REVIEW OF SURFACE COATINGS FOR THE ACCELERATOR HOUSING

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - ABA NO. 82

STANFORD UNIVERSITY SUBCONTRACT S-136

UNDER AEC CONTRACT AT(04-3)-400

Submitted by W. N. Harris

J. M. Keith

Approved by Roland L. Sharpe

AETRON-BLUME-ATKINSON
A Joint Venture
Architect-Engineer-Manager
Palo Alto, California

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A survey has been made to evaluate different methods of minimizing concrete dusting within the Accelerator Housing. This report summarizes sealants, paints, and coatings which have been considered. Various treatments have been classified by type and price rangesto aid in determining which type of treatment should be selected for application within the Accelerator Housing.

SURFACE FINISH

The Portland Cement Association lists four basic causes of dusting in typical concrete structures as follows:

1. Dirty aggregate
2. Excessive water in the concrete mix
3. Finishing of concrete too early
4. Ineffective curing.

Each of the above items has been considered in writing the specifications. With the resultant high strength, high quality concrete, there will be less dusting than with normal concrete.

The interior surface of the completed initial Accelerator Housing (874 feet in length) has a somewhat better than average concrete finish. The concrete floor slab is, in general, satisfactory. The walls and ceiling, which were formed with 2' x 8' reuseable panels, have a repetitive pattern accentuated by minor grout seepage at the joints. Additional irregularities exist at the construction joints. Small protrusions and air holes exist throughout. Dry pack repairs have been made at various locations along the length of the initial housing. It is anticipated that the remaining 9400' of Accelerator Housing will have an improved surface through the use of large prefabricated moveable steel forms which produce fewer form joints.

Patching or sacking of surfaces tends to increase the dusting and, therefore, repair of marginal irregularities or discontinuities was not required of the Contractor. Sandblasting, which was not required by the specifications, could be used to achieve a smooth surface by removing the small protrusions. However, this would not improve the dusting characteristics of the surface and would be costly.

The surface area under consideration (for approximately 10,300 feet of Housing) is as follows:

Floor	115,000 sq. ft.
Walls and ceiling	320,000 sq. ft.

FUNCTIONAL REQUIREMENTS

ABA has reviewed the known and assumed requirements for installation, operation and maintenance of equipment within the Accelerator Housing. The major requirement for all three phases is cleanliness. An improvement in the cleanliness of the concrete surfaces (by minimizing dusting) can be attained by the application of single or multiple coatings which range in price and quality from a relatively inexpensive penetrating type sealant to a radiation resistant and decontaminable two component phenolic or epoxy system.

The ventilation system for the housing contains 1" thick disposable media filters which will eliminate the major portion of impurities in the air. The housing air, however, will still have particles several times larger than the maximum encountered in clean room atmospheres (approximately 5 microns). Particle size of concrete dust generated within the housing will be in the order of 100 microns and larger. It should be noted that rust particles (varying upwards in size from 100 microns) will also be present in the Housing as a result of untreated service shafts and sleeves being exposed to the atmosphere for as long as six months prior to construction of the Klystron Gallery and/or SLAC installation of wave guides and piping. The rust can be eliminated by painting. It is understood that some welding may be performed on the inside of the shafts, however, minor welding can be performed on painted surfaces and the benefits gained by minimizing rust should outweigh the disadvantage of welding on a painted surface.

It is possible that the housing concrete surfaces may be entirely satisfactory and that alternate methods will be required by SLAC to temporarily isolate the equipment, such as portable glove boxes or plastic sheets. The degree of cleanliness required for installation, operation, and/or maintenance of equipment must ultimately be determined by SLAC.

COATING TYPES

A. Penetrating Sealer - Several synthetic liquids are available which penetrate, harden and dustproof concrete surfaces. A one coat application will give a fair abrasion resistance or wear finish. Additional coats or more expensive sealers will provide an improved abrasion resistance for floors. Included in this category are varinishes, methacrylates, synthetic resins, polyurethanes, fluosilicates, and silicones. The price for these sealers (applied) varies from 4 to 15¢ per square foot.

B. Paint - These coatings contain sufficient solids to form a continuous film over the concrete surface. Several coats are required including a preliminary primer-sealer for walls and ceilings. Paint provides a tough coating for floor surfaces subjected to heavy wear. Included in this group are latexs and alkyds. The price for these paints (applied) varies from 15 to 25¢ per square foot. Prior to an application of paints, the surface alklinity of the concrete should be neutralized by aging or washing with muriatic acid.

C. Two Component Systems - These coatings are, in general, the ultimate in surface treatment and are used for chemical or corrosion resistance. Abrasion resistance is ex-ellent. A washable surface is provided which lends itself to radioactive decontamination procedures. The surfaces to which the coating will be applied must be commercially cleaned and dried to assure satisfactory application. This category is the most expensive and includes epoxies and modified phenolics. The price for these systems (applied) is approximately 25 to 50¢ per square foot.

COATING CRITERIA

Each type of coating has been reviewed with respect to the following characteristics:

A. Composition - The material composition of the coatings is given within the major groupings of penetrating sealer, paints and two component systems.

B. Color - A light color which will aid in lighting the housing is assumed preferable to a transparent or dark colored coating.

C. Surface Preparation - Minimum surface preparation or treatment of the existing surface is desireable from a time and cost aspect. Some coatings require a chemical cleaning and an extremely dry surface for application.

D. Radiation Resistance - The coating applied should have a reasonable radiation tolerance. The fast neutron flux at the wall of the housing is estimated to be 6×10^5 n/cm^{2}sec for a ten year exposure of 2×10^{14} n/cm^2 (2×10^6 rads or approximately 2×10^6 roentgens).

E. Applied Cost - Costs summarized therein include the total cost of material, surface preparation and application.

F. General - Other items considered are ease of application, flammability, toxicity, decontamination properties, abrasion resistance, etc.

TABLE OF COMPARISONS

The attached table summarizes the types of coatings which were considered and includes the approximate applied cost of each type.

RECOMMENDATIONS

Because of uncertainty by ABA as to the specific functional requirements for installation, operation and/or maintenance of equipment within the Housing, a series of recommendations is presented. Application of any of the protective coatings listed will result in minimizing dusting. The ABA recommendations are presented in sequence below in the order of increasing cost, abrasion resistance and decontaminability.

A. No Surface Modification - As stated in "Surface Finish" there will be less dusting in this Housing than with normal concrete due to the high quality and strength. Prior to installation of SLAC equipment (and subsequent to installation of the west portal door), a broom and water washdown of the Housing surfaces would be beneficial.

B. Minimum Protection - Application of one coat of clear or pigmented sealer will provide a minimum of protection for the Housing surfaces at a cost of approximately 6¢ per square foot, or approximately $26,000.

C. Improved Abrasion Resistance - Application of a more durable floor coating (either sealer or paint) at approximately 10¢ per square foot with a clear or pigmented sealer for the walls and ceiling can be obtained for approximately $31,000.

D. Decontaminable Floor - The use of a phenolic or epoxy coating on the floor will improve the abrasion resistance as well as providing ease of decontamination at a cost of approximately 25¢ per square foot. Using a surface and paint coating on the walls at 25¢ per square foot, the additional work would cost approximately $110,000.

E. Decontaminable Housing - The use of a phenolic or epoxy coat on the entire Housing would involve a cost of approximately $220,000 using a unit cost of 50¢ per square foot. This coating would provide the maximum radiation resistance and ease of decontamination.

As the basis for any final determination of the exact coating to be used, short sections of Housing can be painted with suitable samples. However, as a prerequisite to choice of samples, the range of cost and the degree of protection should be established by SLAC.

In addition to the protective coatings listed above, ABA recommends sandblasting and prime coating of the inside of all Housing shafts and sleeves to eliminate rusting. This work is estimated to cost approximately $20,000.

COMPARISON OF COATINGS FOR CONCRETE

	Mfg.	Composition	Color	Surface Preparation	Radiation Resistance*	Approx. Applied Cost/S.F.	No. of Coats	Coverage Per/Gal	Abrasion Resistance
PENETRATING SEALER									
1. Florcote 7955	Fuller	Varnish	Clear	None required	Low	4¢	1	600SF	Fair
2. Floor Preservative 5865	Fuller	Varinish	Clear	None required	Low	4	1	600	Fair
3. Clear Seal	Horn	Synthetic Rubber	Clear	None required	Low	6	1	250	Fair
4. Carboline 2109	Carboline	Modified Methacrylate	Clear	Clean & Dry	Fair**	6	1	250	Fair
5. Dehydratine 22	Horn	Silicone	Clear	Clean & dry	Low	6	1	250	Fair
6. Thoroseal	Standard	Cement Base	Grey	Clean & damp	Good	6	2	50	Good
7. Duocrex	Horn	Synthetic Resin	Clear	Clean & dry	Low	10	2	250	Good
8. Hornolith	Horn	Fluosilicate	Clear	Clean & Dry	Good **	10	2	100	Good
9. Dynathane	Horn	Polyurethane	Clear	Clean & dry	Good	12-15	3	350	Excellent
10. Horntraz	Horn	Comb. Fluosilicate & Polyurethane	Clear	Clean & dry	Good	12-15	2	400	Good
PAINT									
1. Fuller 9800	Fuller	Latex	Grey	Clean & dry	Fair**	20-25	2	500	Good
2. Fuller 4000 Series	Fuller	Phenolic Alkyd	Grey	Clean & dry	Good**	20-25	2	500	Good
2. Vinyl Copolymer	Carboline	Vinylon Latex Surfacer	Clear & Grey	Clean & dry	Excellent	15-25	3	130-200	Good
TWO COMPONENT SYSTEM									
1. Phenoline 305	Carboline	Modified phenolic	White & Grey	Clean & dry	Excellent	25-30	2	260	Excellent
2. Phenoline 300	Carboline	Modified phenolic	White & grey	Clean & dry	Excellent	40-50	2	190	Excellent
3. Duraflor	Horn	Epoxy	Clear & Grey	Chemical Cleaning	Excellent	45-50	1	250	Excellent
4. Acidex	Horn	Epoxy	Grey	Clean & dry	Excellent	40-45	2	275	Excellent
5. Epolith	Fuller	Epoxy	White & Grey	Clean & dry	Excellent	30-40	2	400	Excellent

* Materials in Design Engineering July 1960
** Assumed

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