Experimental painting studies: Central Mortgage and Housing Corporation rental projects Cornwall, Ontario: first progress report

O'Doherty, G. A.

Internal Report (National Research Council of Canada. Division of Building Research), 1968-07-01

NATIONAL RESEARCH COUNCIL OF CANADA
DIVISION OF BUILDING RESEARCH

EXPERIMENTAL PAINTING STUDIES: CENTRAL MORTGAGE AND HOUSING CORPORATION RENTAL PROJECTS, CORNWALL, ONTARIO

First Progress Report

by

G. A. O'Doherty

Internal Report No. 361
of the
Division of Building Research

OTTAWA
JULY 1968

PREFACE

Because paints and coatings have undergone greater changes than almost any other material used in the Building Trade during the past 15 years, the Division of Building Research has an objective of bringing new developments to the attention of those active in building design and maintenance.

Studies of the performance of coatings in service is an important part of the field activities of DBR/NRC. This report is, therefore, one of a series recording observations of the various aspects of surface preparation in relation to the performance of applied coatings.

The Division is most grateful to Central Mortgage and Housing Corporation who have made their buildings available for these experiments and the members of its staff who have assisted so kindly in facilitating these field studies.

Ottawa
June 1968

R. F. Legget
Director

EXPERIMENTAL PAINTING STUDIES: CENTRAL MORTGAGE AND HOUSING CORPORATION RENTAL PROJECTS, CORNWALL, ONTARIO

First Progress Report

by

G. A. O'Doherty

Frequent complaints of early deterioration and failure of paint coatings on exterior wood cladding stimulated interest in DBR in setting up an experimental painting program that could be carried out on occupied buildings. Fundamental research on coatings by the Division has produced several promising coating systems which have proved durable on test fences. Unfortunately, similar coating systems, when introduced to the consumer market, met with only moderate success. Variables associated with field-applied coatings are:

1. condition of the surface at the time of painting; and
2. behavior of the coating when applied to old and partially deteriorated painted surfaces.

Central Mortgage and Housing Corporation, as landlord of many rental projects, can control the paint material and its application to their buildings. A joint program was therefore organized in 1966-67 to observe paint application and performance in the field*.

Experimental projects similar to those carried out in the Montreal area during the early summer of 1966 were initiated in Cornwall, Ontario, in 1967. This report deals with the Cornwall project. The test program was devised to evaluate the relationship between various methods of surface preparation and improved performance of conventional and newer type coating systems. The Division of Building Research suggested coating systems and methods of surface preparation that could be amended to the job specifications of the Corporation. In addition it was agreed that DBR personnel would make all observations of the surface preparation and coating performance as required.

An experienced building inspector who was familiar with the object of the experiments was assigned to the project by CMHC.

---

* DBR Technical Notes Nos. 483, 484.

A meeting between the painting contractor, the Corporation inspector, and DBR personnel was arranged to review the experimental detail and to ensure compliance of materials and methods with the design. As a consequence, there was only slight divergence from the specified procedure.

The painting experiments were carried out on three apartment blocks, known as Cumberland Court, located in the western outskirts of Cornwall. The buildings rise 2 1/2 storeys above grade level, and have wood spandrel panels located above and below the windows at mid-height. The panels are approximately 4 by 6 ft in dimension and are constructed of 3-in. tongue and groove boards; there are twelve pairs of panels on each building. The coatings and surface treatments were assigned at random to paired panels on the three buildings in order to reduce the effect of exposure direction and surface conditions. Before any of the work began the type of preparation and the coatings to be applied were marked on each panel. This information was readily available from the excellent blueprint provided by CMHC that clearly showed all details of the experiment. (Figure 1).

For a few days prior to the start of work unsettled weather conditions in the form of early morning or evening storms or intermittent showers had prevailed; there had not been any continuous rain. The workmen were able to do some surface preparation during the overcast and damp part of the first day. The sun dried the surfaces by afternoon and mechanical sanding was begun where necessary. The actual painting of the test panels was carried out under satisfactory conditions. Moisture readings, taken on the wood panels approximately 4 to 6 in. above the board ends, averaged 20 per cent moisture content over 60 readings. Values of 30 per cent (fibre saturation point) were found in eight instances; half of these were on the sheltered north side of the building.

PART I: OBSERVATIONS OF SURFACE PREPARATION

The surface was to be prepared in four ways to evaluate its effect on coating durability. Examination of failures of exterior coatings has indicated that insufficient removal of deteriorated paint contributed to the breakdown of subsequent coatings. The experiment was designed to compare increasing levels of surface preparation with the method commonly employed.

Normal Surface Preparation

The workmen's conception of surface preparation is biased toward appearance or decorative effect rather than to protective maintenance.

Their tools are usually a putty knife, approximately 1 to $1\frac{1}{2}$ in. wide, and medium to coarse sandpaper. The knife is used as a prying tool to slip under loose edges of the old coating forcing it to break off. Sometimes the knife is held almost perpendicular to the surface and scraped over the scaling paint using firm pressure to remove curled edges at paint cracks and peeled areas. Sandpaper is then used for the finishing operation to remove any firmly adhering dirt, raised sides of cracks and to slightly feather the broken edges of peeled patches (Figure 2). The dusty, chalked surface is often rubbed with sandpaper in a dusting motion if it is thought necessary. Little attempt is made to reduce the total thickness of accumulated paint coatings or to renew the surface of exposed wood.

It appears that the normal surface preparation tends to remove any loose material that might break off under the brush in paint application and become mixed with the coating thus making imperfections in the dried film. The time consumed in surface preparation is not proportionate to the condition of the old paint. Severely deteriorated surfaces receive only the preparation necessary to remove the loose and bothersome paint. Any irregularities in the old coating such as imbedded dirt, sags, runs, or raised knots, are inevitably given particular attention with sandpaper so they will not interfere with the smoothness of the paint being applied.

Hoe Scraper, Brushing and Sanding

Surfaces prepared utilizing hoe-type scrapers, wire brushing and sanding were not appreciably different than those prepared in the normal preparation category (Figure 3). The over-all appearance, however, suggested that more of the old paint was removed from the wood over a larger area. The hoe scraper rips off more of the marginally adhering paint adjacent to the peeled and cracked areas. It is also more effective in raking the vee joint of any scaling paint. The use of a wire brush seems unnecessary. Considering the labor involved the results of wire brushing are not obvious except on exceptionally loose or curling paint. It does, however, roughen the exposed wood and removes the grayed fibers on the surface. The hoe scraper will perform the same operation if used in a cross-grain direction but leaves a ragged surface which demands more sandpapering. The scraper - brush treatment in general, requires more sanding to feather the edges of the remaining paint. Less attention is given to areas of firm coating because additional time is consumed in sanding specific irregularities; consequently, more chalk is left on the surface.

Mechanical Sanding

A small disc power sander was used for this portion of the

experiment. It was light in weight and could be effectively operated by the workmen while on a ladder. The sandpaper disc had to be changed about every two panels (which is approximately 50 sq ft). The paper discs are prone to tearing when doing the corners and edges of the wood panel. It is possible that an even greater area could be sanded per disc on large, unrestricted surfaces.

The sanding operation removes all the loose, scaling paint as well as some areas of apparently firm coating. A certain amount of caution is necessary to avoid burning or blistering the acceptable painted surface by frictional heat caused by sanding. When using the sander it is easier to do the whole area of the wood panel rather than only the spots that have obvious defects. This is desirable because the total thickness of paint is reduced, exposed wood faces are renewed, and the surface to be painted is moderately scored to promote better adhesion (Figure 4). Two of the painters, one of whom was the foreman, said they liked this method better than the scraping and agreed that the surface was well prepared to receive paint. One drawback was the necessity of scraping the vee joint by hand.

The time consumed in mechanical sanding averaged $7\frac{1}{2}$ minutes per 25 sq ft; $1\frac{1}{2}$ minutes were needed to change sanding discs. To approximate the time required to prepare similar surfaces by hand methods is difficult because each panel was only worked on long enough to obtain the required appearance. Observed times ranged from 5 to 11 minutes per panel. Some panels took longer than others depending upon the conscientiousness of the worker and the accessibility of the surface. The machine-sanded upper panels on the buildings were more uniformly prepared and compared more favorably with the lower panels than those prepared by either of the hand methods.

Soft Sandblasting

The sandblasting operation was performed by a building cleaning company on a subcontract with the painting firm. The operator had never sandblasted painted wood before although he was experienced in sandblasting exterior structures. The apparatus used is quite versatile, having the sand hopper fixed to the truck with connecting lengths of hose leading to the work area. There was no difficulty supplying adequate pressure over more than 100 ft of feed line. The operator carried out the blasting conveniently from a ladder; larger areas could be handled better from a scaffold.

The surface after sand blasting, although slightly rough, should be excellent for repainting. The old paint is thoroughly removed from

all of the softer wood. Knots and wide bands of late wood retain about 30 to 50 per cent of the old coating. There is a slight to moderate accumulation of old paint remaining in the vee joints. The wider cracks in the wood remain but small cracks and surface checks disappear. These wide cracks and some holes would require filling in any event. The surface, in general is very clean with a moderate stipple appearance apart from the raised areas around the knots (Figure 5).

Preparation of this type can be practical and it encountered less difficulty in Cornwall than it had in Montreal. A few complaints about the dust were received from tenants in the building whose windows could not be closed because of their absence; another one came from a neighbor who was painting outside at the time. There was a slight wind blowing and cars parked in the vicinity were covered lightly with dust. The amount of sand falling to the ground was not significant for it was barely visible after the weekend.

Critical points in this procedure are air/sand pressure and distance from the nozzle to the surface being cleaned. An eighteen-to twenty-four-in. distance was found best using only enough pressure to remove the paint coating. Aluminum surfaces or window glass do not require protective masking at this rate of flow. The motion should be across the grain with a slight angle from the normal. The nozzle must be kept continually in motion otherwise the sand will create deep holes in the wood in a few seconds. This is especially true on sections of deteriorated wood such as on board ends located above window flashings where accumulated moisture has caused partial rotting of the wood, (Figure 5).

Surface Washing

The final step in the surface preparation was the washing of that area of the old painted surface that did not require removal. While the term washing is employed in the specification, in practice it is interpreted to mean wiping with a saturated cloth. The deviation from the intent of the specification is probably due to the fact that a solvent, varsol, was designated by Central Mortgage and Housing Corporation although DBR had suggested an alkaline wash. It is common practice to swab metal work with solvent to remove oily deposits before painting. The washing was carried out on 18 of the 36 panels, being omitted in the painters' normal treatment method and unnecessary in the sand-blasted method.

The washing or wiping did not change the appearance of the surface to any extent. Oily residue was at least partially dissolved but little of the surface chalk or solvent insoluble dirt was removed; it is difficult to maintain sufficient wetness in the cloth while wiping the surface. There were no instructions to rinse the surface afterward so

the painting schedule was not altered as the solvent wash does not interfere, as water would, with the application of solvent-based paints.

PART II - OBSERVATIONS OF COATING PROCEDURES

Surface Fillers

Older wood substrates that have experienced recurring coating failures over the years have considerable deterioration in the form of cracks and checks. Coatings applied to such surfaces are forced to bridge these cracks in the wood with a continuous film or else coat either side of the gap along the surface. The latter condition will not reduce moisture passage into the wood while the former situation places extraordinary stresses on the paint film with any dimensional change in the wood. It was suggested, therefore, that suitable fillers might be employed to fill these fissures and provide additional support for the finish coats of paint.

Fillers are available as highly pigmented viscous liquids or in paste form. The pastes are to be thinned to a consistency best suited to the method of application. When applied to a surface these materials fill the voids and dry rapidly to provide a more regular substrate. Any excess may be removed by wiping the surface before it is completely set. Two types of fillers were applied experimentally. One was a latex filler designed for use on concrete blocks or similar porous surfaces; it contained fine sand in addition to other pigments. The other filler employed was the conventional exterior grade paste wood filler which was thinned before application.

The original plan was to apply the filling materials with a squeegee or similar tool to force the filler into the cracks and smooth out the irregularities of the surface leaving nothing on the plane, sound areas. This could not be accomplished on the narrow surfaces of the boards making up the panels. Attempts were made to apply the paste filler with a broad knife but again the contours of the wood surface prevented reasonable productivity.

The paste wood filler when applied at approximately the same consistency as latex paint will obliterate all cracks and checks in wood that are less than 1/32 in. wide. Application by brush across the grain is most effective. The efficiency of actual filling can only be judged by the surface appearance which more often resembles an overbrushed prime coat. The roughness of the substrate or the degree of preparation is reflected in the appearance of the dried filler. The mechanically sanded panels showed only a few remaining surface defects after the filling operation. The normal preparation produced the most incomplete filling apart from the sandblasted surface which,

though generally devoid of cracks, was still not entirely filled. This was due in part to the deeply pitted wood surface and the thin consistency of the filler. The wood filler applied to the majority of the panels was reduced more than the conditions required. Coarse, rough surfaces need soft pastes for adequate filling. After priming, the appearance of scraped and sanded panels were very similar to those mechanically sanded, possibly because of better feathering of paint coating or perhaps the consistency of the filler was just right. (Table I).

The latex filler was applied by brush without thinning. It was used in the same fashion as the wood filler, i.e., to fill the cracks and smooth the imperfections rather than as a continuous coating. The fine sand aggregate produced a slightly rough finish which enhanced the appearance by light scattering. Panels filled with the latex had fewer visible cracks than the paste-filled areas. The sandblasted panels, however, retained a fuzzy appearance similar to grain raising, possibly due to water in the filler. There were a few spots of wood color staining as well. With the exception of the sandblasted panels, the latex filler produced a high standard of uniformity and little apparent difference between methods of substrate preparation was noted. The smooth, mechanically-sanded panels may appear poorer because of granular effect.

The final coatings needed to complete the specified paint systems were applied on schedule in late June 1967. The first critical examination of the coating systems was made in September after approximately 3 months' exposure. A summary of performance of the systems on the various surfaces is set out in Table II.

The best coating at this time appeared to be the 1-GP-55/28 combination. This material retains medium gloss and reduces the visual imperfections of the surface. The paste-filled substrate gave the poorest appearance of this group in that a few cracks were re-appearing and the gloss was not as uniform. The latex filler gave excellent results on all but the sandblasted panels. The 1-GP-55 coating was applied to the worst panel on the project through random assignment, but even without benefit of filler it retained a respectable rating. It also obtained the highest rating of the three coatings applied to unfilled surfaces regardless of preparation method. Without disparagement, it must be considered that this type of coating is very familiar to painters and it may therefore have benefited in quality of application and amount used.

The alkyd materials, 1-GP-84/59 have a very high gloss and consequently show all irregularities and unfilled checks particularly on the hand-prepared and non-filled surfaces; even the crossgrain

brush marks of the filler coat are sometimes obvious. The enamel appears to shrink on drying and thus accentuates any raised particles of old coating or crack edges. This phenomon could also be the result of high spreading rates. While the alkyd material had the lowest rating of the three coatings it did show a favourable tolerance for different types of filler and surface condition. This type of coating has given good performance on test fences so that whatever it lacks in initial appearance may be made up in later performance.

The most serious defect observed was the loss of tint in the 1-GP-138 Latex topcoat. Nine of the 12 panels exhibited large patches of fading - as much as 50 per cent on some panels. The sandblasted panels showed only traces of this defect. Of the three coating systems the latex paint could be rated as second in appearance. A higher rating might have been obtained had fading not occurred. There were more cracks visible through the latex material on mechanically sanded panels than through any other coating or substrate. The latex coating over latex filler was an excellent system. The 1-GP-138 schedule was comprised of one coat of emulsion primer specified by the manufacturer and one topcoat of latex. Two final coats applied after the primer are usually recommended for optimum coating thickness.

SUMMARY

Normal preparation can be effective if the deteriorated areas are not large or difficult to reach. The hoe-type scraper is more satisfactory because marginally loose coating is removed and the paint still adhering is reduced in thickness. Wire brushing has little effect on hard surfaces. Mechanical sanding seems to be the most efficient method from the standpoint of speed and thoroughness because the total area is easily treated. Sandblasting should only be necessary for extreme cases.

The paste wood filler is more difficult to apply because it requires different consistencies for variations over the surface. The latex filler, however, requires less expertise and presents the best appearance. There are hazards of wood stain, grain raising and poor adhesion to chalky surfaces.

The 1-GP-59 coating has the poorest appearance because surface defects are accentuated. The 1-GP-28 material produces the most uniform surface which might have been equalled by the latex system if serious fading had not occurred.

To evaluate objectively the variables in preparation is difficult at this point in the program because the inadequacies will be

reflected in the ultimate durability of the coatings. The present condition of the various coatings is almost the same for all substrates. The mechanically sanded panels, regardless of paint system or fillers used, show lower ratings than expected.

TABLE I

SUMMARY OF THE EFFECT OF PREPARATION AND FILLING ON THE APPEARANCE OF THE PRIMING PAINTS

Filler	Substrate Preparation			
	A	B	C	D
Fo - None	*6.6	7	5.3	6
F1 - Latex	6	9.3	9	9.6
F2 - Paste	6	8	8.3	7.3

Preparation Methods

A. Sand Blast
B. Mechanical Sand
C. Hoe Scraper
D. Painters' Normal

Rating*

10. Excellent
8. Good
6. Moderate
4. Fair
2. Poor

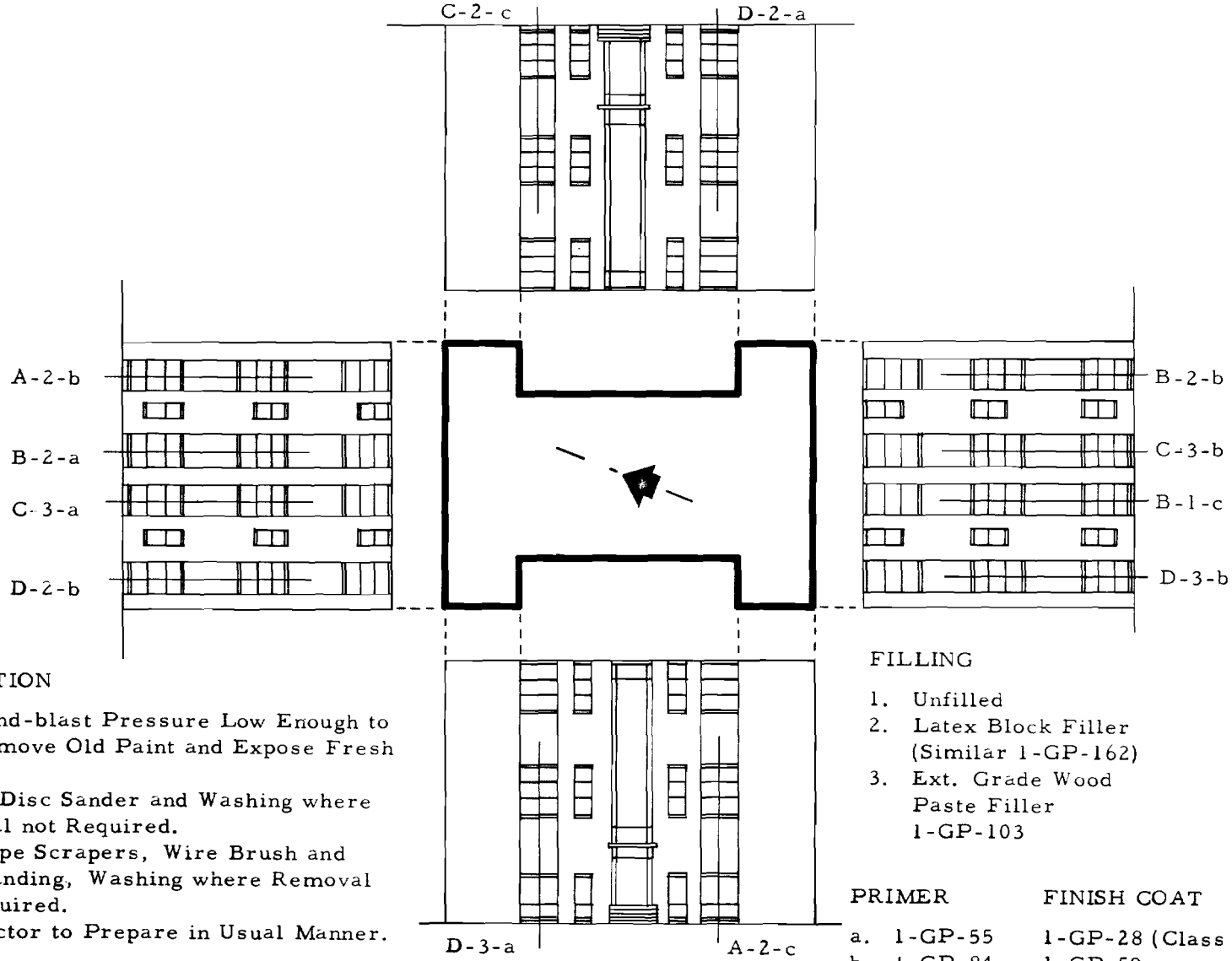
* Mean of the 3 Primers.

TABLE II

EFFECT OF SURFACE PREPARATION AND FILLERS ON QUALITY OF COATING SYSTEMS

Coating System	Filler	Substrate				Coating Mean
		A	B	C	D	
Oil	Fo	9	8	9	10	8.9
	F1	9	10	10	10	
	F2	8	8	10	6	
Alkyd	Fo	9	9	8	7	8.3
	F1	9	7	9	8	
	F2	7	7	10	9	
Latex	Fo	9	6	9	7	8.6
	F1	9	9	10	10	
	F2	8	7	10	9	
Preparation Mean		8.6	7.9	9.4	8.4	

Filler Mean - Fo - 8.3
F1 - 9.2
F2 - 8.3



PREPARATION

A. Soft Sand-blast Pressure Low Enough to just Remove Old Paint and Expose Fresh Wood.
B. Power Disc Sander and Washing where Removal not Required.
C. Hoe Type Scrapers, Wire Brush and Hand Sanding, Washing where Removal not Required.
D. Contractor to Prepare in Usual Manner.

FILLING

1. Unfilled
2. Latex Block Filler (Similar 1-GP-162)
3. Ext. Grade Wood Paste Filler 1-GP-103

	PRIMER	FINISH COAT
a.	1-GP-55	1-GP-28 (Class "B")
b.	1-GP-84	1-GP-59
c.	2 Coats	1-GP-138

FIGURE 1

TYPICAL LAYOUT OF TEST SURFACES
BLOCK NO. 317

BQ 4/87

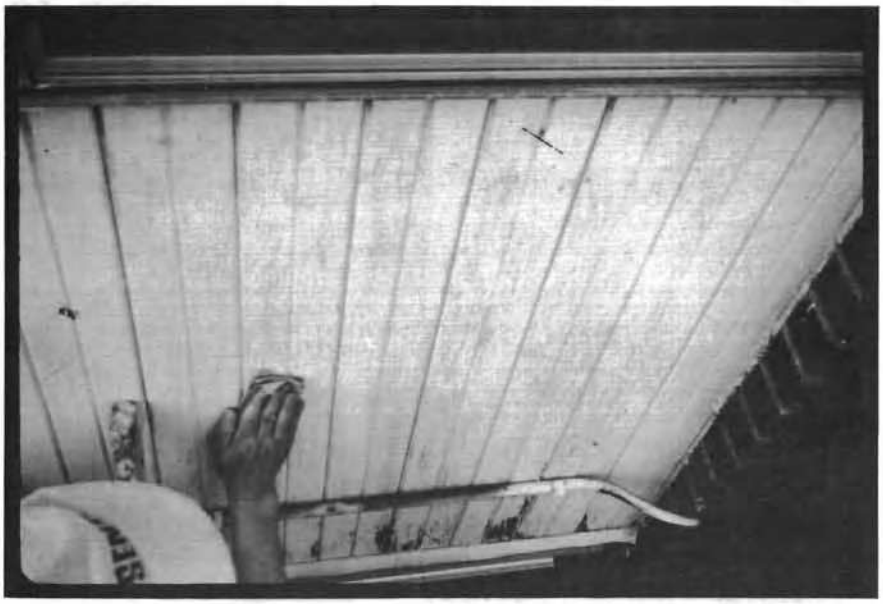


Figure 2. Preparation by Normal Methods

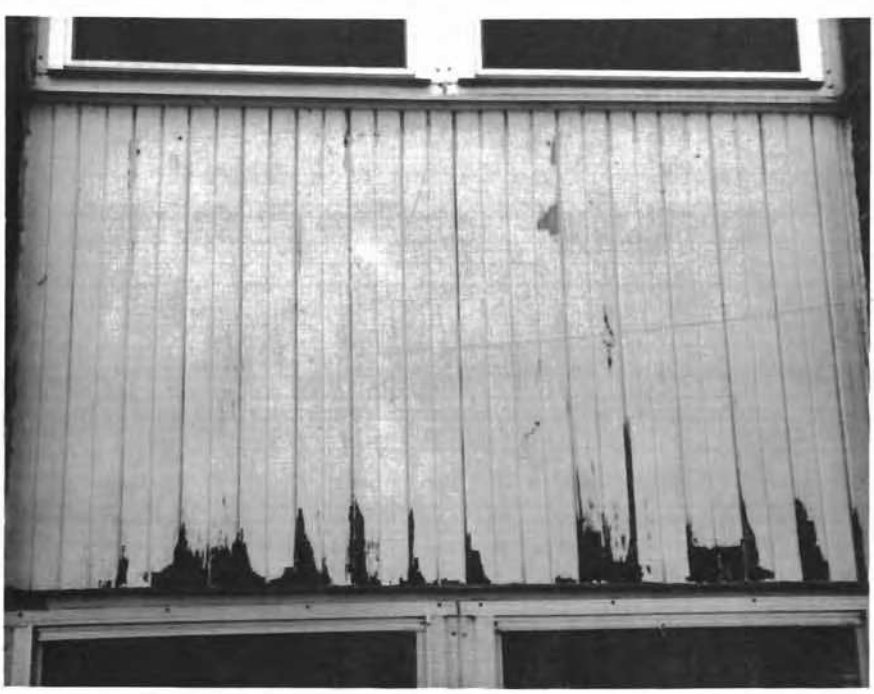


Figure 3. Preparation with Scraper, Brush and Sanding

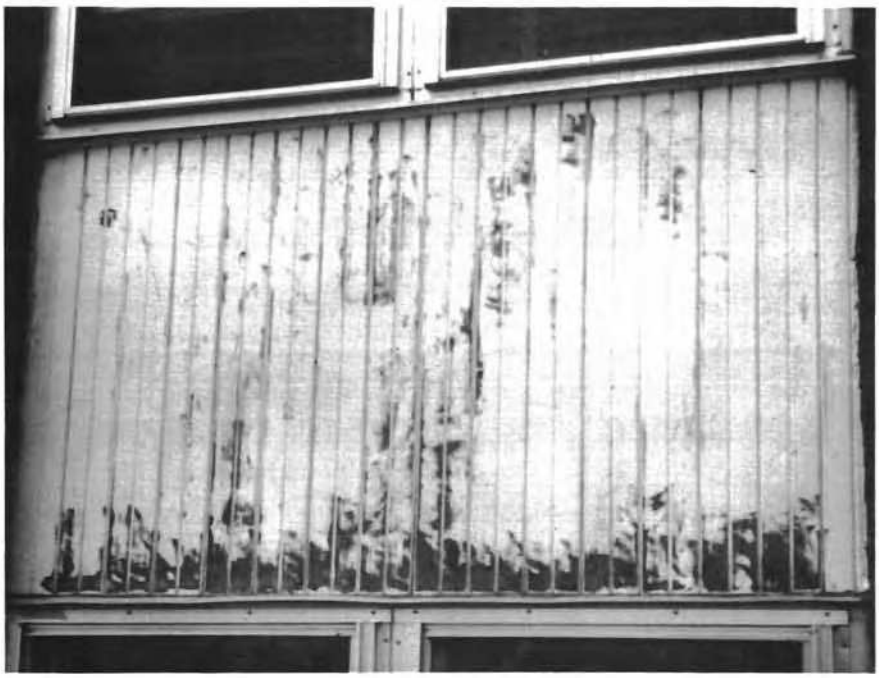


Figure 4. Preparation by Mechanical Sander

Figure 5. Preparation by Soft Sand Blasting