

CRAIG DUBLER
Construction Management Option
Steven F. Udvar-Hazy Center, Chantilly, VA
October 8, 2003



Technical Assignment #1

TABLE OF CONTENTS

Executive Summary	2
Project Delivery System	3
Project Schedule Summary	4
Project Cost Evaluation	5-6
Site Plan	7-8
Local Market Conditions	9
Subsurface and Soil Conditions	10
Client Information	11



EXECUTIVE SUMMARY

During this technical assignment, I developed a better understanding of the existing site conditions for the Steven F. Udvar-Hazy Center. This development was achieved through the research of several different categories which include: Project Delivery System, Schedule Summary, Cost Evaluation, Site Plan, Market Conditions, Site Conditions, and Owner Information.

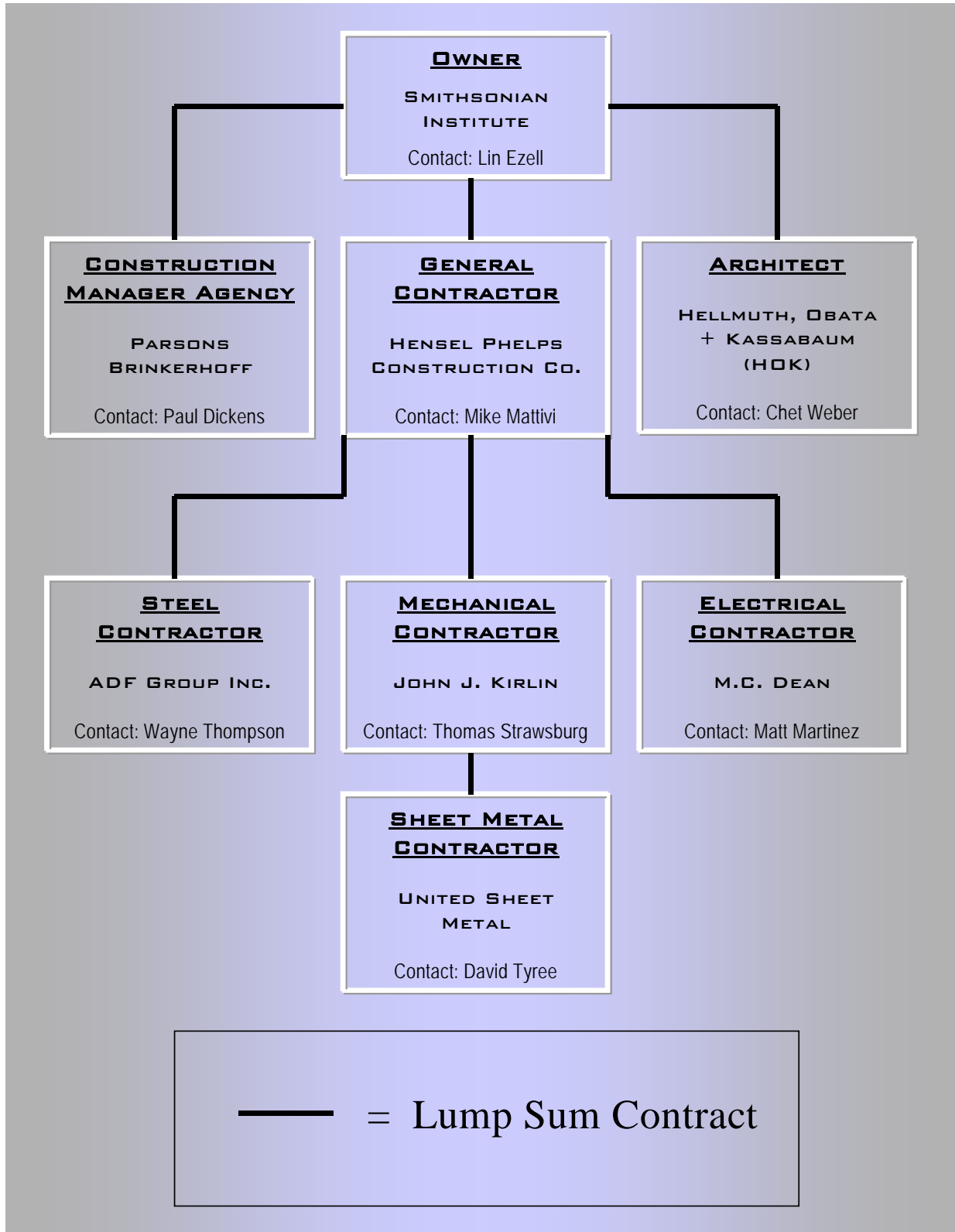
In my research I discovered some interesting issues dealing with the construction of the Steven F. Udvar-Hazy Center, which is the new National Air and Space Museum located in Chantilly, VA. I found that this is actually a good area for a large project because skilled labor is easy to find. The delivery system on this project I discovered to be traditional with Hensel Phelps being the general contractor, and Parsons Brinkerhoff being the construction management industry. Both companies were hired by the owner, Smithsonian Institute, to manage the construction on the project. This project was in the design stage for around ten year, until 2001, when the Smithsonian Institute received enough funds to get the project up in the air. This has been a long time in the making for the Institute, so they want to make sure the project is completed to the highest standards and quality. Another challenge is to open the building in time for the 100th anniversary of the Wright Brother's first flight, which will be on December 17, 2003.

Overall the Steven F. Udvar-Hazy Center costs around \$125 million dollars to build, with overall cost, including design, and site, of \$309 million. The building is split up into four main parts: Main Hangar, Public Amenities, IMAX theater, and Observation Tower. Because of this, I found it to be difficult to project the building cost using a parametric or square foot estimate.

In understanding the time constraint and quality, Hensel Phelps has developed a schedule that lasts around three years. The main key issue dealing with the schedule is the fabrication and erection of the steel for the Main Hangar. Due to the large site, steel can be stages in different areas, which is shown in the site plan, to allow for a good flow of work. One issue that put the schedule back a bit was the need to drill caissons for each footing in the Main Hangar. Caissons had to be used because the results of the soils report showed unstable soils conditions. Finally, in order to meet the completion date, the Main Hangar will need to be turned over four months prior in order for them to erect and hang artifacts.



PROJECT DELIVERY SYSTEM





PROJECT SCHEDULE SUMMARY

Design

Design Activities	1993	1994	1995	1996	1997	1998	1999	2000	2001
Congress allows Smithsonian to build new museum									
Design for museum begins									
Museum is allowed to build at Dulles Intern. Airport									
Refined Design									
Smithsonian buys 176.5 acres from Dulles									
Groundbreaking									
Contract is awarded to HP and construction begins									

Construction

** See [Link](#) for Schedule

Key elements of major activities:

Foundations:

- Main Hangar -Drill and Pour Caissons
 -Form and Pour Caisson Caps (Thrust Blocks)
- Public Amenities -Excavate and Pour Spread Footings

Structure:

- Main Hangar -Assemble arched tri-truss tube steel structure on ground
 -Three sections (2 Sides and center)
 -Tilt up sides (3 column lines at once)
 -Finish structure by tying in center section of tri-truss
- Public Amenities -Typical structural steel erection

Finishes:

- Metal Studs and drywall
- Miscellaneous Metals
- Millwork
- Interior Panels/Tile
- Terrazzo
- Painting
- Furniture



PROJECT COST EVALUATION

<u>Actual Building Construction Cost (CC):</u>	\$125,000,000
<u>Total Square Foot (SF):</u>	470,000 SF
<u>Construction Cost per Square Foot:</u>	\$266/SF
<u>Total Project Costs (TC):</u>	\$309,000,000
<u>Total Project Cost per Square Foot:</u>	\$657/SF
<u>Major Building Systems Costs:</u>	Costs are confidential as per request of Hensel Phelps Construction Company.
<u>Design Costs:</u>	\$8,000,000

Parametric Estimate (Using D4 Cost 2002):

Estimate of Probable Cost

NASM – Dec 2003 – VA – Arlington

Building Sq. Size	: 470000
Site Sq. Size	: 29947500
No. Of Buildings	: 5
No. Of Floors	: 4
Project Type	: NEW
Building Use	: Civic/Gov.
Exterior Walls	: Panelized
Interior Walls	: Drywall/Gypsum Sheathing
Foundation	: Cast in place concrete
Roof Type	: Membrane
Floor Type	: Concrete

Total Project Costs	65,941,799
---------------------	-------------------



Square Foot Estimate: (R.S. Means Square Foot Estimate, 2003)

Description	SF	LF	Story Hgt. (ft)	Means						Total \$/SF	Cost
				\$/SF	Perimeter Adj.		Story Hgt. Adj.				
					Unit	Total	Unit	Total			
Main Hangar	240,000	2300	100	65.5	0.65	6.5	0.25	19	91	\$21,828,000	
Public Amenities	200,000	1250	18	95.2	0.85	0	0.8	4.8	100	\$19,990,000	
Theatre	30,000	420	50	131	7.6	0	1.25	32.5	163	\$4,894,500	

TOTAL	470,000	3970
--------------	----------------	------

\$46,712,500

Description	Means Description	Page in R.S. Means
Main Hangar	Aircraft Hangar (Steel frame)	140
Public Amenities	High School 2-3 Stories (Steel frame)	190
Theater	Auditorium (Steel frame)	84

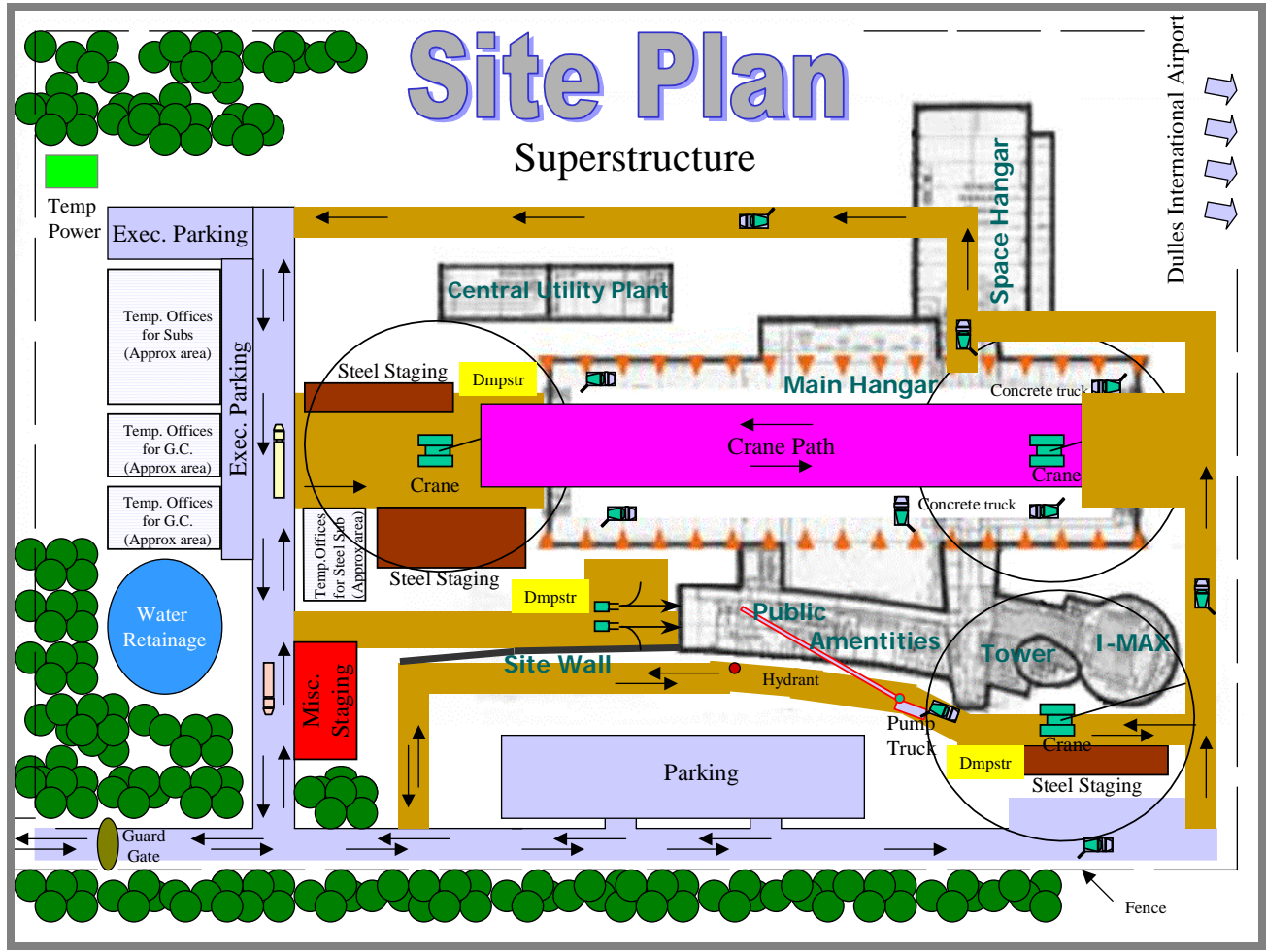
Understanding the Estimates:

As you can see from the Building Statistics, the Steven F. Udvar-Hazy Center is like no other building in the world. This means that choosing a building to compare it to can be quite a challenge. For the parametric estimate, I chose to look at two Airport projects, due to the Hangar and Observation Tower of the new Air and Space Museum. For the square foot estimate, I chose to split the building into three parts: Main Hangar, Public Amenities, and IMAX Theater.

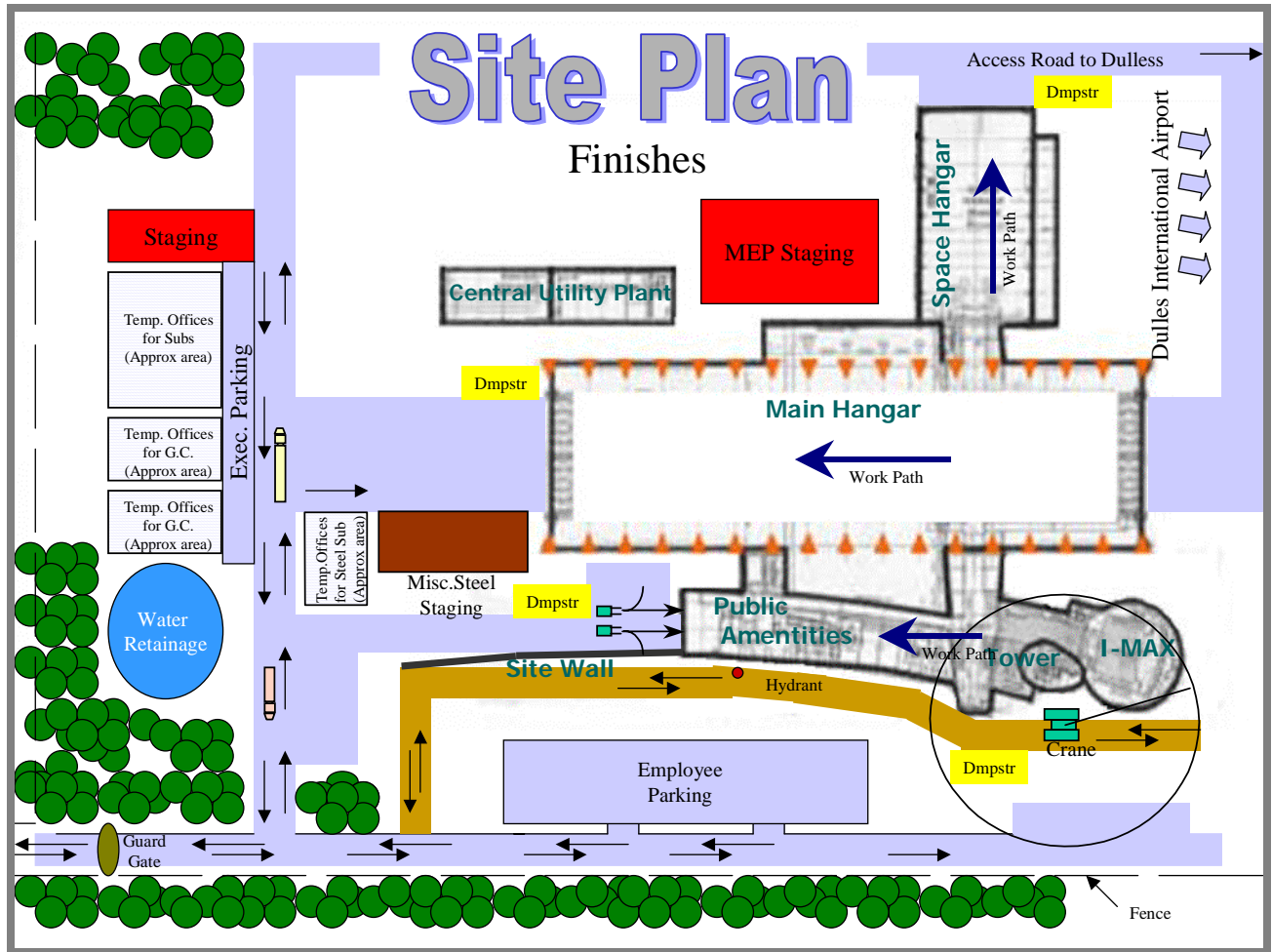
In both the parametric and square foot estimate, the projected costs came out extremely low. As stated above, it is difficult to choose a building that contains a massive hangar, a twelve-story observation tower, an IMAX theater, a restaurant, as well as classrooms. Also, The Steven F. Udvar-Hazy Center contains an energy efficient, state of the art mechanical system that will be used to preserve the artifacts on display. The building is also wrapped in custom metal panels and ceramic tiles. Due to reasons like this, parametric and square foot estimates cannot give a realistic building cost



SITE PLAN



- Site is not very congested, which allows for staging of materials
- Site can get muddy, so materials should be elevated
- Construction path starts from right to left on plan above
- Steel for Main Hangar is delivered and erected in pieces
 - Connections are bolted to save time and allow for adjustments
 - Two cranes are needed to walk center section into place
- Tower is built in three sections up to 5th Floor
 - "Egg" on top is erected prior, then lifted by crane into place



- Site starts to get congested when site construction begins
- Planes are brought in from Dulles on the access road
 - Site must be clean for planes to taxi
 - Parking is limited due to Media
- Tower and Theater finish materials are delivered to floors by crane
- Crane is also used for pouring site walls
- Staging must be moved when site work progresses



LOCAL MARKET CONDITIONS

The current labor market in the Northern Virginia area is very diverse. Skilled workers for most trades can be found relatively easily. This has a lot to do with the workers wanting to stay close to home rather than travel into the District of Columbia, where most of the larger scale projects are located. Since most buildings around the Chantilly are constructed out of concrete, labor unions are used when looking for steel erectors, pipe fitters, and bricklayers.

Another advantage of working outside the city is that project sites, for the most part, are not nearly as congested. This leaves adequate room for employee parking, and material staging. This allows for the delivery sequence to be a little more lax.



SUBSURFACE AND SOIL CONDITIONS

The new Air and Space Museum (Steven F. Udvar-Hazy Center) is located on the grounds of the Washington Dulles International Airport. In total, 30,000 Cubic Yards of soil was removed from the site. Because of the size of the site, most can be stock piled and used later, but some will need to be trucked away to an adjacent site.

Prior to the contract being awarded, Smithsonian Institute hired Patton, Harris, & Rust to perform boring samples on site. The results of the soils report concluded that a creek once flowed through the site. Riverbed sand was found in some of the borings. As a result, the soil was classified as a type C, and caissons had to be drilled for the Main Hangar foundation. For reasons like this, it is important to conduct a soils report prior to bidding on a project.

If a soils report is not drawn out, there are many risks involved in the projected cost of a buildings foundation. Although, a differing site conditions (DSC) clause can be placed in a contract to mitigate a contractor's risk for unforeseen site conditions. As for the new Air and Space Museum, Hensel Phelps contains this clause in their contract. This basically assures the contractor compensation from the owner in the event unforeseen conditions, not discovered prior to bidding, are encountered. A DMC clause is important because these conditions often lead to delays and impacts, which can dramatically increase the costs of completing a project.

When excavation began onsite, a large site wall was built for soil retainage. The wall was later used as a structural exterior wall for the first floor of public amenities. Also, in order to control erosion and settlement on site, silt fences and temporary filter barriers were placed around the site perimeters.



CLIENT INFORMATION

The Smithsonian Institution is the world's largest museum complex and research organization. Composed of 14 museums and the National Zoo in Washington, D.C., and 2 museums in New York City, the Smithsonian's exhibitions offer visitors a glimpse into its vast collection numbering over 142 million objects.

Since the opening of the original Air and Space Museum, the Institute has been planning on building a facility like the Steven F. Udvar-Hazy Center. Less than 10 percent of the National Collection of artifacts that reflect the history of flight are on display at any one time at the Museum in Washington, DC. Also, very large machines, like the Space Shuttle *Enterprise*, can never be trucked into the city.

On this project, Smithsonian is looking for a state of the art; high quality building that is able to preserve their remaining artifacts. This is shown in the amount of time, and money that was spent in design and planning of the new Air and Space Museum. Another issue that is important to SI is safety. This was a big criteria in selecting a general contractor for the job. The contractor that was chosen, Hensel Phelps Construction Company, has one of the best safety ratings in the industry.

Keys to completing this project to the owner's satisfaction integrate quality of work, and deadlines for completion. Superior quality is of course important for a museum that will hold a huge part of aviation history. Also, deadlines must be met to open the building on the 100th year anniversary of man's first flight. This means that the building must not only be complete, but the artifacts must be in place for the grand opening in honor of the Wright brothers' first flight at Kitty Hawk, North Carolina. The doors are set to open on December 17, 2003.