

Techniques and Materials for Better Building from UNITED STATES GYPSUM CO.

PLAINTIFF'S EXHIBIT

USG-660

# contract construction

Issue 1, 1966

Here is the first issue of  
a brand new publication for  
leading general contractors  
and industrialists

HISTORICAL FILE  
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# contract construction

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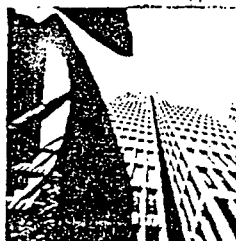
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newest U.S.G. publication—  
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*George E. Harper*  
Editor



ON OUR COVER: dramatic photograph of  
Atlanta's new Peachtree Center is  
highlighted by abstract sculpture in  
courtyard, will be featured in a coming  
issue of CONTRACT CONSTRUCTION.  
Architects: Edwards & Portman; Gen'l  
contractor: J. A. Jones Construction Co.

BE030 1126

# FIREPROOFING:

## FALLACY & FACT

*This article is a condensation of "Fireproofing: Fallacy & Fact," by Ralph E. Carlson, fire protection engineer in the office of the California State Fire Marshal. Reprints of the original 12-page article, with complete tabular material, are available. Address your request to Editor, CONTRACT CONSTRUCTION, 101 S. Wacker Drive, Chicago, Ill. 60606.*

Fire protection has long been one of the most important considerations in building construction, yet one of the least understood. The rapid development of new materials and methods since World War II has, at the same time, heightened the interest and multiplied the confusion. Building codes do not always clarify the situation. While they are gradually changing from "specification" criteria to "performance," they still base many of their provisions on materials and methods of prewar years. As a result, new products and systems have outstripped performance requirements in codes.

### PURPOSE OF FIRE TESTS

Deficiencies in codes notwithstanding, it is imperative that fireproofing products meet the ratings stated in the codes. To establish such ratings for any material or assembly, the ASTM has set up a procedure known as Standard Methods of Fire Tests of Building Construction and Materials, Designation E 119. Testing under this procedure serves three broad purposes:

1. *Determine performance when exposed to fire:* the test provides definite information on reaction and performance of building materials and their assembly when exposed to standard fire temperature. Does the material maintain its bond under exposure to high temperatures? Does it unduly shrink or expand, and in so doing fail to provide the degree of fire protection planned or required, within economic limits? The data gleaned guides development of new materials.

2. *Establish building code requirements:* comparative fire test procedures provide code-writing authorities with the information to convert code requirements from a specification type to a performance type. The code writer can establish performance requirements in terms of fire endurance for specified occupancy, based on the average fire loading of such occupancies.

3. *Guide architects and fire protection engineers:* comparative fire data provide tools for architects and

fire protection engineers in the design of buildings that (a) conform to performance requirements necessary for an acceptable level of safety to life and property, and (b) meet minimum standards established by codes.

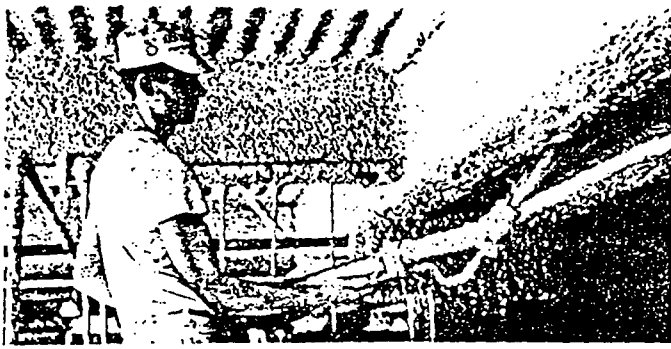
### TEST PROCEDURE AND CRITERIA

Tests aimed at these objectives are conducted by several organizations under ASTM procedure E 119. Materials under test are exposed to a standard fire, selected after careful study as typical of what can be expected in actual fires. A test specimen must be representative of the construction for which classification is desired: columns, floors and roofs, partitions and beams. In order to "remain alive" in a fire test all assemblies except columns, which have specific requirements, (a) support the live load, (b) prevent passage of hot flame or hot gases, (c) limit the unexposed surface temperature rise over the starting temperature to an average of 250° F., or a maximum of 325° F. at any point.

### BEHAVIOR OF STRUCTURAL STEEL AT HIGH TEMPERATURES

Since structural steel is so intimately involved in any fireproofing procedure, data have been prepared on the compressive and tensile strength of steel under high temperature conditions. In terms of fire-resistive ratings the critical temperature for structural steel is usually considered as the temperature at which ultimate strength is reduced to the permissible loading, so that failure of the member is imminent. This is the basis for the alternate criteria in ASTM #119 that average temperature in any section must not exceed 1000° F., or 1200° F. at any single measured point.

In the opinion of Ralph E. Carlson, fire prevention engineer in the office of the California State Fire Marshal, primary structural steel elements (i.e., those members connecting steel columns and essential to structural stability) should be protected for the required time period (usually expressed in hours) against an average temperature of 1000° F. in any section. The task of



VERSATILITY is one forte of spray-applied fireproofing materials. Applicator sprays FIRECODE "V" plaster on any accessible surface with conventional spray apparatus.

fireproofing material, then, is to prevent temperature from rising to the point where structural elements fail. How long fireproofing materials can accomplish this task depends on the nature and volume of the materials. MATERIALS DIRECTLY APPLIED FOR FIRE PROTECTION

Among the first successful methods in providing fire protection to structural steel was the development of clay tile, followed by the successful application of concrete. However, structures in which they were used were massive in appearance and required strong foundations and heavy structural members to carry the dead weight. The need to lighten structures, however, led to development of metal lath and plaster, and in the past two decades to development of directly applied plaster, cementitious and fibrous materials.

Materials that can be applied directly to structural steel and to steel decks, floor and form units offer many advantages. They permit the use of lighter structural elements, lighter foundations and a greater ratio of usable cubic space to total building volume. One recently developed material offering these advantages is United States Gypsum Co.'s FIRECODE "V" plaster. It is easy to apply and has achieved excellent ratings in standard fire endurance tests.

Unlike ordinary spray plasters, FIRECODE "V" is a cementitious material containing vermiculite aggregate. It is especially formulated for direct application by

machine to steel column, beam and deck surfaces for fire endurance ratings. FIRECODE "V" is mixed at the job location, with water only added. No special additives, chemicals or catalysts need to be measured and added to each batch. No adhesive or other treatment of steel surfaces except cleaning is necessary. The mixed material shows excellent pumping qualities with less wear on machinery and hose. A skilled applicator can apply the required amount of material in either one or two coats, with no hand tamping or finishing necessary.

Though FIRECODE "V" plaster is not specifically designed for use where it might be subject to physical contact, excessive humidity or vibration, it has excellent bonding qualities to steel. The bond to galvanized steel, 605 lb./sq. ft., not only assures a minimum of drop-off during application and setting but also provides good adhesion during fire exposure.

#### FIRECODE PLASTER FIREPROOFING

**Column ratings:** Since development of FIRECODE "V", a number of fire tests have been conducted with several fire-resistive designs listed by Underwriters Laboratories. When test data for columns are examined we find that increasing the thickness of spray-applied FIRECODE "V" provides an increase in protection. It has been found, for example, that on a 10 WF 49 column, 1 in. of material will provide a column rating of one hour, 1 3/8 in. a rating of two hours, 1 7/8 in. three hours and a thickness of 2 1/4 in. four hours.

The principles which apply to column fire ratings also apply to ratings for beams, ceiling-roof assemblies and ceiling-floor assemblies. Essentially, the thicker the application of FIRECODE "V" plaster, the better the rating. In practice, however, there are other criteria which affect the design of fire endurance rated structures. Two of these considerations are the probable severity of fires in buildings for various occupancies and the fire endurance necessary to withstand uncontrolled fire without major damage to the structure.

TYPICAL FIRE RATINGS as listed in UL "Building Materials List" are shown below. This listing pictures and describes materials used in 3- and 4-hr. rated columns. On graph (right) information from UL listing is used as guide points to establish slope of straight line. Ratings for other thicknesses of material may now be read from graph, e.g., 1 in. of material yields a column fire rating of one hour. (This is only one of several graphs which appear in complete reprint.)

