critical | Split | Slack | Project Summary | External Tasks
Critical Split | Progress | Slippage | Rolled Up Critical | External Milestone
Task | Milestone | Summary | Rolled Up Critical Split | Deadline

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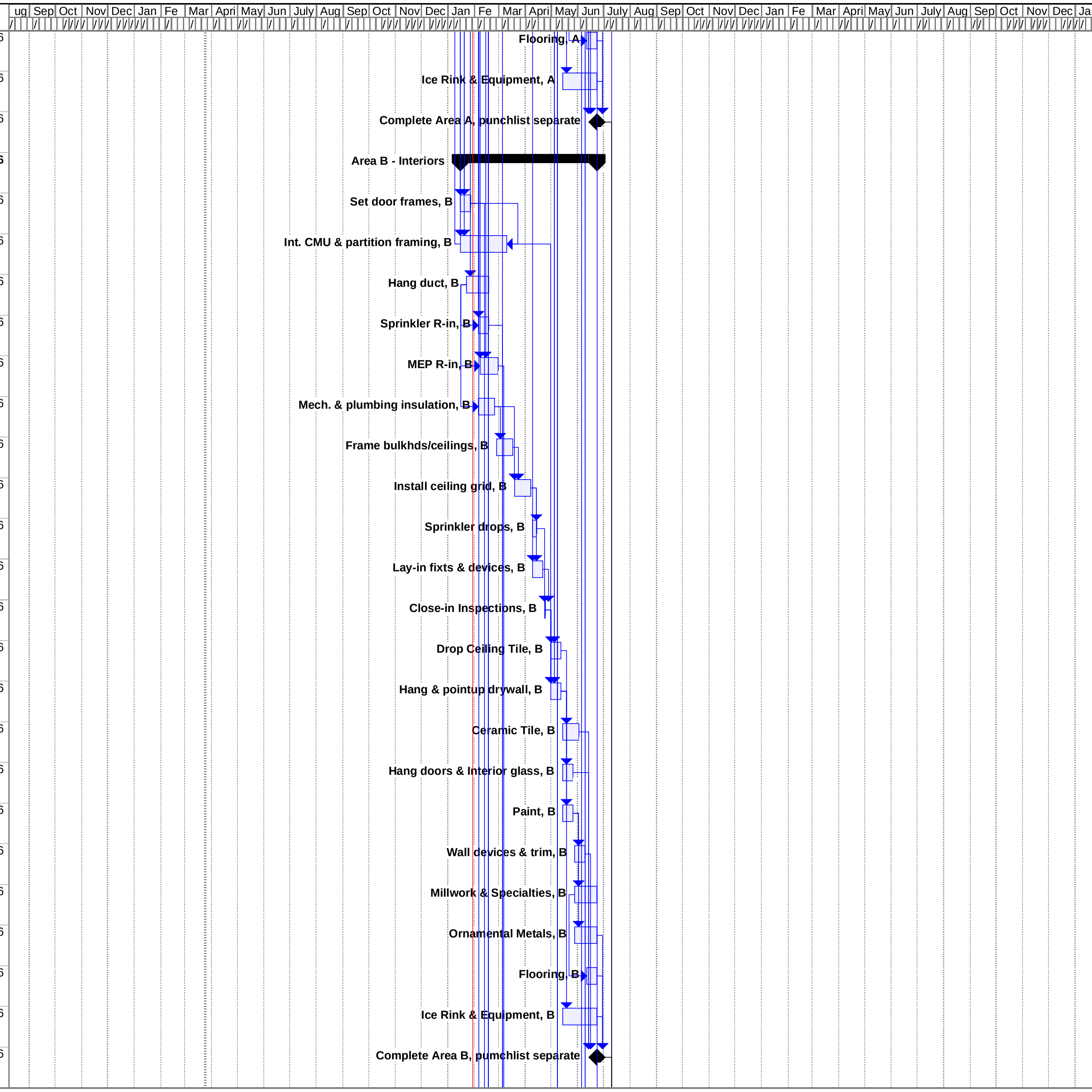
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
235	Flooring, A	10 days	Mon 6/12/06	Fri 6/23/06
236	Ice Rink & Equipment, A	30 days	Mon 5/15/06	Fri 6/23/06
237	Complete Area A, punchlist separate	0 days	Fri 6/23/06	Fri 6/23/06
238	**Area B - Interiors**	**115 days**	**Mon 1/16/06**	**Fri 6/23/06**
239	Set door frames, B	10 days	Mon 1/16/06	Fri 1/27/06
240	Int. CMU & partition framing, B	40 days	Mon 1/16/06	Fri 3/10/06
241	Hang duct, B	20 days	Mon 1/23/06	Fri 2/17/06
242	Sprinkler R-in, B	10 days	Mon 2/6/06	Fri 2/17/06
243	MEP R-in, B	15 days	Wed 2/8/06	Tue 2/28/06
244	Mech. & plumbing insulation, B	15 days	Mon 2/6/06	Fri 2/24/06
245	Frame bulkhds/ceilings, B	15 days	Mon 2/27/06	Fri 3/17/06
246	Install ceiling grid, B	15 days	Mon 3/20/06	Fri 4/7/06
247	Sprinkler drops, B	5 days	Mon 4/10/06	Fri 4/14/06
248	Lay-in fixts & devices, B	10 days	Mon 4/10/06	Fri 4/21/06
249	Close-in Inspections, B	1 day	Mon 4/24/06	Mon 4/24/06
250	Drop Ceiling Tile, B	10 days	Mon 5/1/06	Fri 5/12/06
251	Hang & pointup drywall, B	10 days	Mon 5/1/06	Fri 5/12/06
252	Ceramic Tile, B	15 days	Mon 5/15/06	Fri 6/2/06
253	Hang doors & Interior glass, B	10 days	Mon 5/15/06	Fri 5/26/06
254	Paint, B	10 days	Mon 5/15/06	Fri 5/26/06
255	Wall devices & trim, B	10 days	Mon 5/29/06	Fri 6/9/06
256	Millwork & Specialties, B	20 days	Mon 5/29/06	Fri 6/23/06
257	Ornamental Metals, B	20 days	Mon 5/29/06	Fri 6/23/06
258	Flooring, B	10 days	Mon 6/12/06	Fri 6/23/06
259	Ice Rink & Equipment, B	30 days	Mon 5/15/06	Fri 6/23/06
260	Complete Area B, pumchlist separate	0 days	Fri 6/23/06	Fri 6/23/06



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Critical		Split		Slack		Project Summary		External Tasks	
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

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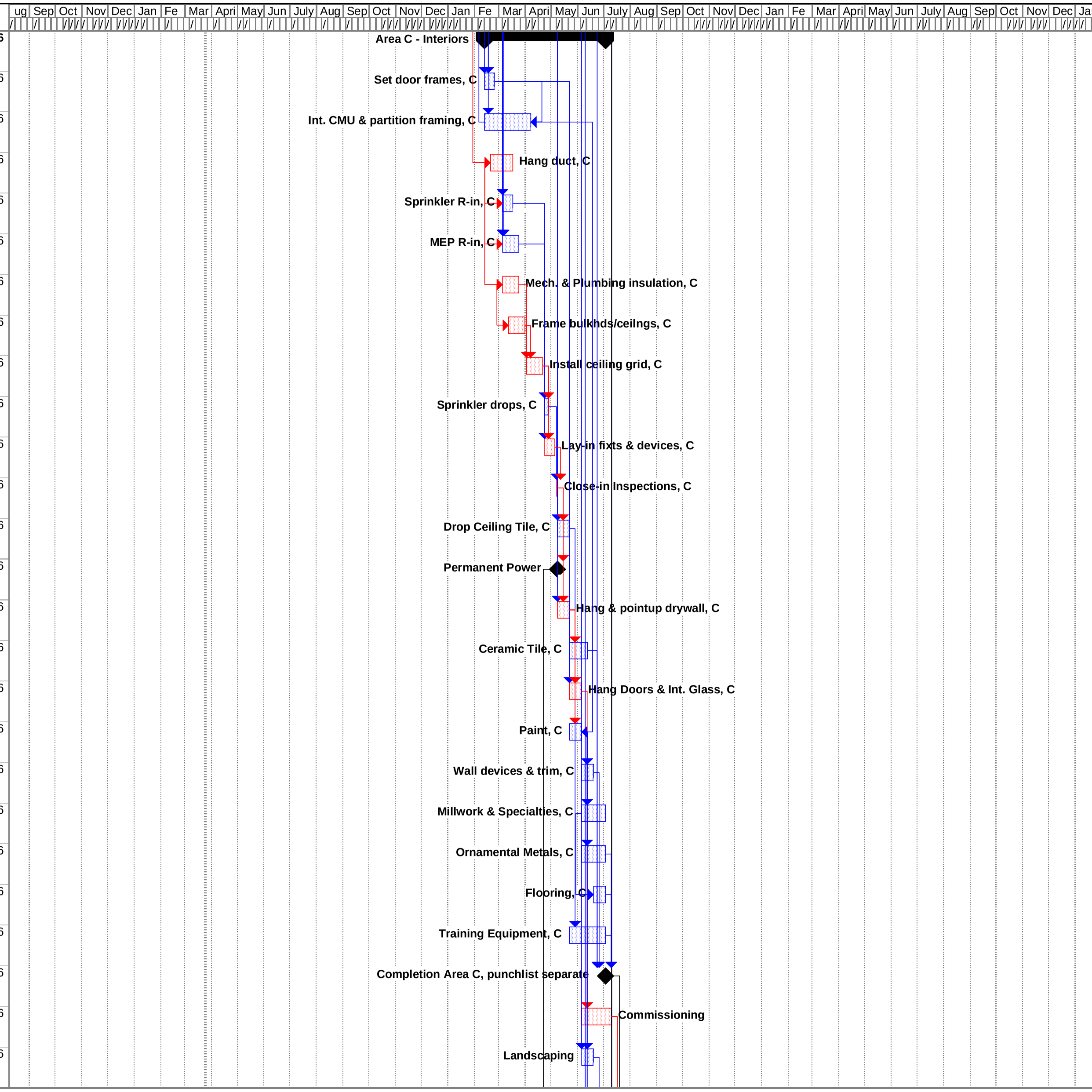
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
261	**Area C - Interiors**	**101 days**	**Mon 2/13/06**	**Mon 7/3/06**
262	Set door frames, C	10 days	Mon 2/13/06	Fri 2/24/06
263	Int. CMU & partition framing, C	40 days	Mon 2/13/06	Fri 4/7/06
264	Hang duct, C	20 days	Mon 2/20/06	Fri 3/17/06
265	Sprinkler R-in, C	10 days	Mon 3/6/06	Fri 3/17/06
266	MEP R-in, C	15 days	Mon 3/6/06	Fri 3/24/06
267	Mech. & Plumbing insulation, C	15 days	Mon 3/6/06	Fri 3/24/06
268	Frame bulkhds/ceilngs, C	15 days	Mon 3/13/06	Fri 3/31/06
269	Install ceiling grid, C	15 days	Mon 4/3/06	Fri 4/21/06
270	Sprinkler drops, C	5 days	Mon 4/24/06	Fri 4/28/06
271	Lay-in fixts & devices, C	10 days	Mon 4/24/06	Fri 5/5/06
272	Close-in Inspections, C	1 day	Mon 5/8/06	Mon 5/8/06
273	Drop Ceiling Tile, C	10 days	Tue 5/9/06	Mon 5/22/06
274	Permanent Power	0 days	Mon 5/8/06	Mon 5/8/06
275	Hang & pointup drywall, C	10 days	Tue 5/9/06	Mon 5/22/06
276	Ceramic Tile, C	15 days	Tue 5/23/06	Mon 6/12/06
277	Hang Doors & Int. Glass, C	10 days	Tue 5/23/06	Mon 6/5/06
278	Paint, C	10 days	Tue 5/23/06	Mon 6/5/06
279	Wall devices & trim, C	10 days	Tue 6/6/06	Mon 6/19/06
280	Millwork & Specialties, C	20 days	Tue 6/6/06	Mon 7/3/06
281	Ornamental Metals, C	20 days	Tue 6/6/06	Mon 7/3/06
282	Flooring, C	10 days	Tue 6/20/06	Mon 7/3/06
283	Training Equipment, C	30 days	Tue 5/23/06	Mon 7/3/06
284	Completion Area C, punchlist separate	0 days	Mon 7/3/06	Mon 7/3/06
285	Commissioning	25 days	Tue 6/6/06	Mon 7/10/06
286	Landscaping	10 days	Tue 6/6/06	Mon 6/19/06



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Critical		Split		Slack		Project Summary		External Tasks	
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

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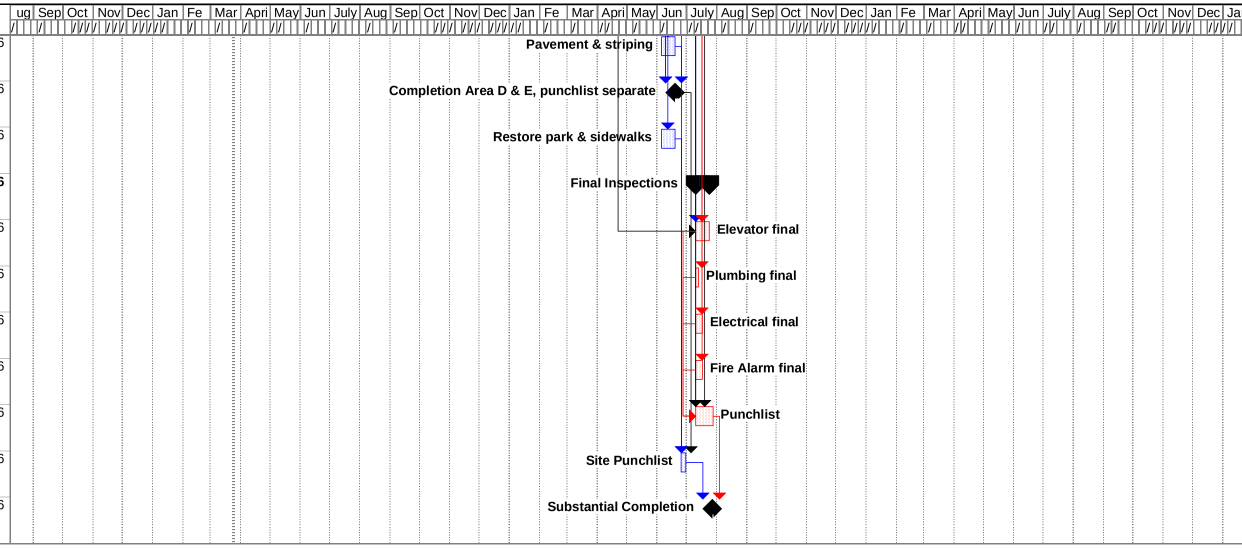
Arlington County Ice Rink - Baseline

ID	Task Name	Duration	Start	Finish
287	Pavement & striping	10 days	Tue 6/6/06	Mon 6/19/06
288	Completion Area D & E, punchlist separate	0 days	Mon 6/19/06	Mon 6/19/06
289	Restore park & sidewalks	10 days	Tue 6/6/06	Mon 6/19/06
290	**Final Inspections**	**10 days**	**Tue 7/11/06**	**Mon 7/24/06**
291	Elevator final	10 days	Tue 7/11/06	Mon 7/24/06
292	Plumbing final	3 days	Tue 7/11/06	Thu 7/13/06
293	Electrical final	5 days	Tue 7/11/06	Mon 7/17/06
294	Fire Alarm final	5 days	Tue 7/11/06	Mon 7/17/06
295	Punchlist	14 days	Tue 7/11/06	Fri 7/28/06
296	Site Punchlist	5 days	Mon 6/26/06	Fri 6/30/06
297	Substantial Completion	0 days	Fri 7/28/06	Fri 7/28/06



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Project: ACIR-Preliminary
Date: Thu 3/24/05

Critical		Split		Slack		Project Summary		External Tasks	
Critical Split		Progress		Slippage		Rolled Up Critical		External Milestone	
Task		Milestone		Summary		Rolled Up Critical Split		Deadline	

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APPENDIX E

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Musser, Chris III, PE. Structural Engineer III. Office of Physical Plant. Penn State University.

Seacrist, Ryan, PE. Civil Engineer III. Office of Physical Plant. Penn State University.

Sweigart, Jamie. Sales Representative. High Concrete Group.

Professors

Geschwindner, Louis F. Jr., PhD, PE. Professor Emeritus. Penn State University.

Hanagan, Linda, PhD, PE. Associate Professor. Penn State University.

Lepage, Andres, PhD, PE, SE. Assistant Professor. Penn State University.

Parfitt, M. Kevin, PE. Associate Professor. Penn State University.

Websites

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Virginia Department of Transportation. <http://www.vdot.virginia.gov/>

United States Department of Agriculture. NRCS. < http://www.va.nrcs.usda.gov/technical/Soils/>

U.S. Census Bureau. <http://www.census.gov/

Email Contacts

Baur, Ken, PE. Director of Research and Development & Technical Sales Support. High Concrete Group.

Carter, Charlie. AISC.

Chamberlain, Kevin, PE. CEO, President. DeStefano & Chamberlain.

Duvall, Bill, PE. Structural Engineer. Rathgeber Goss Associates.

Holbert, David, PE. Principle. Holbert Apple.

Pudleiner, Jim, PE. Project Manager. Walker Parking Consultants.

Shevitz, Michael. Project Manager. Sigal Construction Corporation.

Strand, Gary, SECB. Associate Principle. Simpson, Gumpertz & Heger.

Taylor, Mark, PE. President. Nitterhouse Concrete Products.

APPENDIX F

From: "Pudleiner, Jim" <Jim.Pudleiner@walkerparking.com>
To: "Megan Kohut" <mkk157@nw.opp.psu.edu>
Date: Monday - March 10, 2008 8:14 AM
Subject: RE: Another Question

Megan,
You are definitely pushing the limit. We go more than 300', but 408' is long. If you are going to use the 372' and the 408' lengths, consider keeping your shearwalls towards the center of rigidity in each direction. Think about it this way - if you locate any shearwalls at the ends, when the building contracts due to volume change (thermal or other) the shearwalls at the end will fight this contraction resulting in serious cracking in the diaphragm. Another way we help the situation is to cut loose shearwalls at the lower tiers that are located further from the center of rigidity. This will relieve some of the stresses.
Hope this helps.
Jim

-----Original Message-----
From: Megan Kohut [mailto:mkk157@nw.opp.psu.edu]
Sent: Sunday, March 09, 2008 1:43 PM
To: Pudleiner, Jim
Subject: Another Question

Jim,

Sorry to send another email...I forgot to ask this in my last email. I was reading the PCI book on parking structures and it mentions that expansion joints should be used if a structure is larger than 300 ft. in length. My garage's maximum dimensions are 372' x 408' which will mean that I will need one joint in each direction. Then I will need to locate lateral members for each "individual structure." But since my garage is constructed over two ice rinks, I'm having a problem finding locations for shear walls that can span the entire height of the building without interfering with the ice rinks or with the parking layout. It's possible to keep all lateral members along the perimeter of the entire structure but then I'm anticipating a major torsional problem. Is it possible to design a precast garage with these dimensions without the use of expansion joints? If so, are there any important things that I need to take into consideration? I've attached my plans to help illustrate what

I'm talking about. The floorplan with the ice rinks is for the ground level and shows the overall building dimensions. The parking layout plan is for levels 4-8 and shows where I'm thinking of locating lateral members. Please excuse my drafting!

Thanks again!

Megan

From: Kevin Chamberlain <kevinc@dcstructural.com>
To: "Structural Mentors" <structuralmentors@arche.psu.edu>
Date: Monday - March 17, 2008 1:05 PM
Subject: RE: [structuralmentors] Precast Piles AND Truss Design

This message is being sent via the AE Senior Thesis e-Studio - Structural Mentors discussion board/listserv.

Precast piles work best is soft sand and clay. If you have fill, boulders, buried debris, dense sands, gravel, shallow rock, then forget it. Driving stresses would cause the piles to break. We tried precast piles on an urban site in Connecticut about 10 years ago, and 12 out of 16 test piles broke when they hit boulders or other obstructions. We quickly proceeded to pick a different pile type. Are the soils in Arlington soft or rocky?

If site soils are suitable to support spread footings, and not prone to liquefy under seismic loading, then spread footings are always preferred over deep foundations.

Kevin

Kevin H. Chamberlain, P.E., CEO
President - Structural Engineers Coalition of ACEC/Connecticut

DeStefano & Chamberlain, Inc.
Structural and Architectural Engineering
50 Thorpe Street
Fairfield, CT 06824
(203) 254-7131
Fax (203) 254-0263

website: www.dcstructural.com
email: kevinc@dcstructural.com

-----Original Message-----
From: Megan Kohut [mailto:mkk157@psu.edu]
Sent: Monday, March 17, 2008 12:24 PM
To: Structural Mentors
Subject: [structuralmentors] Precast Piles AND Truss Design

This message is being sent via the AE Senior Thesis e-Studio - Structural
Mentors discussion board/listserv.

My building is located in Arlington, VA and is a 6 story precast parking garage built over two story ice rinks and offices.

It was recommended to me by an engineer working for a precast garage firm that I use a deep foundation system instead of spread footings for my foundation system in this part of the country. He said that this will help minimize settlement. I chose to use precast piles, however, I'm not too familiar with deep foundation systems. We discussed them for a class in my foundation class but never in detail. How do they work? Are they located under all columns or spread out over the entire site? How many piles are used per column? How many piles are used per pile cap? Any general information will be extremely helpful.

Also, since the parking garage spans over the ice rinks, I have a large transfer level. I'm designing trusses with vertical truss members located directly beneath the columns from above which are spaced at 30ft. What is the maximum distance that I should use between vertical truss members? I know that 30' is too large, but how far apart can I space them to make the truss as efficient as possible? I will obviously design diagonal members between these vertical members. I'm planning on using wide flange shapes for these members due to the high loads.

Thanks for all your help!

Megan Kohut

From:	"Carter, Charlie" <carter@aisc.org>
To:	"Structural Mentors" <structuralmentors@arche.psu.edu>
Date:	Monday - March 24, 2008 11:16 AM
Subject:	RE: [structuralmentors] Steel Truss cost estimating

This message is being sent via the AE Senior Thesis e-Studio - Structural Mentors discussion board/listserv.

Justin,

I don't think you will get a very good cost estimate by allowing 20 percent of member weight for connection costs, especially for truss fabrication and erection. 20 Percent won't reflect much of the actual costs of fabrication and erection (which is where the costs are in the connections).

I previously posted some cost data on wide-flange and HSS material costs ($0.44 per pound for W-shapes; $0.49 for HSS) and suggested the 0.27 divisor to convert material cost to total cost, on average. But trusses will have a lower divisor because they have more connections than typical steel framing.

If you can send me some typical connection details, we can talk further about how you might go about determining how the divisor would change. Also, we could talk about how to compare connection options if that is what you intend to do.

Charlie

-----Original Message-----
From: Justin Raducha [mailto:jmr451@psu.edu]
Sent: Monday, March 17, 2008 10:55 AM
To: Structural Mentors
Subject: [structuralmentors] Steel Truss cost estimating

This message is being sent via the AE Senior Thesis e-Studio - Structural Mentors discussion board/listserv.

I am investigating the cost and schedule impact of replacing concrete

skip trusses with a steel staggered truss system. The building is a 12-story precast concrete structure in Orlando, FL. RS Means has not given me much insight on pricing associated with this type of system. What I am looking for is market price (per ton or by assembly) for the steel that will makeup these trusses.

As I currently have them designed, they will have W14x90 and W12x79 Chords. Vertical and diagonal members are HSS shape ranging from HSS4x3x0.125 to HSS10x8x0.375. Each truss is 45feet long and 12feet tall, and equates to just under 6 tons of steel + connection plates and bolts. There will be 48 of these trusses in the final design. (Total 277 tons + connections)

I need guidance on what sort of pricing range i am looking at, and what allowance i should make for connections (gusset plates) / bolts / additional steel. I have read an allowance of 20% (of truss member weight) is conservative for connection steel estimation. I also am looking at schedule impact for fabrication / transport / erection of these pieces to compare to the as designed schedule.

Seeing as this project is in Orlando, FL; a predominantly concrete construction market; i am particularly interested in the costs associated with this area, but any general guidance would be useful.

My thesis page is located at
http://www.engr.psu.edu/ae/thesis/portfolios/2008/jmr451/

Please reference my web page and current reports for additional details.

Thank you for your time,

Justin Raducha
jmr451@psu.edu

From: "Gary R. Strand" <grstrand@sgh.com>
To: "Structural Mentors" <structuralmentors@arche.psu.edu>
Date: Tuesday - March 25, 2008 9:51 AM
Subject: RE: [structuralmentors] Deflection criteria for Transfer Trusses

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Megan: This is a very interesting problem. Not only do you have a very heavy structure above but there are many issues you need to consider. I agree with Mr. Parfitt's suggestion of cambering your truss to address the initial dead load deflections. Here are some things to think about:

1) As the precast garage is being erected, more and more load will create more and more deflection. Can the precast structure handle this movement during the erection process and can their connections be flexible enough not to be overstressed during this initial vertical movement. Perhaps a question for Nitterhouse to address.
2) You will need to watch the truss deflections relative to the garage's floor sloping to drains. You'd hate to have the truss deflect so much that you lose your positive drainage pattern. Or worse yet, reverse the drainage of the garage. (There is nothing like draining your garage down the elevator and stair shafts..ha) You will need to look at this not only for the dead load of the garage but with it fully loaded with cars as well (when your drainage requirements are their highest). I wouldn't worry about checking the live load deflections for the code specified 40 psf (or 50 psf depending on what code you are using). I would use only 20 psf to determine a more accurate live load deflection due to a fully loaded garage. Remember, typically no one is parking in the drive lanes and even if they are, I believe the actual load per square foot when cars are parked bumper-to-bumper and door handle-to-door handle is approximately 20 psf.
3) Camber is definitely the answer to address the dead load deflections from the weight of the precast garage. I'd start off by cambering at least 80% of the dead load deflection since they are so well defined. Though you will need to use the code specified load for the actual design of the various members you may consider something less for calculating your actual live load deflections. In short, I don't think you can use 'standard' deflection criteria for this problem. As long as the deflections do not affect the usability and serviceability of the garage above, who's going to complain about a garage that slopes? Don't they all?

Gary R. Strand, SECB
Associate Principal

Simpson Gumpertz & Heger

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-----Original Message-----
From: Megan Kohut [mailto:mkk157@psu.edu]
Sent: Monday, March 24, 2008 12:00 PM
To: Structural Mentors
Subject: [structuralmentors] Deflection criteria for Transfer Trusses

This message is being sent via the AE Senior Thesis e-Studio - Structural Mentors discussion board/listserv.

Mentors:

I'm designing large steel trusses using wide flange members to span over two ice rinks which will transfer gravity and lateral loads from a precast parking structure above. The longest span of these trusses is 169 ft. Since these trusses will support the loads from the parking garage, do I limit LL deflection to L/360 like any other floor member? Or should I be using a different deflection criteria? The DLs are much higher than the LLs so I feel like I should limit total deflection to a specific amount. I'm just a little unsure what to limit it to. I feel that it should be limited using stricter standards than what I'm used to using. Any ideas or rules-of-thumb will be very helpful.

Thanks,

Megan Kohut

From: "Sweigart, Jamie" <JSweigart@high.net>
To: <MKK157@nw.opp.psu.edu>
Date: Thursday - March 27, 2008 6:31 PM
Subject: Precast Concrete Budget Numbers

Megan,

It was very nice meeting you yesterday. As a follow up to our meeting, listed below are some rough budget numbers for a precast parking structure:

Columns - $300/LF

Girders - $270/LF

Spandrels - $43/SF (The premium for plant applied brick would be $14-$16/SF)

Ramp/Light walls - $34/SF

Stair - $5,000 per piece

Shear walls - $46/SF (The premium for plant applied brick would be $14-$16/SF)

Interior wall panels - $42/SF

Transfer Beam - $300-$320/LF

Double Tees - $18/SF

**All prices are furnished, delivered, and installed

Additional lump sum budget pricing:

* $30-$36/SF of elevated precast floor surface for the entire structure (Precast scope of work only, does not include site work)
* $14,000-$16,000 per Car (this would include everything from start of project to completion of project)

Please feel free to call or email with any additional comments or questions that you may have.

Jamie Sweigart

Sales Representative

High Concrete Group LLC

125 Denver Road

Denver, PA 17517

PH: 717.336.9370

Cell: 717.824.1542

Fax: 717.336.9301

From: "Baur, Ken" <KBaur@high.net>
To: "Megan Kohut" <mkk157@nw.opp.psu.edu>
CC: "Sweigart, Jamie" <JSweigart@high.net>, "Baur, Ken" <KBaur@high.net>
Date: Friday - April 4, 2008 2:57 PM
Subject: RE: Parking Structure Estimating

Hi Megan:

Precast garages (or buildings) are typically erected one bay at a time from the ground all the way to the top level. A typical bay size is 48' x 60'. Each floor of this bay would be made up of three 16' wide tees x 60' long. There could be a column on each corner of the bay and in the 48' direction. There would need to be supporting beams which would be 48' long. The tees are then spanning 60' and they bear upon the 48' long beams, which are supported by the four columns. Columns are made in lengths of up to 65', which is enough height for a six level garage. If the garage is higher than six levels it is done by erecting the bay up to level six, then adding four more columns (which could also be up to 65' in length) to continue to the top level. When the entire bay is erected, the crane moves to a new position to begin the next bay, again erecting all the way to the top level.

It is done this way because of the heavy weight of the pieces. The limited reach of the crane would make it impossible to reach far into the interior of a garage. Hence the crane by this method is always erecting from a position very close to where the members need to be set. One of the tasks of a precast engineer is to determine bracing methods to keep the structure stabile during the erection process.

A 9 man crew can typically erect 18 to 26 pieces per day. The best way to determine a schedule is to count the number of pieces needed on a garage and to plan to erect an average of 22 pieces per day. In the above example, if the garage is six levels in height (above a slab on grade) then following is a list of quantities needed:

a. Four columns
b. Two beams x six levels = 12 beams
c. Three Tees x six levels =18 tees
Total = 34 pieces 34 / 22 = about 1.5 erection days per bay

Note that for the next bay only two columns are needed because two of the columns in the previous bay will serve to support the beams on one end. Otherwise, the count would be the same. Hence there are 32 pieces in the next bay of this example.

I recall that on your project there are some very long concrete trusses, perhaps in a length of 140'? For members of this length, it is likely that two cranes would be used; one near to each end of the truss. Erection would proceed in the same manner: columns to be set first, then the lowest supporting floor, then the second level, etc. Two cranes on the same site will lower the productivity due to the logistical issues of having more trucks delivering to the site, caution needed to prevent crane interference, etc. Each crane and crew for this case would be less efficient; hence I would count on averaging only 18 pieces per crane per day (36 total).

I hope this is all clear and helpful. Let me know if there are further questions.

I have considered coming to Penn State periodically to assist with precast thesis projects. If I were to plan on doing this next year, who shall I contact?

Ken Baur,
PSU AE, Class of 1977.

-----Original Message-----
From: Megan Kohut [mailto:mkk157@nw.opp.psu.edu]
Sent: Thursday, April 03, 2008 12:07 AM
To: Baur, Ken
Subject: RE: Parking Structure Estimating

Ken,

Thank you for setting me up with Jaime. He was extremely helpful. I understand that you guys are very busy so I really appreciate both of you taking the time to help me with my senior thesis.

I have one more quick question. I'm currently doing my construction management breadth topic for my report. This breadth will include a detailed cost estimate and project schedule. I have the estimate done (with Jaime's help) and am currently working on the schedule. I understand that precast parking garages are constructed in footprint segments, not floor by floor like typical construction. How large of an area is constructed at one time? How long does it take to construct one of these segments? I'm trying to determine an approximate schedule such as "100'x50' segment, floors 1-7 = 60 days". My structure is 408'x372' and a total of 9 levels including the roof. The number of parking levels over the ice rinks was decreased to 5 levels. Do you have a "rule of thumb" that your company uses to estimate construction times of your precast systems? Any information will be extremely helpful.

Thanks again,

Megan Kohut

>>> "Baur, Ken" <KBaur@high.net> 03/19/08 3:03 PM >>>
Hi Megan:

I will work with one of our sales people to provide unit pricing for the members which you are using. We should be able to provide something by late next week. I'll take a look at the drawings on your website.

If you would like to have a plant tour at some point, you can let me know. There is a group of PSU Architectural students who will be visiting our plant on April 10. Perhaps they would even allow you to tag along.

We have done a number of projects on your campus. The most recent one used the 15' wide double tees (the garage next to the new Creamery) also perhaps the Eisenhower P/G. Also the one off campus which is near the Post Office (might be on Pugh Street). You've probably visited some of these already, but if not, it would give you a good insight on how these garages are framed.

Ken Baur

-----Original Message-----
From: Megan Kohut [mailto:MKK157@nw.opp.psu.edu]
Sent: Wednesday, March 19, 2008 2:35 PM
To: Baur, Ken
Subject: Parking Structure Estimating

Mr. Baur,

My name is Megan Kohut and I'm an architectural engineering student at Penn State University. I saw on the website that you're a fellow AE! I'm working on my senior thesis project and have a few questions about the cost of using your MEGA-SPAN system. Jim Pudleiner at Walker Parking suggested this system to me.

First, I'll give you a little background on my project. My project is located in Arlington, VA and is the practice facility for the NHL team, the Washington Capitals. I'm redesigning the structure and building a parking garage over two regulation size ice rinks. I have a large transfer level to transfer out the above loads over the rinks. The building footprint is 372'x407'. My garage will be 6 levels over the ice rinks and 9 levels elsewhere including two vertical ramps. You can see my thesis work from last semester (studying the existing structure) on my website listed below.

I need to estimate to cost that this precast parking structure will cost. I was planning on using RS Means, but since the MEGA-SPAN system is so unique with it's long spans, I wasn't sure how accurate Means would be. Do you have any cost estimations for the 45' double Ts, T beams (30'span), L beams (30' span), interior columns, exterior columns (11' floor-to-floor), and spandrels? Even a very general unit price will work.

I greatly appreciate your help!

Megan Kohut
BAE/MAE
Structural Option
Penn State University

http://www.engr.psu.edu/ae/thesis/portfolios/2008/mkk157/

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