Request for Qualifications for Design Services/Project Brief

Project: **Genetic Medicine Building First Floor Lab Renovation**
The University of North Carolina at Chapel Hill

Advertised: **November 14, 2022**

Closing Date: **December 9, 2022**

The University of North Carolina at Chapel Hill is soliciting submittals from firms interested in providing design services for the following described project:

I. Project Description

This project intends to renovate laboratory space on the first floor of the Genetic Medicine Building for the Structural Genomics Consortium (SGC). The existing SGC lab space will be expanded to accommodate research growth. While this project will displace other users, no scope is anticipated related to their relocation. The anticipated SGC growth will requires up to eleven (11) additional fume hoods across the southern half of the floor plate. A preliminary study suggests that the building's exhaust system has adequate capacity to add this quantity of hoods (see attached). Additional air valves in the mechanical penthouse and new duct risers will be required.

A standard State Construction Office contract for full design services will be the form of agreement.

This project has been approved for Advance Planning spending authority by the UNC-Chapel Hill Board of Trustees. A preliminary total project cost of $2.3 million is targeted; however, additional detailed investigation during the initial design phase will more accurately set both the construction and total project budget.

The project delivery method has not been determined.

The anticipated designer selection schedule is shown below:

	Estimated Dates
Advertise RFP	11/14/2022
Pre-proposal Meeting **(ZOOM Meeting at 10:00am)**	11/21/2022
Proposals Submission	12/9/2022
Selection Committee's Short List Recommendations	12/13/2022
Interviews	1/13/2023
Board of Trustees Approval	1/26/2022
Execute Design Agreement	February 2023

II. Master Plans and Design & Construction Guidelines

The Master Plans and Design & Construction Guidelines will be the guiding documents for the design of this project. For more information on these documents, please visit the University's Facilities Services web site http://www.facilities.unc.edu/ under Plan & Policies pull down menu.

III. Project Scope

The design team shall:

- Assist in coordination of University stakeholders, such as Energy Services, Facilities Planning + Design, Construction Management, Facilities Engineering, Environmental Health and Safety, and other University support services.
- Prepare designs including Cost Analysis of multiple options. All contract documents shall be in compliance with provisions regarding the NC Building Codes.
- Respond to comments as part of the State Construction Office review process for Capital Planning Projects.
- Prepare Cost Estimates, Project Schedules, and Phasing Plans (as may be necessary) for the project.

IV. Design Team

The University expects prospective design teams and the individuals identified as members of those teams to have demonstrated experience in successfully delivering projects of a similar type and size. Design proposals should include a comprehensive listing of all consultants needed to address the specific needs of this project.

V. Selection Process

There will be a virtual (Zoom) pre-proposal meeting on the date listed in the table above. Interested designers will be able to discuss the issues & opportunities with the University's Facility Project Manager. Tours of the project site will NOT be hosted by UNC. Zoom meeting details are as follows:

Zoom Link:
https://unc.zoom.us/j/94503395346?from=addon

Meeting ID: 945 0339 5346
Call-In (US): (309)-205-3325

All proposals are due on the date listed in the table above at or before 3:00 PM. A Selection Committee will convene on **the date listed in the table above** to discuss the Design Teams' proposals and determine a short list for interviews. The Project Manager will then notify all teams as to the short-listed firms and schedule for interviews.

Designer Interviews will be scheduled for the date listed in the table above. The format of the virtual (Zoom) interview will consist of a ***30-minute*** presentation by the design team that is followed by a ***15-minute*** question and answer session. Each design team is expected to have present the person(s) from their firm(s) who will be responsible for leading the execution of this project. Zoom meeting details will be provided at the time of notification of shortlisting. Following the interviews, the Selection Committee will issue recommendations, in priority order, for the selection of the design team. This list will be presented on **date listed in the table above** to the University's Board of Trustees for approval.

VI. Submittals

The University of North Carolina at Chapel Hill seeks letters of interest from firms who have recent experience with similar projects. Please format all proposals utilizing an SF-330 format. The submittal must include descriptions of *(based on 01 NCAC 30J .0303 SELECTING CRITERIA)*:

1. Specialized or Appropriate Expertise in the type of project.
2. Past Performance on similar projects.
3. Adequate staff and Proposed Design & Consultant Team for the project.
4. Current Workload and State Projects awarded.
5. Proposed Design Approach for the project including design team and consultants.
6. Recent experience with Project Costs and Schedules.
7. Construction Administration capabilities.
8. Proximity to and familiarity with the area where project is located.
9. Record of successfully completed projects without major legal or technical problems.
10. Historically Underutilized Business (HUB) participation & utilization in proposed team structure; and who/how HUB designers were utilized on previous projects.
11. The team's recent experience with the NC State Construction Office (SCO).
12. Include current SF-330 Part II of lead firm and each proposed consultant.
13. Include information regarding lead firm's current license to practice in the State of North Carolina

To fairly evaluate the submittals and to better utilize the Selection Committee's review time, we request that only pertinent information relating to the specific selection criteria listed above be provided in Section H of the SF-330 formatted submittal. UNC-CH does not limit the quantity of pages for proposals.

Note: Only (1) one electronic PDF file of the submittal is required.

Please contact only the individual listed below for any matters related to this submittal. No other University staff, The University's Board of Trustees, or any university officials is to be contacted. All questions and project submittals shall be directed to:

Chris Johnson, AIA
Assistant Director, Planning & Project Management
Facilities Planning and Design
chris.johnson@fac.unc.edu

SEE ATTACHMENTS ON FOLLOWING PAGES.

2019 Campus Map/Master Plan

UNC GENETIC MEDICINE BUILDING FUME HOOD STUDY
Chapel Hill, North Carolina

Prepared for

The University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Prepared by

Newcomb & Boyd
CONSULTANTS AND ENGINEERS

Durham, North Carolina

September 7, 2022
22N222

Newcomb & Boyd
CONSULTANTS AND ENGINEERS

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I. EXECUTIVE SUMMARY

Newcomb & Boyd performed a study to assess the feasibility of adding (11) additional 8' fume hoods within the Genetic Medicine Building. The fume hood exhaust system is served by high induction exhaust fans F-P-1, F-P-2, and F-P-3, and exhaust air valves serving fume hoods are all located within the penthouse. A pre-Test and Balance (TAB) scope was drafted indicating locations for duct traverse velocity measurements as well as specific air valves requiring a differential pressure measurement. Pre-tab was then performed by Palmetto Air Balance, and the requested measurements were provided. This data was reviewed by Newcomb & Boyd in addition to original submittal documentation from the original construction, and it was determined that the system has spare capacity to serve the additional hoods. A site visit was also performed to review available shaft space in the penthouse, and it was determined that adequate space is available for fume exhaust ducts to serve the proposed hoods. In addition, a survey of all fume hoods currently in the building was performed by Newcomb & Boyd in which face velocity, hood size, and operational status was recorded.

We understand from conversations as a part of other feasibility study efforts related to the actual 1st floor fitup that the eventual additions may include some walk-in hoods in lieu of 8' goods as well as a few 4' fume hoods, however the findings of this study are still generally applicable; there is sufficient capacity available in the system. The building's supply air systems were also determined to have sufficient capacity.

END

II. INTRODUCTION

The University of North Carolina at Chapel Hill has expressed a desire to add (11) new 8' fume hoods on level 1 of the Genetic Medicine Building. Newcomb & Boyd performed a study and analysis to determine whether the existing system could handle such an add. The fume hood exhaust system consists of fans F-P-1, F-P-2, and F-P-3. These fans are Greenheck Vektor-MD-36 and operate together in a 3X1 array.

Rectangular fume exhaust duct branches extend from these fans throughout the penthouse, and all exhaust air valves serving fume hoods tap off these branches. The air valves are located within the penthouse, and round fume hood exhaust ducts drop down shafts to serve hoods throughout the building. The fume exhaust fan system typically operates with N+1 redundancy, but F-P-1 is currently not in operation. F-P-2 and F-P-3 operate in parallel to maintain system flow. We understand this is due to a vibration issue associated with this fan.

Palmetto Air Balance took measurements of the penthouse fume hood exhaust systems as part of a pre-TAB effort. These measurements included duct traverses at the exhaust fan inlets and bypass as well as at each main exhaust branch in the penthouse. Differential pressure measurements were originally taken across the two most upstream exhaust valves at each main duct branch. There were some outliers with the original differential pressure readings including some pressures that appeared abnormally low. For this reason, Palmetto returned to measure the differential pressure across all air valves in the penthouse. Newcomb and Boyd reviewed this test data to determine spare capacity within the exhaust fans as well as each exhaust branch.

A series of two site visits was also performed by Newcomb & Boyd as part of the feasibility study. The initial site visit focused primarily on the penthouse systems as site conditions were confirmed as compared to existing record drawings. Empty shaft space was also documented as potential locations to drop new fume hood ducts. During the second site visit, a complete survey of the building's fume hoods was performed. Newcomb & Boyd was given the master fume hood spreadsheet as an initial starting point, and the data was cross-referenced with the air valve TAB data provided by Palmetto. During the survey, floors 1 through 5 were walked, and the hood size and latest recorded face velocity were documented for each hood noted in the master spreadsheet. The hood numbers were also confirmed. Differential pressure data was also able to prove which hoods listed in the master spreadsheet had been decommissioned, and it was also useful in determining where hoods had been removed and the existing ducts were simply capped above ceiling.

END

III. OBSERVATIONS & ANALYSIS

<u>Penthouse Site Visit</u>

Newcomb & Boyd performed an initial site visit in the penthouse to confirm field conditions as compared to as-built drawings. Empty shaft space was recorded, and it was determined that ample free space is available in the existing shafts for new fume hood ducts. Refer to Appendix A for free shaft locations as observed in the field. Determining the number of hoods each shaft space could serve will be a future design task and will depend on how conservative the ductwork is sized. This will also depend on if all future air valves are located in the penthouse like the existing systems or if manifolded ducts drop down the shaft with air valves located on the floor.

Figure 1: Penthouse Air Valve Configuration

Figure 1 illustrates the typical air valve configuration within the penthouse. Fume exhaust ducts tap off the bottom of the main exhaust branches, and air valves are oriented in the vertical position for maintenance access. Shafts extend vertically from the penthouse down to the level 1 slab.

Figure 2: Fume Hood Shaft at Level 1

Figure 2 shows a fume hood shaft above ceiling at Level 1. The shaft extends down to the level 1 slab, and the hood exhaust duct penetrates the shaft wall. It is assumed that this condition exists for all the hood exhaust shafts. This will be verified as a future design task for all shafts intended to be used for the level 1 renovation. As shown in Figure 3, ducts serving hoods on the top floor were installed in the slab in lieu of within adjacent shafts.

Figure 3: Fume Hood Ducts at Penthouse Slab

This has contributed to the available free shaft space necessary to serve new hoods on level 1. As part of the site investigation, several of the plywood covers protecting the free shafts were removed to observe the shaft interiors. As part of a future design task, covers will be removed from all shafts that will be utilized in the renovation to verify they are free from obstruction.

Figure 4: Empty Shaft

As shown in Figure 4, the unoccupied shafts are mainly unobstructed. There was a slight concern that shafts may be subdivided with structural members in the field, but it was confirmed that this is not the case. As shown in Figure 5, it was also confirmed that the largest shaft size is 23” by 32”.

Figure 5: Existing Shaft Dimension

Many shafts are partially occupied but have space for additional ductwork. The shaft shown in Figure 6 is already occupied by ductwork upstream of air valves EV-P-46 and EV-P-47.

Figure 6: Partially Occupied Shaft

Ducts currently inhabiting the shaft are supported at the top of the shaft and at two additional levels. It is assumed that new ductwork would be supported at the top of the shaft and at the level containing the fume hoods served. Ductwork would need to be welded in segments and gradually dropped into the shaft. Based on field observations, it was determined that shafts in the southeast of the penthouse could accommodate 14-18 new hoods, and the shafts in the southwest of the penthouse could accommodate 8-12 hoods.

Fume Hood Survey

In addition to verifying field conditions in the penthouse, Newcomb & Boyd also performed a survey of all fume hoods in the building. A current master fume hood spreadsheet was provided by UNC, and a field investigation of each of these hoods was performed. The original penthouse air valve schedule was also used to cross reference the master hood spreadsheet. The original air valve schedule listed valves serving rooms that were not listed on the master spreadsheet. These rooms were also visited during the site investigation, and it was determined if the air valves had been reconfigured to serve other equipment or if the ductwork had been capped above ceiling. For each hood observed, the operational status, hood length, and face velocity from the most current EPS sticker were recorded. The results of this investigation are shown in Appendix B.

Table 1: Exhaust Valve Differential Pressures

Exhaust Valve	Airflow (cfm)	Room	Hood (Note 1)	Inlet SP (in. wg)	Outlet SP (in. wg)	dP (in. wg)
EV-P-35	660	1027	45903	-0.44	-3.32	2.88
EV-P-36	660	1027	45904	-0.57	-3.41	2.84
EV-P-61	660	1053	45909	-1.90	-3.23	1.33
EV-P-62	660	1053	45910	-0.42	-3.25	2.83
EV-P-51	660	1066	45907	-0.40	-2.44	2.04
EV-P-52	660	1066	45908	-0.31	-2.40	2.09
EV-P-14	660	1104	45905	-0.48	-2.74	2.26
EV-P-15	660	1104	45906	-0.42	-2.89	2.47
EV-P-42	785	2025	46925	-2.68	-2.68	0.00
EV-P-43	660	2025	NL	-2.64	-2.64	0.00
EV-P-44	660	2025	NL	-2.64	-2.65	0.01
EV-P-37	785	2027	45887	-0.68	-3.16	2.48
EV-P-38	660	2027	45888	-2.67	-2.68	0.01
EV-P-39	660	2027	45889	-2.66	-2.69	0.03
EV-P-28	660	2030	45890	-0.41	-3.60	3.19
EV-P-29	660	2030	45891	-0.43	-3.66	3.23
EV-P-30	785	2030	45892	-0.48	-3.43	2.95
EV-P-69	1080	2050	NL	-1.95	-2.81	0.86
EV-P-70	1080	2050	NL	-1.55	-2.81	1.26
EV-P-57	485	2057	45880	-1.00	-2.32	1.32
EV-P-58	485	2057	45881	-0.81	-2.25	1.44
EV-P-53	660	2064	45878	-0.67	-2.50	1.83
EV-P-54	660	2064	45879	-0.46	-2.51	2.05
EV-P-01	785	2101	NL	-1.80	-2.36	0.56
EV-P-02	660	2101	45899	-0.20	-2.88	2.68
EV-P-03	660	2101	45900	-0.18	-2.89	2.71
EV-P-18	660	2104	45896	-0.69	-2.99	2.30
EV-P-19	660	2104	45897	-0.30	-2.81	2.51
EV-P-20	785	2104	45898	-0.76	-2.75	1.99
EV-P-21	785	2107	45894	-2.63	-2.65	0.02
EV-P-22	660	2107	NL	-2.60	-2.61	0.01
EV-P-23	660	2107	NL	-2.59	-2.63	0.04
EV-P-40	485	3025	45872	-0.49	-2.81	2.32
EV-P-41	485	3025	45873	-0.49	-2.76	2.27
EV-P-26	485	3031	45870	-0.47	3.14	2.67
EV-P-27	485	3031	45871	-0.56	-3.17	2.61
EV-P-67	485	3050	45858	-0.68	-2.73	2.05

EV-P-68	485	3050	45859	-0.54	-2.73	2.19
EV-P-59	485	3057	45860	-0.82	-2.31	1.49
EV-P-60	485	3057	45861	-0.93	-2.41	1.48
EV-P-55	485	3063	45862	-0.86	-2.11	1.25
EV-P-56	485	3063	45863	-0.85	-2.17	1.32
EV-P-45	485	3069	45865	-0.69	-2.15	1.46
EV-P-46	485	3069	45864	-0.80	-2.18	1.38
EV-P-04	485	3101	45866	-1.05	-2.29	1.24
EV-P-05	485	3101	45867	-0.58	-2.31	1.73
EV-P-24	485	3108	45882	-2.54	-2.56	0.02
EV-P-25	485	3108	45883	-2.55	-2.56	0.01
EV-P-31	485	4029	45856	-0.48	-3.38	2.90
EV-P-32	485	4029	45857	-0.38	-3.34	2.96
EV-P-65	485	4053	45844	-0.47	-2.83	2.36
EV-P-66	485	4053	45845	-0.90	-2.89	1.99
EV-P-47	485	4066	45847	-0.42	-2.32	1.90
EV-P-48	485	4066	45846	-0.50	-2.53	2.03
EV-P-06	485	4102	45850	-0.52	-2.36	1.84
EV-P-07	485	4102	45849	-0.55	-2.39	1.84
EV-P-08	485	4102	45848	-0.51	-2.34	1.83
EV-P-09	485	4102	45851	-0.52	-2.51	1.99
EV-P-10	485	4103	45852	-0.55	-2.46	1.91
EV-P-11	485	4103	45853	-0.51	-2.52	2.01
EV-P-12	485	4103	45854	-0.43	-2.49	2.06
EV-P-13	485	4103	45855	-0.51	-2.53	2.02
EV-P-33	485	5029	45838	-0.39	3.23	2.84
EV-P-34	485	5029	45839	-0.40	-3.28	2.88
EV-P-63	485	5053	45836	-0.35	-2.80	2.45
EV-P-64	485	5053	45837	-0.44	-2.79	2.35
EV-P-49	485	5066	45842	-0.29	-2.40	2.11
EV-P-50	485	5066	45843	-0.65	-2.42	1.77
EV-P-16	485	5104	45840	-0.47	-2.72	2.25
EV-P-17	485	5104	45841	-0.52	-2.68	2.16
EV-P-76	870	1049H	48804	-0.88	-2.06	1.18
EV-P-77	870	1049H	48805	-0.98	-1.97	0.99
EV-P-84	870	1070A	49853	-0.53	-2.67	2.14
EV-P-85	870	1070A	49854	-0.75	-2.55	1.70
EV-P-83	870	1070G	49855	-0.55	-2.56	2.01
EV-P-86	870	1070G	49856	-0.67	-2.67	2.00
EV-P-75	870	1070H	48806	-0.69	-2.47	1.78
EV-P-78	870	1070H	48807	-1.42	-1.93	0.51

EV-P-81	860	2100G	49853	-2.71	-2.76	0.05
EV-P-82	860	2100G	49854	-2.70	-2.70	0.00
EV-P-79	860	2100H	49855	-2.67	-2.67	0.00
EV-P-80	860	2100H	49856	-2.65	-2.66	0.01
EV-P-72	485	UB05	NL	-0.75	-2.52	1.77
EV-P-71	785	UB46	45691	-0.67	-2.97	2.30
EV-P-73	Note 2					
EV-P-74	Note 2					

Notes:

1. UL – Unlisted. Original air valve schedule notes air valve serving a hood in the listed room, but current master spreadsheet does not list a hood.
2. An attempt was made to locate the air valve in penthouse, but the valve was not found.

Table 1 lists differential pressures measured by Palmetto across each air valve and also cross references the rooms served as noted in the original valve schedule with hoods listed in the master hood spreadsheet. Rooms listed in the table are as scheduled in the original design documents, and changes made since then are discussed below. This table was compiled prior to visiting the site, and valves with a negligible differential pressure were highlighted. The corresponding rooms were investigated during the survey to determine if the valves in question were still active. Valves EV-P-42 through EV-P-44 are scheduled to serve hoods in room 2025, and a negligible differential pressure was measured across each valve with a large negative static pressure on the inlet side. The master hood spreadsheet indicates that hoods in room 2025 were removed in 2016, and this was confirmed on site. The high negative pressure on the valve inlets indicates that these ducts are likely capped above ceiling.

EV-P-37 through EV-P-39 are scheduled to serve hoods in room 2027, and a similar condition as mentioned above is observed for valves EV-P-38 and EV-P-39 with a negligible differential pressure across the valves and a high negative static pressure at the valve inlet. The master hood spreadsheet indicates only one of three hoods remains active in room 2027, and this was confirmed during the survey. EV-P-01 through EV-P-03 were scheduled to serve hoods in room 2101. The master fume hood spreadsheet indicates that hoods 45899 and 45900 were removed in 2015, but it was observed on site that valves EV-P-02 and EV-P-03 previously serving these hoods are now ducted to biosafety cabinets in the room. A higher negative static pressure was measured at the inlet of EV-P-01, so this duct is likely closed with a damper above ceiling. If this is the case, this duct should be capped to avoid consuming excess energy.

The master spreadsheet lists one hood in room 2107 that was removed in 2016, but negligible differential pressure across EV-P-21 through EV-P-23 indicate that all three valves originally serving this room are now closed off. The associated ducts are likely capped above ceiling.

EV-P-24 and EV-P-25 were originally scheduled to serve hoods in room 3108 and were submitted as 8” valves at 485 cfm each in the original phoenix submittal. EV-P-69 and EV-P-70 were submitted as 12” valves at 1080 cfm each and scheduled to serve hoods in room 2050. However, no hoods are listed for room 2050 in the master spreadsheet.

A negligible differential pressure was measured across EV-P-24 and EV-P-25, but active hoods were observed in room 3108. It was determined that EV-P-24 and EV-P-25 were exchanged with EV-P-69 and EV-P-70 in the penthouse. This is shown in Figure 7 below. It seems that the hoods in room 3108 were originally 4’ hoods and could be adequately served by the 8” valves. The hoods are now 8’ hoods, so the 12” EV-P-69 and EV-P-70 were moved over to accommodate the larger airflow requirement.

Figure 7: Valves EV-P-22, EV-P-23, EV-P-69, and EV-P-70

Air valve EV-P-72 was originally scheduled to serve a hood in room UB05, but a hood is not listed on the master spreadsheet for that room. However, a large differential pressure was measured across the valve. It was observed onsite that the hood has been replaced with an exhaust grille in the ceiling.

END

IV. CALCULATIONS & TABLES

Pre-TAB Review of Exhaust Systems

Newcomb & Boyd performed a review of the TAB data provided by Palmetto including duct traverse readings and differential pressure measurements.

Table 2: Lab Exhaust Fan TAB Airflows

Total Penthouse EA, cfm	Total Bypass Airflow, cfm	Total System Airflow, cfm
49,159	21,132	70,291

Table 2 shows the airflows recorded at the exhaust fans during the pre-TAB effort by Palmetto. The total penthouse exhaust airflow comes from two duct traverses taken at the fan inlets. These locations are shown in Figure 8 below. At DT-01, 24,020 cfm was measured at a static pressure of -3.88 in wg. 25,139 cfm at a static pressure of -4.10 in wg was recorded at DT-02. The fans were originally scheduled and submitted with a static pressure capability of 6.0 in wg.

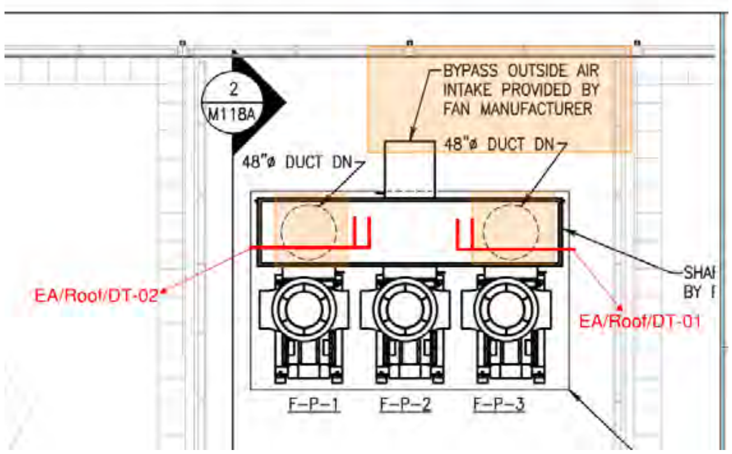


Figure 8: Exhaust Fan Traverse Locations

Table 3: Airflow Required for new Hoods

Number of Hoods	Hood Length, ft	Sash Height, ft	Face Velocity, fpm	Airflow per Hood, cfm	Total Airflow, cfm
11	8	1.5	100	1200	13,200

Table 3 illustrates the total airflow required for the addition of the (11) 8' hoods. This calculation assumes a maximum sash height of 18" and a required face velocity of 100 fpm for each hood. The resulting total airflow is 13,200 cfm as shown in the table. Per Table 2, with a bypass airflow of 21,132 cfm, there is ample capacity in the system to handle the 13,200 cfm required for the new hoods. 100 fpm is also a conservative value for face velocity as UNC will allow a face velocity as low as 80 fpm.

Table 4: Airflow Requirements for Supreme Air Walk-In Hood

Face Velocity, fpm	Airflow, cfm
80	1,040
100	1,290
120	1,550

Table 4 above shows published airflow requirements for a Supreme Air General-Purpose 8' Walk-In Fume Hood. At 80 fpm, based on the current bypass airflow, there is adequate airflow in the system to support up to 20 of these particular hoods. At 100 fpm, the system could support 16 of these. Different hood manufacturers have varying airflow requirements to achieve certain face velocities, but this example acts as a good indicator of the capacity available for system expansion. Using the calculated value of 1,200 cfm per hood, as shown in Table 3 above, the bypass airflow indicates that up to 17 new 8' hoods could be added to the system.

Figure 9 shows an excerpt from the original TAB report dated January 12, 2009, at substantial completion of the building.

	Specified	Actual
Total CFM - Fan	26,000	*
Total CFM - Outlet	---	---
Total Static Pressure* (External)	6.0	4.05
Inlet Pressure	---	-3.60
Discharge Pressure	---	.45
Fan RPM	1345	1371

Figure 9: Original TAB Data F-P-3

The actual airflow was not measured at this time, but the total static pressure measured is consistent with the results obtained from Palmetto's recent tests. Figure 10 below shows the fan curve from the original fan submittal. At the selected point, the fan operates at 1345 rpm with a flow of 26,000 cfm and 6.0 in of static pressure. Per Figure 9 above, the fan is actually rotating at 1371 rpm with a measured static pressure of 4.05 in wg. As shown on the fan curve, this static pressure would result in a flow of 31,000 cfm

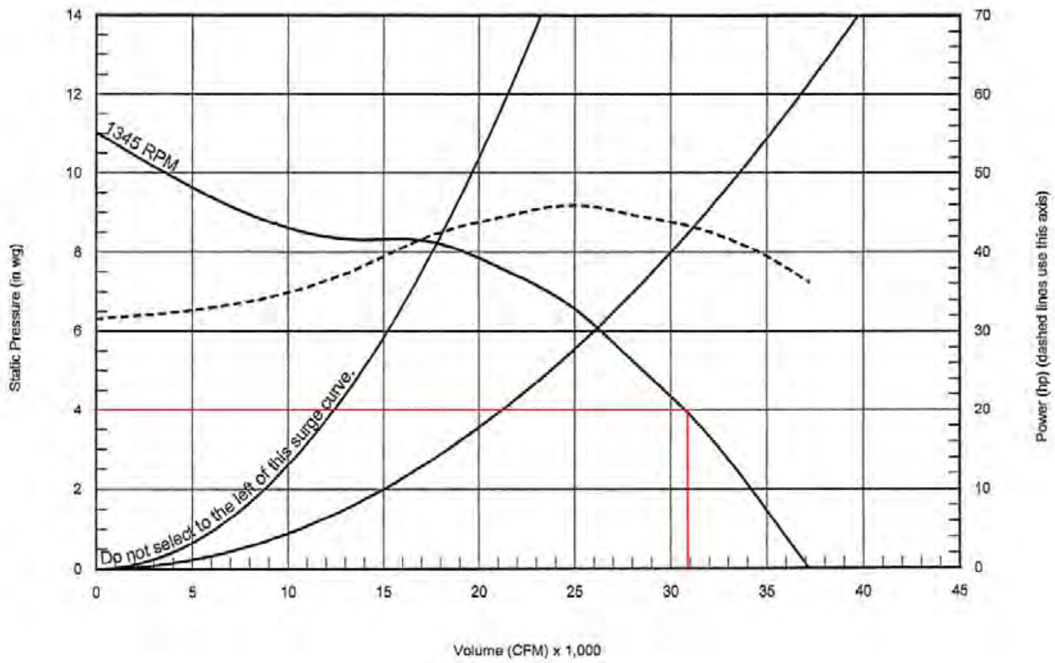


Figure 10: Original Fan Curve from Submittal at 4 in wg

Without a curve for operation at 1371 rpm, an exact flow cannot be determined, but it is assumed that this would be closer to 35,000 cfm which would explain the total system flow of 70,291cfm as shown in Table 2 with two fans in operation.

Fans F-P-1, F-P-2, and F-P-3 operate at constant speed with two fans running at a given time. A static pressure sensor is located at the fan intake plenum, and the outside air bypass damper modulates to maintain a constant static pressure at this sensor. The static pressure control setpoint has been determined to correspond with a flow producing a 3,000 fpm stack velocity at the fan discharge.

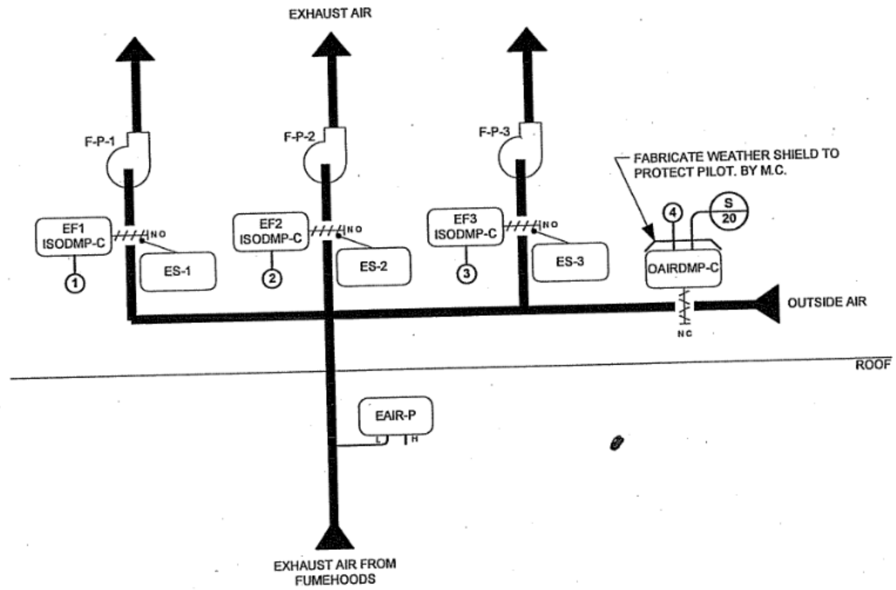


Figure 11: Submitted Johnson Controls Schematic

Figure 11 shows the originally submitted controls schematic for the high induction fan system by Johnson Controls.

As shown above in Table 1 containing differential pressure readings across each air valve, 52 out of the 84 valves in the penthouse had a pressure drop of 1.75 in wg or greater. This appears to indicate that the valves are closing to maintain their scheduled airflows. The valves were originally scheduled for a pressure drop not to exceed 0.6 in wg for energy efficiency and maximum controllability. Out of the 52 valves mentioned above, only 11 of these have an inlet static pressure greater than 0.6 in wg. The high pressure drop across the valves is driven by a highly elevated negative pressure downstream of the valves. This indicates that the fans are either running at too high a speed or the system is underloaded.

From Tables 2 and 3, current penthouse exhaust flow is 49,159 cfm, and an additional 13,200 cfm would be required for the 11 new hoods for a total flow of 62,359 cfm from the penthouse. Per Table 2, the total system flow could remain unchanged, and the bypass could modulate to maintain the same discharge velocity. The additional static pressure added to the system would need to be further evaluated during design, but assuming a highly conservative 2 in. wg increase, this would result in a new brake horsepower of 47.2hp per Equation 1 below.

$$BHP = \frac{Q * dP}{\mu * 6356}$$

Where Q is system flow of 35,000 cfm, dP is total static pressure of 6 in wg, and μ is assumed fan efficiency of 70%.

The fans are equipped with 50hp motors and currently operating at 42bph as measured by Palmetto. The calculated brake horsepower of 47.2 is still within the capabilities of the motors.

Table 5: Available Airflow in Existing Duct Branches

Duct Branch	Duct Width, in	Duct Height, in	Airflow, cfm	Velocity, fpm	Maximum Duct Velocity, fpm	Available Airflow, cfm	Airflow per Hood, cfm	Number of Hoods
NW	80	24	20,631	1,647	1800	3,369	1,200	2
SW	52	18	9,473	1,457	1800	2,227	1,200	1
NE	76	24	17,498	1,381	1800	5,302	1,200	4
SE	42	18	4,840	922	1800	4,615	1,200	3

Table 5 analyzes the available airflow in each penthouse duct branch measured by Palmetto. This calculation utilizes the flow and velocity in the branches as measured by Palmetto's duct traverses and assumes a maximum duct velocity of 1800 fpm. Refer to Appendix C for locations of measurements. The available airflow in each branch is calculated as the remaining flow before maximum velocity is reached. Assuming the previously stated 1200 cfm per 8' hood, the number of hoods per branch is then presented based on available airflow. The NW duct branch can accommodate two new 8' hoods before maximum velocity is reached. The SW branch can only accommodate one additional hood. The NE branch can handle an additional four hoods, and the SE branch has spare capacity for up to three hoods.

Based on the limitations presented above with the existing ductwork, it is assumed that a new duct branch will need to be routed in the penthouse to accommodate all 11 hoods, assuming the hoods are in close proximity. This new branch could either tap into one of the main 92X24 ducts close to the fan inlets or as a new roof penetration into the fan intake plenum. During the site investigations, it appeared that adequate free space was available in the penthouse to accommodate a new duct run. Routing and sizing of this duct would need to be further evaluated after determining exact locations of the new hoods. Depending on how hoods are placed, some hoods could be served by existing branches and others could be served by the new branch. New hoods could also be served by separate new branches on each side of the penthouse.

Figure 12 illustrates a potential location to tap into the existing 76X24 exhaust duct on the plan east side of the penthouse. Tapping in upstream of the 60X20 branch appears to be the ideal location based on space observed in the penthouse during site visits.

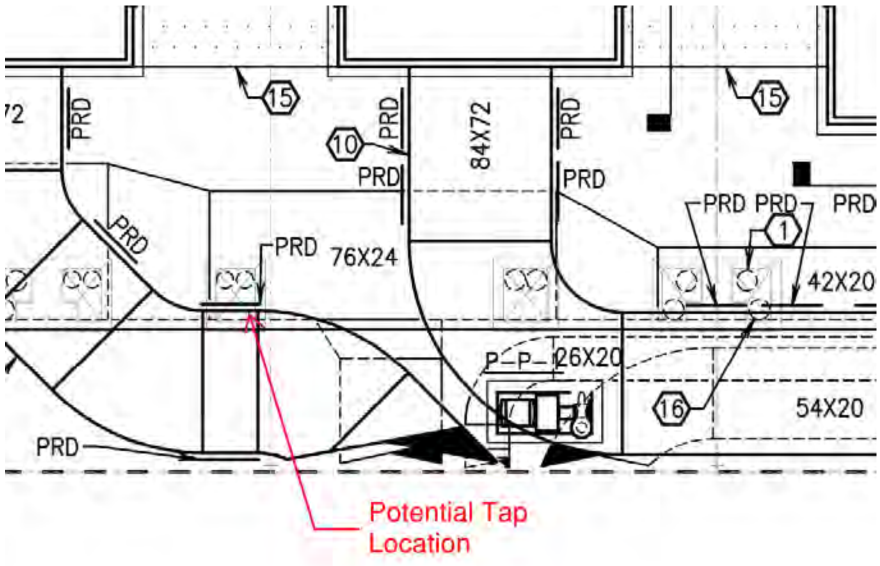


Figure 12: East Exhaust Branch Tap Location

Tapping into the existing 76X24 branch would raise the velocity in that section of duct to a value above 2,000 fpm, but this would have a negligible impact on the system as the duct immediately transitions to a 92X24 where velocity would drop down.

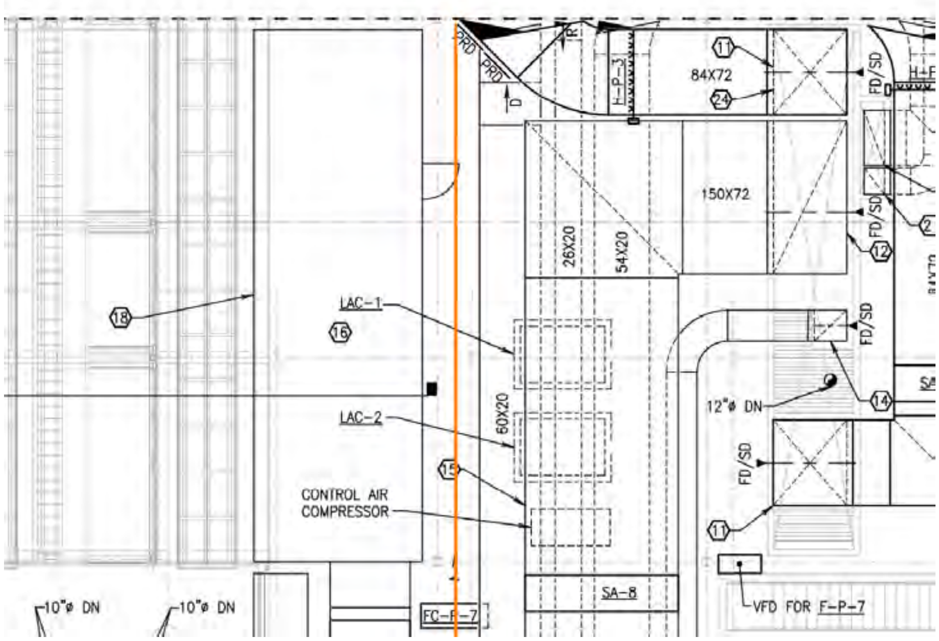


Figure 13: East Penthouse Proposed Routing

Figure 13 indicates a potential routing path in the south of the penthouse as observed on site. The space between the atrium smoke exhaust plenum and the 156X36 general exhaust main is relatively clear for a new branch duct to pass through.

Potential pathways were also observed on the west side of the penthouse, but it is understood that majority of hoods are planned to be located on the east side of Level 1.

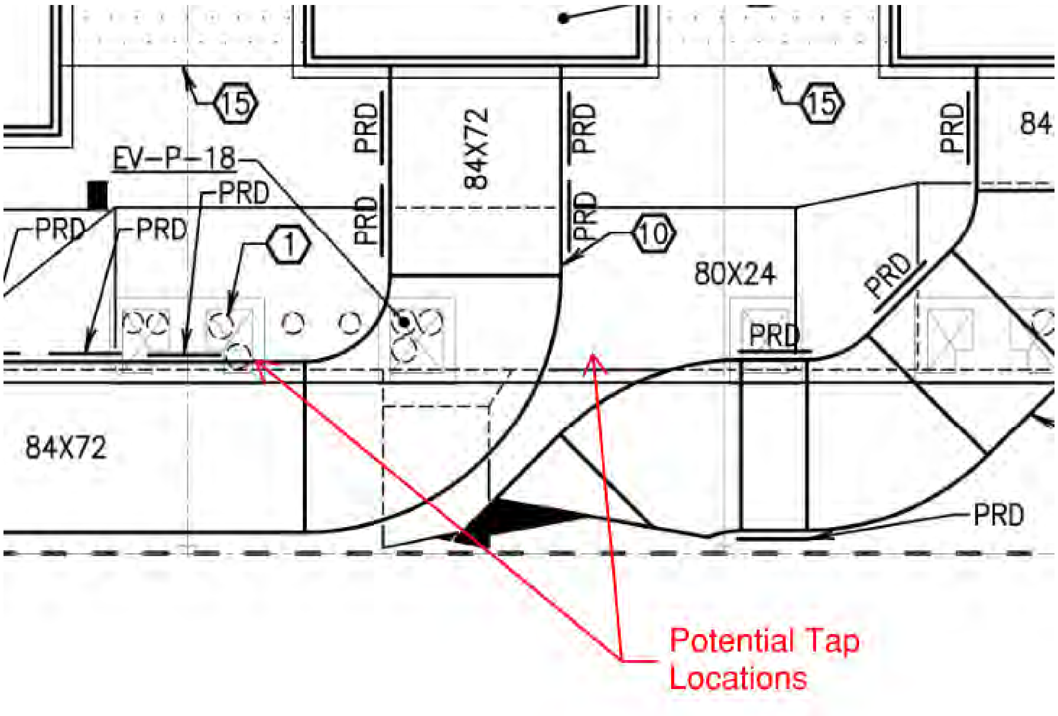


Figure 14: West Exhaust Branch Tap Location

Figure 14 illustrates potential locations for the new exhaust branch to tap into existing mains on the west side of the penthouse. According to observations on site, either upstream or downstream of the 52X18 branch in the 80X24 exhaust main appeared to be viable locations.

<u>Supply Systems Review</u>

To estimate available capacity for make-up air, UNC Building Services provided data on the recent operating conditions of lab air handling units. AHU-P-5 through AHU-P-12 simultaneously serve all lab floor areas through supply air risers that connect in a loop at each floor. AHUP-7, AHU-P-8, AHU-P-9, and AHU-P-10 manifold together to serve the northern half of the building, and AHU-P-5, AHU-P-6, and AHU-P-11 and AHU-P-12 serve the south half. Per Data provided by UNC, AHU-5, 6, 7, and 8 were operating at approximately 52% of maximum capacity.

Table 6: Available Make-up Air

Zone	Airflow per AHU, cfm	Total Supply Airflow, cfm	Approximate Current Operating Capacity	Total Available Make-Up Airflow, cfm
North	41,000	164,000	52%	78,720
South	41,000	164,000	52%	78,720

Operating status for air handlers serving the southern half of the building was not reported, but it is assumed that similar conditions exist. Table 3 above indicates that future fume hoods will require 13,200 cfm of make-up air, and as shown in Table 6, ample capacity for this volume of make-up air exists at the system level.

Also, the level 1 supply ducts at 24” X 52” were originally sized for high air change rates that have since been reduced. Additional data would need to be collected to determine current flow in these ducts, but it is reasonable to assume that sufficient flow can be achieved without exceeding the maximum velocity of the ducts. Both the southeast and southwest quadrants of level 1 were each originally designed for 8,800 cfm of general exhaust for a total of 17,600cfm. The original supply air for this space would have been equal to this exhaust airflow plus additional makeup air for original hoods. Considering the building underwent an airflow reduction effort in which air change rates in the labs were reduced, it is reasonable to assume that these supply ducts were sized for a much greater airflow than they are currently experiencing and could accommodate more air.

END

V. CONCLUSION

In conclusion, Newcomb & Boyd performed a study an analysis of the existing fume hood exhaust system at the UNC Chapel Hill Genetic Medicine Building. The goal of the analysis was to evaluate the ability of the system to handle the addition of (11) additional 8' fume hoods. The current system consists of fans F-P-1, F-P-2, and F-P-2. These fans are Greenheck Vector-MD-36 high induction plume fans, and they operate in parallel in a 3 X 1 array with a plenum and bypass outside air intake. The system was originally designed with N+1 redundancy so that only 2 out of 3 fans are operating at a given time with the third fan on standby. However, F-P-1 is out of service, so F-P-2 and F-P-3 are currently serving the building. The fans operate at constant volume, and the outside air bypass damper modulates to maintain the intake plenum static pressure setpoint corresponding to a discharge velocity of 3,000 fpm. All exhaust air valves in this system are located in the penthouse and serve fume hoods throughout the building.

As an initial step in the analysis, Palmetto Air Balance performed field measurements on the existing system as a pre-TAB effort. Velocity, flow, and static pressure were measured at the fan intakes. Velocity and flow were also measured in several branch ducts in the system. Differential pressure was originally measured across several air valves in the system, and later differential pressure measurements were taken for all air valves in the penthouse. This data was studied in order to understand the current operating conditions of the system. As measured, the exhaust flow from the penthouse was 49,159 cfm, and the bypass flow was 21,132 cfm. Also, as noted above, only 13,200 cfm would be necessary for the additional 11 hoods. As the required flow is much lower than the current bypass airflow, it was determined that the fans are able to accommodate the additional airflow. Using actual published data from a hood manufacturer, it was also determined that with the current bypass airflow, the system could accommodate up to 20 new 8' walk-in hoods at 80 fpm. A static pressure of 4 in wg was also measured at the fan inlet. The fans were scheduled and submitted for a flow of 26,000 cfm and 6 in wg of static pressure. As measured by Palmetto, the fans are currently operating at a static pressure 2 in wg lower than anticipated with a higher airflow. It was also measured that the brake horsepower is 42bph out of the nominal 50hp motors. It can be assumed that additional exhaust valves in the penthouse serving new hoods will add pressure drop to the system, but the exact pressure drop would need to be evaluated once fume hood locations and duct routing are determined. As shown above, a very conservative value of 6 in wg was used to show that the fans could achieve the proper airflow with a brake horsepower of 47bph. It is reasonable to assume that the additional ductwork would not result in such a large pressure drop, but this value can serve as a measure of how much additional load the system could carry.

Part of the test data provided by Palmetto included traverse measurement indicating velocity and flow in various branch ducts in the penthouse. These were used to estimate the number of hoods each branch could accommodate before reaching a maximum velocity of 1800 fpm. While the fan system was determined to have ample spare capacity, the existing ductwork presents the limiting factor for expansion as the majority of the existing ducts are already approaching maximum velocity. An additional branch will likely need to be routed in the penthouse to serve the additional hoods. However, it was observed in the field that space exits to accomplish this.

As an additional piece of the analysis, Newcomb & Boyd performed a survey of all fume hoods in the building. A current master fume hood spreadsheet was provided by UNC, and operational status, hood size, and the last recorded face velocity were reported for each listing. Differential pressure measurements across penthouse air valves proved helpful in this endeavor as high inlet pressures were used to determine which hoods had been taken out of service with a capped duct above ceiling. Hoods noted to be decommissioned in the master spreadsheet were confirmed in the field, and note was taken of air valves which had been repurposed to exhaust other equipment or ceiling grilles.

A site survey of the penthouse was also performed to assess spare shaft space. While some shafts have been filled over the years since the original construction, many shafts remain either completely or partially free. It was determined that the southwest shafts could potentially have space for 8-12 new hoods, and the southeast shafts could serve 14-18 hoods. As previously stated, the exact number of hoods per shaft will depend on ductwork sizing and whether air valve location is constrained to the penthouse.

As an overall result of the study, it was determined that the fume hood system has ample spare airflow and static pressure capability to serve the proposed hoods. There is also plenty of shaft space available, but the available space is spread throughout the penthouse. Additional ductwork will likely need to be routed in the penthouse due to velocity constraints, but fume hood ducts may also need to route across a floor depending on the density of future hoods and final location. It was also determined that lab air handling units have the spare capacity to support the new hoods.

END

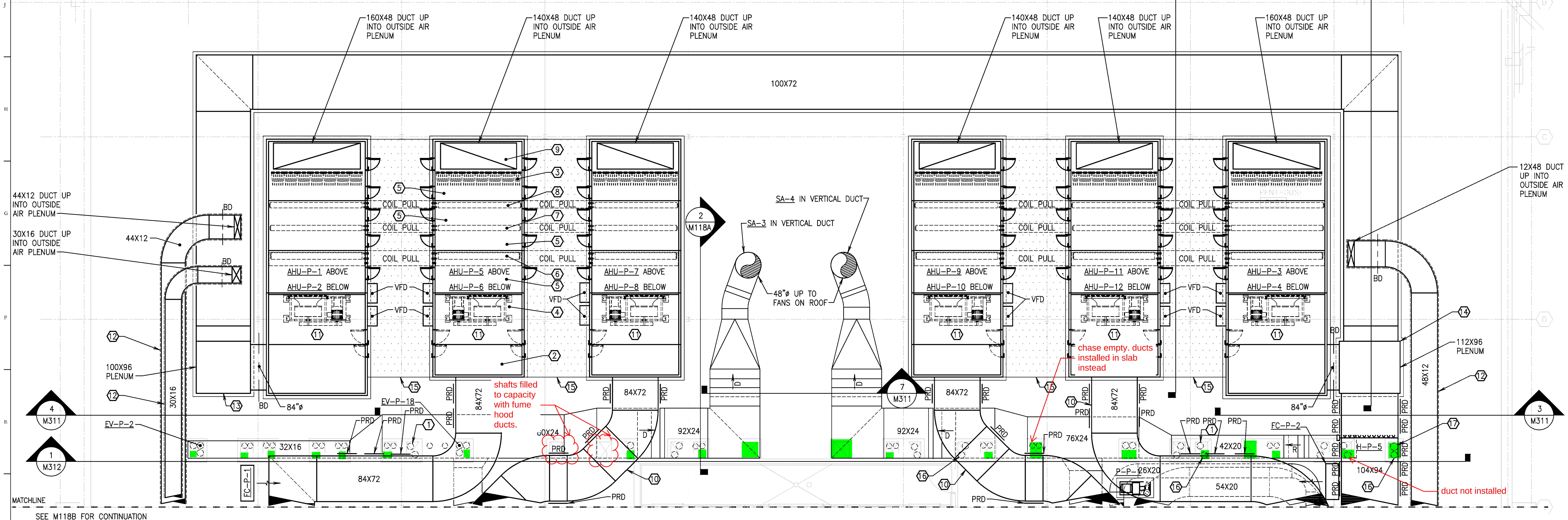
VI. APPENDICES

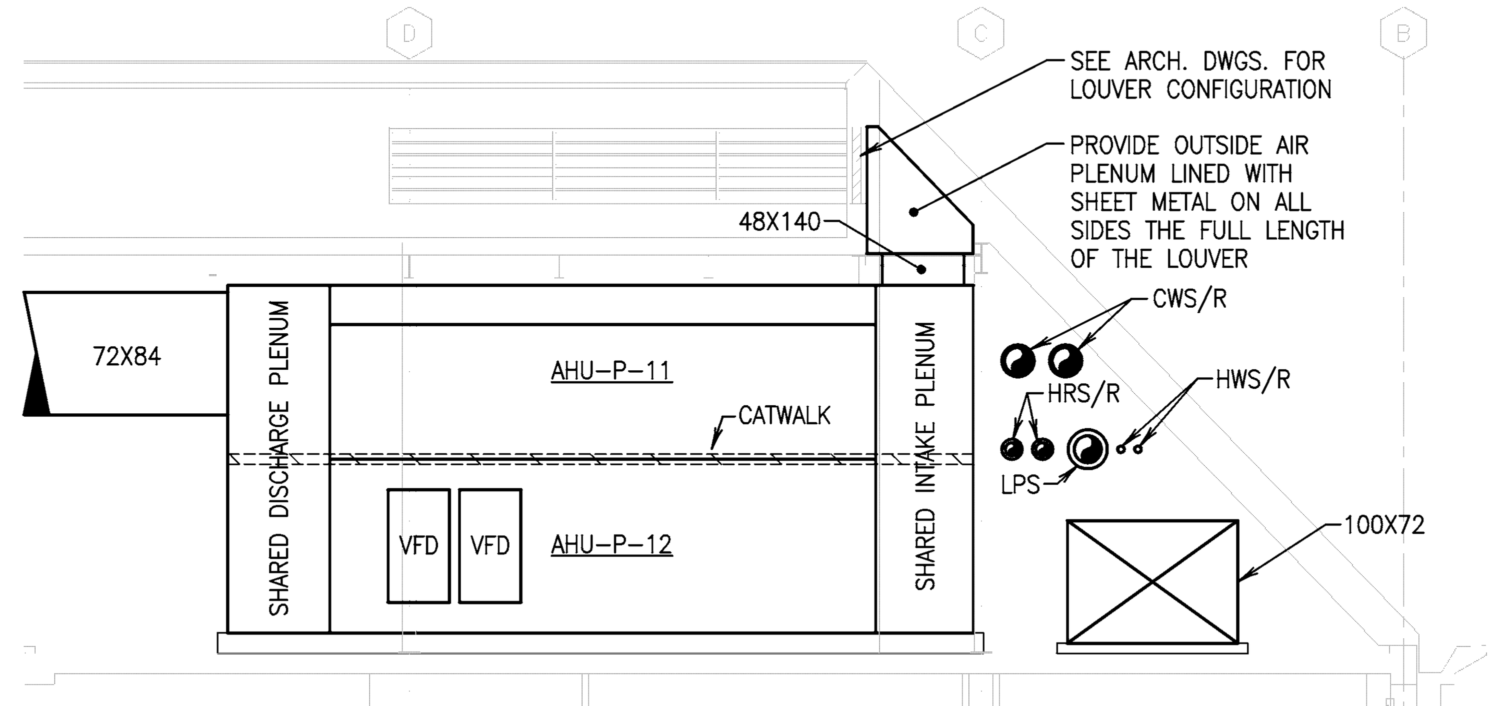
END

BZH/jvm
20220805 Description of Systems.docx

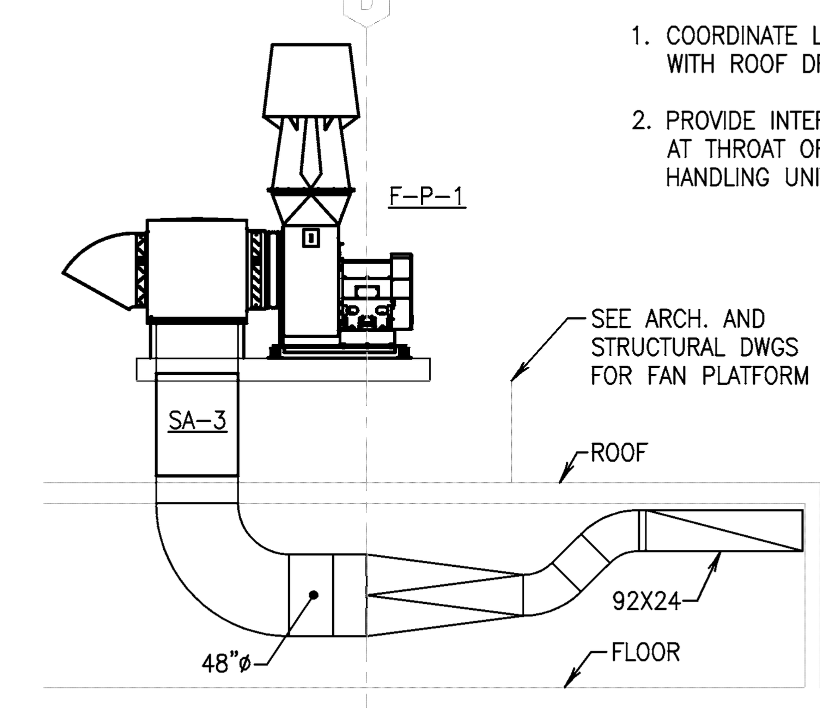
Appendix A: Available Penthouse Shaft Space

= empty shaft space





1 M118A HVAC PENTHOUSE SECTION



2 M118A HVAC PENTHOUSE SECTION

GENERAL NOTES:

1. COORDINATE LOCATIONS OF DUCTS WITH ROOF DRAINS.
2. PROVIDE INTERNAL SMOKE DAMPERS AT THROAT OF PLENUM FANS IN AIR HANDLING UNITS.

KEYNOTES:

1. FUME HOOD EXHAUST DUCT UP FROM LAB FLOORS. FUME HOOD EXHAUST VALVE INSTALLED IN VERTICAL WITH CENTERLINE AT 4'0" AFF. (TYP)
2. SHARED DISCHARGE PLENUM (TYP)
3. FILTERS (TYP)
4. PLENUM FAN (TYP)
5. ACCESS (TYP)
6. COOLING COIL (TYP)
7. STEAM PREHEAT COIL (TYP)
8. HEAT RECOVERY COIL (TYP)
9. SHARED INTAKE PLENUM (TYP)
10. MOUNT DUCTWORK TIGHT TO STRUCTURE
11. TWO AIR HANDLING UNITS STACKED VERTICALLY
12. INSULATE THE STAIR PRESSURIZATION DUCTWORK LOCATED IN THE PENTHOUSE WITH FIRE-RESISTANT DUCT WRAP.
13. PLENUM HEIGHT SHALL BE DETERMINED BY THE ELEVATION OF THE 84"ø SUPPLY DUCT.
14. PLENUM HEIGHT SHALL BE DETERMINED BY THE ELEVATION OF THE 104X96 SUPPLY DUCT.
15. PROVIDE CATWALK FOR ACCESS TO THE TOP AIR HANDLING UNIT.
16. 12"ø DN. CAP DUCT AT PENTHOUSE SLAB.
17. 14"ø DN. CAP DUCT AT PENTHOUSE SLAB.

RECORD CONSTRUCTION DRAWING

THIS DRAWING REPRESENTS A RECORD OF THE PROJECT DESIGN AND CONSTRUCTION. GENERAL INFORMATION REGARDING AS-INSTALLED CONDITIONS PROVIDED BY THE CONTRACTOR HAS BEEN INCORPORATED INTO THIS DRAWING, BUT THE ACCURACY AND COMPLETENESS OF THAT INFORMATION HAS NOT BEEN VERIFIED. REFER TO THE CONTRACTOR'S RECORD SHOP DRAWINGS FOR EXACT SYSTEMS INFORMATION.

PARTITION LEGEND

1 HR FIRE-RATED PARTITION
2 HR FIRE-RATED PARTITION

KEY PLAN

PROJECT NORTH

SEAL

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 027058 JEFFREY L. LINDE 4-1-11

REVISION: RFP 04/13/07

LORD·AECK·SARGENT

Newcomb & Boyd

SHEET TITLE: HVAC DUCTWORK PENTHOUSE FLOOR PLAN NORTH

SCALE: 1/16" = 1'-0"

DRAWN BY: TZM

JOB NAME: UNC CHAPEL HILL GENETIC MEDICINE BUILDING PHASE 2

LOCATION: CHAPEL HILL, NORTH CAROLINA

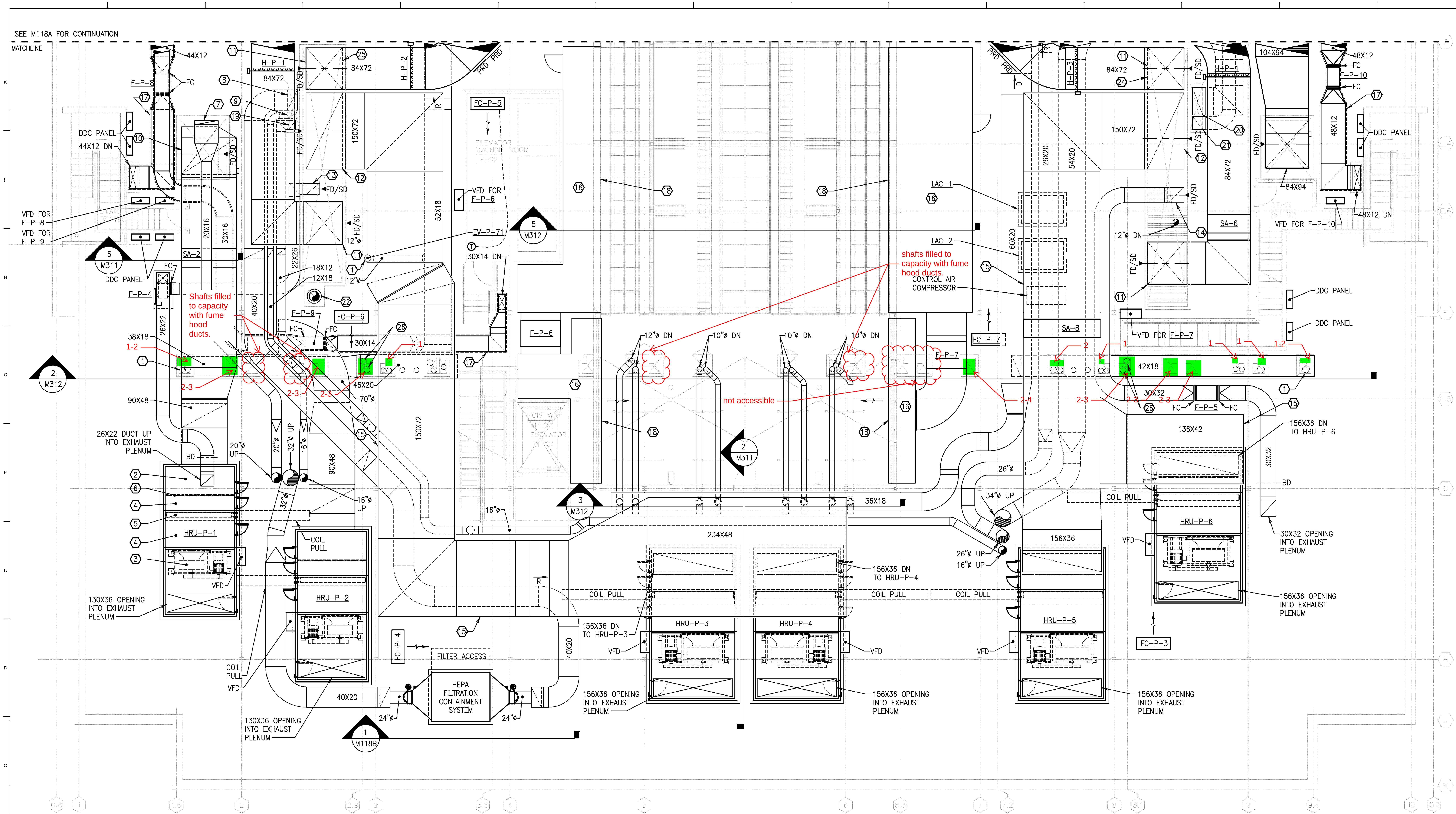
ISSUE DATE: 11/16/09

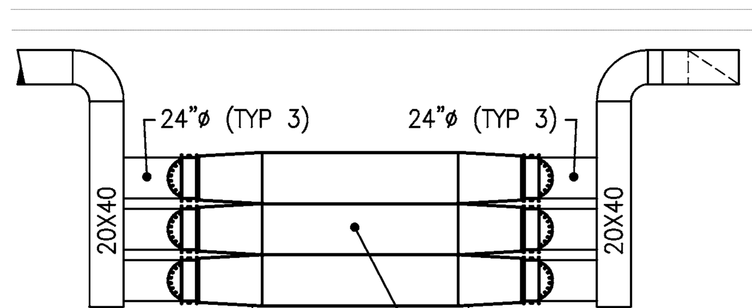
JOB NO.: 21042-01

DWG. NO.: M118A

RECORD DOCUMENTS - NOVEMBER 16, 2009

SEE M118A FOR CONTINUATION





1 HVAC PENTHOUSE SECTION M118B

GENERAL NOTES:

1. COORDINATE LOCATIONS OF DUCTS WITH ROOF DRAINS.
2. PROVIDE INTERNAL BACKDRAFT DAMPERS AT THROAT OF PLENUM FANS IN HEAT RECOVERY UNITS.

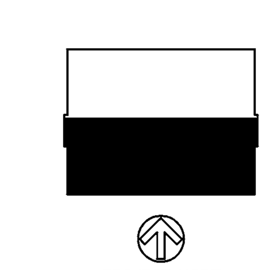
KEYNOTES:

1. FUME HOOD EXHAUST DUCT UP FROM LAB FLOORS. FUME HOOD EXHAUST VALVE INSTALLED IN VERTICAL WITH CENTERLINE AT 4'0" AFF. (TYP)
2. INTAKE PLENUM (TYP)
3. PLENUM FAN (TYP)
4. ACCESS (TYP)
5. HEAT RECOVERY COIL (TYP)
6. FILTERS (TYP)
7. 46X8 DN
8. 20X40 DN
9. 18X12 DN
10. 108X72 UP & 72X94 DN
11. 72X84 DN
12. 72X150 DN
13. 26X22 DN
14. 32X30 DN
15. MOUNT DUCTWORK TIGHT TO STRUCTURE.
16. PLENUM FULL LENGTH OF LOUVER AND FULL HEIGHT TO STRUCTURE
17. INSULATE THE STAIR PRESSURIZATION DUCTWORK LOCATED IN THE PENTHOUSE WITH FIRE-RESISTANT DUCT WRAP.
18. SEE ARCH. DWGS FOR LOUVER CONFIGURATION.
19. 12X18 DN
20. 20X54 DN
21. 20X26 DN
22. 20"ø GENERATOR EXHAUST DUCT UP
23. NOT USED
24. SA-5 IN VERTICAL DUCT
25. SA-7 IN VERTICAL DUCT
26. 12"ø DN. CAP DUCT AT PENTHOUSE SLAB.

RECORD CONSTRUCTION DRAWING

THIS DRAWING REPRESENTS A RECORD OF THE PROJECT DESIGN AND CONSTRUCTION. GENERAL INFORMATION REGARDING AS-INSTALLED CONDITIONS PROVIDED BY THE CONTRACTOR HAS BEEN INCORPORATED INTO THIS DRAWING, BUT THE ACCURACY AND COMPLETENESS OF THAT INFORMATION HAS NOT BEEN VERIFIED. REFER TO THE CONTRACTOR'S RECORD SHOP DRAWINGS FOR EXACT SYSTEMS INFORMATION.

KEY PLAN



SEAL

PARTITION LEGEND

1 HR FIRE-RATED PARTITION
2 HR FIRE-RATED PARTITION

REVISION:
REVISED JULY 14, 2005
RFP 04/19/07

LORD·AECK·SARGENT

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SHEET TITLE
HVAC DUCTWORK
PENTHOUSE FLOOR PLAN SOUTH

SCALE (U.N.O.) 0 8 16FT

DRAWN BY TZM

JOB NAME
UNC CHAPEL HILL
GENETIC MEDICINE BUILDING
PHASE 2

LOCATION
CHAPEL HILL, NORTH CAROLINA

ISSUE DATE 11/16/09

JOB. NO. 21042-01

DWG. NO. M118B

RECORD DOCUMENTS - NOVEMBER 16, 2009

Appendix B: Fume Hood Survey										
Hood	Room	Hood Size	Active?	Face Velocity (sticker)	Air Valve	Valve Inlet SP, in wg	Valve Outlet SP, in wg	Valve DP, in wg	Branch	Notes
--	2101	--	--	--	EV-P-01	-1.80	-2.36	0.56	NW	Valve previously served hood in room 2101. Assumed duct is closed with damper above ceiling.
45899	2101	--	no	--	EV-P-02	-0.20	-2.88	2.68	NW	Hood removed. Valve now ducted to BSC
45900	2101	--	no	--	EV-P-03	-0.18	-2.89	2.71	NW	Hood removed. Valve now ducted to BSC
45866	3101	4	yes	90	EV-P-04	-1.05	-2.29	1.24	NW	
45867	3101	4	yes	103	EV-P-05	-0.58	-2.31	1.73	NW	
45850	4102	4	yes	155	EV-P-06	-0.52	-2.36	1.84	NW	
45849	4102	4	yes	96	EV-P-07	-0.55	-2.39	1.84	NW	
45848	4102	4	yes	106	EV-P-08	-0.51	-2.34	1.83	NW	
45851	4102	4	yes	95	EV-P-09	-0.52	-2.51	1.99	NW	
45852	4103	4	yes	98	EV-P-10	-0.55	-2.46	1.91	NW	
45853	4103	4	yes	87	EV-P-11	-0.51	-2.52	2.01	NW	
45854	4103	4	yes	89	EV-P-12	-0.43	-2.49	2.06	NW	
45855	4103	4	yes	111	EV-P-13	-0.51	-2.53	2.02	NW	
45905	1104	4	yes	99	EV-P-14	-0.48	-2.74	2.26	NW	
45906	1104	4	yes	89	EV-P-15	-0.42	-2.89	2.47	NW	
45840	5104	4	yes	109	EV-P-16	-0.47	-2.72	2.25	NW	
45841	5104	4	yes	113	EV-P-17	-0.52	-2.68	2.16	NW	
45896	2104	5	yes	86	EV-P-18	-0.69	-2.99	2.30	NW	
45897	2104	4	yes	72	EV-P-19	-0.30	-2.81	2.51	NW	
45898	2104	4	yes	101	EV-P-20	-0.76	-2.75	1.99	NW	
45894	2107	--	no	--	EV-P-21	-2.63	-2.65	0.02	NW	Hood removed, and valve likely inactive, but further analysis not possible as AIDS lab is not accessible.
--	2107	--	--	--	EV-P-22	-2.60	-2.61	0.01	NW	Valve likely inactive, but further analysis not possible as AIDS lab is not accessible.
--	2107	--	--	--	EV-P-23	-2.59	-2.63	0.04	NW	Valve likely inactive, but further analysis not possible as AIDS lab is not accessible.
--	--	--	--	--	EV-P-24	-2.54	-2.56	0.02	SE	Valve previously served hood in room 3108 but has been exchanged wsith vavle EV-P-69. Current duct upstream of EV-P-24 assumed to be capped above ceiling.
--	--	--	--	--	EV-P-25	-2.55	-2.56	0.01	SE	Valve previously served hood in room 3108 but has been exchanged wsith vavle EV-P-70. Current duct upstream of EV-P-25 assumed to be capped above ceiling.
45870	3031	4	yes	95	EV-P-26	-0.47	3.14	2.67	NE	
45871	3031	4	yes	86	EV-P-27	-0.56	-3.17	2.61	NE	
45890	2030	4	yes	101	EV-P-28	-0.41	-3.60	3.19	NE	
45891	2030	4	yes	110	EV-P-29	-0.43	-3.66	3.23	NE	
45892	2030	5	yes	129	EV-P-30	-0.48	-3.43	2.95	NE	
45856	4029	4	yes	116	EV-P-31	-0.48	-3.38	2.90	NE	
45857	4029	4	yes	104	EV-P-32	-0.38	-3.34	2.96	NE	
45838	5029	4	yes	119	EV-P-33	-0.39	3.23	2.84	NE	
45839	5029	4	yes	118	EV-P-34	-0.40	-3.28	2.88	NE	

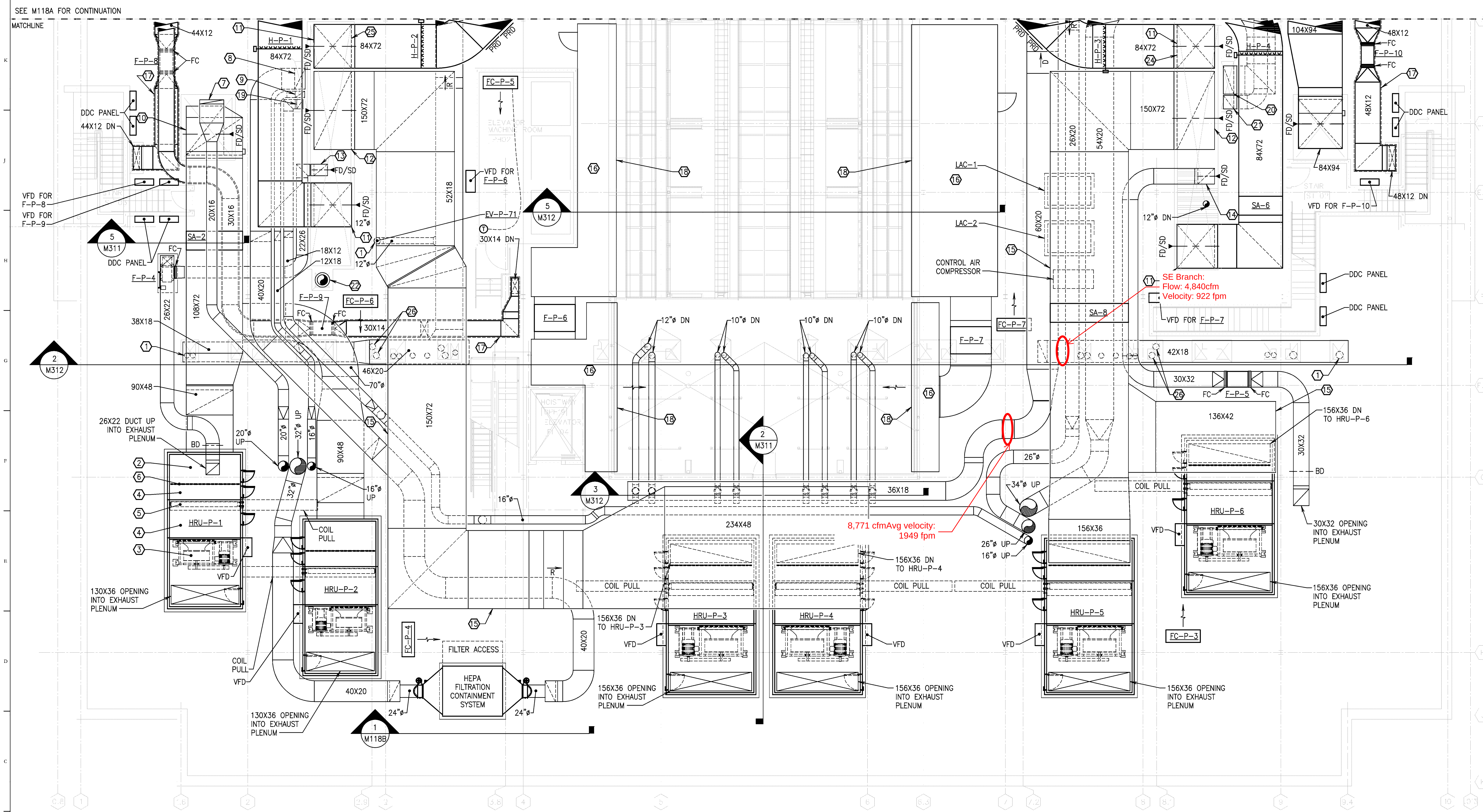
45903	1027	4	yes	110	EV-P-35	-0.44	-3.32	2.88	NE	
45904	1027	4	yes	120	EV-P-36	-0.57	-3.41	2.84	NE	
45887	2027	5	yes	102	EV-P-37	-0.68	-3.16	2.48	NE	
45888	2027	--	no	--	EV-P-38	-2.67	-2.68	0.01	NE	Hood removed. Duct assumed to be capped above ceiling.
45889	2027	--	no	--	EV-P-39	-2.66	-2.69	0.03	NE	Hood Removed. Duct assumed to be capped above ceiling
45872	3025	4	yes	103	EV-P-40	-0.49	-2.81	2.32	NE	
45873	3025	4	yes	99	EV-P-41	-0.49	-2.76	2.27	NE	
45885	2025	--	no	--	EV-P-42	-2.68	-2.68	0.00	NE	Hood Removed. Duct assumed to be capped above ceiling.
45886	2025	--	no	--	EV-P-43	-2.64	-2.64	0.00	NE	Hood Removed. Duct assumed to be capped above ceiling.
--	2025	--	--	--	EV-P-44	-2.64	-2.65	0.01	NE	No hood listed in master spreadsheet, but inferred from original exhaust valve schedule that 3 hoods once existed in room 2025. Duct assumed to be capped above ceiling.
45865	3069	4	yes	99	EV-P-45	-0.69	-2.15	1.46	SW	
45864	3069	4	yes	105	EV-P-46	-0.80	-2.18	1.38	SW	
45847	4066	4	yes	95	EV-P-47	-0.42	-2.32	1.90	SW	
45846	4066	4	yes	115	EV-P-48	-0.50	-2.53	2.03	SW	
45842	5066	4	yes	110	EV-P-49	-0.29	-2.40	2.11	SW	
45843	5066	4	yes	106	EV-P-50	-0.65	-2.42	1.77	SW	
45907	1066	4	yes	123	EV-P-51	-0.40	-2.44	2.04	SW	
45908	1066	4	yes	134	EV-P-52	-0.31	-2.40	2.09	SW	
45878	2064	4	yes	90	EV-P-53	-0.67	-2.50	1.83	S	
45879	2064	4	yes	98	EV-P-54	-0.46	-2.51	2.05	S	
45862	3063	4	yes	129	EV-P-55	-0.86	-2.11	1.25	S	
45863	3063	4	yes	126	EV-P-56	-0.85	-2.17	1.32	S	
45880	2057	4	yes	141	EV-P-57	-1.00	-2.32	1.32	S	
45881	2057	4	yes	109	EV-P-58	-0.81	-2.25	1.44	S	
45860	3057	4	yes	97	EV-P-59	-0.82	-2.31	1.49	S	
45861	3057	4	yes	110	EV-P-60	-0.93	-2.41	1.48	S	
45909	1053	4	yes	98	EV-P-61	-1.90	-3.23	1.33	SE	
45910	1053	4	yes	124	EV-P-62	-0.42	-3.25	2.83	SE	
45836	5053	4	yes	85	EV-P-63	-0.35	-2.80	2.45	SE	
45837	5053	4	yes	102	EV-P-64	-0.44	-2.79	2.35	SE	
45844	4053	4	yes	90	EV-P-65	-0.47	-2.83	2.36	SE	
45845	4053	4	yes	90	EV-P-66	-0.90	-2.89	1.99	SE	
45858	3050	4	yes	110	EV-P-67	-0.68	-2.73	2.05	SE	
45859	3050	4	yes	101	EV-P-68	-0.54	-2.73	2.19	SE	
45882	3108	8	yes	122	EV-P-69	-1.95	-2.81	0.86	SE	
45883	3108	8	yes	90	EV-P-70	-1.55	-2.81	1.26	SE	
45691	UB46	5	yes	99	EV-P-71	-0.67	-2.97	2.30	NW	
--	UB05	--	no	--	EV-P-72	-0.75	-2.52	1.77	SW	Hood has been removed, and valve now serves an exhaust grille in ceiling.
--	--	--	--	--	EV-P-73	--	--	--	--	Unable to locate valve in penthouse.
--	--	--	--	--	EV-P-74	--	--	--	--	Unable to locate valve in penthouse.
48806	1070H	8	yes	132	EV-P-75	-0.69	-2.47	1.78	SW	
48804	1049H	8	yes	104	EV-P-76	-0.88	-2.06	1.18	SE	
48807	1070H	8	yes	120	EV-P-77	-0.98	-1.97	0.99	SW	
48805	1049H	8	yes	98	EV-P-78	-1.42	-1.93	0.51	SE	

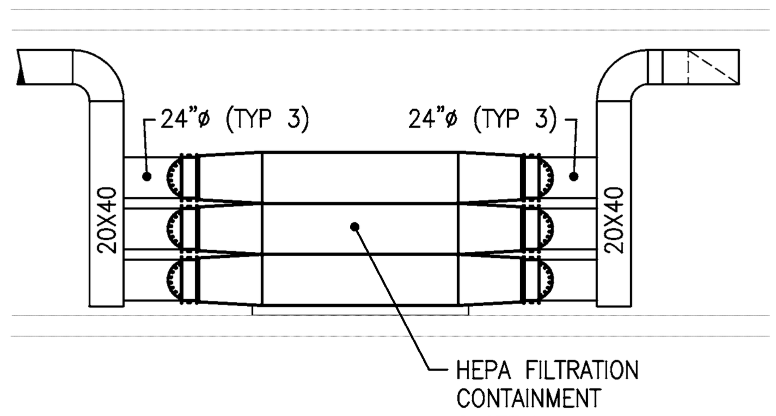
--	2100H	--	--	--	EV-P-79	-2.67	-2.67	0.00	--	Hood removed. Duct assumed to be capped above ceiling.
--	2100H	--	--	--	EV-P-80	-2.65	-2.66	0.01	--	Hood removed. Duct assumed to be capped above ceiling.
49854	2100G	--	no	--	EV-P-81	-2.71	-2.76	0.05	--	Hood removed. Duct assumed to be capped above ceiling.
49853	2100G	--	no	--	EV-P-82	-2.70	-2.70	0.00	--	Hood removed. Duct assumed to be capped above ceiling.
49854	1070A	8	yes	103	EV-P-83	-0.55	-2.56	2.01	SW	
49853	1070A	8	yes	111	EV-P-84	-0.53	-2.67	2.14	SW	
49855	1070B	8	yes	105	EV-P-85	-0.75	-2.55	1.70	SW	
49856	1070B	8	yes	115	EV-P-86	-0.67	-2.67	2.00	SW	

Appendix C: Duct Traverse Measurements

SEE M118A FOR CONTINUATION

MATCHLINE





1 M118B HVAC PENTHOUSE SECTION

GENERAL NOTES:

1. COORDINATE LOCATIONS OF DUCTS WITH ROOF DRAINS.
2. PROVIDE INTERNAL BACKDRAFT DAMPERS AT THROAT OF PLENUM FANS IN HEAT RECOVERY UNITS.

KEYNOTES:

1. FUME HOOD EXHAUST DUCT UP FROM LAB FLOORS. FUME HOOD EXHAUST VALVE INSTALLED IN VERTICAL WITH CENTERLINE AT 4'0" AFF. (TYP)
2. INTAKE PLENUM (TYP)
3. PLENUM FAN (TYP)
4. ACCESS (TYP)
5. HEAT RECOVERY COIL (TYP)
6. FILTERS (TYP)
7. 46X8 DN
8. 20X40 DN
9. 18X12 DN
10. 108X72 UP & 72X94 DN
11. 72X84 DN
12. 72X150 DN
13. 26X22 DN
14. 32X30 DN
15. MOUNT DUCTWORK TIGHT TO STRUCTURE.
16. PLENUM FULL LENGTH OF LOUVER AND FULL HEIGHT TO STRUCTURE
17. INSULATE THE STAIR PRESSURIZATION DUCTWORK LOCATED IN THE PENTHOUSE WITH FIRE-RESISTANT DUCT WRAP.
18. SEE ARCH. DWGS FOR LOUVER CONFIGURATION.
19. 12X18 DN
20. 20X54 DN
21. 20X26 DN
22. 20"ø GENERATOR EXHAUST DUCT UP
23. NOT USED
24. SA-5 IN VERTICAL DUCT
25. SA-7 IN VERTICAL DUCT
26. 12"ø DN. CAP DUCT AT PENTHOUSE SLAB.

PARTITION LEGEND

1 HR FIRE-RATED PARTITION
2 HR FIRE-RATED PARTITION

RECORD CONSTRUCTION DRAWING

THIS DRAWING REPRESENTS A RECORD OF THE PROJECT DESIGN AND CONSTRUCTION. GENERAL INFORMATION REGARDING AS-INSTALLED CONDITIONS PROVIDED BY THE CONTRACTOR HAS BEEN INCORPORATED INTO THIS DRAWING, BUT THE ACCURACY AND COMPLETENESS OF THAT INFORMATION HAS NOT BEEN VERIFIED. REFER TO THE CONTRACTOR'S RECORD SHOP DRAWINGS FOR EXACT SYSTEMS INFORMATION.

KEY PLAN

PROJECT NORTH

SEAL

NORTH CAROLINA REGISTERED PROFESSIONAL ENGINEER SEAL 027038 JEFFREY L. LINDE

REVISION:
REVISED JULY 14, 2005
RFP 04/19/07

LORD·AECK·SARGENT

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N&B PROJECT: 01N230

JOB NAME: UNC CHAPEL HILL GENETIC MEDICINE BUILDING PHASE 2

LOCATION: CHAPEL HILL, NORTH CAROLINA

SHEET TITLE: HVAC DUCTWORK PENTHOUSE FLOOR PLAN SOUTH

SCALE: 0 4 8 16FT

DRAWN BY: TZM

ISSUE DATE: 11/16/09

JOB NO. 21042-01

DWG. NO. M118B

RECORD DOCUMENTS - NOVEMBER 16, 2009