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THE ARCHITECTS COLLABORATIVE INC.

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1945 1965
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1945 1969
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18 November 1976

Mr. Clinton Hewitt
Assistant Vice President
Physical Planning
University of Minnesota
340 Morrill Hall
Minneapolis, Minnesota 55455

Regarding: University of Minnesota
Health Sciences Expansion
JOML Remodeling
TAC Job No. 75026

Dear Mr. Hewitt:

It is our pleasure to forward to you at this time the finalized Design Development Phase III Report on the remodeling of the Jackson-Owre-Millard-Lyon Complex for your records.

As you are aware the body of this effort was completed two months ago when we began the preparation of Contract Documents for the project. In the intervening time we have undertaken with the University the task of adjusting the project budget and the project scope to insure their compatibility in order to realize the project. In addition the task of identifying deduct alternates was undertaken and should soon be completed for incorporation into the Contract Documents.

As the enclosed breakdown of Probable Costs indicates, the construction budget is now $5,640,000 and represents the work described herein. Prior to the finalization of Contract Documents another cost estimate will be prepared to reflect more specifically the anticipated construction costs.

Very truly yours,

THE ARCHITECTS COLLABORATIVE, INC.

John Scott

John J. Scott
ljg

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TABLE OF CONTENTS

CONSTRUCTION OUTLINE

A. EXTERIOR SURFACES

Site Work	- Excavation, fill, and grading.
	- Landscaping at SE Tower by Unit B/C Contractor.
	- Landscaping at SW Tower N.I.C.
Footings	- Reinforced concrete spread footings.
Foundation Walls	- Reinforced concrete foundation walls. Damp-proofing on exterior face.
Main Structure	- Steel columns and beams. Concrete floor slabs.
Fireproofing	- Beams at towers to be fireproofed by encasement in concrete. Steel columns to be fireproofed in metal lath and plaster as a part of Contract B.
Roof Structure	- Reinforced concrete roof slab.
Exterior Walls	- Mechanical Equipment towers to be face brick matching existing.
	- Metal louvers.
	- Metal panels matching existing.
Exterior Doors	- HM in 16 GA HM frames.
Roofing	- Pitch and gravel built-up roofing.
Roof Insulation	- Insulating concrete fill.
Wall Coping and Flashing	- Galvanized sheet metal, painted.

B. INTERIOR SURFACES

Floors	- Type 1 Existing; repair and patch as required.
	- Type 2 Concrete A: steel trowel finish.
	- Type 3 Concrete B: non-slip finish.
	- Type 4 Resilient; 12x12x1/8 smooth vinyl asbestos tile.
	- Type 5 Sheet vinyl.
	- Type 6 Carpet (N.I.C.)
	- Type 7 Ceramic tile; 1x1x¼ unglazed ceramic mosaic natural clay tile, thin-set.

- Type 8 Composition; seamless chemical resistant flooring.

Bases

- Type 1 Existing; repair and patch as required.
- Type 2 Resilient A: 4" coved vinyl.
- Type 3 Resilient B: 4" coveless vinyl.
- Type 4 Ceramic tile: coved base matching wall ceramic tile.
- Type 5 Sheet vinyl: 4" high base contiguous with and matching sheet vinyl flooring.
- Type 6 Composition: 4" high base contiguous with and matching composition seamless chemical resistant flooring.

Walls

- Type 1 Existing plaster; add repair and patch as required. On clay tile backup.
- Type 2 Concrete: as-cast plywood finish.
- Type 3 Veneer plaster: 2-coat, high strength smooth trowel finish, on ½" thick plaster base board laminated to 1½" thick rigid insulation applied to existing exterior wall.
- Type 4 Gypsum Board A: Single layer 5/8" thick, on 3 5/8" steel studs at 16" O.C.
- Type 5 Gypsum Board B: Single layer 5/8" thick fire-rated, on 3 5/8" steel studs at 16" O.C. (1-hr rating)
- Type 6 Gypsum Board C: Single layer 5/8" thick, on 3 5/8" steel studs at 16" O.C. with acoustic insulation in cavity.
- Type 7 Gypsum Board D: Double layer 5/8" thick fire-rated, on 2½" steel studs at 16" O.C. (2-hr rating)
- Type 8 Concrete Block A: Normal weight concrete block, running bond, concave joints.
- Type 9 Concrete Block B: Light weight concrete block, running bond, concave joints.
- Type 10 Ceramic tile: 2x2x¼ unglazed ceramic mosaic natural clay tile, thin-set, over gypsum board on steel studs.
- Type 11 Existing concrete: Repair and patch as required.

- Type 12 Existing plaster: Repair and patch as required.

- Type 13 Existing gypsum board wall: Repair and patch as required.

- Type 14 Existing 2-1/4" metal wall partition: Repair as required.

- Type 15 Existing 2-1/4" metal wall partition: Removed - to be reused.

Ceilings

- Type 1 Existing plaster: repair and patch as required.

- Type 2 Plaster: 7/8" portland cement plaster with steel trowel finish, on metal lath.

- Type 3 Gypsum board: Single layer 5/8" thick on metal furring.

- Type 4 Acoustic tile: Fully accessible standard 2x4 painted aluminum T-grid system with lay-in acoustical panels.

- Type 5 Fully accessible metal slat ceiling.

Doors and Frames

- Interior doors - 1-3/4" solid core wood door, paint finish, closers at rated doors. Magnetic hold-open devices at selected doors.

- Frames - 16 gauge hollow metal, welded construction.

Finishes

- Typical - flat enamel paint.

- Public toilet rooms, animal rooms, and selected wet areas - "spray-glaze finish".

C. STAIRS

Existing Stairs

- Enclose and provide access to exterior as shown on drawings.

New Stairs

- Steel construction. Steel pans filled with concrete; Non-slip nosings.

D. ELEVATORS

Elevator to be Inactivated

- Seal off shaft of elevator #7 at 4th & 5th Floors.

Other Elevators

- Interior of shafts to be remodeled into 2 Hour rated wall.

E. SPECIALTIES

Toiler Compartments	- Ceiling mounted, plastic laminate.
Urinal Screens	- Wall mounted, plastic laminate.
F.E. Cabinets	- Recessed; extinguishers N.I.C.
Toilet Accessories	- As per University standards.

F. FIXED EQUIPMENT

Casework	- Selected existing casework to be refinished and/or re-topped; some to be relocated.
	- New laboratory casework to be standard floor mounted metal casework with epoxy resin, stainless steel or plastic laminate tops as required.
Fume Hoods	- Standard automatic partial bypass type chemical fume hoods, sizes as shown on drawings, 100 feet per minute face velocity. Isotope capability where shown.
	- Laminar flow and biological hazard hoods with variable speed fans N.I.C.
Cold Rooms	- All cold rooms with interior casework N.I.C. They are to be provided and installed under another contract.

G. HVAC SYSTEMS

Ventilation Supply System	- Central built-up variable supply air units with coils, filters, humidifiers, etc. discharging to medium velocity ductwork distributing to ceiling located control boxes and air diffusing devices at rooms without fume hoods. Laboratories with fume hoods to be high or low (50%) air supply. Hot water reheat or variable-air-volume space temperature control. Separate systems for Animal Areas.
Toilet Exhaust System	- Fan and duct system with negative pressure in ductwork.
Fume Hood Exhaust System	- Fan and duct system with negative pressure in ductwork. One fan per hood (or in some cases per room). Fume hood fans to operate continuously at high or low (50%) speed.
General Exhaust System	- Fan and duct system. System to serve primarily laboratories.
Animal Exhaust Units	- Built-up housing with automatic roll filter and space for future odor removal equipment.

Supply Fans	- Vane-axial fans with variable pitch blade controls with motors and V-belt drives in Base Bid. Double inlet centrifugal blowers with air foil blades and inlet vane controls with motors and V-belt drives in Alternate to Base Bid. Outlet velocities, tip speeds, etc. in accordance with ASHRAE guide recommendations.
Return/Relief Fans	- Axial centrifugal blowers with inlet vane controls, motors and V-belt drives to vary air quantity in proportion to supply blowers.
General Exhaust Fans	- Axial centrifugal blowers with inlet vane controls, motors and V-belt drives to vary air quantity in proportion to supply blowers.
Cooling Coils	- Copper tubes with aluminum fins arranged for counter flow of air and water. Face velocity not more than 600 FPM. Provided with 16 gauge soldered drip pans.
Preheat Coils	- Steam distributing type with 1" diameter copper tubes and aluminum fins with motorized face and bypass dampers.
Humidifiers	- Steam manifold type.
Air Filters	- Two stage providing 90% dust spot efficiency.
Ductwork	- Material, bracing and hangers to be in accordance with the most recent ASHRAE guide. Galbestos or Type 316 stainless steel for fume hood exhaust.
Acoustic Duct Insulation	- Fireproof glass fiber with protective coating.
Reheat Coils	- Hot water type with copper tubes and aluminum fins.
Variable Air Volume Units	- Automatic thermostatically controlled boxes providing air volume modulation and sound attenuation.
Heating Media	- High pressure steam from the central University heating plant. Steam-to-water convertors in equipment rooms to provide hot water for reheat coil systems.
Radiation Systems	- Existing forced hot water or steam system supplying finned tube perimeter radiation. Existing cast iron radiation to be replaced with finned tube radiation in remodeled areas. Vestible unit heaters to be served by existing steam system.
Reheat System	- Forced hot water system, separate from radiation system, supplying reheat coils. Two pipe reverse-return system.
Chilled Water System	- Forced cold water system. Chilled water generated by absorption refrigeration units in the Unit A-B/C plant. Distribution through a direct return primary loop in the sub-basement. Coils fed by secondary loop pumps.

Temperature Control - Pneumatic/Electronic automatic temperature control system. Provisions to be made to accommodate future central control and surveillance system.

H. PLUMBING AND FIRE PROTECTION

Plumbing Systems - To conform with State and Municipal Codes plus requirements of governing agencies. Plumbing fixtures, laboratory services, drains and laboratory equipment connections will be provided. Drainage and water services provided in remodeled animal areas for wash down operations and cage cleaning.

- The following system will be modified or expanded: sanitary drainage, acid waste, storm drainage, domestic water, natural gas, compressed air, laboratory vacuum, de-ionized water.

Fire Protection - Fire Department standpipes with hose valves per floor will be provided in stair towers at locations required by Code. Hose cabinets in corridor walls will not be provided as were not required by Minneapolis Fire Marshall.

I. ELECTRICAL CONSTRUCTION AND COMMUNICATIONS SYSTEM

Primary Electrical Work - Primary switch gear, feeders, disconnections and reconnections for the addition of a transformer in the Jackson-Owre and Millard vaults.

Transformer Additions - Two new three-phase distribution transformers will replace the existing 3 single-phase transformers in the Jackson-Owre vault. A new 3-phase distribution transformer will be added to the Millard vault.

Main Service - The existing main service switchgear #2 in the Millard Switch Board Room will be replaced with a 3000 Amp 120/208 volt 3-phase 4-wire fused switchboard. The existing Jackson-Owre switchboard will be replaced with two new 2000 Amp 120/208 volt 3-phase 4-wire fused switchboards.

Secondary Distribution - The existing power distribution system will remain, however additional feeders and circuit breaker panelboards may be added to remodeled areas depending on the extent of the remodeling. New risers and panels will be installed in the new mechanical towers. The risers will be plug-in busduct serving fuse switch panelboards at each floor. Feeders will be conduit and wire.

Lighting Systems - Where existing ceilings are maintained, existing light fixtures and switching will be used. Where new ceilings are installed the light fixture will be a 2'x4' two, three and four lamp lay-in fluorescent fixture with an acrylic prismatic lens. Corridor lighting will consist of fluorescent lights in a ceiling system. Individual rooms will be individually switched rising multi-level switching. Corridors will be relay controlled centrally switched.

Telephone System

- The telephone system will consist of empty conduit risers, equipment closets and cable tray in the corridor ceiling space with empty branch conduits extending into the rooms.

Intercom Systems

- The intercom system will consist of empty conduit in rooms. The cable tray will be shared by the intercom wiring.

Fire Alarm System

- The fire alarm system will consist of manual stations, automatic stations, area smoke detectors, duct smoke detectors, general alarm horns, door holders, annunciator, data gathering panels and a central processor.

- Fire detection system will be installed in remodeled areas only, with exception of horns and manual stations.

Emergency Systems

- The emergency system will consist of battery power pack units for stairwell lighting, corridor evacuation lighting, exit lights, and fire alarm systems.

CONTRACTS & SEQUENCE

CONTRACTS

The work of the 75 GRANT CONSTRUCTION project occurs in two major construction contracts as follows, to expedite the construction in meeting the requirements of the Federal Grant.

CONTRACT A

Construction of the General Construction portion of the Southeast and Southwest Mechanical Equipment Towers constitutes the scope of Contract A. The Towers will house air handling units provided as part of Contract B. It is noted that as part of the Northwest and Northeast Mechanical Equipment Towers will occur as part of future construction projects. Contract A construction work has begun and will be completed in May 1977.

CONTRACT B

Construction of all interior remodeling work and the equipping of the Mechanical Equipment Towers, provided under Contract A described above, will constitute the work of Contract B. Construction under Contract B should be accomplished within 18 months from the start of construction.

Remodeling work within and associated to the corridors and stairs may be started and completed at any interval during this period as the contractor's construction sequence permits, coordinated with related mechanical and electrical work.

Remodeling work within the occupied laboratories will be per the following:

Anatomy Department

1. Basement Jackson-Owre Hall Rooms 54, 1, 2, and 6:
   Remodeled from June to September during either 1977 or 1978 per contractor's scheduling, but must be completed before Item 3 started.
2. Basement Jackson Hall, Rooms 88.1 and 88.2:
   Remodeled per contractor's scheduling.
3. Second Floor Jackson Hall, Rooms 297 and 298:
   Remodeled per contractor's scheduling but must be started after Item #1.
4. Second Floor Owre Hall, Room 210:
   Remodeled per contractor's scheduling.
5. Second Floor Owre Hall, Room 242:
   Remodeled per contractor's scheduling.
6. Third Floor Jackson-Owre Hall, Rooms 356 and 364:
   Remodeled per contractor's scheduling.

Biochemistry Department

1. Third Floor Owre Hall, entire area:
   Remodeled per contractor's scheduling but must be completed before Item #2 started.
2. Second Floor Millard Hall area:
   Remodeled per contractor's scheduling after Item #1 completed.

Physiology Department

1. Third Floor Millard Hall, Rooms 336, 339, 342, 356, 360, 311, 307:
   Remodeled per contractor's scheduling.
2. Fourth Floor Owre Hall, rooms north and south side of corridor and Fourth Floor Millard Hall Rooms 457, 461 and Third Floor Millard Hall, Rooms 312, 313:
   Remodeled per contractor's scheduling but must be completed before Item #3 started.
3. Fourth Floor Millard Hall, Rooms 456, 458, 424, 418, 411, 412, 409, and 405 and Fourth Floor Lyons Laboratory Rooms 462, 464, 466, 468, 467 and 475:
   Remodeled per contractor's scheduling after Item #2 completed.

Pathology Department

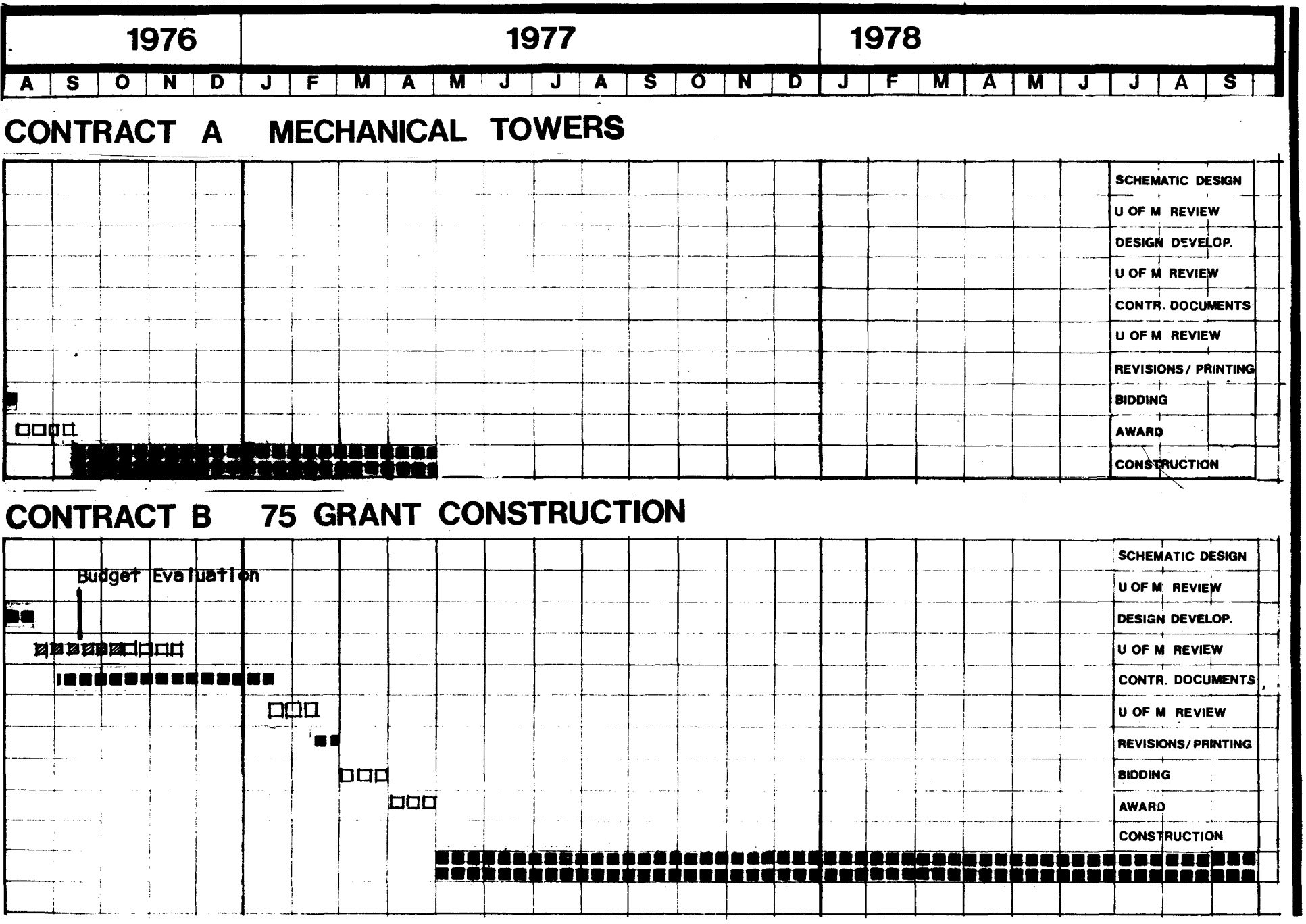
1. Fourth Floor Jackson Hall Room 496:
   Remodeled per contractor's scheduling but must be completed before Item #3 started.
2. Fourth Floor Owre Hall, rooms south of corridor:
   Remodeled per contractor's scheduling.
3. Fourth Floor Owre Hall, rooms north of corridor:
   Remodeled per contractor's scheduling after Item #1 completed.

Pharmacology Department

1. Basement Owre Hall, Room 19 Animal Quarters:
   Remodeled per contractor's scheduling.
2. Basement Millard Hall, Rooms 20, 21, 22; First Floor Millard and Owre Rooms 123, 122, 121, 119, 118, 117, 116, 115, 114, 126 and 127, 136, 113, 112, 111 and Second Floor Owre Hall, Rooms 227, 228, 221, 220, 216, 217, 219:
   Remodeled per contractor's scheduling but must be completed before Item #3 started.
3. Basement Millard Hall, Rooms 24, 3; First Floor Millard Hall, Rooms 101, 136, 134, 132, 131, 130, 128, 124; and Second Floor Lyons Laboratory Rooms 274, 280, 282, 277:
   Remodeled per contractor's scheduling after Item #2 completed.
4. Second Floor Lyons Laboratory Rooms 275, 269, 265, 263:
   Remodeled per contractor's scheduling after Item #3 completed.

Contractors will be required to submit after Contract award a schedule of construction dates for all rooms remodeled. This will facilitate any moving necessary and will permit possible conflicts to be corrected.

CONSTRUCTION SCHEDULE



COST ASSUMPTIONS

Preparing a cost estimate before the final construction drawings requires that any assumptions made upon which an estimate is based be defined so that consistent interpretation occurs. The following assumptions have been made in this Statement of Probable Costs.

SITE ACCESS. Contractors will have access to the JOML courtyard from Washington Avenue and entire courtyard will be for their storage and staging area. The Church Street delivery area will be for the contractor's use and the Elevator #2 will provide vertical transportation within the complex. In addition certain areas within the complex may be used as storage areas by the contractor. It should be realized that some relocation, noise and dust may cause certain occupants to endure hardships during construction.

SCHEDULE. All costs were based on the Construction Schedule incorporated and any deviation from this schedule may alter the cost.

CONTRACTS AND CONSTRUCTION SEQUENCE. All costs were based on the incorporated Construction Sequence. This will allow the contractor maximum flexibility in his scheduling while providing some latitude for certain changes that might cause conflict with occupants. The schedule the contractor will provide gives a guideline of construction dates so that each occupant may plan his relocation.

BUILDING COSTS. Code correction work will be done only as indicated during this 75 GRANT CONSTRUCTION phase. Other correction work will be done at some future time. Code interpretations by Building Officials may alter the scope of work and cost.

AIR CONDITIONING. Air conditioning in the project is limited to those areas to be served by permanent central systems as shown on the design development drawings. Air conditioning by local systems is N.I.C.

NON-BUILDING COST DATA. Data for the non-building costs was taken and/or interpolated from data supplied by the University of Minnesota personnel.

ENERGY CONSERVATION. No corrective work on the exterior fenestration or insulation of walls will be done at this time except that where new surfaces are applied to exterior walls, insulation will also be provided.

PROBABLE COSTS

I. CONSTRUCTION

a.	Unassignable Spaces (Related to Assignable)	
	1. Stairways	155,680
	2. Elevators	12,200
	3. Corridors	217,130
	4. Toilets	76,580
	5. Fan Room Towers (Contract 'A')	517,200
	6. Mechanical Equipment in Towers	180,360
	7. Interior Equipment Rooms	66,050
		$1,225,200
b.	Distribution Systems (Related to Assignable)	
	1. Corridor Ductwork	300,770
	2. Fire Protection	48,000
	3. Chilled Water Piping	247,030
	4. Steam Piping	115,360
	5. Signal Systems	65,090
	6. Power Systems	179,500
	7. Emergency Systems	26,600
		$ 982,350
c.	Assignable Spaces	
	1. Basement	443,968
	2. First	464,118
	3. Second	668,908
	4. Third	702,748
	5. Fourth	385,428
		$2,665,170
d.	Contractor's Direct and Indirect Expenses	$ 767,280
	TOTAL CONSTRUCTION COST	$5,640,000

II. NON BUILDING COSTS

a.	Contract A	
	1. A/E Fees	
	a. Base fee	74,994
	b. Reimbusables	3,750
	2. Sitework	12,712
	3. Supervision	6,465
	4. Miscellaneous engineering	1,500
	5. Soil borings	500
	6. Building Activation & Incidentals	3,000
	7. Health Sciences Planning Office	6,465
	8. SAC Charge	400
	9. Permits	900
	10. Material testing	1,000
	11. Contingency	15,516
		$ 127,202

b.	Contract B	
	1. A/E Fees	
	a. Base Fee	512,280
	b. Reimbursables	28,000
	c. Master Planning	146,456
	2. Consultants	
	a. Special	5,000
	b. Testing and Balancing	10,000
	3. Sitework	7,000
	4. Utilities	10,500
	5. Supervision	63,645
	6. Miscellaneous engineering	6,500
	7. Building activaion	10,000
	8. Site survey	1,500
	9. Health Sciences Planning Office	63,645
	10. SAC Charge	4,000
	11. Permits	10,245
	12. Material testing	3,000
	13. Furnishings and Equipment	
	a. New Cold Rooms	187,500
	b. Remodeled Cold Rooms	55,200
	c. Other	198,300
	14. Contingency	270,836
	15. Control Center Wiring	40,000
	16. Chiller #5	98,679
		1,732,286
	TOTAL PROJECT COST	$7,499,488

III. FUNDS AVAILABLE

a.	HEW Grant Commitment	2,362,338
b.	1973 Legislature Appropriation	200,000
c.	1976 Legislature Request	4,937,150
	TOTAL FUNDS AVAILABLE	$7,499,488

ENERGY CONSERVATION REPORT

The increasing scarcity of fuels and the tightening restraints on energy consumption by government agencies make energy conservation a primary consideration in planning the Jackson/Owre/Millard/Lyon building complex remodeling. This is primarily a research laboratory facility, and as such is exempt, to a great extent, from the 1975 Energy Conservation Amendments to the Minnesota State Building Code. The University policy to be followed in this document, however, is that the State Energy Code will be complied with except where laboratory procedures or other building functions require that the exemptions to the Code be taken.

Compliance with the State Building Code (SBC) can be accomplished by two different methods. The first is to meet the detailed requirements of the code established in SBC Sections 6006 through 6011 for the building exterior envelope; Heating Ventilating, and Air Conditioning (HVAC) systems; HVAC equipment; service water heating systems; electrical distribution systems and lighting systems. The second method is to substitute a design of building and energy-using service systems for which the total annual amount of those forms of building energy covered by SBC 6006 through SBC 6011 (expressed as equivalent Btu's or equivalent Kwh) is less than that for the building and systems designed according to SBC 6006 through SBC 6011.

The existing JOML Building Complex does not meet the detailed requirements of SBC 6006 through SBC 6011. The remodeling recommended in the planning report would involve changes to the HVAC systems, HVAC equipment, service water heating equipment, electrical distribution and lighting systems; and these systems could be improved to comply with the code. Changes to the building envelope would not be easily accomplished, however, and preliminary studies indicate that a large monetary investment would be required.

The State Building Code requirements set down in SBC 6006 and average existing values are summarized as follows:

	Therm. Trans. - BTU/sq. ft. -Hr. $-^{o}F$	
	Existing	SBC 6006
Ceiling/Roofs	.15	0.10
Combined Gross Wall (includes windows)	.54	0.22

The additional roof insulation (standard preformed roof insulation) which would be required to improve the existing roof values to meet the code requirement varies from approximately 1" to 2½".

To meet the code requirement for the combined gross wall area, even if the existing windows were replaced with new triple insulating glass with one-half inch air spaces and new frames, would require that an unrealistic thickness of insulation be added to the existing walls.

The information above shows that meeting the detailed code requirements for the building envelope is extremely difficult and preliminary estimates indicate that it is also prohibitively expensive. The second method of compliance with the code by the equivalent annual energy consumption method will, therefore, be considered.

Preliminary rough calculations indicate that the peak heating rate for outdoor ventilation air is approximately 8 times the amount of heat that could be saved by improvement of the combined gross wall thermal transmittance and roof transmittance to the code required values. This is an indication of the probability of saving, by alternate methods, an amount of energy equal to that which could be saved by building envelope improvements.

All of the preliminary results indicate that a detailed evaluation of the building envelope should be made to determine exact requirements for improvements to the roof, walls, windows, and doors to attain the thermal transmittance values required by the State Building Code. These values should then be used as a basis for a computerized evaluation of equivalent annual energy consumption with alternative forms of energy conservation under the provisions of SBC 6012. From these computerized evaluations a final determination of building envelope improvements and additional energy conservation methods to be used should be made.

The provisions of SBC 6012 allow alternate building and system designs which can be shown to reduce the total energy supplied to a similar building which would have followed the detailed requirements of SBC 6006 through SBC 6011. The analysis of the alternative designs must be done on an annual basis comparing energy consumption for the building design meeting the detailed requirement with the alternative design.

The following is a list of energy conservation methods employed in this remodeling project. Where these methods go beyond code requirements they may be considered possible substitutions for use in the method described above.

ENVIRONMENTAL DESIGN CRITERIA

The environmental design criteria are in strict accordance with the State Building Code. The winter indoor conditions are 68°F and 20% relative humidity when the outdoor temperature is -19°F; and the summer indoor conditions are 78°F and 55% relative humidity when the outdoor conditions are 89°F dry bulb and 75°F wet bulb.

SPACE TEMPERATURE CONTROL

Space temperature control will be achieved in all rooms, except laboratories with fume hoods, by the use of variable-air-volume terminal devices controlled by pneumatic room thermostats. In outside walled rooms, room temperature will also control heating radiation in that room. Laboratories with fume hoods will have constant air supply to match hood exhaust with room thermostat controlling a reheat coil in the air terminal device.

VENTILATION

Outside air ventilation quantities will be limited to the minimum rates allowed by the State Code except for areas where higher ventilation rates are required for specific laboratory or other special building functions. The building ventilation systems will be designed for cooling with outdoor air when air temperatures allow.

EQUIPMENT OPERATION

The zones supplied by individual supply air units will be small to allow operation of minimal equipment to supply one space and also to allow units to be shut down when spaces are not occupied.

A program should be implemented to provide shut-down of units when spaces are not occupied and to take advantages of the consequent energy savings.

FUME HOODS

Fume hoods have been selected and will be operated to provide maximum energy conservation. All fume hoods have been selected at the smallest usable size and hoods which use primarily recirculated air have been selected wherever possible.

All hoods which exhaust 100% of the air passing through them have been designed for reduced airflow at times when the operator is not at the hood.

HEAT RECOVERY

Heat recovery should be provided on systems where the installation cost can be justified. Supply and exhaust air systems which run continually such as those serving animal areas will have heat recovery systems of either a thermal wheel or a run-around type.

As each space is remodeled the new systems installed and existing systems to remain will be evaluated for installation of heat recovery equipment. This evaluation should include all exhaust air including fume hood exhausts, steam condensate including flash steam vents, and plumbing wastes from equipment using large quantities of hot water.

PERIMETER RADIATION SYSTEM

The system of perimeter radiation recommended is a forced hot water system through finned tube units with individual space control. This system will eliminate heat wasted by unsatisfactory controls and system inertia. The system will react quickly to heating needs and will allow maximum use of solar heat gains available in winter.

The Jackson Hall and Jackson-Owre buildings already have this type of heating system and only room controls need be added.

Each of the three remaining buildings shall have their existing steam heating system changed to forced hot water. Existing cast iron radiators shall be changed to finned tube radiation at this remodeling. New steam to water convertors, circulating pumps, controls, etc. shall be located in the basement mechanical rooms of each building in a future remodeling.

Each system then will have the horizontal supply main installed in Sub-Basement pipe space connected to new supply risers at locations of existing steam supply risers extending up to the top dloor. The return risers will start at the basement floor, with new return risers at locations of existing condensate return risers, extend up to the Third Floor ceiling collecting all risers and finally drop down in a pipe chase to Sub-Basement equipment room.

Finned tube radiation will be provided in all areas requiring heat. Existing finned tube if in good condition may be reused. Radiation will connect to supply and return risers on either side of radiation. Each piece of radiation will be controlled by an automatic valve having a remote room thermostat or by a self-contained valve stat. The temperature of the hot water supplied to the room radiation will be controlled at the equipment room convertor to vary in proportion to the outside temperatures.

TEMPERATURE CONTROL

Temperature controls shall be selected for maximum energy conservation. Heating and cooling temperatures of air and water system should be delivered at respective minimums and maximums to provide precise control without wasteful recooling or reheating. Controls on existing equipment should be evaluated and revised where economically justified.

INSULATION

The insulation for existing and new equipment, piping and ductwork will be provided to meet the latest requirements of the State Code.

Where remodeling existing cast iron radiation or construction affects exterior walls a 10" space will be furred out from the existing wall and 1½" of rigid insulation will be inserted.

The installation of insulation thickness greater than Code Requirements should be evaluated and the extra insulation should be installed where economically justified.

MECHANICAL EQUIPMENT

Mechanical equipment will be selected for maximum efficiency. Evaluations will be made for equipment such as fans and pumps to determine if energy savings can be made through the use of variable volume equipment.

Equipment sizes will be carefully evaluated for selection of equipment at economical operating points. Where equipment is selected with reserve for future expansion, the use of multiple units will be considered for operation at maximum efficiency during periods of reduced capacity.

PLUMBING SYSTEMS

Plumbing systems should be designed for maximum conservation of energy. Hot water heating temperatures should be set as low as the usage of the system will allow without excessive need for storage and consequent heat loss because of increased surfaced areas.

Hot water and distilled water outlets should be selected to eliminate waste. Timed delivery systems and flow limiting type equipment will be provided.

ELECTRICAL EQUIPMENT

Power factor correction will be applied at existing motor control centers and new motors. Power factor correction will reduce the necessary current in the supply conductors and main electrical service and will thereby reduce I^2R losses.

LIGHTING SYSTEMS

All new lighting systems in the corridors, laboratories, classrooms and office will be designed using lamp sources with efficiencies in excess of 55 lumens per watt. Only special accent lighting, display lighting or fume hoods will be lower efficiency lamps. All corridors, laboratories and classrooms will incorporate dual level switching to allow reduced lighting levels during peak load periods or times when task requirements are less. All new fixtures with the exception of corridor fixtures will have a coefficient of utilization greater than .55 when the room cavity ratio is 1. Corridor fixtures will have a coefficient of utilization of greater than .63.