WEDNESDAY MORNING SESSION

April 14, 1954

The Conference convened at nine-fifteen o'clock, Mr. A. D. Mayer, Vice-President, Wisconsin Bridge & Iron Company, presiding.

CHAIRMAN MAYER: Gentlemen, your regular chairman selected for this morning's meeting, Mr. Eugene Zielsdorf of the C. Hennecke Company, could not be here today, and it is my pleasure, as your Co-Chairman, to open this meeting.

I drove in from my home out in the country this morning, and for those of you who haven't been outside let me tell you it is a beautiful spring day in Milwaukee.

I don't intend to make a speech, but as a representative of your host group again I want to say we are very pleased to have you with us here in Milwaukee.

With that, I will get the show on the road by turning the meeting over to the very able hands of our friend Ted Higgins.

CHAIRMAN HIGGINS: Thank you. I thought for a moment you were tempting them to go outdoors and leave this meeting.

Yesterday we followed the more orthodox method of having our dessert after lunch. Up in New England where I came from it is not unusual to have pie for breakfast, so we are going to have dessert the first thing this morning, the moving picture, "Steel Spans the Chesapeake," through the courtesy of the Bethlehem Steel Company.

(The sound motion picture, "Steel Spans the Chesapeake" was shown.)

CHAIRMAN HIGGINS: The subject of this morning's panel discussion is of extreme importance to the structural steel fabricating industry. If we were to devote the entire day to the subject, we could probably not cover all of its ramifications.

In the preparation of their remarks the members of the panel have been asked to consider the following more or less typical structural steel painting problems:

No. 1. A steel frame apartment building of about 8 stories covering a quarter of a city block, the construction being rolled steel columns and beams with open web steel joists, the columns to be encased in brick in the exterior walls and to be fireproofed with lightweight concrete on the interior, the floors to be concrete directly on the steel, and the ceilings to be suspended.

No. 2. A manufacturing building consisting of a single story building with steel columns, steel roof beams, steel purlins and a steel deck, covered on the outside with corrugated, galvanized steel siding and glazed steel sash, the steel work being exposed on the inside but underneath the roof.

No. 3. A highway bridge with a clear center span of about 500 feet and a total length of about 1000 feet; the construction to be built-up riveted and welded members exposed to the weather, with a concrete floor system cast directly on steel floor beams and steel stringers.

No. 4. A suburban garage for the storage and maintenance of a fleet of delivery trucks, in which the steel framing, including purlins, roof trusses and bracing are left exposed, and the columns are partially encased in the exterior masonry walls.

Represented on the panel are the viewpoints of research, engineering design and construction, and the structural steel fabricator.

The first speaker, Dr. Joseph Bigos, is a graduate of the University of Pittsburgh. As a Senior Fellow of the Mellon Institute in Pittsburgh, he is currently devoting all of his time as Director of Research, Steel Structures Painting Council, whose manual, "Good Painting Practice, Volume I," was distributed to the members of the Institute in January of this year. Dr. Bigos!

Shop Paint and Painting Practices

Panel Discussion—Part I

DR. JOSEPH BIGOS

This paper is a brief presentation of recommendations for cleaning and painting four types of steel structures which are commonly encountered in the day-to-day practice of steel fabricators. The recommendations are based upon what is believed to be current good practice by the Steel Structures Painting Council. The use of specifications already issued and to be issued by the Council is discussed.

General Principles

Adequate protection of structural steel demands recognition of the service to be expected of the structure. The requirements of that service may be little or no protection, or may be extensive, costly painting. Practical economics dictates the advisability of limiting the expenditures for cleaning and painting to only that sufficient to protect the structure and to satisfy appearance needs. Let us briefly review the corrosion of steel and later apply the basic principles we develop to protective schemes for typical structures.*

Steel does not rust except when exposed to atmospheres above a certain critical humidity—about 70% relative humidity. Serious corrosion of steel or iron occurs at normal temperatures only in the presence of both oxygen and water, the water being present either as liquid in contact with the steel or vapor in air above a relative humidity of 70%. Furthermore, the oxygen and water must be replenished. In a hermetically sealed container, corrosion will continue until this oxygen and water are used up; then corrosion ceases. This corrosion is electrochemical in nature. Any residues of soluble salts, welding fluxes, acids, cleaning compounds, etcetera, which form a solution of electrolytes, have a tendency to accelerate localized corrosion. In dry atmospheres, however, even bright, clean steel may be exposed for extremely long periods of time with no evidence of rusting and only a thin, transparent film of iron oxide forms. This layer of ferric oxide is actually beneficial since it protects the steel from further corrosion. It is similar to some of the chemical corrosion coatings which are used as pretreatments prior to painting.

The thick layer of iron oxides, or mill scale, which forms on structural steel, subsequent to rolling operations, provides protection to the steel as long as the mill scale is maintained intact and firmly adhered to the metal. Unfortunately, such intact mill scale is seldom encountered on fabricated steel, due to the weathering which occurs in storage and shipment prior to the fabricating procedures, and due to the cracking and flaking off of mill scale by fabricating operations. In the mild environments generally encountered in atmospheric exposures, the tight mill scale remaining is found to be sufficiently adhered to cause little difficulty except for occasional spotty lifting caused by moisture penetrating cracks and undercutting the surface of the mill scale. In strongly corrosive environments, such as immersion in salt water, the broken mill scale is exceedingly detrimental to the metal itself as well as to the paint. Rapid deterioration of the protective coating develops and pits form in the steel because of electrochemical corrosion. A similar reaction occurs above the critical humidity in atmospheric exposures, when the surface is maintained in a moist condition and corrosive chemical gases or vapors contaminate the air. For example, sulfur dioxide in the absence of water will not corrode steel. When the water content of the air is above the critical humidity, rapid and serious corrosion occurs.

Summarizing, the principle factors which cause the corrosion of structural steel are the presence of both oxygen and water in abundance. Under these conditions, overall corrosion occurs at an average rate of roughly 5 mils loss of surface metal per year. If the steel is comparatively dry, this rate will drop to about one-half a mil per year after the first year, in typical industrial atmospheres. Significant corrosion of steel does not occur in the atmosphere below relative humidities of 70% at normal temperatures. Excessively high, usually localized, corrosion rates occur only in the presence of electrolytes or corrosive chemicals.

For these reasons, it is often difficult to justify, as a protective measure, the painting of steel structures exposed to the atmosphere under normal conditions, due to the low overall rate of corrosion. In such cases, the appearance of the structure must be considered in justifying the cost of painting. Where corrosion damage is severe, it is usually found that serious loss of metal occurs at localized spots, due to accumulations of moisture, often associated with dissolved corrosive chemicals. If this localized corrosion could be eliminated, the loss of metal on the remaining parts of the structure would be so small that a normal corrosion allowance would be adequate to protect the structure economically.

Painting Weathertight Building Frames — Problem 1

Let us analyze the corrosion conditions encountered in the type of service associated with Problem No. 1. The building itself could be exposed in corrosive atmospheres ranging from mild rural environments to industrial or marine environments, but it is unlikely that it would be exposed to the severe chemical environment associated with chemical plants. Regardless of the environment in which the apartment building will be erected the life expectation of its frame will be long; protection by temporary expedients is therefore ruled out. However, the frame, consisting of rolled steel columns and beams, will be either encased in masonry and light-weight concrete or enclosed by means of a suspended ceiling. Hence it is protected from any corrosive environment, regardless of its location.

Examination of a number of buildings torn down after periods of as high as 50 years' service has indicated no corrosion of any consequence on such building frames whether painted or not. Isolated cases of severe corrosion of building frames in localized spots have occurred; but in every case to the writer's knowledge the

* This subject is covered in much more detail in Chapter 1 of *Good Painting Practice,* the first volume of the Steel Structures Painting Manual.

corrosion occurred because poor construction or maintenance allowed water to seep into the structure and remain in contact with the steel for long periods. It may be categorically stated that painting is not mandatory for the frame in this service, provided the structure is maintained water tight. Obviously, this latter condition is a necessary requirement, even though the best type of cleaning and painting were applied. Note that the construction need not be airtight provided the air is below the critical humidity. Even if it is above this point, the alkaline nature of the masonry or concrete will keep corrosion to a low rate, provided condensation is not continuous.

The question then arises, "Why paint the building frame at all?" Primarily, customer preference and mental reaction to rusty surfaces usually dictate the specifying of a shop coat. For normal periods of exposure before enclosure, the corrosion which would occur on unpainted structural steel cannot be considered to be structurally detrimental. The unsightly appearance of the rusted steel, however, perturbs some customers and architects, who therefore specify shop coating of such structural steel. This shop coat does provide some insurance to the building frame against corrosive conditions due to water later reaching the framework of the building. Prevention of rust-staining of concrete, masonry, and plaster may also require painting of the steel frame. The disadvantages of the painting practice are, first, its cost; secondly, the poor bond of concrete or mortar to the paint; and, third, the possibility of customer dissatisfaction due to its inadequacy as a permanent surface protection. The solution to this last point may be to educate the customer to a realization that the shop coat, normally applied to this type of building frame, is one which is not expected to protect the steel for excessive periods prior to enclosure.

The final item to consider is the floor joists. These joists will be completely enclosed in a dead air space between the concrete floor above and the suspended ceiling below. As a result, the stagnant air will be sufficiently dry to be noncorrosive. Again here, a basic premise of the recommendations to be made is that water will be prevented from entering the structure. Because noncorrosive conditions prevail, little cleaning and painting is required to protect the floor joists. But, because of the thin metal sections used, a limited degree of cleaning and painting is customary, to provide a factor of safety.

Recommendations:

Recommendations for cleaning and painting the structural steel in this building are as follows:

Heavy deposits of oil and grease should be removed by solvents before cleaning. Loose mill scale, loose rust, accessible welding slag and dirt should be removed by wirebrushing or by other effective means elected by the fabricator. The steel should then be primed with one coat of iron oxide, zinc chromate, alkyd paint.

This treatment in its entirety is identified, under the nomenclature of the Steel Structures Painting Council, as "Paint System Specification SSPC-PS27-54T." Each Council paint system specification covers the method of cleaning the surface, the type or types of paint to be used, the number of coats to be applied, and the techniques to be used in their application. System No. 27 calls for a minimum degree of cleaning and painting, and is intended for steel which will be enclosed in masonry or be encased in concrete, or which will not be exposed to corrosive conditions except for a temporary period prior to completion of the structure. A nominal cleaning of the steel is required to remove very detrimental foreign matter such as loose mill scale, loose rust, weld slag, and heavy deposits of oil and grease. This cleaning is no more than required by Section 34 in the present A.I.S.C. Specification. One coat of paint* conforming to Federal Specification TT-P-636, "Primer Paint; Synthetic (For ferrous metal and wood surfaces), May 7, 1946," is then applied in the shop by brushing, or spraying or dipping or any method desired by the fabricator. This paint was selected because of its low cost and quick drying. It has some rust inhibiting characteristics because of the zinc chromate content of its pigment. To obtain quick drying, a synthetic resin vehicle is used. Since such a vehicle has poor wetting characteristics there is danger of some loss of adhesion over poorly cleaned surfaces, particularly oily or greasy surfaces. It is expected that some spotty failures may occasionally develop because of this poor wetting characteristic, but it is felt that this would be acceptable in view of the type of work for which the paint system is intended.

The above recommendation as to type of primer reflects current thinking in the Steel Structures Painting Council. Recently, however, some fabricators have objected to the use of this primer because of fear that customers will require repainting if some rusting or spotty failure develops. For that reason, the Steel Structures Painting Council is presently conducting a test program to evaluate other primers with possibly better wetting characteristics that might be safer to use. In the event a better primer is developed, it will be substituted for TT-P-636 in Paint System No. 27; but it must be clearly understood that 100% protection cannot be guaranteed and is not intended with this class of painting.

While the Council currently recommends its Paint System No. 27 as a standard shop coat for a building of

* The composition and characteristics of the primers discussed in this paper are tabulated in Table I, page 185, of Volume 1 of the Steel Structures Painting Manual.

this type, there are other paint systems which are of equal value and cost. Paint System No. 28 is the same as Paint System No. 27 except that it uses an iron oxide, linseed oil paint* fortified with spar varnish and zinc oxide. It is also an excellent low cost paint, but it has the disadvantage of requiring at least 18 hours for drying. It does have better properties, such as better wetting and greater dry film thickness, and there is less probability of failure due to poor wetting. Council Paint System No. 30, which uses an asphalt varnish**, is also a satisfactory shop coat for this structure.

Painting Manufacturing Buildings† — Problem 2

The corrosive conditions encountered in a manufacturing building exemplified by Problem No. 2 can vary from conditions which are no more severe than the apartment building frame exposure of Problem No. 1, to those of a chemical plant. For example, such a manufacturing building might be used for assembling purposes in which the environment could be dry and non-corrossive, or the manufacturing might consist of galvanizing, with pickling, fluxing, and galvanizing operations which cause severe corrosion to the steel work. For the purpose of this discussion, it will be assumed that the manufacturing building will be one in which steel fabricating operations will be conducted, including gas and electric cutting and welding, bending, shearing, machining, riveting and heating, but that no corrosive chemical fumes will be generated with the exception of products of combustion which escape into the air.

Such a building will generally be located in industrial areas, and subjected to considerable temperature changes with possibly intermittent condensation occurring in the upper portions of the building and along the exterior walls. Although no great amount of highly corrosive gases or fumes will be generated of necessity in the manufacturing operation, corrosion may be expected at damp localized spots in crevices, joints, and contact surfaces due to absorption of sulfur dioxide and carbon dioxide, plus possibly other gases, from both the fabricating operations and the local industrial atmosphere. Accumulations of dust and dirt containing residues of cinders, heat treating salts, and de-icing salts tend to absorb moisture from the air and cause localized corrosion. A better type of cleaning and painting than specified for Problem No. 1 is usually demanded. The paint on the building frame must be capable of continuously protecting the framework from probable corrosion. A more rust inhibitive and more durable paint will be required than for the first structure. Such paints are more expensive than those previously discussed and will require better surface preparation to be effective. The better surface preparation is required for two reasons. First, a better degree of surface preparation is required to realize the full economy of the rust inhibiting primer, particularly around trouble spots such as welds, rivets, crevices, joints, etc. Secondly, to maintain the satisfactory appearance of painted steel work, the primer must develop proper adhesion to the steel, and this adhesion must be maintained during the life of the paint system; careful cleaning, especially in regard to the removal of oil, grease, loose mill scale, loose and nonadherent rust is therefore required. Hand cleaning is adequate for such an exposure if properly done. A primer of good wetting power must be used and will generally require semi-long periods to dry—probably 18 to 24 hours. In general, a minimum of one coat of shop paint with a suitable finish coat applied after erection is recommended. In many cases, a total of three coats of paint will be warranted.

The steel roof purlins are often much thinner material than the remainder of the building frame. They are, therefore, more vulnerable to failure due to loss of section through corrosion. A minimum of two coats of paint should be applied to the steel purlins, particularly to those areas which will be difficult or impossible to paint after the steel deck is laid. In this building, paint thickness is a factor and three mils thickness of dry paint should be obtained as a minimum.

Recommendations:

There are six Paint System Specifications (Nos. 2, 3, 4, 5, 7, and 8) which the Steel Structures Painting Council would recommend for a structure such as the one represented by Problem No. 2. All of these systems call for substantially the same surface preparation. The same surface cleaning specified for Problem No. 1 would be used in connection with the six paint systems, but greater care would be required to insure a more thorough removal of all foreign material and loose scale. The details of this cleaning technique are covered in the Council's Surface Preparation Specification No. 1—Solvent Cleaning—and Surface Preparation Specification No. 2—Hand Cleaning.

Regardless of the system used, all paint—both shop and field coats—should be applied in accordance with the Steel Structures Painting Council's Paint Application Specification No. 1—Shop, Field and Maintenance Painting. Each of the six paint systems recommended for the given problem contain a number of alternate types of field paint. These alternates are the same for all six systems. Hence the distinguishing difference in the systems is entirely in the type of shop primer.

The shop primer* specified under Paint System No. 2 is the closest to the standard red lead structural steel primer which has been used successfully for many years.

* Federal Specification TT-P-31b.

** Federal Specification TT-V-51a.

† Painting of industrial plants is covered in Chapter 16 of *Good Painting Practice.*

* Federal Specification TT-P-86a, Type I

It is virtually 100% red lead pigment and a raw and bodied linseed oil vehicle. It is excellent for the exposure under consideration. Its principal disadvantages are:

1. A drying time of at least 36 hours, and
2. The cost of the paint.

The shop paint called for in System No. 3 is also an excellent primer,* containing 75% red lead and 25% red iron oxide mixed in two parts of raw linseed oil to one part of alkyd resin vehicle. This primer will dry in 24 hours, or less, and has excellent weathering characteristics and rust inhibitive properties. More care is required in surface preparation for this primer than for the primers specified under Systems Nos. 2, 4 and 5. The difference between the primers specified under Systems Nos. 3 and 4 are entirely in the type of vehicles used. System No. 4 primer uses a fractionated linseed oil; this primer** dries in 24 hours and has excellent wetting properties for the type of surface under consideration.

The vehicle used in the primer for Paint System No. 5 is the same as that required for Paint System No. 2, namely a mixture of raw and bodied linseed oil; the pigmentation is somewhat different, consisting of 75% red lead and 25% extender. This paint† is somewhat less expensive than that called for in System No. 2. It has excellent wetting properties, but like the paint in System No. 2 requires 36 hours to dry. The pigmentation and vehicle for the primers called for in System No. 7 and No. 8 are essentially the same. Both contain zinc chromate and iron oxide mixed in equal parts, and raw linseed oil and long oil alkyd resin. Because of a difference in the type of iron oxide used, the primer†† for Paint System No. 7 is yellow in color, while that for No. 8 is red.‡ Both paints will dry in 24 hours, or less.

While at first it may seem somewhat confusing to recommend several paint systems, there are valid reasons for their inclusion here. There is seldom one, and only one, solution to a given paint problem. Each fabricator may find one or more of these specified primers suit his particular operations best; he may prefer a longer drying primer, while another may be forced to use semi-quick drying paint. For some conditions a paint containing red oxide is particularly suitable because of its good weathering resistance; if a white field coat is to be applied, however, a light colored yellow oxide may be necessary for the shop coat in order to get satisfactory hiding.

Because of the limited corrosivity of the atmosphere in the typical manufacturing building in the given problem, a total of two coats of paint—one good coat of shop primer and one good finish coat—will be adequate. If a more severe environment were to be encountered, two coats of the priming paint should be applied—one in the shop and one in the field after erection—in addition to the finish coat. On the other hand, if the environment had been less severe than assumed in the given problem, and appearance was unimportant, the field coat might have been omitted on all interior steel work. In rather dry and mild exposures Paint System No. 27, discussed in connection with Problem No. 1, would be adequate.

Obviously customer preference for color and type of finish paint will dictate the alternate to be used for each individual case. In the given problem, an aluminum phenolic paint might be a happy choice. This paint has the advantage of better resistance to moisture, condensation, and mild chemical environment than the oleo-resinous-aluminum paints commonly used. The use of aluminum paint on the interior of the building has the advantage of high reflectivity resulting in better lighting and more pleasant working conditions, although a matching complementary color of trim would be even better.

The Painting of Highway Bridges — Problem 3

Bridges represent one of the most serious and difficult painting problems* facing the fabricator today. Because of the size of these structures and the consequent cost of cleaning and painting involved, a paint system of low initial cost is desirable, particularly in view of the methods of financing large bridges. At the same time, a paint system is also desired which will result in low annual maintenance cost. The problem is tremendously aggravated by the elapsed time between shop priming and field painting. A bridge of this size is fabricated in a shop, usually cleaned and painted there, and then shipped to the site of erection. The time between shop painting and field painting may be as high as two years and will often be at least one year. This long exposure of the shop coat to the weather has often resulted in deterioration of the shop coat, with subsequent losses to the fabricators who have had to replace or repair the shop coat at their expense. Furthermore, while the condition of the shop coat may not have deteriorated visibly to the point where repriming is necessary, the performance of the complete paint system may be adversely affected by partial breakdown of the shop coat.

Typical failure of the shop coat, and even of the complete paint system shortly after field painting is completed is a phenomenon known as "mill scale lifting." Large patches of the outer layers of mill scale are raised by rust forming underneath. Often, the entire paint system is removed intact over patches of the scale. It is believed that mill scale lifting is caused by penetration of water and oxygen under the edges of mill scale. This penetration occurs at cracks or breaks in the mill scale and may occur before shop painting, or it may occur after shop painting in the event painting is improperly

* SSPC Paint No. 2
** SSPC Paint No. 3
† SSPC Paint No. 4
†† TT-P-57, Type I
‡ SSPC Paint No. 11

* This problem is discussed in detail by Jonathan Jones in Chapter 8 of the Painting Manual.

done. Cold and damp conditions are believed to be particularly conducive to mill scale lifting. If moisture is trapped under mill scale prior to painting, it will continue to react with the layer of ferrous oxide and the steel surface beneath the outer layers of mill scale and failure is sure to occur.

The best insurance against such mill scale lifting is to do a thorough and conscientious job of removing loose mill scale, rust, oil and dirt, and applying a high quality primer with good wetting power to the clean, dry steel. The primer must have a pigmentation which is capable of protecting the vehicle for the period of exposure in addition to preventing corrosion. The best vehicle for the wetting of typical structural steel surfaces which will be exposed for long periods of time is raw linseed oil. Unfortunately, a straight raw linseed oil primer requires approximately 72 hours to dry. When such a long period of drying is practical, this is believed to be the best type of paint to use over such steel.

The numerous cases of bridges having been built without completely removing mill scale, on which the paint system has satisfactorily stood up for long periods of time, prove that economical protection of such structures is possible provided conscientious and thorough hand or power-tool cleaning is used as a method of surface preparation, and provided that a properly designed and properly applied paint system is used. In such cases it is impossible to state that no mill scale lifting will occur, but it is safe to venture the opinion that only minor patches of mill scale will lift and that the structure will soon be stabilized to the point where the presence or absence of mill scale is not a factor in the performance of paint. This situation will prevail for the normal structure exposed in rural, industrial, or marine atmospheres. In cases of extremely severe exposures, such as locations adjacent to chemical plants or in actual immersion in fresh salt water, it is advisable to remove mill scale completely and then to provide the very best type of painting system to protect the costly investment in surface preparation. Often, this work may be done more economically at the site of erection due to the expense of blast cleaning large members in the fabricating shop. When experience indicates that the particular location or atmosphere is very corrosive and detrimental to paint, it may be economical to blast clean and apply three or four coats of high quality paint. A number of highway departments and railroads have resorted to blast cleaning as an answer to the short paint life they were obtaining on bridges in severe environments, such as highly humid coastal regions or brine dripping and salt spray.

Recommendations:

As in the case of Problem No. 2, there are a number of paint systems that are satisfactory for this type of structure. The Council's Paint Systems Nos. 1 to 10 are suitable. Paint Systems Nos. 2, 3, 4, 5, 7 and 8 have already been discussed. Paint Systems No. 1 and No. 6 require the same hand cleaning specified under the recommendations for Problem No. 2. Paint Systems No. 9 and No. 10 require power-tool cleaning as described in the Council's Surface Preparation Specification No. 3 *Power Tool Cleaning. The priming paint specified in Paint System Nos. 1 and 6 both have a raw linseed oil vehicle with consequently good surface wetting properties ; No. 1 calls for a straight red lead pigmented paint*, while No. 6 is based upon a zinc dust-zinc oxide pigmented paint.** Both of these paints require very long drying times, which make them difficult for normal fabricating procedures. The primers required for Paint Systems Nos. 9 and 10 employ vehicles consisting of equal parts of raw linseed oil and alkyd resin, and as a consequence will dry in 16 hours. Because of their somewhat poorer wetting characteristics, power-tool cleaning is a requirement with these two systems. The primer in System No. 9 is based upon red lead, iron oxide, extended pigment†; the other is based upon a straight red lead pigment‡.

Some comments regarding the use of these systems for this type of structure are pertinent. To begin with, each system calls for a second coat of primer (suitably tinted for contrast) to be applied in the field, and a third coat of paint to be selected by the customer from the list of suitable alternates. Three coats of paint are believed to be a minimum recommendation for any normal atmospheric exposure. In the event the exposure is believed to be exceptionally corrosive, such as a heavy industrial atmosphere or a severe marine atmosphere, four coats of paint are recommended. In the latter case, the fourth coat of paint could be the same as the third coat of paint.

All of the Council Paint Systems from No. 1 through 10 are suitable for this type of exposure, but the better choices are believed to be Paint Systems 2, 3, or 4. Their shop primers are all of approximately the same quality, they do not vary much in price, and they have proved practical on large bridges; furthermore they are suited to the fabricator's operations. It is important to point out that the cost of the paint, here, is a minor factor and quality should not be sacrificed for price, because of the high cost of repainting in case of a paint failure. In the painting of such structures, the cost of the paint itself is a minor item; the price variation between a good paint and the very best paint is generally small as compared with the total cost.

* SSPC Paint No. 1 (A.A.S.H.O. Specification M72-51, Type I)
** Federal Specification TT-P-641*l*, Type I
† Federal Specification TT-P-86a, Type II
‡ A.A.S.H.O. Specification M72-51, Type IV

The Painting of Miscellaneous Unexposed Steel in a Service Garage — Problem 4

This problem is not different in any significant manner from Problem No. 1 since it represents enclosure in masonry on the one hand, and exposure to a relatively dry atmosphere on the other. Here again, the air is noncorrosive and, even though it may not be enclosed in a dead air space, as long as the air is below a relative humidity of 70% it will not be corrosive to the steel. Again, it must be pointed out that it is assumed that the structure will be water-tight and that the steel will not be in contact with water for long periods. A minimum degree of cleaning and painting is adequate.

In passing, it might be remembered that failure to maintain water-tight roof and walls can generally increase the maintenance cost of items other than the steel frame. It is common sense to watch this matter anyway.

Recommendations:

Recommendations for cleaning and painting this structure are the same as for Problem No. 1.

It is not contemplated that more than the one shop coat will be required for any normal exposure of this nature. In the event that the situation arises where additional coats of paint are desired, the primer in Paint System No. 27 will provide a suitable base for any of the ordinarily used top coats.

Summary

Typical painting schemes have been recommended for common types of fabricated steel exposed to normal atmospheric conditions. There is no one solution to any of these problems. Many other equally good painting systems are in use or may be devised. The methods presented are believed to be practical, economical, and representative of current good practice.

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CHAIRMAN HIGGINS: Thank you, Dr. Bigos.

Our second speaker, Mr. G. Wood Smith, is a graduate of the Colorado School of Mines. He is Vice-President of the engineering firm of Sverdrup & Parcel, Inc. of St. Louis, having joined that organization in 1932. Mr. Smith's activities with Sverdrup and Parcel are such as to give him an unusually broad experience not only in construction but in the maintenance of steel structures. Mr. Smith!

Shop Paint and Painting Practices
Panel Discussion—Part II

MR. G. WOOD SMITH

Right at the start I would like to introduce these thoughts: Oftentimes the maintenance of these very important structures is not necessarily placed in the hands of people who are highly skilled in such maintenance. Too often they are at the mercies of local labor. They derive a great deal of their information from salesmen, who sometimes are not always well informed, or who are pushing products at the expense of the actual facts of the matter. So when a piece of steel is erected, painted, and starts its life's span, that is just the beginning. Now, that's the viewpoint from which I would like to approach the matter.

Proceeding along the line that a panel discussion should bring out all phases of the problems under consideration, I would like to consider the effects on owner's problems and long-run maintenance in connection with the four steel protection cases offered.

It is thought that certain generalities apply to all four of the cases and it might be well to enumerate these generalities, and the extent to which they may be conceivably applied. They are:

1. The consideration of the cost to the owner, of the coatings or paint to be applied by the fabricator and subsequently in the field. It might be well as part of this question to consider whether cost to the fabricator is necessarily cost to the owner. In other words, will the conditions of competition prevent the fabricator from passing on some additional cost to the owner.
2. The ultimate cost to the owner to maintain the paint or coatings and to preserve the steel for its full life.

Of course, there are many subdivisions of these two generalities which could be applied in regard to the cases offered.

Case No. 1. Eight-Story Steel Frame Apartment Building

Under normal conditions of moisture and corrosive gases, our experience indicates there is a serious doubt that steel which is to be encased in good masonry and good concrete needs to be painted. Specimens which have been removed from old buildings, where certainly we have no right to expect encasement of the quality

which we can achieve today, have shown the original surface or the original paint, generally red lead, in excellent condition. There is also the question whether, in the event of some break or damage to the encasement, paint arrests or checks any spread of corrosion along the steel. My experience does not show any great difference between painted and unpainted steel in this connection.

One of the other panel members has pointed out that there seems to be a psychological feeling that the steel should be coated before encasement. I agree that that does prevail many times as the prerogative of the architect, the engineer, and the owner. They like to see bright painted steel against the skyline. The fact is that it doesn't add anything to the structure's life.

Actually, the cost of original prime coating, the added cost of handling to prevent damage to the prime coat, and the field cleaning and spot painting necessary before encasement does not seem warranted in the problem outlined in Case No. 1. However, its cost as compared with the total cost of the completed structure generally is not so large that it becomes a matter of serious consequence to the owner and his engineer and architect.

Dr. Bigos has raised the point of cleaning. Now, I think there is a distinct line of demarcation between cleaning of structural steel (1) for the purpose of subsequent prime coats; and (2) to achieve just the normal cleaning you would expect, to send good steel out of your shop. I think, in any event, whether the steel is to be coated or not, reaming cuttings, drill cuttings and scrap pieces should be removed particularly from box members and other points where they accumulate. To the inspector in the shop, it is always a bugaboo to see a paint coat applied, and later on, when the piece is picked up and moved, to find the coating filled with metal scraps. I also think the cleaning of oily residue, shop filings and reaming cuttings are indicated as a matter of sending out a good clean product to the people who are going to use it.

Now, we have spoken here in terms of a stated set of conditions, ordinary or normal conditions. That's very well and good. We all must recognize, however, that in the United States of America one broad specification can't cover the many unusual circumstances that are encountered. There are many cases where high humidity or other local conditions would definitely indicate a need for such coating of steel. They can only be isolated. They can only be considered by local people and, almost inevitably, the fabricators are the best judges of whether material going into a certain area should be coated in advance.

In summary, I don't believe it is necessary to coat the steel for Case No. 1 unless it is going into an area of high humidity, or for protracted periods of storage where some coating is indicated merely to protect it until it can be raised and encased. Then possibly the minimum coating should be applied, knowing that it is only going to be of real use until encasement is applied. It might be more economical to coat the steel than to perform the extensive cleaning that might be required if unpainted or uncoated material were used in situations were these or other extraordinary conditions prevail.

Case No. 2. Single-Story Manufacturing Building

It is my opinion that the manufacturing building set out in Case No. 2 presents an altogether different picture. We are not going to have anything in here which will be corrosive; that's not our intention. Yet, three years later you have a call from the owner saying, "We are having a lot of trouble. Some of the purlins are beginning to rust through." Then you find a zinc kettle busily putting out fumes over in one corner, and several things you hadn't anticipated. We find we must accept some of the owner's basic criteria with a little bit of skepticism.

The force and pressure on any organization, from operations and the cost of operations, is such that they forget what they told the engineer and the architect initially. So we always approach that type of a building with a deep suspicion and the mental reservation that it better be "but good," because we don't know what they are going to have in there three years from now. Regardless of what was said at the time they were dealing with basic criteria, they will come back and say, "We found conditions that we hadn't anticipated."

We have every right to expect that manufacturing processes which would create corrosive conditions would be used, and it is felt that the best possible steel protection is indicated under such circumstances. To this end, the steel should be given the best shop coat that can be obtained. My experience has indicated that hand cleaning is not always satisfactory, particularly in the removal of mill scale, and that to mill scale can be attributed a large part of the premature coating failure which often occurs in this type of building.

Given a good shop coat initially, the cost and the problems of maintenance over a protracted period are appreciably reduced. Given a poor shop coat, the problems will never end. So the responsibility of the fabricators to deliver the very best possible shop coat under such conditions is not an inconsiderable one.

I feel that often a more positive method of cleaning such as flame cleaning, shot or sand blasting, is required. The field cleaning and the removal of burned and scorched material around field riveted joints, the spot painting and the satisfactory repair of the shop coat prior to the application of the field coats is particularly important. Particular attention should be given also to the protection of the coating of those surfaces which might be inaccessible subsequent to construction and of those which will be in contact with roof surfaces.

I know that this is a tough thing. Where do you break

down the costs of repairing the shop coat? Where do you differentiate between the costs of repairing the shop coat and the cost of putting on the additional coat? I know these questions go on indefinitely and, almost inevitably, the architect and engineer get pinched in the deal. Even though we say, "You are the subcontractor; we have nothing to do with that," we often find ourselves in the position of trying to be an arbitrator, to try to determine whether the coating was damaged or whether it failed, and whose responsibility it is to replace the coating.

We concur with the idea that a minimum of three coats should be applied not only to the purlins but to all steel, and it is felt that either a specially selected coating should be used in addition to the two coats, or else a sufficient number of additional coats should be applied to guard against the corrosive conditions.

In my own personal experience, I think the life of a coating is directly proportional to its thickness, assuming it was placed under good conditions. I would even go so far as to say I like a five coat job better than I do a four; I like a four-coat job better than I do a three. I think the thickness of the coat is all important in that particular case.

Again, such a discussion is not always applicable to the broad picture. You can't say, for example, that you would do the same in Maine as you would in Arizona. But speaking in general terms, on such a building I want to see the best possible shop coat that can be applied, the best field repair of that shop coat, and a carefully considered program of the subsequent coatings that go on. I think in many instances they can be specialized to take care of the particular problem in hand. There is no quarrel with the standard specification; I think it merely goes beyond it. It becomes the responsibility of the engineer and the architect to give exact detailed study to those coatings which are applied under special conditions, rather than to accept a broad general specification.

Case No. 3. Highway Bridge with a 500-foot Span

Without question this type of steel job presents one of the most difficult protection problems. On the larger bridges considerable time usually elapses between the application of the shop coat and the subsequent coats. Another factor is that maintenance painting after the bridge has been in operation is, on a tonnage basis, higher than that of the other cases under consideration. The problem is further complicated by the fact that the maintenance funds come from taxes or tolls and, as a usual thing, it is often a problem getting the necessary funds to do the work as required.

With these points in mind, the best job in the shop as to cleaning, application, and material, cannot, it is believed, compare in performance with that of a sand blasting cleaning and the application of all paint after erection. Several instances are known in which touching up and repainting was not required for 15 or more years when the material was erected without paint and then sand blasted and painted. In comparison, other similar structures in the same general location and conditions of humidity and corrosive substances in the atmosphere, on which good prime coats were applied in the shop, followed by field application of second and third coats, required extensive spotting and repainting in about half the time.

As an aside, spotting and repainting is a very expensive annual operation. Here, in particular, will the owner benefit greatest by the cleaning and application of the prime coat. If the decision is made to do this in the shop, the matter of drying time should be secondary. Now, it becomes secondary to the owner. I recognize it doesn't become secondary to the production people who have a limited space for laying out trusses and members and limited space in which to paint; and they must keep this material moving. I think you are familiar with seeing a painter chase a truss down the yard to try to catch it before it gets loaded into a car for the last piece of touch-up work.

From the owner's standpoint, I think a drying time of 72 hours, as Dr. Bigos said, is essentially accurate, but I think it is safe to take into account the many variations we have in painting conditions. Let's take a specific example; when a specification goes out from the State of Kentucky for the furnishing of 4,000 tons of steel for a bridge and they invite, as they should, all of the fabricators to propose on the furnishing of that steel, you can't tell when you write that specification whether the steel is going to be fabricated in Gary, or in Pittsburgh, or possibly in Kansas City. There isn't any way you can tell where the steel is going to be fabricated; consequently, how can you make any estimate of the number of decent painting days you are going to have to coat that steel? For example, a shop in Milwaukee adjacent to the lake where there are relatively high humidity conditions and where there is a relatively short warm season, as compared to a shop in some other part of the country, may have infinitely fewer painting days. The hardship of keeping a piece of steel in your yard 72 hours, or six or seven days if necessary, to obtain the desired curing of that coat, may change the aspects of all your conditions of bidding. So from the standpoint of a fabricator, the time of drying of a shop prime coat must be secondary if we look at the thing we are interested in, the ultimate life of that coat. Now, we are sympathetic with their problems but, nevertheless, that's the fact of the matter.

Now, over the years I have become increasingly sold on the value of the wetting characteristics of the vehicle in the various coatings. We frequently get quotations on the application of field coats that will vary markedly with the type of coating or paint that is specified. If it wets

well, if you don't have to drag the brush and work it back and forth, if it has a natural tendency to seek out the abrasions and the small crevices, the cost of applying that coat is immeasurably reduced. The characteristics of coating that I like to see best is the wetting characteristic, and I think it is most important.

Getting back to the owner's viewpoint, it has come to my attention that even a slightly corrosive atmosphere will produce startling results, such as breaking down of the paint film on the windward truss with apparently very little effect on the leeward truss. Specifically, we have one bridge the upstream truss of which is costing us probably three times as much to keep that paint in condition as any other part of the bridge. Yet you wouldn't say from casual inspection that it is in a particularly bad situation. It is not; but something comes down river on the wind that will eat off the coating on the upstream truss. It takes off the final field coats. As a general rule the prime coat, being good, isn't disturbed. If we had a poor prime coat, we would have a greater problem on that particular truss.

Another point which deserves special consideration—your counsel too, Doctor—is the special protection of the lighter members of this bridge which is under discussion. I am thinking particularly of the sway frames and lateral systems which are subject to practically continuous vibration from winds and live loads. That is where we have a great deal of trouble. It is not trouble in the sense of the word that the sway frames and wind braces have ever rusted to the point where replacement was indicated. Actually, the lateral plate will go first. Almost invariably we have a degree of rust in those particular braces which discolors the bottom of the angles, and it causes a bad appearance before very long.

On numerous occasions I have personally gone after this problem with the painters, and we have either spray painted or mopped paint in there. We carefully cleaned, and then used sheepskin daubers to apply paint between the laced angles. I am of the opinion that the early paint failure is probably due to repition of vibration; perhaps it is stress repetition. I know specifically that the coating between the backs of the angles needs to be done oftener than anywhere else, and I think something should be done along that line.

Case No. 4. Suburban Service Garage

This problem is very similar to that of Case No. 1, inasmuch as the atmospheric conditions should be relatively dry and noncorrosive. The exposed structural steel will be readily accessible for maintenance painting if and when required. For these reasons, a minimum amount of cleaning prior to the application of the shop coat, if required for looks, should be satisfactory.

It is not intended that the above be an exhaustive dissertation on all of the aspects of the questions which have been raised. However, one thought applicable to all four cases should be examined. The question of the paint or coatings which are used to protect the material is most important.

I have picked on the responsibility of the fabricator. In a highly competitive market where your competition is growing—you have got to remain competitive in steel—there are other materials which are making inroads along certain lines. We recognize that. I think you must accept the responsibility that when you do put on a prime coat its performance is of terrific importance to the owner over a long period of time. The owners will know who fabricated their steel, and they will know which paint held up and which didn't hold up. You have to recognize the problem of the owners. I realize that a good deal of this is academic. You put paints on, inevitably, in accordance with the owner's and architect's requirements.

I wonder if it wouldn't be apropos for the fabricators to take a small leaf from the book of the architectural builders. For example they specify "Crane" fittings of a certain number and a certain type. They will get bids in through the general contractor, who will get bids in from the subcontractor, and they will give you a figure. The contractor goes on to say, "However, if you will use "Standard" fittings No. so-and-so in lieu of "Crane" fittings No. so-and-so, we will make a reduction in the price of so much." Perhaps this is just an idealistic type of approach, but I wonder when a fabricator is called on to quote on steel, with a certain kind of coating on it for which he must accept a certain amount of responsibility later on, if it wouldn't be well to go back to the owner and say, "If you will permit us to ship the steel unpainted we will give you a credit of so much per ton." This certainly would be bait to the engineer and architect and the owner to consider, because we never know how much that coat of paint is costing the fabricator. When we see a price of steel quoted to us, delivered erected and painted, it is very hard to isolate the cost of the coatings we have been talking about.

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CHAIRMAN HIGGINS: Thank you, Mr. Smith.

Now, we have the viewpoint of the researcher and the viewpoint of the consulting engineer. We have yet to hear from the fabricators. Our next speaker, Mr. Ethan Ball, Chief Engineer of Fabricated Steel Construction, Bethlehem Steel Company, likewise can draw from extensive experience in the construction and maintenance of steel structures. He, naturally, may be expected to approach the problem of painting from the viewpoint of the fabricator, if, in fact, there is any essential difference in the viewpoint of the several members of our panel. Mr. Ball!

Shop Paint and Painting Practices

Panel Discussion—Part III

MR. E. F. BALL

One of the purposes of the Painting Council was to determine present good painting practice in all the fields where large numbers of steel structures are painted. Another purpose was to report such current practices in the form of a painting manual and specifications. The Council has reported by issuing Volume 1—Good Painting Practice, and by printing a number of specifications covering surface preparations, painting systems, and paint application, all of which will be contained in Volume 2 of the Painting Manual, to be issued soon.

Dr. Bigos has just told us how the Manual and Specifications should be used by engineers to specify practical and economical methods of protecting steelwork by painting for four different conditions of exposure. The four problems for which Dr. Bigos has offered solutions cover, in total, a substantial majority of the tonnage fabricated by AISC members. If the solutions are in general satisfactory to fabricators and engineers, it would therefore seem that the Painting Council has gone a long way towards accomplishing its stated purposes as far as AISC members are concerned.

The reason for having this panel discussion is to explore the solutions suggested by Dr. Bigos for the four problems, from the viewpoints of fabricators and engineers. The remarks following are from the viewpoint of a large fabricator equipped to produce all types of fabricated steel in all parts of the country.

Problem No. 1 refers to a field which is very important to fabricators, as it is one where steel construction is vulnerable to competition from reinforced concrete construction. It is therefore essential that no unnecessary expense be added to the fabricator's costs. The most satisfactory solution would be to omit paint entirely as it is not needed for protective purposes, but many owners specify that the steel must be painted, probably on account of appearance. When painting is demanded, Dr. Bigos recommends Painting System No. 27 as sufficient and economical. The cleaning method specified in PS-27, though not in accordance with any of the Council's specifications for surface preparation, has been used for many years for work not subject to corrosive conditions. It is not expensive, and it is quite satisfactory to fabricators. However, the paint specified—Federal Specification TT-P-636—is not at all satisfactory to large fabricators who ship steelwork to all parts of the country. Considerable time may elapse before the painted steel is enclosed, and there is apt to be a considerable amount of paint failure during shipment, storage, and erection. The writer would not recommend the use of any paint with a 100% alkyd vehicle as such a paint does not adhere well to steelwork unless it has been thoroughly cleaned by blasting or pickling. The Painting Council is presently considering other primers and may possibly change the paint requirement of PS-27 to make it more satisfactory to all concerned.

Manufacturing buildings of the type described in Problem No. 2 probably vary more in regard to painting requirements than any other type of fabricated steel. This wide variation in requirements may be due to different locations of structures, or to the varying character of operations performed in the buildings, or it may be due to the owner's desire, or lack of desire, for a first-class plant. Many manufacturing concerns demand that materials and workmanship in their buildings be of the highest grade, and they are willing to pay for that grade. In any event, fabricators find that a substantial tonnage of manufacturing buildings have to be fabricated with a better type of cleaning and painting than specified for Problem No. 1.

The procedures suggested by Dr. Bigos for this quality work are about in line with what has been required by many engineers. In other words, when high quality painting is demanded and paid for by the owners, fabricators would be satisfied to follow the Council specifications recommended by Dr. Bigos. For run-of-mine work, where high quality is unnecessary, they would want to follow the less costly Painting System 27.

The painting of major highway bridges, represented by Problem No. 3, has been one of the most difficult and costly problems facing large fabricators.

Dr. Bigos points out that the main reason for the failure of paint for this type of structure usually is the long lapse of time between shop priming and field painting. It is essential therefore that the steel be thoroughly cleaned and that high quality paint with good wetting power be properly applied, and allowed to dry before handling.

Dr. Bigos recommends the use of one of the Council's Paint Systems 1 to 10, some of which require power-tool cleaning. The writer prefers to use the red lead shop primers specified for Systems 2, 3 or 4 which are suitable for hand cleaning, unless exposure conditions demand a paint with a different kind of pigment. That is, red lead paint is not particularly resistant to water, and some structures may require zinc chromate, or something of that nature. It is somewhat questionable whether power-tool cleaning produces much better results than a conscientious job of hand cleaning, which is cheaper. I also

question the value of flame cleaning. I think the principal advantage of flame cleaning is that the steel is warm when you paint it. You have to paint it right after you flame clean it, and that has been found to be quite impractical in most shops. So I am sold on a good job of hand cleaning. Of course, the whole cleaning and painting operation must be carefully supervised to make sure that all work is done in a thorough manner. The situation is further complicated by the fact that field contact surfaces must be left unpainted or covered with a thin coat of lacquer.

It must be admitted that shop painting of major bridges, done properly, is an expensive proposition. However, fabricators have found by bitter experience that it is more economical to do a first-class shop painting job than to pay heavy backcharges to the field painters.

The writer agrees with Dr. Bigos that when blast cleaning of the steel is necessary for cases of extremely severe exposure, such cleaning should be done at the site of erection. It is practically impossible to blast clean large bridge members in the shop.

Problem No. 4 is just about the same as the first problem, and Dr. Bigos' solution seems to be quite satisfactory.

In conclusion, the solutions suggested by Dr. Bigos to the four painting problems seem to be, in general, practical and economical and should, therefore, be satisfactory to fabricators. The Painting Manual is a valuable addition to the literature pertaining to the fabricating industry, as it contains a mine of information not available elsewhere regarding the painting of steel surfaces. The Council should be congratulated on both the content and the appearance of the Manual.

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CHAIRMAN HIGGINS: Thank you, Mr. Ball.

Our final panel speaker, Mr. Paul Foehl, likewise brings to the discussion the background experience of a structural steel fabricator. As Design Engineer for the Midwest Steel & Iron Works Company of Denver, Colorado, a fabricator whose normal area of operations may enjoy more favorable exposure conditions than average for the country, it does not follow that his viewpoint with respect to the painting of structural steel will necessarily exactly parallel that of Mr. Ball. In fact, it has been my observation that when two or more fabritators get together there is always opportunity for a difference of opinion as to the best way to protect structural steel with paint. Mr. Foehl!

Shop Paint and Painting Practices

Panel Discussion—Part IV

MR. PAUL J. FOEHL

I notice that quite a few of you are squirming around looking for softer places on those chairs. Maybe you would like to have one-half minute of standing, right now. While you are up, I might say something like the minister who was delivering a long sermon, and he interrupted himself to point down to a little boy near the front and say, "Jimmy, wake up your father," and Jimmy said, "Wake him up yourself, Reverend, you put him to sleep." *(Laughter)*

The fabricating operation which I represent is considerably smaller than the one that Mr. Ball represents. So that you may have some idea of our operation, we have three plants, two in the City of Denver, and one in southern Colorado at Pueblo, and the total capacity of these three plants is in the neighborhood of 1,000 to 1,200 tons of structural steel a month. We also fabricate stairs, and miscellaneous material. Most of our sales are in the states of Colorado, Wyoming, and New Mexico; and, to a lesser extent, in western Kansas, western Nebraska, Montana, Idaho, and Utah.

Now, a factor strongly influencing my thinking in this matter of painting is that we operate in a climate which is very favorable to structural steel from a corrosion standpoint. Dr. Bigos has pointed out that humidity is the key to corrosion, and the humidity in most of this area is seldom as high as the critical 70% mentioned. In fact, the normal humidity in and around Denver ranges from about 10% to 65%, and it is frequently as low as 5%. You might be interested in knowing that that is lower than the average humidity on the Sahara Desert. The lowest on record is 1%.

Unpainted, unprotected steel can be left outdoors for several years and if it is kept up out of the dirt little corrosion results. Consequently, our raw materials are all in open crane runways. The only material we keep under cover is sheets and small bar stock. In our case, painting is not a serious problem for the usual job.

Now, we use the hand cleaning method with wire brushes, etcetera. We do no flame cleaning, no pickling, no blasting. Most of our jobs receive one shop coat only, whether inside or exposed structures, the notable exception, of course, being highway bridges, which receive the usual prime coat and two field coats.

The paints we generally use are red oxide, zinc chro-

mate, aluminum, black graphite, and gray. This gray is a titanium dioxide pigment, plus lamp black to make it gray. We had this paint developed at the request of some of the architects that wanted a light primer, so that it could be easily covered with one coat of a light field paint; for example, in gymnasiums where they might want it painted aluminum or white.

I have a little book here with which you are all familiar, the AISC Manual. Between its covers is a world of information. It lists all the structural shapes and their properties, beam tables, column tables, design information, and a complete set of specifications for the design and fabrication of structural steel. It contains just about all you need to know about steel, as a matter of fact. So, you can imagine our reaction when we received a book, having nearly twice the page area of the AISC Manual, on Good Painting Practice. This is the Steel Structures Painting Manual—Volume I, and it is just on the subject of putting some paint on after all the hard work is done. Of course, the two books are not alike. The one is a Manual—a condensation; and the other is more like a textbook, a compendium—and a very fine one too. Furthermore, the large book does not treat the subject of painting structural steel alone; it covers painting of all sorts of fabricated steel products, and for different industries, such as railroads, etcetera.

For those of you who may not be completely familiar with this new bosk—I assure you I haven't read it all, and I rather imagine most of you haven't—it covers a great many kinds of painting systems for a great many kinds of corrosive conditions. It covers many kinds of cleaning and preparation systems. It has an excellent chapter on the theory of corrosion. It even goes into such matters as metalizing. Certainly it is an excellent reference to have on hand in the case of special, difficult painting problems if you have the time, of course, to study a large amount of material.

But how about just the ordinary, everyday job that comprises the bulk of our work? I believe we need more than a textbook; we need something condensed, easy to use.

Now, I don't criticize this Steel Structures Painting Manual. I have said it is a good book. I believe it is. However, I have some criticism to make of the specification pamphlets that have been issued, namely, in that they say too much too many times, and they say a lot of things that don't need to be said at all.

Take the Painting Specification 27 that has been referred to. It takes three pages to tell you to clean the steel by hand, to use an iron oxide, zinc chromate-alkyd resin paint, one coat—three pages! Some of it has been said two and three times. Now, I realize they have established a form here, and they have stuck with it on all the different specifications; but, as a matter of fact, you could leave out the entire front page, because everything that is said there is repeated inside, or else it isn't particularly needed.

Now, I appreciate the amount of effort that has gone into this—don't mistake me. It has taken a lot of research and it has taken a lot of work to get these up. But I think the writers got carried away a little bit. For one thing, I am sure they lost all respect for brevity.

I am not recommending that the AISC divorce itself from the Steel Structures Painting Council; I don't think it can, I don't think it should, but I believe the AISC should come out with a "painting pamphlet" of its own —small, concise—with specific recommendations for one-coat, two-coat, and three-coat jobs, and where and when to use them.

Paint costs must be economically justified. Paint performance greater than that required, therefore, should not be specified.

For example, in the western part of the country steel inside a building subjected to no more than normal atmosphere will be adequately protected with one coat of just about anything. Even outdoor structures in the western area protected with only one shop coat will hold up well for three to six years. Actually, the effect of the strong sunlight is more destructive to the paint than the moisture in the atmosphere.

Now, this is a large area of the country, gentlemen; it extends from Canada to Mexico and from western Nebraska to eastern California—about a third of the area of the United States.

I would recommend, further, that this "pamphlet" should contain a map of the United States, or of North America if you prefer, dividing the country into three or four zones, ranging from Zone A, the most favorable zone, to Zone C or D, the most difficult one insofar as atmospheric corrosion is concerned. This map would be similar to the snow-load maps and earthquake maps that you are familiar with. I should be glad to assist, if requested, in establishing zone boundaries in the inland western section of the country.

I realize that by saying this it puts me somewhat in the classification of the colored minister who wound up a long prayer with the words, "Use me, O Lord; use me in Thy work, especially in an advisory capacity." *(Laughter)*

Now, I've been speaking about some of the easier problems. The "pamphlet," of course, would include requirements for the difficult problems too, recommending specifically for moist and salt-air climates, various industrial corrosive atmospheres and for the various plant fumes, etcetera, but making clear that these more elaborate and expensive methods are for these special cases only. Aside from the climatic zones, the "pamphlet," as I visualize it, would contain a list of conditions of usage, perhaps a dozen. Condition 1 might be for steel inside a building, such as the building in Prob-

lem No. 1 on the list which you received this morning. Condition 2 might be the minimum protection for exterior structures, and so on, from the more corrosive conditions, such as acid industrial fumes, waterfront structures, swimming pool structures, and the like. These specifications then could be tabulated, with the first column in the tabulation giving the zone, and the conditions under which the paint is applicable. The second column might give the cleaning method used; and the third column a choice of several paints—if it is a one-coat job, for example, the choice of several paints. Then elsewhere in the specification the paints themselves would be specified. And, I don't necessarily think that referring to Federal specifications is the best way either. I think perhaps the specification should be flexible; that it should state maybe the composition and weight of a certain pigment to a certain vehicle, and so forth. The simplest paint specification, for example, might include Zone A and B, Condition 1; the second one might include Zone C, Condition 2, and so on.

Referring to the four problems discussed by Dr. Bigos and the other speakers this morning, I find myself in agreement with Dr. Bigos that one shop coat of one of the less expensive paints is adequate for Problem No. 1. As the other speakers have pointed out, no paint is needed, so, if you are going to put it on just for appearance' sake there is certainly no sense in spending money or time putting on anything more than the very minimum. Now, that would, of course, depend on what the size of the building is. Very obviously, a 20-story building is going to be exposed to the weather for a longer time before it is covered up; much longer than a one- or two-story building.

Problem Nos. 2 and 4 should be considered together, as they are both buildings that are covered. The steel is exposed, but it is all under cover, and I think one shop coat is sufficient, at least if corrosive industrial fumes are not present.

Now, here a division in the specification might be called for, depending on which zone of the U. S. the building is located in. Because of low humidity, condensation rarely occurs in many western areas. Hence, a field coat is applied in our part of the country only if required for appearance. Our shop coat is frequently aluminum in such buildings because of the pleasing appearance.

On Problem No. 3, the highway bridge, I agree with Dr. Bigos. Again, I think the specification might differ according to the zone and according to the size of the bridge. For example, I don't believe we have ever built a bridge the size of the one you saw in the movie this morning, and I don't think we are going to. We don't have such large bridges in our part of the country that we have long periods of time between priming and field painting. So, I think not only location but size would dictate the complete specification of painting to be used.

In closing my remarks, I'd like to further suggest and emphasize that this "painting pamphlet" which I have recommended, if prepared, should be prepared quickly. Enough time, and study, and writing has been done to date so that a condensation—a tentative specification—now can be written. I don't wish to oversimplify, but neither should we overcomplicate the cleaning and painting operation in our plants.

I would recommend, further, that a draft of this tentative specification be submitted to at least some of the fabricators in various parts of the country for comments before formal publication.

Then, after making any changes resulting from these reviews, publish the pamphlet. After a short period of time, two or three years, it should be included, in my opinion, with any further changes experience might dictate in the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings in lieu of the present Section 34 of that specification.

If there are others here who agree in general with the ideas I have presented, I hope you will speak up and lend your support to a concise, usable paint specification.

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CHAIRMAN HIGGINS : Thank you, Mr. Foehl.

Now that we have the opinions of the four panel speakers before us, I think perhaps it might be in order, before we throw the matter open for discussion from the floor, if the members of the panel were first given an opportunity to ask one another any questions that may have been provoked by the discussion. With your permission, I will do that first. Do any members of the panel have any questions they would like to ask any other member of the panel?

If not, the matter is open for discussion from the floor. Will you, as yesterday, when you arise give your name, your company, and to whom your question is addressed?

Discussion

MR. R. W. BINDER (Bethlehem Pacific Coast Steel Corpn.) : May I say a word about the earthquake probability map? This map has been withdrawn by the original sponsors, inasmuch as certain areas contested the zone in which they were placed.

CHAIRMAN HIGGINS: Do I draw the conclusion that you are not enthusiastic about a zone map?

MR. FOEHL: I anticipated that. That is one reason, of course, why I think the specification should be sent out first, before formal publication, to give anybody a chance who feels they have been zoned wrong to speak up. If they don't speak up, it is their own fault.

As to the earthquake map, of course I was just using that as an example. I think most of the fabricators and most of the architects in the various regions of the country know pretty much which zone they should be in, if you define four zones. Certainly, with the U. S. Weather Bureau reports that are available over a great number of years, it shouldn't be too hard to establish the zones.

MR. BINDER: I was merely making an observation based on many, many years of this probability map, that what they finally came up with is a map on which they spot the earthquakes of a given magnitude that have occurred, and let it go at that. It is similar to what was suggested for spotting humidity, and things such as that.

CHAIRMAN HIGGINS: Any other question, or comment?

MR. H. W. BRINKMAN (Phoenix Bridge Co.): Mr. Smith, you were speaking of the rust problem on lateral bracing, especially if they have washer spacers. If these angles are riveted back to back, what is your opinion of the shop contact surfaces for that type of member?

MR. SMITH: I approach that one gingerly too. We have never made a practice of requiring painting before assembly. Unless the space is just microscopic, we have had good luck putting the paint in with a spray under certain pressure conditions, or with a sheepskin dauber. There is too much emphasis attached to the initial application of the paint coat in that particular case, because I have seen it disintegrate later on. Therefore, I am not too sold on the thought that the individual parts should be laid out and given one or two coats in advance of assembly.

MR. BRINKMAN: What if they are riveted tightly back to back?

MR. SMITH: I think the same thing applies, riveted, or bolted, or any other way. The ones I am familiar with are back to back.

Without the washers? In that particular case, I think it is entirely possible to put a substantial coat of paint over the surface that will waterproof them to a satisfactory degree. I am not too concerned in that particular case. It is where you have the angles separated that I find paint failures on the upstanding leg, rather than on the lay leg, is where this disintegration of the coating will take place. I attribute it—the Doctor may not agree with me—to vibration or multitudinous stresses. That will occur whether or not they are back to back, but probably to nowhere near the same degree as when they are separated by washers.

MR. HOWARD A. FITCH, JR. (Kansas City Structural Steel Co.): I would like to address my remarks not to any individual member of the panel, but to steel fabricators. I would like to point out that our main function is to give an adequate structure to the customer as cheaply as we can possibly do it, and in doing that it has been suggested we don't always pass on added costs. If we don't pass them on, very shortly there will be no more fabricators. If we pass on too many unnecessarily, very shortly the customers will get along without steel and will use substitute materials. *(Applause)*

CHAIRMAN HIGGINS: There is no question but that it is a very important problem to the fabricating industry.

MR. HARRY R. CAMERON (Pittsburgh Bridge & Iron Works): I would like to direct my question to Mr. Smith. What recent cost data is available on sand blasting or shot blasting? I am just wondering what present-day costs are.

MR. SMITH: I am not prepared to say what it is going to cost in the shop, but in various localities in the field I have found sand blasting costs will run in some instances as low as $15 for the brush-off coat referred to in the Painting Manual, and in other cases it is as high as $25 a ton. These costs are dependent upon the type of design and make-up of members the engineer has worked into the structure. So, when an owner approaches the question of sand blasting in the field, the initial outlay will probably be — to be conservative — from $20 to $25 a ton, depending on the locality and the type of labor available.

I can't give you any figures as to shop costs, if that is what you wanted.

MR. CAMERON: Mr. Ball, what would be an average cost to sand blast a typical bridge in your shops? Have you any cost-per-ton figures?

MR. BALL: We don't do anything like that in our shops, so I can't give you any shop costs on it. We have had some done in the field, which I think is the best way to do it. The average of that is perhaps around $20 per ton. It is subject to a great deal of variation due to the thickness of material, and the character of the work—whether it is a builtup structural member, or a rolled shape. The cost for sand blasting — and painting itself, for that matter — varies all over the map, due to the different conditions and different thicknesses.

CHAIRMAN HIGGINS: While you are on your feet, Mr. Ball, assuming that $20 to $25 a ton would be a fair cost, how many years' extra life in a paint job must you get to balance that cost — say, in 25 years?

MR. BALL: I don't know.

CHAIRMAN HIGGINS: Is that too difficult a problem? Dr. Bigos, in the material you received that led to the statement in the Painting Manual, do you have any further figures that would develop the range of cost of shot blasting and sand blasting?

DR. BIGOS: That figure of $20 a ton is a very good average. It varies a great deal depending upon the thickness of the metal. Actually, it is square feet per ton, and eventually dollars per square foot per year will be a factor. That would extend the life from 50% to 100%.

I would venture a hand cleaning job would run approximately 25 cents per square foot for a three-coat job,

including hand cleaning. That cost would shoot up to 35 or 40 cents a square foot by blasting in the field. Therefore, you can get an idea that the paint life has to be nearly doubled in order to make it economical. Unfortunately, we don't always get that double life. We have cases on record where bridges have performed as long as 15 to 20 years under favorable circumstances without requiring repainting in that interval, where the mill scale was left on and it was hand cleaned. We also have cases where sand blasted bridges have failed in a period of a month to two years.

One incident occurred in the Midwest last fall when we were doing some test work in connection with railroads. We had occasion to observe a contractor sand blasting one of the state highway bridges in the vicinity. The contractor went over the entire bridge with his sand blasting equipment and sand blasted the entire bridge. To begin with, he used a very rough, cheap grit to do the work, and made the surface entirely too rough for the type of paint he applied. Secondly, he allowed the sand blasters to stay there until the bridge was finished, and at that time the entire bridge was covered with a thin coating of rust. To all intents and purposes it invalidated the sand blasting by not putting the paint on in time to prevent rusting.

MR. DON C. BEAM (Canadian Institute of Steel Construction, Inc.) : Assuming that a highway bridge or a railroad bridge is one of those High Tensile Bolted structures in which the faying surfaces of connected parts should not be painted, I would like to have an expression of opinion as to whether there is any danger of corrosion on those faying surfaces providing the bridge is properly painted overall.

CHAIRMAN HIGGINS: Such joints would be at least as tight as riveted joints, and Mr. Smith commented a moment ago that in riveting two parts together, painted or unpainted, he believed the paint along the boundary of the surface would form an adequate seal. Does that answer your question?

MR. BOYD O. BACH (Bethlehem Steel Co.): Dr. Bigos and other members of the panel, do you have any general comments as to the relative merits of spraying versus brushing under the different conditions we took up today?

DR. BIGOS: That is a controversial subject. If you check in the chapter on Painting of Railroad Bridges in our Painting Manual, you will find it discussed very extensively.

I will say we do favor the brush application of the prime coat of paint if it is worked into the surface. However, either brushing or spraying, if properly done so that the film thickness is adequate, will result in a good job. We also feel that spraying is a little more advantageous, because you get better coverage.

CHAIRMAN HIGGINS: Would you like to comment on that, Mr. Smith?

MR. SMITH: Yes, I would. I will go right along the line with Dr. Bigos on the application. However, on most bridges, particularly the old bridges, there are many places you can't get to properly with the brush. The question is a little academic, however. Regardless of the engineer, the research man, or anybody else, our opinion is often dictated to us by the business agents. We spray it where they let us spray, and we brush where they let us brush. *(Laughter)*

MR. ALEX D. SWEEK (Pacific Car & Foundry Co.): My question is whether Mr. Foehl would list in his "pamphlet" a specification paint or a proprietary paint. These proprietary paints usually have had a lot of tests to show their value. Why can't we have that for a specification?

CHAIRMAN HIGGINS: If I understand the question correctly, Mr. Sweek wants to know whether there is any reason why you should not specify by brand name — is that the question specifically? — or why you should use, say, the Council designation or some specification number rather than to mention a proprietary brand of paint.

DR. BIGOS: I think I can best answer that by reading briefly from the foreword of the Painting Manual, which is by J. E. Jackson, and he reflects the opinion of the Painting Council on that particular matter. It is a very important one.

"—— Throughout both volumes of this Manual and likewise in the specifications of the Council repeated reference is made to Federal Government or other specifications and extensive use is made of composition specifications for paints. It should not be assumed that these specifications are better than many proprietary paints offered for the same uses. It is believed that these specifications will result in paints of known minimum acceptable quality provided the manufacturer furnishes good and suitable materials, properly formulated and manufactured. Purchasing paints strictly to specifications does not always result in securing the desired materials. It is very difficult to verify completely the quality of paint ingredients by inspection methods. The best assurance the purchaser can have that either "specification" or "proprietary" paints are suitable and of good quality "is to buy them from a competent manufacturer of high integrity. Many proprietary paints are available which meet such specifications; others may be still better for particular uses. The ideal arrangement is for purchasers to cooperate with reputable paint suppliers who will furnish paints of the same general types as the specified paints which will perform as well or better by actual tests. ——"

Does that answer your question?

MR. SWEEK: In general, I think it does.

DR. BIGOS: We feel we cannot specify on the large

scale. We must use our own judgment in deciding whether a particular paint is valid or not. We can't tell you whether a proprietary paint is good or not. You have to use your own common sense, judgment, and experience to make that decision.

MR. SWEEK: The ordinary architect can't go through the paint specification and decide whether it is going to be proper for his use.

DR. BIGOS: I think he should be able to make that decision; otherwise, he shouldn't be specifying paints.

MR. SWEEK: He has got to specify a paint, if it is for an ordinary building with some exposure. He doesn't know anything about the wetting quality of the paint in this Federal specification, but if some paint manufacturer comes to him, and comes back often enough, he will convince him. If we recommend it, he thinks it is all right.

DR. BIGOS: If it is all right, go ahead and use it. We are not trying to sell anybody our specifications. Our specifications are intended to cover the field where there is a question of doubt. There are something like 2500 paint manufacturers in this country. We don't run a consumer's research council and evaluate all their products. Their products are in a constant state of change. A good paint manufacturer improves his product; a poor manufacturer cheapens his products. Mr. Smith probably will have some comment on that particular item.

MR. PAUL J. FOEHL: Maybe I didn't make my point very clear. The architect can't stop and read this book. The Institute ought to have a pamphlet perhaps 10, 12, 15 pages at the most — just a small thing — that will tell you what to do in a certain zone and for a certain condition; be specific. It might give you a choice of several paints, and then elsewhere in the specifications tell you what the requirements for those paints are. Then any manufacturer, upon request, will tell you what the ingredients in the paints are; in fact, many of them mark it right on the can. If he won't you'd better not use his product. I think that's what we need.

CHAIRMAN HIGGINS: Before you sit down, Mr. Foehl, I want to be sure I understand your suggestion. Do you mean that the Institute ought to list paints by a series of proprietary brands, or do you mean list paints specified by formulation?

MR. FOEHL: List paints by formulation.

MR. SWEEK: I think his idea is good, but the manufacturer in some way should be able to say that his paint meets the requirements specified in a certain column, Section A or Section B, or whatever paint it is. In the welding society, for instance, the welding rods have to meet a certain specification. They have their own brand names but, in addition to that, they have the welding society classifications.

CHAIRMAN HIGGINS: Do you have any comment, Mr. Smith?

MR. SMITH: Dr. Bigos and I have had some previous conversation about that very point.

I would like to bring up one thing. I think it is a specific answer to your question. I don't think an engineer or an architect has any more business specifying paints with which he is not basically familiar than he has of specifying other materials with which he is not familiar. He should familiarize himself with paints and acquire a basic knowledge and a background before he specifies material, either through blanket specifications or otherwise. I think that is just as much a part of having your shingle out as it is to have your drafting paper.

To get back to your particular question, many architects and engineers have had specific personal experience with certain proprietary paints and the companies that manufacture them, and have found that they are good.

From the competitive angle, which I know many people are considering, it is not only a question of getting a good material, but also of getting it at a reasonable price.

In the past, a device we have used is to set up comparable schedules of certain proprietary paints, and offer them as an option to the fabricator. You could elect, for example, to use a schedule of paints of a certain manufacturer from prime coat through to finish coat. We have found that has been very satisfactory, particularly when in the same price range. It places the manufacturer of the paint squarely on your team to see to it that you get the best material, and that you apply it in the best way according to his knowledge.

I can't speak for the other members, but Dr. Bigos has already expressed himself by saying that many of the proprietary paints are most excellent.

MR. FLOYD W. MOORE (Vermont Structural Steel Corpn.): I think Mr. Foehl's recommendation of a concise, practical specification in the Manual is very good, and I just wonder if the other members of the panel concur or disagree with him.

CHAIRMAN HIGGINS: Let's poll them and find out. Mr. Moore has commented favorably on Mr. Foehl's suggestion that the Institute publish a concise paint specification, or summary of painting requirements, and inquired what the feeling of the other members of the panel was with respect to this recommendation. How do you feel, Mr. Ball?

MR. BALL: I am in favor of it.

CHAIRMAN HIGGINS: Mr. Smith, would that help you?

MR. SMITH: Not particularly. I mean I have nothing against it, but it is our job to read the whole book.

CHAIRMAN HIGGINS: Are you favorably disposed, Dr. Bigos?

DR. BIGOS: No, I am not. Let me say a word, since the matter was brought up.

I am very much opposed to many of the things Mr. Foehl brought out, particularly this idea. We haven't

been sitting on our hands for the last three years, spending a lot of money and a lot of the Council's money. We have approximately 200 of the best minds in this country working very closely with us on painting, painting specifications, and so forth. If something that simple would have been possible, we would have come up with it a long time ago.

We are not in this business over night; we have had men who have had a lot of experience and know what they are talking about. This is not just Joe Bigos. I appear as Director of Research of the Steel Structures Painting Council, and what the Council has prepared is a list of different types of ingredients and the properties of certain vehicles, and so forth. It lists standard paints, which we have taken as the basis of our Council paint systems, with recommendations as to various types of exposures — rural, industrial, marine, fresh water immersion, and salt water immersion. That is part of Volume II, which is going to be about 3- or 400 pages.

On some of these specifications I will grant you that we may be verbose, but there is a reason behind it. This isn't something that grew topsy-turvy. There is a legal angle to many of these things. I am sure many of the fabricators have had a lot of complications from Section 34 of the AISC Specification. I can interpret Section 34 to your disadvantage, and get a lawyer to back me up any time I require. That section can require far, far more cleaning that you have any idea, if you interpret it literally.

The same is true of the AAR specification for painting and cleaning railroad bridges. That has proved very costly to a number of fabricators.

For that reason, for as simple a job as Paint System No. 27 we have three pages — which, incidentally, are capable of being printed on one page. There are three pages, because they are double-spaced for editorial comment.

Some of our paint systems do get very involved. Again, it is all part of an overall picture. If it can be improved, we would like to have it improved.

In regard to a map showing zones, I think that is extremely impractical, and I doubt that it would be workable. However, if somebody thinks it would be I would be willing to cooperate and try to work out something on that basis.

In connection with classification of paints according to certain categories, that has been proposed for many years by the Department of Agriculture. It has been proved to be completely unworkable, because of the fact that two paints can have identically the same composition, and one can be a good paint and the other a poor one. It is the "know-how" of the manufacturer and the way the material is put together, and not what is on the label the manufacturer puts on his paint, that counts.

MR. FOEHL: I thought I was quite careful not to appear critical of the work that has been done, as Dr. Bigos seems to imply. I don't think they have been sitting on their hands, not by any means. I have stated that I think the book is excellent, and I have stated that I know the preparation of the book and the preparation of these specifications has required a lot of research and a lot of work; but I also have stated that I think the specifications are too long, they are too wordy, and they are too voluminous. If the AISC specification for the fabrication and design of steel had been written in this same manner, the AISC Manual wouldn't be big enough for it alone, because it is a complicated subject. The welding specification is a complicated thing. You can write for days and days and days on that too. But the specification is small. You don't have a whole textbook.

I think the work behind these painting specifications is excellent, but I think they can be greatly condensed, and I think they should to be usable. That's what we want, something usable. *(Applause)*

CHAIRMAN HIGGINS: Dr. Webb indicated a moment ago he wanted the floor, and as Chairman of the AISC Specification Committee I think perhaps he was going to talk on that very point.

DR. WEBB: As Chairman of the AISC Committee on Painting, and also Chairman of the Committee on Specifications, I have had occasion to go over these painting specifications. The Painting Council, I think, was started four years ago because of inadequate specifications on painting.

Now, I think this Painting Manual that has been written is a wonderful thing. What I am afraid of is that a lot of people are not reading that Manual. In other words, they look at the whole book and say, "Oh, that's too big; I won't look at it." On the structural end of it, there are only three or four chapters that they have to read, and it doesn't take very long to read those chapters.

I would like to address a question to the last speaker. He made a remark about the number of pages required to condense the subject— 14 or 15. Do you think we could get what you referred to in a pamphlet of 14 or 15 pages?

MR. FOEHL: I haven't gone into it that far, but I think you could.

DR. WEBB: You listed quite a lot of things that ought to be in that pamphlet.

MR. FOEHL: Supposing it is 20 pages.

DR. WEBB: Supposing it goes to 30 pages, would people read the "pamphlet" or study it?

MR. FOEHL: I think on the specification they would.

DR. WEBB: Have you read Painting Structural Steel, for your class of work?

MR. FOEHL: I would like to say I am not objecting to what is in the Painting Manual. It is a textbook. I have said that too. I think we should take the cream

off what we have now in this Manual and these specifications and reduce it, condense it down. After all, we have textbooks on steel design, and we have textbooks on welding, big thick ones, but we also have manuals and specifications which are very brief, and can be quickly and easily referred to. We don't have that on painting, I don't believe.

DR. WEBB: You didn't have anything on painting.

MR. FOEHL: That's right. I tried to emphasize that I am not criticizing the good work that has been done, but I do say I think we should go further now and condense it.

DR. WEBB: As Chairman of the Painting Committee, I will say that we have not yet been able to decide what different types of paint to use for different classes of work, and we can't put a little "pamphlet" out until that is decided. Too many people have different ideas. I think, for the time being, we should use this Manual — read it and know what is in it. Then, later on we can make up a "pamphlet" on specific things for certain classes of work.

MR. FOEHL: My idea on the "pamphlet" was that it would be a tentative thing. I am not suggesting at the present moment to incorporate it in the specifications, or call it a specification. It would be tentative and subject to change. After all, the AISC Specification isn't frozen solid; it is subject to change. It has been changed not too many years ago, and I expect, before too many years go by, there will be other changes. I think the same could be true of painting or anything else. I think we have got to have something to start with, and if it is wrong we will have to change it occasionally.

DR. WEBB: You are entirely right, there will be changes every year or two as we go on. Until we decide to make the first changes in the Manual, why not use the Manual and learn something from that before we put out this pamphlet?

MR. FOEHL: I don't think it is adequate. That's my opinion.

MR. LAURENCE McKINNEY (James McKinney & Son, Inc.) : I represent a small fabricating plant. I have nothing against the Encyclopedia Britannica. We don't have it in our office; we have Webster's Collegiate Dictionary. When we want to find out about something unusual, we do consult the Encyclopedia Britannica.

I am thoroughly in favor of Mr. Foehl's suggestion that we break this thing down to a usable Manual, or pamphlet that we can use in our own office. I have read this book through, believe it or not. It is repetitive. It is extremely scientific, and shows a terrific amount of research and effort. That isn't what we want.

Suppose you give that book to every architect. What would you get? Every architect would have a different kind of paint; even in the case of structural steel alone I don't know how many kinds. When you make a recommendation requiring three coats of a paint that take 18 hours to dry — you place a big handicap against a small plant which does not have the space to store the work between coats.

You realize that steel is a competitive product. It not only has competitors in the steel business, but in other materials. How do I know whether a competitor is going to spend $25 or $50 for sand blasting? That would make a difference of between 7½ and 10% on the price. Jobs are lost on considerably less than that.

I am thoroughly in favor of taking a step that would assist structural steel fabricators (the 250 of us who do not make bridges) by developing a practical manual that we can pass on to architects, to give to their specification department. We can use the research when a particular problem comes up. We can use both things to a great degree, but I am thoroughly in favor of putting out a little pamphlet. *(Applause)*

DR. WEBB: We have been hearing from fabricators and engineers. We have a paint man here. I wonder if we could ask him to say a word.

MR. BRADLEY (Pittsburgh Plate Glass Company): I had the pleasure four years ago of addressing this group, and I was standing next to your President, John Jackson, when this Painting Manual was born. One of the things I stated then from a paint manufacturer's standpoint — and I will repeat it — is the fact that there is more propaganda to paint selling than to any other industry. If this book does no other one thing it is going to be very helpful in taking some of that propaganda out of paint salesmen's manuals, because you can argue on paint from both sides and be partially correct. The theory advanced on this phase, and the theory advanced on that phase both are sound, but when you apply it to the fabricator's own practical use they are completely opposite.

I think one of the things the Manual has brought out very forcefully to certain specific industries is the importance of adequate wetting. Now, there are a number of paints that will give you that, and the fabricator and the engineer can apply the information to his own use, whether it is in Denver, in Gary, or in Bethlehem. They have their shop facilities and they have the fundamental truths on which to arrive at a decision.

The best commendation I could make for the Manual is the fact that I use it quite a bit for actual reference. Its soundness with respect to getting the most out of a paint is right in those pages.

I agree with Mr. Foehl on the point that they are lengthy — and a lot of people may not fully appreciate that — but if it can keep some of the propaganda away from the mouths of paint chemists and paint salesmen it will be a big step forward in the structural steel industry.

As I see your problem, it is not the paint you are going to value and protect. Whatever will protect that structural steel, in the long run, is the type of system you should employ, regardless of where it is.

On your problem No. 1, I wouldn't use a darned thing. I would go ahead and wire brush it in the field, and coat that. I was called in by a large company, who had paint all over their brick walls. It was all flaking off. They were going to shot blast it off and repaint. I said, "Why put it on?" The same thing applies to your problem No. 1. You have an alkaline atmosphere and you are not going to get corrosion, so why put paint on for people to complain about, regardless of the appearance. The paint you are probably talking about will look just as much like rust as the rust itself. You aren't accomplishing anything, except to make your product more expensive.

When you get some of these theories advanced by paint salesmen, say "That's not what it says in the book." — they will soon learn that the structural fabricators know what they are talking about on paint. I think the book is entitled to commendation from that standpoint.

CHAIRMAN HIGGINS: Thank you, Mr. Bradley.

I wonder if there would be a basis for possible clarification of the problem if we could know what percentage of our production is covered by Problem No. 1 used in this morning's panel discussion, and what part of it is in Problem No. 3. In one case the panel was in agreement that there wasn't any paint problem and their recommendation bordered on the line of leaving paint off. Mr. Bradley has just made the same point. I am not sure that all paint manufacturers would be happy to have that thinking prevail, but it seems to be the consensus of the panel that it could be left off.

What per cent of our product is represented by Problem No. 1 and Problem No. 4? I suspect myself that those who have responded most favorably to Mr. Foehl's suggestion are thinking primarily in terms of a structural steel product that is represented by Problems No. 1 and No. 4, or they are in an area such as Mr. Foehl has described where Problem No. 2 and even Problem No. 3 are not as serious as they are along the coast.

MR. FRED EISELE (Omaha Steel Works): I would like to support Mr. Foehl's recommendation for the preparation of a pamphlet for study and eventual insertion into the AISC Manual as a part of the Manual.

As far as our company is concerned, probably about 50% of our work will come in the category of 1 and 4, and about 50% in category 3, the bridge category.

MR. S. R. WEBB (Carolina Steel & Iron Co.): I think there has been a little confusion this morning as to the Painting Manual and the Paint Specifications. I haven't read all the Manual. What part I have read had an awful lot about painting. But, I have read the tentative Specifications. I gather that Mr. Foehl is recommending proper changes in the Specifications. I thought, myself, they were a little long.

I think Dr. Bigos said the Standards Association wish to follow certain forms, and that explained in part the reason the Specifications were drawn in the particular form they are. I would like to hear him comment a little more along that line. I think that is where the repetition occurs in the Specifications.

DR. BIGOS: That is very true. The American Standards Association in this country, in cooperation with the British Standards Association in England, has set up a pattern for this type of work which covers all the technical fields in this country, and we are trying to cooperate with them by adopting the suggested form for specifications which they have used. You pick this up and it looks almost identical to theirs. The ASTM has not come around to that yet; they are a senior organization and have been in business many years. Practically every technical society or association in this country today has adopted this form and format.

I would also like to refer you to the ASTM specifications. It must be there "in black on white" in case of litigation or an argument. You pick out the particular items you are interested in and read them.

Perhaps our specifications are wordy and perhaps they are repetitious, but we feel they have everything that is essential. Part of the additional material in these Specifications was added at the request of numerous fabricators and users. They said, "We like the Specification, but we want explanatory material to help us out in using the Specification." That's why the Appendix has been added. In some cases the Appendix is as long as the Specification itself.

CHAIRMAN HIGGINS: Perhaps a solution to the problem would be to adopt by citation. When it comes to the plain material, steel, our Specification simply says that this material shall be ASTM A7 — period! That's all that is printed in our Specification on the subject. Perhaps when we can agree upon what the paint system ought to be, that would be all that it would be necessary to include in the AISC Specification; a statement that the paint system shall be Steel Structures Painting Council PS-27, or whatever number they can agree on. Perhaps we, as an industry, because of our different climatic problems, can't agree upon one and will have to agree upon several as a minimum.

I personally think the subject is still in the study stage. I think Dr. Webb will confirm my recollection that a suggestion was made by a member of the AISC Specifications Committee some time ago how the problem could be resolved — that a simplification could be made at this time — but that the Specifications Committee members to date have not agreed with the suggestion. Paint System 27 was proposed and it didn't take long to discover that the Specifications Committee couldn't, at this time at least, agree that that was the one specification suitable for all cases where an architect or an engineer had failed to specify his own preference.

DR. BIGOS: The suggestion was made by Mr. J. O.

Jackson to Dr. Webb, and in turn by Dr. Webb to the Specifications Committee of the AISC, that certain changes be made, based on Council recommendations, on Section 34 to cover the shop painting of steel for buildings, which is what that section now covers. To my knowledge it was never intended to cover bridges, and these other things we are talking about. The recommendation made was as follows:

"Referring to the fifteenth printing of the fifth edition of the Steel Construction Manual, — pages 304 & 305, Section 34. SHOP PAINTING. Delete sections (a) to (e) inclusive and substitute the following:

"Unless otherwise specified in the agreement between the purchaser and the fabricator, all fabricated structural steel shall be cleaned and painted with one coat of structural steel primer in accordance with the Steel Structures Painting Council Paint System Specification No. SSPC — PS 27 (latest revision), entitled 'Shop Priming with Iron Oxide Zinc Chromate Structural Steel Primer'."

That is all that is required for buildings, in which practically all the categories we are discussing fall.

DR. WEBB: I think one trouble is that this is new. It is something you can't get over night. In our committee, we can't come to a decision, because there are four or five viewpoints. When these are harmonized there will be something put in the AISC Specification. It probably will be a page or two covering paint. Until such time as we get agreement on that, there is no use going into it, only to find we have to change it six months from now because some don't like it.

CHAIRMAN HIGGINS: I might remark at this point that in suggesting the panel program I had in mind guidance for Dr. Webb's Committee on Specifications. They have the problem before them and are trying to arrive at a workable answer.

The ASTM A7 Specification is considerably longer than Paint System 27. We have never objected to the thought that we were citing in our own Specification a 3- or 4-page standard covering a great many technical details. At some time in your life you had to become familiar with it, but you didn't expect to be able to quote from it without looking up the reference.

Isn't that parallel to what you are really trying for, Mr. Foehl?

MR. FOEHL: Partly. As I have stated before, I think that you have some different conditions, and you can't just sit down and specify one paint and refer to it. I think you have so many different conditions of application and so many different climatic conditions that, somehow or other, you have to have some sort of chart on one page to list them, and then maybe in the last column tell what Specification to use. I think we have to get a little bit more specific. It is left too vague at the present time.

CHAIRMAN HIGGINS: Am I right, Dr. Bigos, that there is a table proposed for Volume II that will skeletonize the recommendations?

DR. BIGOS: That is true. The interim guide, which I referred to before, condenses everything, just as has been suggested here many times. We have approximately 35 paint systems. We have tabulated those specifications on two pages, for all the different types of exposure which you would ordinarily encounter, with recommendations as to those one would, and those one would not use for any given set of conditions. That's all you need. This other thing is a reference, just like you use A7 for steel. You don't object to the fact that ASTM has 50 specifications, or 100 specifications in steel. You are concerned with A7, so you say A7. All you refer to here is Paint System 27, or 33, or whatever it is. We have a guide, or recommendation, where it should be used, or where it should not be used. When you have to study the detail, refer to the Manual text.

CHAIRMAN HIGGINS: Gentlemen, I made the statement in introducing the panel this morning that we probably could devote a whole day to the subject.

I have just been informed that the buses are outside waiting to take us on our tour, so I am afraid I will have to adjourn the Conference.

Before I do so, however, I would like to take this occasion to thank all of the speakers who have participated in the Conference, and particularly to thank the Milwaukee Fabricators for their wonderful hospitality that helped us so much in this Conference.

(The Conference adjourned sine die at twelve-fifteen o'clock.)

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