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PLAINTIFF'S EXHIBIT WRG-703

CONSTRUCTION PRODUCTS DIVISION

INTER-OFFICE CORRESPONDENCE

TO: District Managers
Plant Managers
All Sales Personnel

DATE: March 28, 1973

SUBJECT: Vermiculite Fireproofing

From: C. H. Wendel

cc: R. M. Vining
H. A. Brown

WRG 000811

Walt Pickthall was asked to prepare an article on Vermiculite Fireproofing for the Western Plasterer magazine. Attached is a copy of his article which should prove educational for all of us.

Walt Pickthall's new title is "Doctor Of History" and he is now the official historian for the Pacific Region.

CHW:me

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Past and Present

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Whether this or other equally plausible stories of the discovery are the real truth is relatively unimportant but this one serves well to point up the principal physical properties of the mineral vermiculite and the industry which developed from its discovery.

The time would have been shortly after the end of World War I. The place, the Rocky Mountain area in Montana near the Canadian border. Present day maps show the site as Libby, Montana, where the townspeople will tell you with unabashed pride that they have the largest vermiculite deposit and mining operation in the world and that the nearly seven million dollars Zonolite is presently spending on new facilities will triple the capacity of the operation by 1974.

[illegible] prospector banked his lonely fire that night some fift[illegible] years ago the presence of the small brown mica-like flakes in the earth he used probably went unnoticed. Certainly he would have had no way of knowing that these flakes were composed of microscopically thin laminates, between which were entrapped water cells. As the flakes grew hot from contact with the coals the water cells turned to steam forcing the laminates to separate. At the same time oxidization was occurring and the color changed from dark brown to a highly reflective gold. The result was a granular material roughly ten times the original size. impervious to fire, and an excellent insulator.

Early marketing of the new discovery concentrated on the home insulation field. High resistance to fire, permanence, lightweight and ease of installation found ready acceptance in the market place. The remarkable ability to ship ore in concentrated form and expand it at strategically located plants made the new product an economic success from the start.

It was World War II however, that gave the fledgling business entree to the Construction Industry and the uses which are so common today.

The first major job was the Mercantile National Bank Building in Dallas, Texas. As was common practice the steel was to have been encased in Concrete for fire protection. At the last minute however the government cut the steel tonnage allocation and it was

mandatory that another fire protection method be devised to eliminate the dead load factor of the concrete. A fire test of vermiculite-portland cement was run at the National Bureau of Standards and passed. The steel was redesigned and the project was built with the same usable space, but with only 2/3 of the steel required in the original design.

The high fire resistance of the vermiculite-portland cement combination came to the attention of the military and with the impending threat of bombing attacks on our military installations thousands of cubic yards were poured on roofs of defense facilities. The Pentagon Building alone required 275 carloads of expanded vermiculite to complete the installation.

The use of vermiculite concrete has continued to grow and today a national group of over 100 Certified Roof Deck Applicators pour an estimated ____________ million square feet of insulating concrete annually. A wide range of systems is available for installation over structural concrete or steel decks providing high insulation values, permanence, proper drainage and maximum fire resistance.

The end of World War II was marked by an immediate revival of the private sector of the Construction Industry. All materials were in short supply and steel was one of the most critical. If the needs of the country were to be met Architects' and Engineers were going to have to utilize every ton to the maximum. Again

vermiculite played a major role. Research and testing had continued and a number of assemblies had successfully passed Fire Tests at Underwriters' Laboratories. Gypsum had replaced portland cement as the binder with resulting reduction in thickness requirements and application time.

The West Coast led the way in acceptance of the new concept. Two major projects in Los Angeles, the Richfield Oil Building and the Prudential Insurance Building amazed old timers in the construction field with major reductions in steel tonnage and completion schedule.

Metal lath and vermiculite gypsum plaster for columns and vermiculite plaster suspended ceilings had permanently replaced the old slow cumbersome and expensive procedure of erecting wood forms around every member of the steel frame and then tediously filling each form with concrete.

Metal lath and plaster fire protection continued as the standard through the rest of the 40's and into the mid fifties. Other forces were at work however which were destined to replace the new concept by the end of that decade.

In England laboratory work was being done with directly applied asbestos fiber encasement of structural steel. Reports reaching the United States indicated that the method had considerable promise. Not to be outdone by their European counterparts work was started on direct application of vermiculite.

Introduction and widespread use of the plaster pump accelerated interest in the idea and in 1958 the first formulations were ready for testing.

Old timers in the plastering business will recall that one of the major breakthroughs in membrane fireproofing was a vermiculite acoustical plaster ceiling. The system had passed the fire test with a 4 hour rating and gave the plastering industry its first fire rated acoustical ceiling.

The basic formula for that acoustical plaster was modified and became the first vermiculite based material to pass the fire test for direct application on steel.

The new system was readily accepted by the design profession. Heating, air conditioning and lighting of major structures had become exceedingly complex and the necessity to maintain the integrity of membrane fire resistant ceilings made proper design even more difficult. The new fireproofing system, because it was directly on the steel and out of the way, provided complete flexibility and a much wider choice in finished ceilings.

It was obvious too, that the new approach was faster and more economical than metal lath and plaster. Elimination of the time and expense of lathing accounted for most of the savings.

A number of West Coast buildings were fire protected with the new system during the next few years. Among the first were the Zellerbach Building in San Francisco, a California State Office Building in Oakland and another in Los Angeles.

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The consistent clamor of the Environmentalists continued and it was decided that an asbestos free product was advisable. MONO-KOTE® Type IV Asbestos Free Fireproofing was fire tested in 1971 and is now available for use when required.

While the asbestos controversy was raging a more subdued change but one with far greater effects on the industry was slowly working its way through the E5 Committee of the American Society for Testing Materials. This Committee is responsible for writing the test procedure to determine the Fire Resistance provided by building materials and construction assemblies. The test procedure in use until January 1, 1972, had been adopted originally in 1908. It is designated as ASTM Test Method E-119.

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Assemblies were not performing in Fire Tests in the manner indicated by the known performance characteristics of the materials. It is known that the tensile strength of steel falls off sharply at temperatures between 1000° F. and 1200° F. Contrary to this, steel beams were passing the fire tests with temperatures which sometimes reached 1800° F. to 2000° F. Fire tests are conducted in a massive reinforced concrete cell which resists the expansion of the specimen as the temperatures rise. The forces developed puts the assembly in compression with a resultant increase in its load carrying capacity. Failure only occurs then at temperatures exceeding those which would cause failure in an actual building fire where the retaining forces are not present.

Several years ago San Francisco, Los Angeles and Uniform Building Code officials recognized this deficiency in the fire test procedure and had established their own criteria for acceptance based solely on temperature. Failure point was established at 1000° F. average at any quarter section or 1200° F. at any single point.

The ASTM E-5 Committee worked for 10 years trying to develop a new test but it wasn't until 1970 that a compromise solution was finally reached.

The revisions are complicated and confusing and there are those who believe that the problem has been compoundedrather than solved.

In its simplest form the new fire test provides for two ratings RESTRAINED and UNRESTRAINED. Under its provisions portions of a building can be considered restrained while other portions of the same building could be unrestrained.

Temperature limitations have been established for all beams and floor assemblies but a time factor has been introduced which provides that in the testing of beams in the restrained condition the temperature of the steel shall not exceed 1100° F. average or 1300° F. maximum at any point for at least one hour or for one half of the classification period. A Restrained beam then could be rated at 4 hours if it sustained its design load for 4 hours and the limiting temperatures were not exceeded for 2 hours.

In the case of Unrestrained beams the temperature limitations cannot be exceeded during the entire classification period. A 4 hour Unrestrained beam then would have to be protected with sufficient material to prevent a temperature rise exceeding the 1100° F. average or 1300° F. maximum at any point for the full 4 hours.

Obviously the Unrestrained beam requirements are much more severe, and except for a 100° difference in temperature are similar to the present San Francisco, Los Angeles and the Uniform Building Code requirements.

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In unrestrained floors or roofs one other provision has been added. The temperature of the steel from which the deck is fabricated cannot exceed 1100° F. during the entire classification period.

Column tests have not been changed. Failure is based on temperature and occurs when temperatures exceed 1000° F. at any quarter section of the member or 1200° F. at any single point. The same test procedure and temperature limitations are applicable to both steel and concrete construction.

The whole test procedure has been further complicated by failure of the E-5 Committee to define RESTRAINT in realistic terms. It reads as follows "Floor and Roof Assemblies and individual beams in buildings shall be considered restrained when the surrounding or supporting structure is capable of resisting substantial thermal expansion throughout the range of anticipated elevated temperatures. Constructions not complying with this definition are assumed to be free to rotate and expand and shall, therefore, be considered as unrestrained."

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Several years ago San Francisco, Los Angeles and Uniform Building Code officials recognized this deficiency in the fire test procedure and had established their own criteria for acceptance based solely on temperature. Failure point was established at 1000° F. average at any quarter section or 1200° F. at any single point.

The ASTM E-5 Committee worked for 10 years trying to develop a new test but it wasn't until 1970 that a compromise solution was finally reached.

The revisions are complicated and confusing and there are those who believe that the problem has been compoundedrather than solved.

In its simplest form the new fire test provides for two ratings RESTRAINED and UNRESTRAINED. Under its provisions portions of a building can be considered restrained while other portions of the same building could be unrestrained.

Temperature limitations have been established for all beams and floor assemblies but a time factor has been introduced which provides that in the testing of beams in the restrained condition the temperature of the steel shall not exceed 1100° F. average or 1300° F. maximum at any point for at least one hour or for one half of the classification period. A Restrained beam then could be rated at 4 hours if it sustained its design load for 4 hours and the limiting temperatures were not exceeded for 2 hours.

In the case of Unrestrained beams the temperature limitations cannot be exceeded during the entire classification period. A 4 hour Unrestrained beam then would have to be protected with sufficient material to prevent a temperature rise exceeding the 1100° F. average or 1300° F. maximum at any point for the full 4 hours.

Obviously the Unrestrained beam requirements are much more severe, and except for a 100° difference in temperature are similar to the present San Francisco, Los Angeles and the Uniform Building Code requirements.

Floor and Roof Assembly Tests have also been revised. They must be fully loaded and carry the load for the full time period. Temperature transmission through the floor or roof cannot exceed 250° F. average or more than 325° F. at any point. Cotton waste

on the unexposed side cannot ignite from passage of hot gas or flame. This portion of the test procedure has not been changed, but a new element has been added. The beam supporting the floor or roof assembly is now considered an integral part of the assembly. The requirements for the beams in restrained or unrestrained floors or roofs is identical to those outlined previously for beams only.

In unrestrained floors or roofs one other provision has been added. The temperature of the steel from which the deck is fabricated cannot exceed 1100° F. during the entire classification period.

Column tests have not been changed. Failure is based on temperature and occurs when temperatures exceed 1000° F. at any quarter section of the member or 1200° F. at any single point. The same test procedure and temperature limitations are applicable to both steel and concrete construction.

The whole test procedure has been further complicated by failure of the E-5 Committee to define RESTRAINT in realistic terms. It reads as follows "Floor and Roof Assemblies and individual beams in buildings shall be considered restrained when the surrounding or supporting structure is capable of resisting substantial thermal expansion throughout the range of anticipated elevated temperatures. Constructions not complying with this definition are assumed to be free to rotate and expand and shall, therefore, be considered as unrestrained."

This language is so broad and so vague that many feel that only the structural engineer who designed the building can determine what is restrained or unrestrained. There are even those who insist that such a determination cannot be made realistically; that fire loading changes in structures and who can say what is "substantial thermal expansion" or "anticipated elevated temperatures". It is this group who have for practical purposes rejected the "RESTRAINED" criteria and will use the more practical "UNRESTRAINED" condition.

The next few years will be difficult and risky for everyone concerned but it will be particularly so for those who are bidding and are doing the field application.

There is reason to believe that there will not be agreement among Code Authorities on the subject. Some will adopt the new criteria others will reject it. There will be varying time schedules for adoption or rejection even by communities operating under the same basic code.

Extreme caution plus reliance on qualified material manufacturers representatives will be necessary until some of the unresolved issues are settled.

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