HAI Project No.: 1JJB05264.006

Report Concerning the Exterior Wall Claddings Involved in the Monte Carlo Hotel Fire

Prepared for

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August 13, 2008

EXECUTIVE SUMMARY

Just before 11 AM on January 25, 2008, a fire occurred at the Monte Carlo Hotel & Casino in Las Vegas, Nevada. The fire is reported to have been started by workmen on the roof area and it then spread over the upper portion of the exterior wall claddings on the South and West facing sides of the hotel towers.

The Building Division of the Clark County Department of Development Services (CCBD) requested Hughes Associates, Inc. (HAI) to assist in determining the materials that were involved in the fire and their role in the fire. It should be noted that this report is not intended to address the initiating fire event on the roof area nor how the initiating fire initially spread to and involved the exterior wall cladding.

Based on information provided by CCBD, the exterior wall cladding of the Monte Carlo was understood to be an Exterior Insulation Finish System (EIFS) that was installed at the time of building construction. Additionally, it appears that several decorative architectural details were also installed on the exterior wall at the time of construction.

The EIFS used on the Monte Carlo was manufactured by Sto Corporation (Sto) of Atlanta, Georgia. An EIFS contractor actually installed the EIFS and other components on the exterior walls of the Monte Carlo.

After the fire, CCBD personnel obtained several samples from the west wing section of the exterior façade of the Monte Carlo. Smaller samples of these materials were subsequently sent to a laboratory for qualitative analysis.

Based on the information and discussion reported herein, the following findings are provided:

1. The Monte Carlo had as its exterior wall cladding in the fire area the following two components:
   a. An EIFS system that was installed in the flat areas of the building and on the vertical pop-outs between windows on the 29th floor up to the 32nd floorline. It appears these EIFS areas had a non-complying thickness of lamina.
   b. Decorative non-EIFS materials used for ornamentation – These items include the horizontal cornice between the 28th and the 29th floors, the horizontal cornice at the top of the 32nd floor, the railing at the top of the parapet walls and are believed to include the medallions between the windows on the 32nd floor.
2. It appears that the Sto EIFS, when properly applied, did meet the requirements of the 1991 UBC.
3. Based on the analysis of the samples, it appears that EIFS lamina did not have the correct thickness. The actual lamina varied in thickness from approximately 28 to 69% less than the nominal minimum thickness.

4. The EIFS had additional decorative components (see Item 1b) applied to it. These were large shapes that contained significant thicknesses of EPS and these components were not covered with EIFS lamina. It appears that they did not meet the requirements of the 1991 UBC.
5. The primary contributor to the progression of the fire was the combination of materials in the decorative band at the top of the wall, the decorative band at the top of the 32nd floor (EPS with a polyurethane resin coating) and the unknown materials in the medallions.
6. Flaming droplets or pieces of EPS and/or polyurethane caused the ignition of the large decorative band at the top of the 28th floor. This decorative band was composed of EPS and had a non-EIFS coating.
7. The EIFS in the flat wall area (parapet area) was involved in the fire but it was not the primary contributor to the lateral propagation of the fire even though it appears to have a non-complying thickness of lamina. It did burn in the immediate area of fire exposure as would be expected based on testing but it did not significantly propagate beyond the area of fire exposure caused by the burning of the decorative band at the top of the wall, the decorative band at the top of the 32nd floor and the medallions. As the fire progressed along these materials, it continued to involve the EIFS but the EIFS was not the primary cause of the continued the further progression of the fire.

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REPORT CONCERNING THE EXTERIOR WALL CLADDINGS INVOLVED IN THE MONTE CARLO HOTEL FIRE

1.0 INTRODUCTION

Just before 11 AM on January 25, 2008, a fire occurred at the Monte Carlo Hotel & Casino in Las Vegas, Nevada. The fire was reported to have been started by workmen on the roof area and it then spread over the upper portion of the exterior wall claddings on the South and West facing sides of the hotel towers.

Since the fire, a primary question has arisen: What were the materials that were involved in the fire on the exterior of the building?

The Building Division of the Clark County Department of Development Services (CCBD) requested Hughes Associates, Inc. (HAI) to assist in answering the question posed above and provide information and insight as to determining the materials that were involved in the fire and their role in the fire. It should be noted that this report is not intended to address the initiating fire event on the roof area nor how the initiating fire initially spread to and involved the exterior wall cladding.

2.0 BUILDING

The 32-story Monte Carlo was constructed in 1994 and 1995. The Code of Record was the 1991 Edition of the Uniform Building Code (UBC) [1]. The plan layout of the hotel was a center tower from which three wings, each approximately 240 ft. long, extended. Figure 1 provides an overall view of the two wings that were involved in the fire.

The Code of Record required Type I noncombustible construction. The UBC required that, for this type of building construction, the exterior walls be of noncombustible construction.

The exterior walls are non-loadbearing curtain walls. It is our understanding that the walls were constructed with gypsum wallboard on the interior, steel studs and steel members and exterior gypsum sheathing. Over the exterior sheathing, an exterior wall cladding and decorative architectural details were installed. At the top of the building, the exterior wall extended approximately 20 ft. above the roofline around the entire perimeter of the building forming a parapet.

During a limited on-site, post-fire visit, it appeared that the exterior wall in the area above the roofline, was constructed of steel members/steel studs with exterior grade, gypsum sheathing on both the interior face and the exterior face of the members/studs.

2.1 Exterior Wall Claddings – Code Requirements

Based on information provided by CCBD, the exterior wall cladding of the Monte Carlo was understood to be an Exterior Insulation Finish System (EIFS) that was installed at the time of building construction. Additionally, it appears that several decorative architectural details were also installed on the exterior wall at the time of construction.

EIFS has, as one of its components, expanded polystyrene foam plastic insulation (EPS) which is a combustible material.

As mentioned above, the Code in effect at the time of construction was the 1991 Edition of the UBC. Section 1713 (e) 2.A addressed the use of foam plastic insulation on noncombustible exterior walls on one-story buildings. Section 1713 (e) 2.B addressed the use of foam plastics on exterior walls of buildings of any height. This Section states:

*"**B. Buildings of any height.** Except for foam plastic insulation in masonry or concrete construction complying with Section 1713 (d), Exception 3, assemblies employing foam plastic insulation in or on exterior walls of buildings where the exterior walls are required to be noncombustible construction shall comply with the following:*

1. *When the wall is required to have a fire-resistive rating, data based on tests conducted in accordance with U.B.C. Standard No. 43-1, are provided to substantiate that the fire-resistive rating is maintained.*
2. *The foam plastic insulation is separated from the interior of the building by a thermal barrier having an index of 15 unless specifically approved under section 1713 (f).*
3. *Combustible content of foam plastic insulation in any portion of the wall or panels does not exceed 6,000 Btu per square foot of wall area as determined by tests in accordance with U.B.C. Standard No. 17-2.*
4. *Foam plastic insulation, exterior coatings and facings tested separately, shall each have a flame-spread rating of 25 or less and a smoke-developed rating of 450 or less in accordance with U.B.C. Standard No. 42-1. The foam plastic shall be tested in the thickness intended for use.*
5. *The wall assembly is tested in accordance with U.B.C. Standard No. 17-6 and complies with the following information:*
    a. *Inspection agency name.*
    b. *Product for which the insulation is listed.*
    c. *Identification of the insulation manufacturer.*
    d. *Flame-spread and smoke-development classifications."*

Based on Section 1713 (e) 2.B, EIFS were allowed to be applied as the exterior wall cladding assuming that the EIFS met the Code requirements specified. Other types of foam plastic materials used on the exterior walls would also be required to meet Section 1713 (e) 2.B.

For plastics that do not meet the definition of foam plastic insulation, the 1991 UBC addresses their use on the exterior of buildings in Section 3007, Plastic Veneer. This section requires that plastic veneer used on the exterior of a building be an "approved plastic" per Section 417 and the plastic veneer not be attached to any exterior wall to a height greater than 50 ft above grade. When the plastic veneer is used on walls less than 50 ft above grade, limitations exist on the size/area of the plastic veneer and separation distance between sections of plastic veneer.

2.2 Exterior Insulation and Finish Systems (EIFS)

EIFS, when applied as an exterior wall cladding, has the following components:

- Substrate wall system
- EPS insulation board
- Adhesive that attaches the EPS to the substrate wall
- Glass fiber reinforcing mesh
- Base coat on the face of the EPS that embeds the mesh
- Finish coat.

All of these components must be present and each component must be installed per the specific EIFS manufacturer's recommended installation details and their Evaluation Report for the specific system, if any, for the wall cladding to be considered a properly installed EIFS wall cladding.

As is currently the situation, EIFS was not specifically referenced in the 1991 UBC. For fire performance requirements, the EIFS had to meet the requirements of Section 1713 (e) 2.B, but other performance issues were not addressed in the Code. Thus, for overall performance, EIFS had to be evaluated for use on buildings via Section 105 of the UBC "Alternate Materials and Methods of Construction." This Section of the Code allows the Code Official to approve the use of materials, products or methods of construction not specifically referenced in the Code. This approval is to be based on submission of sufficient evidence demonstrating that the material, product or method proposed for use is at least equivalent to that prescribed by the Code.

To assist the Code Official in evaluating materials, products or methods of construction under Section 105, the International Conference of Building Officials (ICBO) had as a subsidiary, the ICBO Evaluation Service (ICBO-ES). The ICBO-ES performed technical evaluations of building products, components, methods, and materials for compliance with the Code and the evaluation process culminated with the issuance of ES evaluation reports. ICBO-ES evaluation reports provided evidence that products and systems met the level of performance intended by the code requirements.

These reports were extremely useful to both regulatory agencies and building-product manufacturers. Agencies used evaluation reports to help determine code compliance and enforce building regulations. Manufacturers used these reports as evidence that their products (and this was especially important if the products were new and/or innovative) met code requirements and thus, helped obtain regulatory approval.

As part of the evaluation process, an acceptance criteria was developed when an application was received for an ICBO-ES report on a product that was an alternate to that specified in the code, and no existing criteria could be applied to the product. This was the case for EIFS and as a result of the ICBO-ES process an Acceptance Criteria was developed for EIFS and it was the "Acceptance Criteria For Exterior Insulation And Finish Systems, AC24." At the time the Monte Carlo was being constructed, the 1993 version of AC24 would have been in effect. The

1993 Edition of AC24 specified the 1991 Edition of the UBC as its base document. Therefore, for use on noncombustible construction AC24 required that the EIFS meet the requirements of Section 1713 (e) 2.B of the 1991 UBC. A copy of the 1993 Edition of AC24 is provided in Appendix A.

At the time of the Monte Carlo construction, EIFS manufacturers would typically have had their ICBO-ES evaluation reports based on the 1993 Edition of AC24. Based on the 1993 Edition of AC24, EIFS as specified in their respective evaluation reports could be used on noncombustible wall construction if it met the appropriate requirements.

The EIFS used on the Monte Carlo was manufactured by Sto Corporation (Sto) of Atlanta, Georgia.[2] An EIFS contractor actually installed the EIFS and other components on the exterior walls of the Monte Carlo.

In the early 1990s, Sto manufactured several EIFS systems that were recognized in their respective ICBO-ES evaluation reports. We have not been provided specific information as to the actual Sto EIFS that was applied, it is thought to be the Sto Exterior Wall Finish and Insulation System as described in ICBO-ES Evaluation Report No. 3906.

CCBD provided HAI with copies of the following Sto ICBO-ES reports:

1. ICBO-ES Report No. 3906, dated November 1993, Subject: Sto Exterior Wall Finish and Insulation System.
2. ICBO-ES Report No. 3906, dated November 1994, Subject: Sto Exterior Wall Finish and Insulation System.

Copies of these two ICBO-ES reports are provided in Appendix B

The November, 1993 and the November, 1994 versions of ICBO-ES Evaluation Report No. 3906 are both based on the 1993 Edition of AC24 and no significant differences between the two reports were noted.

ICBO-ES Evaluation Report No. 3906 addressed the use of the EIFS on noncombustible construction and in general, the assembly specified for this application was:

- Substrate wall:
  - ½ in. thick, Type X gypsum wallboard on interior face.
  - 18 ga., 3-5/8 inch steel studs at 16 in. OC.
  - Unfaced, R-11 fiberglass in stud cavities.
  - 5/8 in., Type X water-resistant core gypsum sheathing.
- Sto Dispersion Adhesive – applied to the insulation board prior to application to the substrate wall.
- Insulation board – 1.0 lb/ft^3 EPS – ¾ inch to 4 inch thick.
- Sto RFP base coat – approximately 1/16 inch (1.6 mm) thick.

- Sto reinforcing fabric – 4.8 oz/yd^2 glass fiber mesh – embedded and covered into the base coat.
- Finish coat – Stolit finish material – approximately 1/16 inch (1.6 mm) thick.

According to the evaluation report, when this assembly was installed per both the conditions set forth in the report and the manufacturer's instructions, it met the requirements of Section 1713 (e) 2.B and was allowed for use on exterior walls of noncombustible construction.

When the Section 1713 (e) 2.B was inserted into the Code (initially in the 1988 UBC), the primary basis of the Code change was the capability of these types of wall systems to exhibit limited flame spread over the exterior face of the wall system or through their foam plastic cores. The Uniform Building Code Standard 17-6 "Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-bearing Wall Panel Assemblies Using Foam Plastic Insulation" test method (initially added in the 1988 UBC Book of Standards) evaluated this fire performance aspect of an exterior wall that contains foam plastic insulation.[3] This test consisted of a large two-story test structure with the test walls installed on two adjoining sides of the test structure while the other two sides were constructed of concrete block. In one test wall, a large window opening was provided in the first floor area. At the start of the 30-minute test, a 1,285lb wood crib in the first floor was ignited and allowed to burn. Figure 2 provides a photograph of a UBC 17-6 test in progress. The acceptance criteria for this test addressed the propagation of both vertical and horizontal flame spread over the surface of the exterior wall as well as flame propagation within the foam plastic core of the wall. A wall system that successfully passed UBC 17-6 would exhibit the following fire performance:

- Limited vertical and lateral flame-spread over the surface of the exterior wall covering, beyond the immediate area of direct flame impingement.
- Limited vertical and lateral flame flame-spread through or in the combustible core material, beyond the immediate area of direct flame impingement.

The wall systems were typically tested with a maximum amount of foam allowed for use at that time. As required by Section 1713 (e) 2.B, the maximum amount of areal fuel loading was limited to 6,000 Btu/ft^2. For EPS this loading translated to approximately a 4 inch thickness of 1.0 lb/ft^3 density foam. When EIFS were tested in accordance with UBC 17-6, this fuel loading was typically applied evenly over the entire test wall area.

While the tested walls were basically flat, there was a realization that in many cases, the foam in certain areas of a wall could be shaped so as to provide a special "look" to the wall. This was typically accomplished by cutting the EPS into the shape desired and then installing it either in a manner similar to the EPS for the EIFS system or it could be attached to the base EPS or EIFS via adhesion or mechanical attachment. In either case, the EPS shapes would be finished with base coat, mesh and finish coat per the manufacturer's instructions.

However, the question as to how to regulate this "look" was sometimes raised. In many cases, the construction industry used a "rule of thumb" that the average areal fuel loading over the entire wall could not exceed the limit of 6,000 Btu/ft^2 or the fuel loading tested, if less than 6,000 Btu/ft^2 was tested. Thus, it could be interpreted that shapes with EPS that were thicker than

4 inches could be used if the thickness of the foam in other areas of the wall was less and the overall areal fuel loading was below the limit. It should also be noted that typically, each EIFS manufacturer had or currently has, specific installation details and testing (shapes or thicker EPS) for creating and using shapes on exterior walls constructed with their EIFS.

2.3 Monte Carlo Exterior Wall Materials

After the fire, CCBD personnel obtained several samples from the west wing section of the exterior façade of the Monte Carlo. Table I provides a summary description of the samples taken and Figure 3 provides a photo showing the approximate locations that the various samples were removed from. The sample descriptions were developed by CCBD and HAI personnel. Figures 4–14 provide photographs of each of the various samples.

During the inspection of the materials removed from the Monte Carlo, smaller samples were removed from areas on the various materials. These samples were subsequently sent by CCBD to MVA Scientific Consultants in Duluth, Georgia for qualitative characterization. The results of the analyses are reported in MVA Scientific Consultants Final Report MVA7406, Characterization of Foam Building Material, dated March 28, 2008. Table II provides a summary of the characterization analyses of the samples.

It should be noted that the sampling involved limited areas from the West wall that were adjacent to the fire. Samples were not taken from other areas of the building and the sampling did not necessarily evaluate construction methods, etc.

3.0 DISCUSSION OF MVA RESULTS

In the samples that contained EPS foam plastic, the results indicate that the EPS did contain bromine which can be used as a marker for the presence of fire-retardant treatments that are typically used in EPS. Thus, it appears that the EPS was fire-retardant treated.

Sample 7 (MVA sample F) which was a sample from the flat wall surface between the windows on the 30th floor appears to be EIFS albeit with a thinner lamina than would be expected. The lamina (defined as the base coat, mesh & finish coat together) measured by MVA had a thickness of approximately 2.3 mm (0.09 in.). Per Sto's evaluation report, the lamina should have had a nominal minimum thickness of approximately 3.2 mm (0.13 in.). This actual thickness is approximately 28% less than the nominal minimum thickness.

Sample 8 (MVA sample G) which was a sample from the upper parapet wall surface appears to be EIFS albeit with a thinner lamina than would be expected. The lamina measured by MVA had a thickness of approximately 1 mm (0.04 in.). Per Sto's evaluation report, the lamina should have had a nominal minimum thickness of approximately 3.2 mm (0.13 in.). This actual thickness is approximately 69% less than the nominal minimum thickness. Visual observations also indicated that the mesh was visible from the exterior face whereas in a proper installation, the mesh would not be visible.

Sample 1 (MVA sample C) was a sample from the horizontal cornice between the 28th and the 29th floors. The EPS was covered with a coating that was approximately 1.5 mm (0.06 in.).

While the EPS was covered with what appears to be base coat and finish coat, no mesh/fiberglass fabric was present.

Sample 2 was a sample from the horizontal cornice at the top of the 32nd floor, just below the parapet area. Two small samples from Sample 2 were sent for characterization. The first small sample identified as MVA sample A was from the top of the cornice. In this sample the EPS was covered with an approximately 2-mm (0.08-in.) thick coating that appears to be a combination of a polyurethane coating covered by a thin EIFS lamina. It should be noted that this small MVA sample A was removed from an area of the larger sample that included mesh/fiberglass fabric. The majority of the Sample 2 from which the small MVA sample B was removed did not have the mesh/fiberglass. In the second small sample identified as MVA sample B, the EPS appears to be covered by a 1-mm ((0.04-in.) thick painted polyurethane type resin. No mesh/fiberglass fabric was present in this sample.

Sample 3 (MVA sample D) was a sample from a vertical column pop-out detail between windows on the 30th floor. It appears that an additional 6-inch thick piece of EPS was adhered to the existing 1-inch thick EPS. While the coating appears to be EIFS lamina, it does not have the correct thickness (approximately 2 mm versus nominal 3.2 mm). This actual thickness is approximately 38% less than the nominal minimum thickness.

Sample 4 (MVA sample E) was a sample of the decorative feature at the top of the parapet. The decorative detail appears to be a plant-on shape. The EPS appears to be covered with one or more components of an EIFS lamina. This coating was less than the required thickness (approximately 2.3 mm versus nominal 3.2mm) and no mesh/fiberglass fabric was present.

Sample 9 (MVA sample H) was a sample from the horizontal cornice between the top of the 31st floor and the bottom of the 32nd floor. This shape was hollow and did not contain any EPS. It was approximately 0.5-inches thick. The MVA analysis and visual observations indicate that this is basically a composite material of fiberglass and a plaster-like binder (gypsum and carbonate).

4.0 SUMMARY – MATERIALS

This summary is based on visual observations and MVA's qualitative characterization of samples removed from the west wing of the Monte Carlo after the fire. It should be noted that these samples and their characterization may not be indicative of the entire building façade. Some areas such as the exterior cladding in the central core parapet area were totally destroyed. However, the collected samples do provide a "snapshoot" of the various materials used in the construction of the exterior façade at the locations sampled.

In general, on the flat sections of the wall (Samples 7 and 8) it appears that EIFS was installed and the EIFS used a 1 inch thickness of EPS. It should be noted however, that the lamina thickness measured on the samples was significantly less (28 – 69% less) than that specified in Sto's evaluation report.

The decorative features that were sampled contained EPS. The decorative features that include the horizontal cornice between the 28th and the 29th floors, the horizontal cornice at the top of the 32nd floor, the vertical column pop-outs, and the railing at the top of the parapet walls appear to

be plant-ons. They appear to have been added after the initial installation of the 1-inch thick EPS with base coat and mesh.

The vertical column pop-out appears to be coated with EIFS lamina but the lamina thickness was significantly less (38% less) than that specified in Sto's evaluation report.

The coatings for the decorative features that include the horizontal cornice between the 28th and the 29th floors, the horizontal cornice at the top of the 32nd floor and the railing at the top of the parapet walls were not EIFS, i.e., no properly installed mesh present over the entire detail and on some features, a polyurethane based coating was used over the EPS.

The horizontal cornice between the 31st and the 32nd floors did not contain EPS or any other foam plastic and appears to be a composite material of fiberglass and a plaster-like binder.

5.0 DISCUSSION OF FIRE

A detailed discussion on the progression of the fire is provided in Appendix C. The following discussion of the fire and its progress is based on review of available videos and information of the fire. In this discussion, references will be made to several different areas of the upper portion of the walls. The area referred to as "parapet wall area" pertains to the area between the decorative band at the top of the wall and the decorative band at the top of the 32nd floor. As noted earlier, these two bands of decorative materials contain EPS but are not EIFS due to their construction.

The fire at the Monte Carlo was reported to have been initiated on the roof area and spread to the exterior wall cladding. The exterior cladding materials first appeared to be involved on the left side (as viewed from the exterior) of the central core area. Currently, it is not known what materials were installed on the exterior of the central core, but based on their decorative nature, their fire performance and the information determined from other decorative elements such as the horizontal cornice between the 28th and the 29th floors, the horizontal cornice at the top of the 32nd floor and the railing at the top of the parapet walls, it would suggest that these materials were EPS with a non-EIFS covering.

The fire on the left side of the central core then progressed laterally. The adjacent materials on the right side of central core façade began to burn and the fire continued to propagate laterally over these decorative materials. The fire also moved to the left along the upper portion of the west tower and began to involve the cladding materials. Figure 15 provides a photograph of this progression.

Over time, the fire on the west tower moved laterally approximately 80 ft. It appears that the fire ignited materials in the immediate area to the central core and continued to move to the West. Based on observations, it appears that the fire spread over the decorative band at the top of the 32nd floor, the medallions between the windows on the 32nd floor, the decorative band to the top of the wall and over the flat wall area.

Once the fire had progressed away from the immediate exposure by the central core area, it appears that the fire on the decorative band at the top of the wall, the decorative band at the top of the 32nd floor, and the window medallions were the primary mode of lateral flame-spread. Not

only did these areas exhibit their own flame-spread, the resultant flames caused the EIFS on the flat area of the wall above to ignite.

EPS is a thermoplastic material that when heated turns to a liquid. This molten EPS can drip and run if not contained and if ignited, can produce flaming, falling material. The polyurethane coatings on the decorative band at the top of the 32nd floor would exhibit flaming droplets as well.

As the fire spread along the decorative band at the top of the wall, molten and flaming material fell onto the decorative band at the top of the 32nd floor, thus continuing to involve it and provide a platform for the burning of these materials. The same effect occurred as the flaming materials, from the decorative band at the top of 32nd floor and the medallions fell onto the horizontal cornice between the 31st and the 32nd floor. It appears that this horizontal cornice did not propagate fire due to it burning but rather it provided a ledge whereby flaming and molten material did collect and burn. At each ledge, the decorative band at the top of the 32nd floor and the horizontal cornice between the 31st and the 32nd floor, fire spread along the burning materials collected on the ledges and this assisted in the lateral movement of the fire.

Observations indicate that the EIFS on the upper wall area while involved in the immediate area of fire exposure from the fire below, did not exhibit significant lateral flame-spread. The burning on the flat wall did not significantly advance the flames per se but rather tended to lag behind the flame front caused by the burning of the decorative band at the top of the wall, the decorative band at the top of the 32nd floor and window medallions. The video observations show for much of the time, that the fire is limited to burning by the the decorative band at the top of the 32nd floor, the window medallions and the upper decorative band on top of the wall. See Figure 16 for a photograph showing this performance.

The combination of burning materials in the decorative band at the top of the wall, the decorative band at the top of the 32nd floor and in the medallions as well as the molten material on top of the horizontal cornice between the 31st and the 32nd floor, provided a fire that continued to move laterally. As this fire moved laterally, it involved the EIFS in the parapet wall area.

This same progression of fire occurred on the upper portion of the South Tower. In this case, the wind also provided some assistance to move the fire laterally over the exterior wall surfaces for approximately 170 ft.

During the lateral progression of the fire along both the South and the West tower walls, flaming materials fell to either the ground or onto the horizontal band at the top of the 28th floor. It is apparent that on each tower wall, and especially on the west tower wall, flaming materials did fall onto the decorative band at the top of the 28th floor. This flaming material fell from the burning of the large decorative band at the top of the 32nd floor and from the window medallions. The horizontal decorative band at the top of the 32nd floor contained significant amounts of EPS and was not covered by EIFS. As this large band burned, it appears that the coatings were destroyed and this allowed flaming, molten EPS to fall and at times large pieces appear to have also fallen.

When sufficient amounts of the flaming materials fell on the 2-ft. thick top of the decorative band at the top of the 28th floor, the EPS in this band ignited and began to burn. This fire slowly progressed laterally along this horizontal band. Since this decorative band did not contain glass mesh, it was therefore, not covered by EIFS. As the fire progressed laterally it exposed the EIFS in the flat wall areas above the band and the vertical pop-outs between the windows. It appears that there was limited vertical progression of the fire in these areas as would be expected. However, a couple of the vertical pop-outs did exhibit some vertical flame-spread and the cause for this performance is unclear.

Overall, the progression of the fire was primarily due to fire-spread on the decorative building elements that contained EPS which were not covered by EIFS. While EIFS (apparently with thin lamina) was involved in the fire, it was not the primary contributor that caused progression of the fire. The primary contributor that caused the progression of the fire was the combination of materials in the decorative band at the top of the wall, the decorative band at the top of the 32nd floor (EPS with polyurethane resins coatings) and the unknown materials in the window medallions.

This type of fire progression has occurred in the past and was discussed in a previous report on fires that were thought to involve EIFS. A copy of this report by Mr. Don Belles of Koffel Associates, Inc. is provided in Appendix D. In these previous fires, non-code-complying decorative features were the materials that were ignited and spread the fires. In these fires, when the EIFS was exposed, the EIFS performed as was expected and did not exhibit significant flame propagation.

The EIFS industry recognized this issue and its trade association, The EIFS Industry Members Association (EIMA) issued a cautionary notice in June, 2002. A copy of this notice is provided in Appendix E.

6.0 SUMMARY

Based on the information and discussion reported herein, the following findings are provided:

1 The Monte Carlo had as its exterior wall cladding in the fire area the following two components:

   a. An EIFS system that was installed in the flat areas of the building and on the vertical pop-outs between windows on the 29th floor up to the 32nd floorline. It appears these EIFS areas had a non-complying thickness of lamina.

   b. Decorative non-EIFS materials used for ornamentation – These items include the horizontal cornice between the 28th and the 29th floors, the horizontal cornice at the top of the 32nd floor, the railing at the top of the parapet walls and are believed to include the medallions between the windows on the 32nd floor.

2 It appears that the Sto EIFS, when properly applied, did meet the requirements of the 1991 UBC.

3 Based on the analysis of the samples, it appears that EIFS lamina did not have the correct thickness. The actual lamina varied in thickness from approximately 28 to 69% less than the nominal minimum thickness.

4 The EIFS had additional decorative components (see Item 1b) applied to it. These were large shapes that contained significant thicknesses of EPS and these components were not covered with EIFS lamina. It appears that they did not meet the requirements of the 1991 UBC.

5 The primary contributor to the progression of the fire was the combination of materials in the decorative band at the top of the wall, the decorative band at the top of the 32nd floor (EPS with a polyurethane resin coating) and the unknown materials in the medallions.

6 Flaming droplets or pieces of EPS and/or polyurethane caused the ignition of the large decorative band at the top of the 28th floor. This decorative band was composed of EPS and had a non-EIFS coating.

7 The EIFS in the flat wall area (parapet area) was involved in the fire but it was not the primary contributor to the lateral propagation of the fire even though it appears to have a non-complying thickness of lamina. It did burn in the immediate area of fire exposure as would be expected based on testing but it did not significantly propagate beyond the area of fire exposure caused by the burning of the decorative band at the top of the wall, the decorative band at the top of the 32nd floor and the medallions. As the fire progressed along these materials, it continued to involve the EIFS but the EIFS was not the primary cause of the continued the further progression of the fire.

7.0 REFERENCES

1. International Conference of Building Officials., "Uniform Building Code," 1991 Ed., May 1, 1991, Whittier, CA.

2. Personal communication from Sto Corp. representative.

3. International Conference of Building Officials., "Uniform Building Code Standards," 1991 Ed., May 1, 1991, Whittier, CA.

8.0 ACKNOWLEDGEMENT

The authors wish to acknowledge the following contributions:

- CCBD personnel and in particular, Mr. Doug Evans, P.E., who provided valuable assistance in the development of this report, and
- EIMA who provided the funding for this report.

Table I—Summary of Sample Locations and Descriptions

Building Sample No.	Location & Description of Material	Figure No.	Analysis Sample No.
7	From wall between windows on 30th floor. ⅝ inch thick wallboard w/ UL label "Fire Resistance Classified WRX," 1 inch of EPS, topcoating with mesh (appears to be woven fiberglass).	4 & 5	F
8	From upper parapet wall area. Appears similar to Sample #7 except that topcoat appears thinner and the mesh/fiberglass fabric was visible through the top coat.	4 & 5	G
1	Horizontal Cornice between 28th and 29th floor. Sample consisted of two sections designated as upper and lower samples. Both sections together are approximately 3 ft. high and range from 10 in. on the lower portion to 2 ft. thick on the upper portion. Both sections were EPS with topcoating. The topcoat did not appear to have any mesh/fiberglass fabric. There was gasketing between the upper and the lower section – appeared to be backer rod with a silicone sealant. See Note 1.	6	C
2	Horizontal cornice at top of 32nd floor & just below parapet area. This cornice consisted of two sections, one upper and one lower. The sections consisted of EPS with a topcoat. Together both blocks measure approximately 6 ft. high and ranged from 9 in. thick at the lowest area to approximately 3 ft. thick at the top. Topcoat on EPS appears to be different than the topcoat on Samples #7 and #8 – it is yellowish in color and very flexible. Mesh/fiberglass fabric was present at the top horizontal surface of each section and extended down on each section a couple of inches. The remainder of the shape did not appear to have any mesh/fiberglass fabric present. Adhesive was present on the back face of the EPS and it appeared that it was adhered to the EIFS wall surface. Thus it appeared to be a plant-on shape. See Note 1.	7 & 8	A (top area of top section with mesh) & B (lower section in area w/o mesh)
3	Vertical column pop-out detail – between windows – on 30th floor. Sample is 2.3 ft. wide and 8 in. thick. Gypsum wallboard substrate with 1 inch of EPS. The 1 in. thick EPS has a coating with mesh/fiberglass fabric. An additional 6 inch thick x 2.3 ft. wide layer of EPS was adhered to the 1 inch EPS. The topcoat on the 6 in. thick portion contained mesh (fiberglass fabric). See Note 1.	9 & 10	D
4	Parapet detail – top railing of parapet wall. The sample is approximately 5 ft. high. Gypsum wallboard substrate, with 1 inch of EPS adhered to gypsum and the 1 in. thick EPS has a coating with mesh/fiberglass fabric. Decorative details appear to be a plant-on shapes. Topcoat of sample does not contain mesh/fiberglass fabric.	11 & 12	E
9	Horizontal cornice – between top of 31st floor and bottom of 32nd floor. Hollow, fiberglass reinforced material. Unsure of binder material. Thickness was ~ ½ to ¾ inch. See Note 1.	13 & 14	H

Note 1 – The wallboard and 1 inch of EPS with coating and mesh/fiberglass fabric appear to have been on all of the samples as noted. Some of the noted samples did not include this portion of the assembly, but due to the adhesive included on the back of the foam, as well as this base assembly being on some of the samples, it was assumed that all the decorative plant-ons included this base assembly.

Table II — Summary of Results of MVA's Material Characterization

Analysis Sample No.	Building Sample No.	Results
F	7	F is a foam-backed coating with a coating thickness of approximately 2.3 mm (0.09 in). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 3 discrete layers; a white paint layer over a white plaster-like granular/porous layer over white plaster-like granular/porous layer containing glass fiber yarns. The white granular/porous layer (layer 3, adjacent to the foam) is a plaster-like layer composed of carbonate, quartz, gypsum and mica. The filaments comprising the fiber yarns are glass and the coating on the yarns is consistent with a polyvinyl chloride polymer. The exterior surface layer is a paint layer.
G	8	G is a foam-backed coating with a coating thickness of approximately 1 mm (0.04 in). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 1 discrete layer; a white plaster-like granular/porous layer containing glass fiber yarns. The white granular/porous layer containing glass fiber yarns is a plastic-like layer composed of carbonate, mica and quartz. The filaments comprising the fiber yarns are glass and the coating on the yarns is consistent with a polyvinyl chloride polymer.
C	1	C is a foam-backed coating with a coating thickness of approximately 1.5 mm (0.06 in.). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 4 discrete layers; a beige paint layer over a white paint layer over a grey cementitious granular/porous layer over an olive green cementitious granular/porous layer. The olive green granular/porous layer (layer 4, adjacent to the foam) is a cementitious layer composed of carbonate, quartz, wollastonite and a high refractive index mineral phase. The exterior surface layer is a paint layer.
A	2	A is a foam-backed coating with a coating thickness of approximately 2 mm (0.08 in.). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 6 discrete layers; a beige paint layer (1) over a white plaster-like granular/porous layer (2) over a white plaster-like granular/porous layer (3) containing glass fiber yarns over a beige paint layer (4) over a white paint layer (5) over a resinous layer (6). The resinous layer (layer 6, adjacent to the foam) is polyurethane type resin. The filaments comprising the fiber yarns are glass and the coating on the yarns is consistent with a polyvinyl chloride polymer. The inclusions in the resinous layer were composed primarily of quartz. The exterior surface layer is a paint layer.
B	2	B is a foam-backed coating with a coating thickness of approximately 1 mm (0.04 in.). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 2 discrete layers; a beige paint over a resinous layer. The resinous layer (layer 2, adjacent to the foam) is a polyurethane type resin. The inclusions in the resinous layer were composed primarily of quartz. The exterior surface layer is a paint layer.
D	3	D is a foam-backed coating with a coating thickness of approximately 2 mm (0.08 in.). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 3 discrete layers; a yellow/beige paint layer over a white plaster-like granular/porous layer over a white plaster-like granular/porous layer containing glass fiber yarns. The white granular/porous layer containing glass fiber yarns (layer 3, adjacent to the foam) is a plaster-like layer composed of carbonate and quartz. The filaments comprising the fiber yarns are glass and the coating on the yarns is consistent with a polyvinyl chloride polymer. The exterior surface layer is a paint layer.

Table II — Summary of Results of Material Characterization (Continued)

Analysis Sample No.	Building Sample No.	Results
E	4	E is a foam-backed coating with a coating thickness of approximately 2.3 mm (0/09 in.). The foam is polystyrene and contains trace amounts of bromine. The coating is composed of 4 discrete layers; a beige paint layer over a thin white paint layer over a grey cementitious granular/porous layer over an olive green cementitious granular/porous layer. The olive green granular/porous layer (layer 4, adjacent to the foam) is a cementitious layer composed of carbonate, gypsum, wollastonite and quartz with an acrylic binder. The exterior surface layer is a paint layer.
H	9	H is a plaster-like coating approximately 13 mm (0.5 in.) thick without a foam backing. The coating is composed of 4 discrete layers; a yellow paint layer over a thick plaster-like layer with uncoated glass fibers and uncoated glass fiber yarns over a white paint layer over a beige paint layer. The white plaster-like layer is composed of glass fibers, gypsum and carbonate. The filaments comprising the fiber yarns are glass. The exterior surface layer is a paint layer.

Figure 1 – Photo – Post-fire

Figure 2—UBC 17-6 Test in Progress

Figure 3—Sample locations

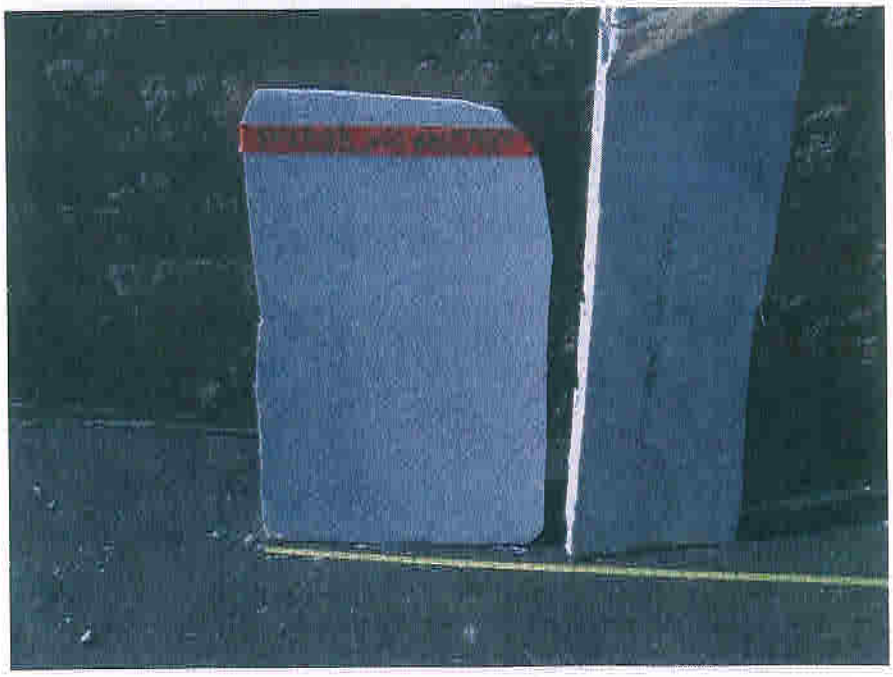

Figure 4—Samples 7 and 8 – front view

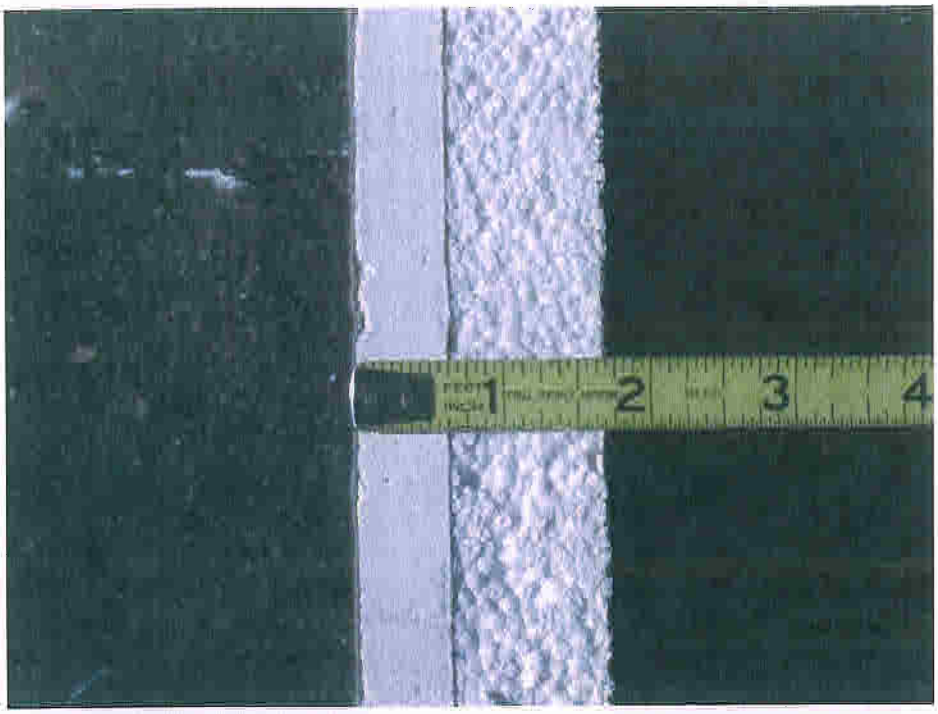

Figure 5—Samples 7 and 8 – side view

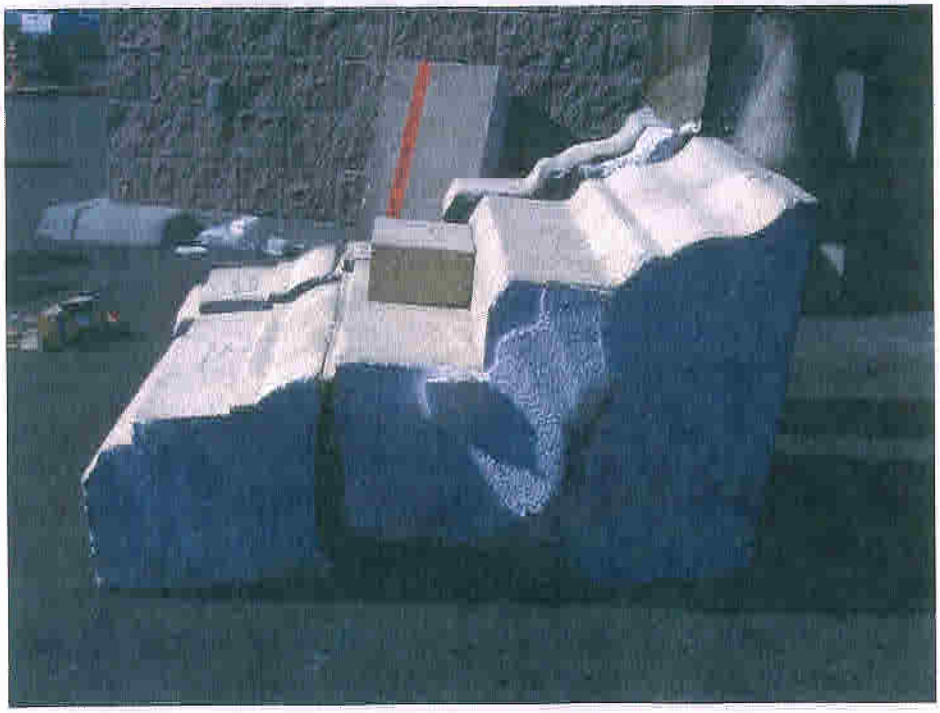

Figure 6—Sample 1 – side view

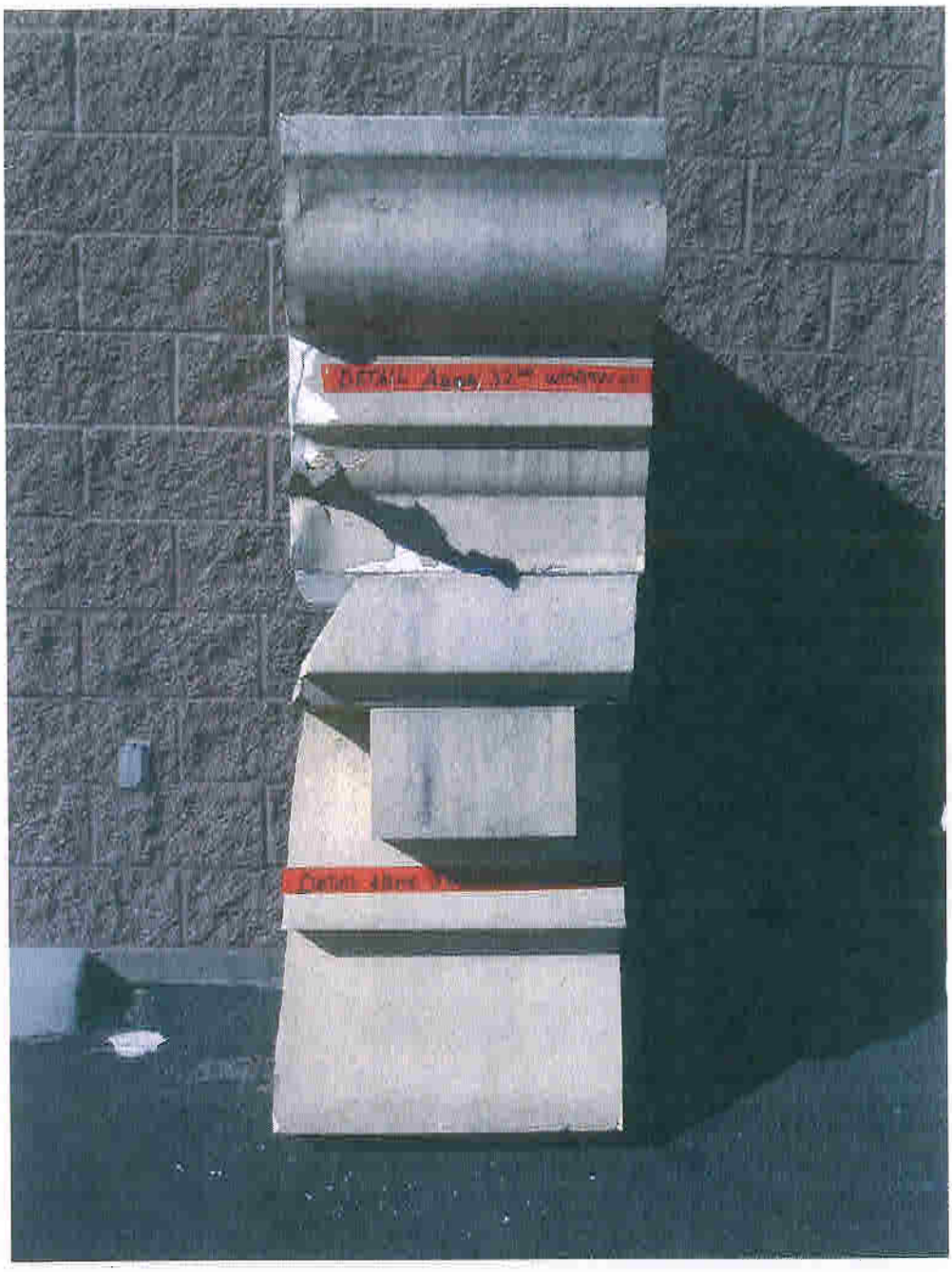

Figure 7—Sample 2 – front view

Figure 8—Sample 2 – side view

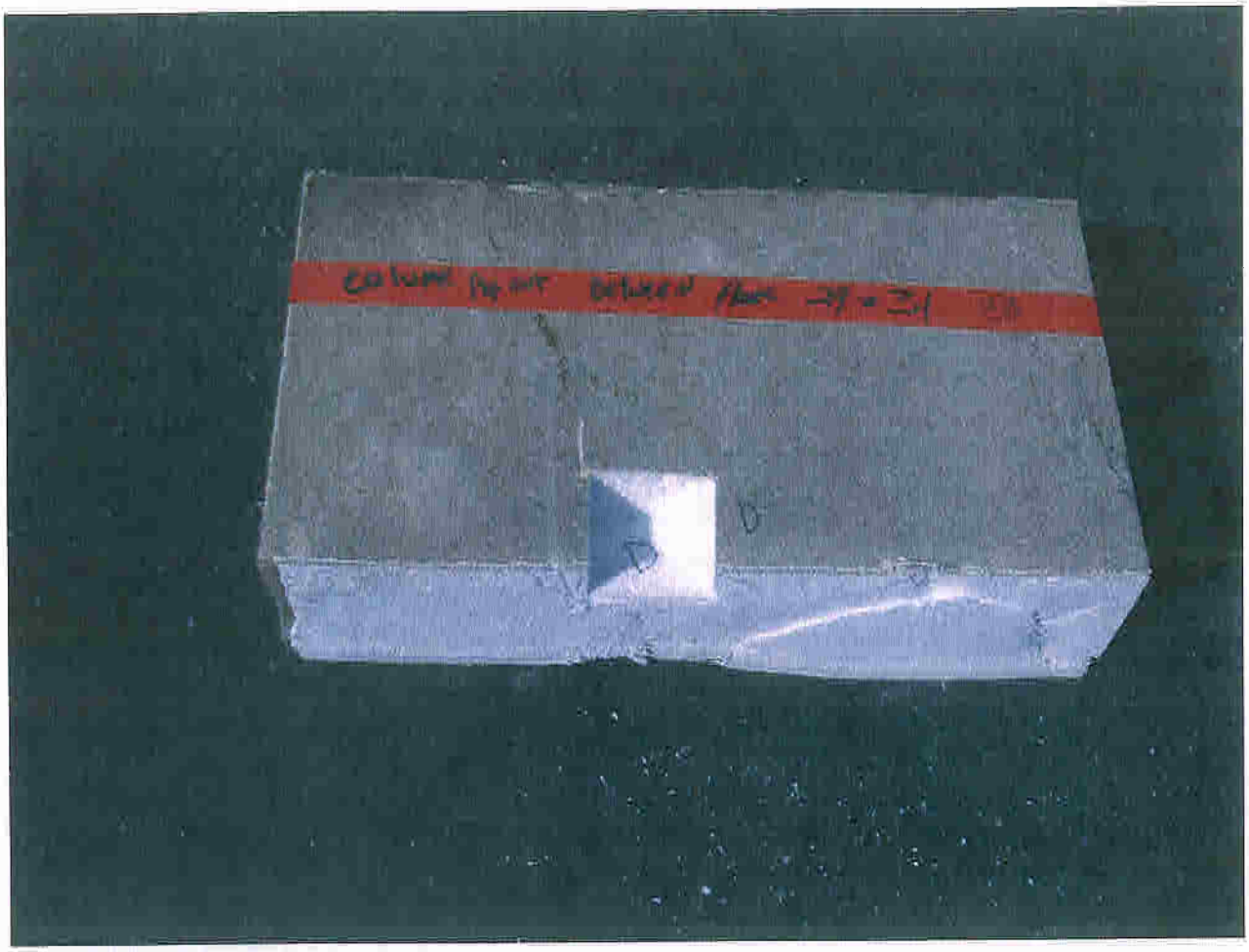

Figure 9—Sample 3 – front view

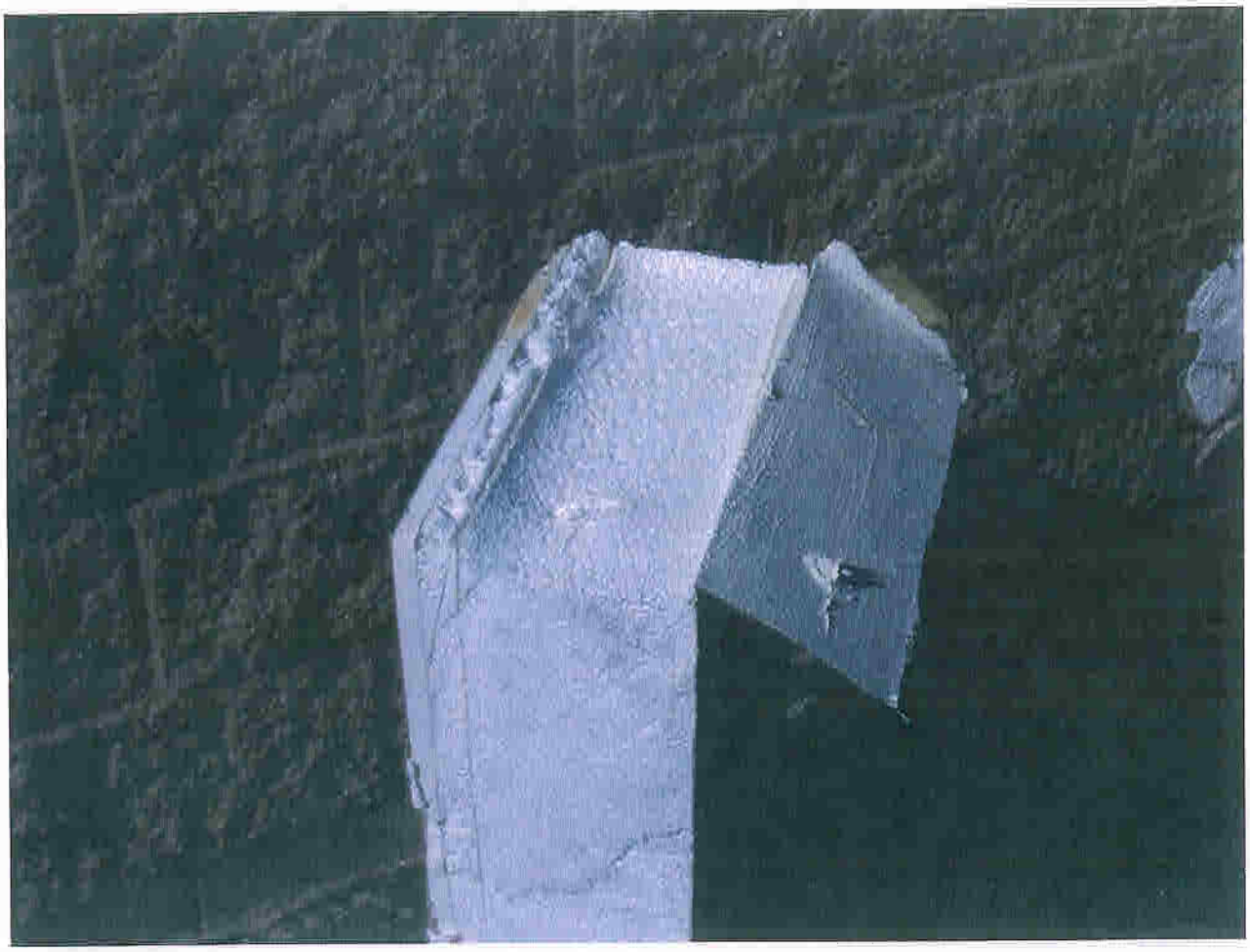

Figure 10—Sample 3 – side view

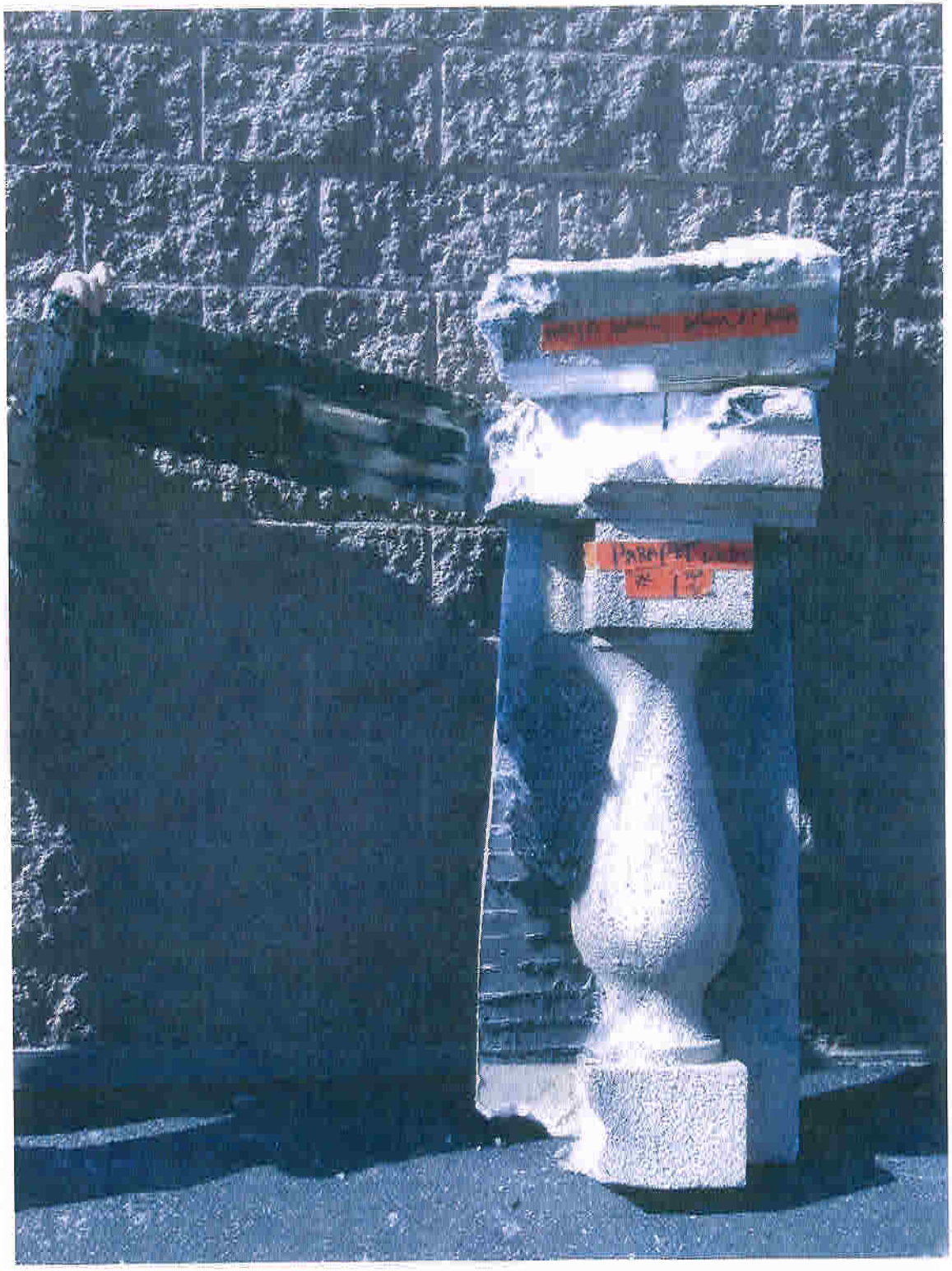

Figure 11—Sample 4 – front view

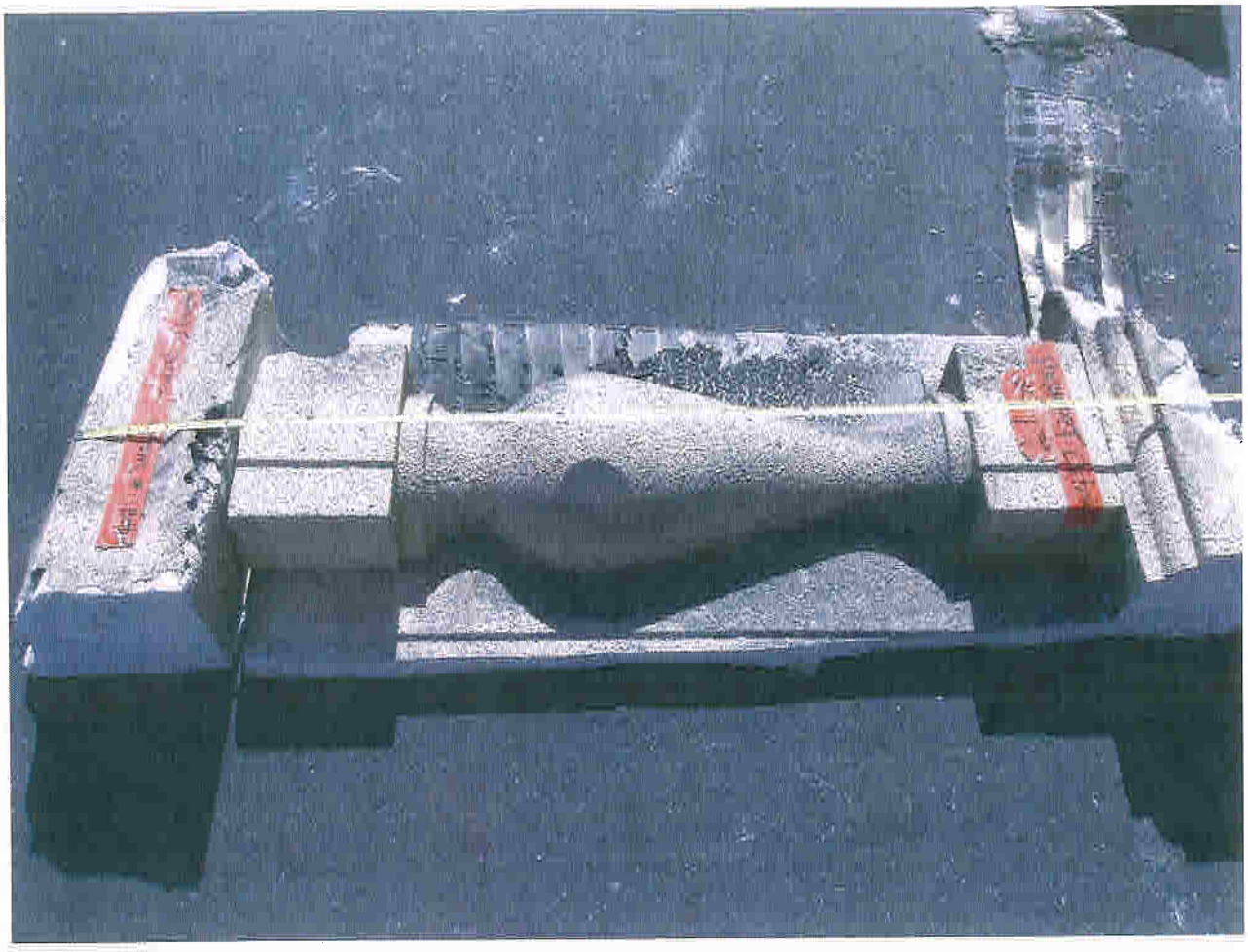

Figure 12—Sample 4 – side view

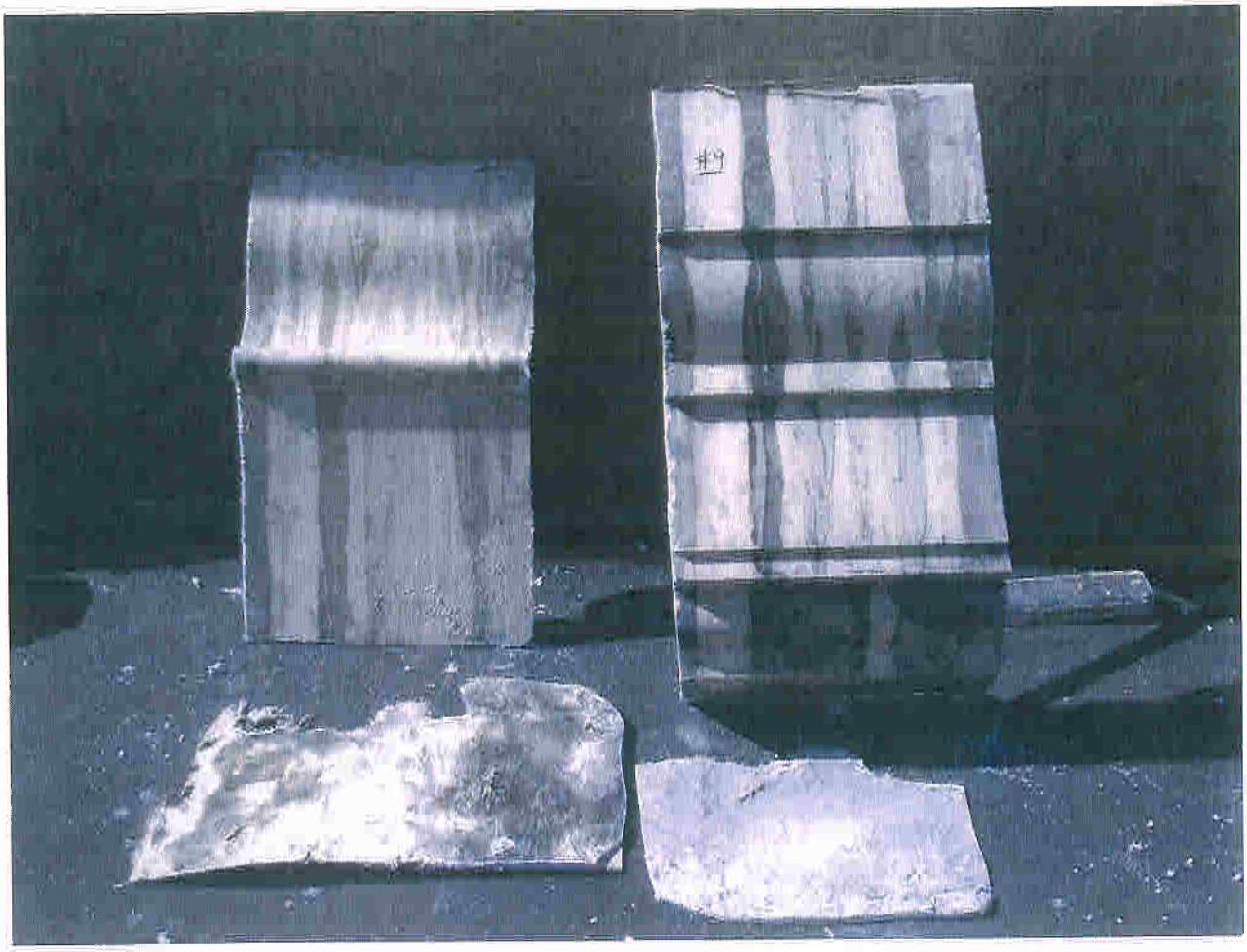

Figure 13—Sample 9 – front view

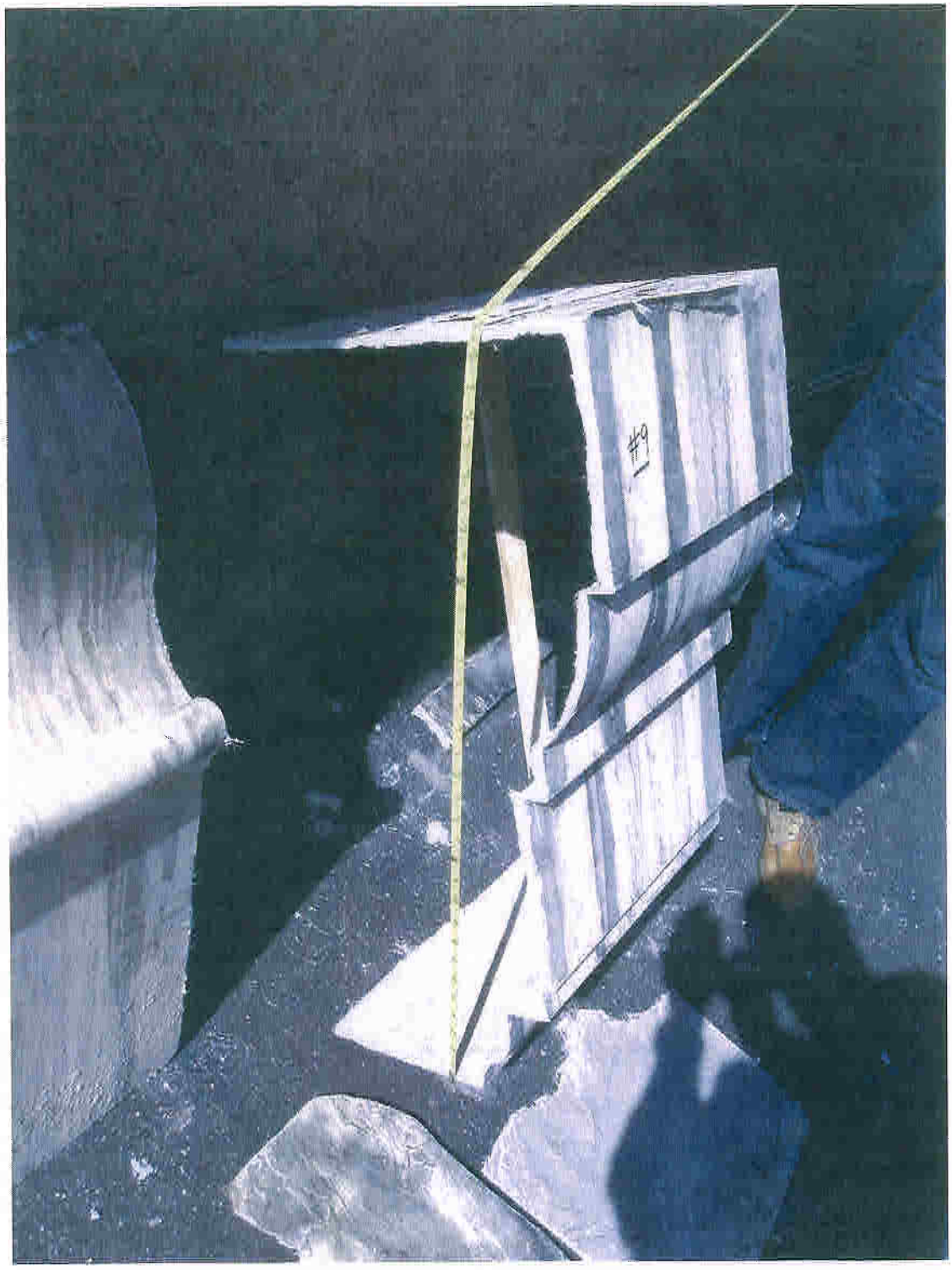

Figure 14—Sample 9 – side view

Figure 15—Early stage of the fire (*photo credit to FOX News*)

Figure 16—Latter stage of fire (*photo credit to FOX News*)

APPENDIX A – 1993 EDITION OF AC24

ICBO Evaluation Service, Inc.
A subsidiary corporation of the International Conference of Building Officials
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ACCEPTANCE CRITERIA FOR EXTERIOR INSULATION AND FINISH SYSTEMS

January, 1993
AC24

PREFACE

Evaluation reports issued by the ICBO Evaluation Service, Inc. (ICBO ES), are based upon performance features of the Uniform Building Code,™ Uniform Mechanical Code, Uniform Plumbing Code and related codes. Section 105 of the Uniform Building Code is the primary charging section upon which evaluation reports are issued Section 105 reads as follows:

> The provisions of this code are not intended to prevent the use of any material or method of construction not specifically prescribed by this code, provided any alternate has been approved and its use authorized by the building official
>
> The building official may approve any such alternate, provided he finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.
>
> The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency

The attached acceptance criteria for the general code sections noted have been issued to provide all interested parties with guidelines on implementing performance features of the codes The attached acceptance criteria were developed and adopted following public hearings conducted by the Evaluation Committee. These criteria may be revised from time to time as the need dictates.

ICBO ES may consider alternate criteria, provided the proponent submits valid data demonstrating that the alternate criteria are at least equivalent to the attached criteria and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a material, type or method of construction, or equipment, meets the attached acceptance criteria, or it can be demonstrated that valid alternate criteria are equivalent and otherwise meet the applicable performance requirements of the codes, if the material, product, system or equipment is such that either unusual care with its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use thereof, ICBO ES retains the right to refuse to issue or renew an evaluation report

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International Conference of Building Officials

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ACCEPTANCE CRITERIA FOR EXTERIOR INSULATION AND FINISH SYSTEMS

I. SCOPE

The purpose of this document is to specify the conditions under which an exterior insulation finish system (EIFS) can be recognized in an ICBO ES evaluation report under the 1991 Uniform Building Code hereinafter identified as "the code." Equivalent systems can be considered with proper justification. As a minimum, the equivalent system must include the exterior coating, insulation, nonmetallic reinforcement and be basically confined to the exterior wall surface.

II. DEFINITIONS

A. An EIFS under this criteria is defined as a nonbearing exterior wall cladding system, applied to a solid substrate or framing. It includes a fastening system insulation board, base coat, nonmetallic reinforcing fabric and a finish coat. The system may also include primers, sealers, and accessories such as trim, corner beads, stops, metal lath, etc.

B. Fastening system is the method used to attach the insulation board to the substrate or framing. It may be an adhesive, mechanical fastener or a combination thereof. For combination systems, either the mechanical or adhesive portion itself must be capable of resisting required forces when justification is other than full-scale structural performance tests. See Section IV-E.

C. The proponent is the applicant for an evaluation report concerning an EIFS.

III. MATERIAL SPECIFICATIONS

A. **Adhesive Components:** 1. **Field blended.** a. **Cement.** Type and description must comply with U.B.C. Standard No. 25-1.

b. **Sand.** Must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter. Sampling and testing must comply with ASTM C 897. Limits for grading sand must be specified when added in the field.

c. **Admixtures.** Description and purpose is needed for each product.

2. **Factory-blended.** A description of the factory-blended materials is needed.

B. **Base Coat:** 1. **Field blended** a. **Cement.** Type and description must comply with U.B.C. Standard No. 26-1.

b. **Sand.** Must be clean and free from deleterious amounts of loam, clay, slit, soluble salts and organic matter. Sampling and testing must comply with the ASTM C 897. Limits for grading sand must be specified when added in the field.

c. **Admixtures.** Description and purpose is needed for each product.

2. **Factory-blended.** Specific description is needed.

C. **Finish Coat.** Specific description is needed, including any field mixing instructions.

D. **Nonmetallic Reinforcing Fabric.** Description must include type, weight, thread count, strength, weave, treatments for compatibility with coating, etc.

E. **Substrates.** The EIFS must be applied to rigid, solid substrates such as concrete, concrete masonry, Exterior or Exposure 1 wood-based panel sheathings, water-resistant core gypsum sheathing complying with ASTM C 79 or equivalent material. In lieu of substrates, the EIFS may be applied to framing with an approved fastening system and weather-resistive barrier complying with Section 1708 (a) of the code.

F. **Foam Plastic Insulation.** Description of insulation, including type, density, flame spread, smoke density, conditioning requirements, dimensional tolerances, flexural strength, maximum water absorption and other requirements to show compliance with Section 1713 of the code, ICBO ES Acceptance Criteria for Foam Plastics and special requirements unique to the EIFS. When used on walls required to be of noncombustible construction, the foam plastic must be identified in accordance with Section 1713 (e) 2 B (vi) of the code.

G. **Other Insulation Boards.** Applicable U.B.C. standard or if not available, are recognized national standard with the concurrence of ICBO ES.

H. **Fastening Systems:** 1. Mechanical fasteners must be specifically described including type, shank diameter length, head diameter and corrosion-resistance treatment.

2. Adhesives for attachment of insulation to framing members must be qualified under the Acceptance Criteria for Sandwich Panel Adhesives.

I. Expansion joints, weep screeds, corner reinforcement, trim, etc., must be specifically described, including any corrosion-resistance treatment.

J. **Primers—Adhesion intermediaries.** Specific description is necessary including type, use, specification and location.

K. **Surface Sealers.** Specific description is necessary, including type, use, specification and limitations.

L. Labelling for field identification must include the following:

1. Name and address of manufacturer and appropriate evaluation report number.
2. Identification of components.
3. Lot or batch number.
4. Quantity of material in packaged mix.
5. Storage instructions.
6. Specific mixing instructions.
7. Curing instructions.
8. Expiration date (when applicable).

IV. ACCESSORIES

A. **Joint Sealants.** Sealant materials must comply with ASTM C 920, and be compatible with the proponent's EIFS. An installation card, completed by the sealant installer in the format shown in Exhibit B, must be presented to the building official with the EIFS contractor declaration at the completion of each project. The sealant declaration states that the sealant installation conforms with the EIFS evaluation report and sealant manufacturer's installation methods and procedures.

B. **Trim.** Expansion joints, weep screeds, corner reinforcement and similar items when required by the proponent, shall be installed in accordance with the proponent's recommendations and as specified by the project designer. Trim shall be described as to type of material, dimensions, thickness, corrosion-resistance treatment, generic plastic, etc.

V. EXTERIOR WALL CONSTRUCTION

A. An EIFS can be recognized for application to walls required to be of noncombustible construction based on Section 1713 (e) 2 B (vi) of the code.

B. **Durability.** Testing is required as follows:

1. Accelerated weathering tests as set forth in Section VI-C.
2. Freeze-thaw tests as set forth in Section VI-D.
3. Salt-spray-resistance tests-ASTM B 117.
4. Water-resistance tests as set forth in Section VI-H.

C. The need for expansion and control joints and locations, must be determined and specified by the architect, designer, builder, or exterior coating manufacturer, in that order. All expansion and control joint materials must be corrosion resistant. If used, expansion and control joints must be a part of test specimens for durability and structural tests.

When the EIFS is placed over wood-frame construction, control joints are required at each floor level.

D. An EIFS is a nonbearing system.

E. **Structural Considerations.** Structural tests are required to determine allowable positive and negative wind pressures that may be imposed on the EIFS.

I. EIFS test specimens must be based on minimum conditions of installation. This includes material thickness, density, connections etc. See Section VIE.

2 Maximum allowable deflection of structural wall components must be specified and limited to a maximum 1/180 of span except where more restrictive requirements prevail

3. Lateral-resistance tests of mechanical connections (nails, screws, etc) are required, if connectors support heavy exterior wall coatings through foam plastic or other nonstructural insulations more than $1^1/_2$ inches thick Where standard specifications on minimum structural qualities of materials involved are available, calculations may be substituted for tests

F. **Weather-resistive Consideration.** Weather-resistive barrier complying with Section 1708 (a) of the code is required except where recognition has been granted without the paper barrier on solid substrates This requires durability tests under Section V-B and water-penetration tests as set forth in Section VI-G of this criteria When the EIFS is installed over wood-based panel sheathings the EIFS manufacturer must state, in writing, that the system with wood-based panel sheathing provides equivalent water resistance to that specified in Section 2516 (g) 3 of the Uniform Building Code.

G. Plans, details, specifications, etc., concerning proper installation of the EIFS that are applicable to the specific building under consideration must be a part of plans submitted to the building official for approval.

H Off-site fabrication of EIFS must be done in the shop of an approved fabricator under special inspection in conformance with Section 306 of the code.

I. Recommended installation details of the EIFS at typical areas of terminations such as parapets, wall openings, intersection with other materials, expansion and control joints, foundations, projections, wood-based panel sheathings, etc., are necessary Details must be of camera-ready quality for inclusion in evaluation reports and must be consistent with recommended application instructions See Section VII-A.

J. **Impact Resistance.** EIFS locations requiring supplementary impact resistance must be specified and detailed on approved building plans The type of nonmetallic reinforcing fabric, overall base coat thickness, and/or number of applications to achieve the necessary impact resistance shall be recommended by the proponent

K. EIFS systems shall be separated from the interior of the building with a thermal barrier having a minimum index of 15, unless specific recognition is granted based on Section 1713 (d) or (f) of the code

L Vertical joints of insulation boards shall be staggered from edges of wall openings

VI. TESTING

A All tests must be conducted by a recognized independent testing agency As an alternate, tests may be conducted by the proponent, provided a qualified independent consultant, specifically recognized by ICBO Evaluation Service, Inc (ICBO ES), can certify that preparation of test specimens, testing and reporting of test results comply with procedures specified ICBO ES

B. Test reports must include the following:

1. Preparation of test specimens and complete information, on the exterior coating type, density, mixing, application, curing, etc.

2 Description of test procedures

3 Test observations, including description of panels after completion of tests.

4 Statement on passing or failing where applicable

5 Photographic record of tests where applicable

6 Small sample of product

C. **Accelerated Weathering Test (Weatherometer):** 1 Five samples prepared as for freeze-thaw test (Section VI-D) except that size shall be as necessary to fit the chamber. The back of the sample shall be sealed with an appropriate impervious seal

2 ASTM Designation G23-81 "Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials" must be used Model D or DH with the operating schedule set forth under method 1, Section 5 of the referenced ASTM procedure must be used.

3. The test shall be for 2000 hours.

4. Failure is defined as surface changes as viewed by minimum

5 X magnification which reveals cracking, checking, crazing, erosion or other characteristics that might affect performance as a wall cladding.

D. **Freeze-thaw Tests:** 1 Five 6-inch-square samples are prepared with the exterior coating applied to the substrate on the front face and edges The back of the sample must be sealed with a material that need not be the coating Specimens must contain typical accessories in both the coatings and insulation representative of those used in construction See Section V-C.

2 Samples are subjected to 10 freeze-thaw cycles. Each cycle consists of air drying at 120°F. temperature for a minimum of eight hours, total immersion in water at 70°F to 80°F. for eight hours and then exposure to -20°F. for 16 hours

3 Failure is defined as surface changes as viewed by minimum 5 X magnification, which reveals cracking, checking, crazing, erosion or other characteristics that may affect performance as a wall cladding. Delamination or indications of same between components is also defined as failure

E. **Structural Performance Tests:** 1. Testing shall be in accordance with ASTM E 330-84, Procedure B. At least three positive and three negative load tests must be conducted on three specimens with the coating, insulation board and sheathing prepared and installed in accordance with the proponent's published instructions Specimen preparation must be done with verification by the testing agency or its authorized representative. Specimens shall be a minimum 4 feet by 8 feet and include vertical-control joints, scored joints or other architectural features located midway between the stud framing, if these features are to be recognized in the evaluation report. Application of load to ultimate shall be in at least six increments with a 10 second load duration for each increment

2. Specimens shall be mounted in accordance with ASTM E 330-84 Framing supporting the panel must be located at the maximum spacing on which recognition is desired In most instances, this will result in triple 16-inch spans or double 24-inch spans. The ICBO ES staff must be contacted in the event that spans vary from those required herein. For mechanically fastened systems, connections to framing members shall be based on minimum conditions since test specimens establish the basis of acceptance. This includes the steel where metal framing is involved.

3. In addition to data specified in Section VI-B, load-deflection readings at midpoint of panel must be reported

4 Conditions of acceptance will be based on the following:

a. Allowable loading will be based on a factor of safety of 3 applied to the ultimate load, if all of the following are satisfied:

(i) No single test result varies by more than 15 percent from the average of three tests Variations exceeding this limit will result in larger safety factors

(ii) Allowable load does not exceed established values for mechanical connectors such as nails, screws and staples.

b. Other factors of safety can be considered based on unique conditions of installation or the material used.

5. To qualify the adequacy of fasteners in concrete or masonry substrates, a tension-load test program consisting of fastener withdrawal from the wall of each building must be provided. The testing must be conducted by an independent testing laboratory. The average withdrawal strength, in pounds, must be six times the design wind pressure for the location in question

A minimum of five tests per program are required, with results varying no more than 15 percent from the average A minimum of 10 tests per program may be provided regardless of variation from the average

For masonry substrates, 40 percent of the tests must be run in masonry joints

A certificate of compliance concerning test results relating to load requirements in the evaluation report must be submitted to and approved by the building official prior to installation of EIFS fasteners.

6 Results of tests conducted over gypsum sheathing as specified in Section VI E 1 to 4 can be extended to EIFS adhered to wood-based sheathing under the following conditions:

a) The EIFS is *adhered* to all sheathing in question, i e , plywood, particleboard, waferboard and oriented strand board

b) Tensile bond tests are conducted according to ASTM C 297.

c) Tensile bond test results average 15 psi minimum.

F **Fire Tests** 1. **U.B.C. Standard No. 43-1 (ASTM E 119-83).** Optional recognition for fire-resistive construction In this regard, the application of the EIFS to a recognized noncombustible fire-resistive assembly negates the recognition unless tested in accordance with the specified standard or equivalent evidence is provided.

2. **U.B.C. Standard No. 17-6.** Optional recognition of EIFS for application to walls required to be of noncombustible construction. Other related requirements are addressed in Section 1713 (e) 2 B of the code.

3. **U.B.C. Standard No. 42-1 (ASTM E 84-84).** Optional recognition for EIFS as an interior finish, provided thermal-barrier requirements for foam insulation are resolved in accordance with Section 1713 of the code. For recognition on noncombustible construction, the system components must be tested separately in accordance with Section 1713 (e) 2 B (iv) of the code

G **Water Penetration Test.** Three samples installed over each panel sheathing substrate to be recognized, each a minimum of 2 feet by 4 feet in size shall be tested in accordance with ASTM E 331 A 2.86 psf air pressure differential is required across the test specimens for 15 minutes duration Conditions of acceptance are:

1. Specimens with insulation fully adhered to substrate: No water penetration on plane of substrate face, i.e , face of test specimen not exposed to test

2. Specimens with insulation mechanically fastened to substrate: No water penetration on plane of innermost face of substrate The substrate must be removed after the test to make this determination.

H. **Water-resistance Tests.** Testing must comply with ASTM D 2247. Three samples, a minimum of 4 inches by 6 inches in size, must be used. Periodic inspections must be conducted. Testing may be concluded after 14 days or after effects from exposure to water are observed. Condition of acceptance is the absence of deleterious effects from water.

I **Salt-spray Resistance:** Testing must comply with ASTM B 117. Three samples 4 inch by 6 inch by the minimum thickness of the EIFS, are mounted to minimum $1/2$-inch-thick gypsum wallboard and cured in accordance with the manufacturer's instructions The testing period is 300 hours. Condition of acceptance is the absence of deleterious effects from salt spray.

VII. APPLICATION

Application instructions bearing the date of publication must be submitted. Instructions must include the following:

A Illustrated details with the following as a minimum:

1 Flashing and/or sealing around heads, sills and jambs of windows and doors and the top of exposed walls.

2. Closures and flashing at other terminations such as eaves, sills and other exterior wall coverings

3. Typical conditions within the field of the wall covering, showing substrates, control joints, etc.

4 Parapet at top and termination on backside

5 Flashing and/or sealing at wall penetrations.

6. Provisions to prevent retention of free water behind all portions of the EIFS over substrates susceptible to moisture.

7. Installation over wood-based panel sheathing.

8. Other details deemed necessary as conditions of an evaluation report

B. Information on any variation of field-mixed components See Section III-A-C.

C Curing instructions.

D Limitations such as angle of installation, interior locations, etc , must be specified. Architectural treatments which can reduce resistance to water penetration are prohibited.

VIII. QUALITY CONTROL

A. All foam plastic boards must be listed and labelled as set forth in Section 1713 of the code. Compliance is based on a current applicable evaluation report issued by the ICBO ES or National Evaluation Service. The quality control procedures must also include special requirements of the EIFS such as conditioning, dimensional tolerances, strength, etc See Section III-F.

B **Field Inspections and Reporting.** 1. Installation must be by a contractor recognized by the proponent as being qualified to perform such installations. A list containing the names and addresses of recognized contractors must be maintained by the proponent and be available to the building official or ICBO ES upon request.

2. An installation card with format as shown in Exhibit A must be completed by the EIFS contractor and presented to the building official with the sealant installer declaration at the completion of each project.

3 Adhesive application, with or without mechanical fasteners, of the insulation board to framing members must be with special inspection under Section 306 of the code.

- EXHIBIT A -

(EIFS CONTRACTOR NAME)

Completion Date:_____

THE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Adhesive(s) _____
Fasteners (mech) _____
Base Coat_____
Reinforcing Fabric_____
Finish Coat(s) _____

	INSTALLATION	CONFORMS
A.	Substrate Type and Tolerance	_____
B.	EIFS	
	1. Adhesive and/or Fasteners	_____
	2. Insulation	_____
	3. Reinforcing Fabric	_____
	4. Base Coat	_____
	5. Finish	_____

C. The information entered above is offered in testimony that the EIFS installation conforms with the EIFS manufacturer's installation methods and procedures, and the EIFS manufacturer's ES report.

NOTE: An installation card shall be received from the Sealant Installer indicating that the sealant installation conforms with the EIFS evaluation report and sealant manufacturer's installation methods and procedures must accompany this declaration.

EIFS Contractor Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (___)_____

cc: Original: Building Department (Must be submitted with sealant
Copy: EIFS Manufacturer installer declaration.)

5

APPENDIX B – STO CORP. EVALUATION REPORTS

ICBO Evaluation Service, Inc.
A subsidiary corporation of the International Conference of Building Officials

EVALUATION REPORT

Report No. 3906
November, 1993

Filing Category: EXTERIOR COATINGS (060)

STO EXTERIOR WALL FINISH AND INSULATION SYSTEM

STO INDUSTRIES,
A DIVISION OF STO CORPORATION
6175 RIVERSIDE DRIVE, S.W.
ATLANTA, GEORGIA 30331

I. **Subject:** STO Exterior Wall Finish and Insulation System.

II. **Description:** A. **General:** The exterior wall finish and insulation system is a six-component system that may be applied to vertical substrates of masonry, concrete, exterior plaster, water-resistant core gypsum sheathing, Dens-Glass Gold™ or Dens-Glass Gold Firestop Type X over steel framing. The system is also applied to vertical wood framing over substrates of sound, unpainted, exterior grade plywood or Exposure 1 grade oriented strand board. The system components are an adhesive, rigid expanded polystyrene, ground coat, a woven fiberglass fabric, primer and a synthetic plaster finish. Dens-Glass Gold and Dens-Glass Gold Firestop Type X are manufactured by Georgia-Pacific Corporation and recognized in Evaluation Report No. 4305.

B. **Materials:** 1. **Adhesives:** STO Dispersion Adhesive is a ready-mixed copolymer packaged in 50-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F. STO Dispersion Adhesive is used on water-resistant core-treated gypsum sheathing, Dens-Glass Gold, Dens-Glass Gold Firestop Type X and exterior grade wood-based sheathing other than fiberboard.

STO BTS-B is a polymer-based adhesive in 60-pound bags that is field mixed with 7 to 9 quarts of clean water per bag. STO BTS-B has a one-year shelf life when stored off the ground in a dry area and protected from moisture. STO BTS-B is used on masonry, concrete, exterior plaster, water-resistant core gypsum sheathing, Dens-Glass Gold and Dens-Glass Gold Firestop Type X.

2. **Insulation Board:** STO insulation board is a rigid expanded polystyrene insulation board with an average density of 1 pound per cubic foot, Class I flame-spread rating and a smoke-density rating of 450, maximum. The board is 24 inches wide and 48 inches long, maximum, with a $^3/_4$ inch to 4 inch thickness.

Rigid expanded polystyrene board identified as WSG board produced by AFM Corporation (Evaluation Report No. 4169) as described for the STO insulation board is an alternate to the STO insulation board.

3. **Base Coat:** Base coat is either STO RFP which is a ready-mix synthetic-resin compound or STO BTS-B field mixed with water as described in Section II B 1. STO RFP is packaged in 65-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F.

4. **Reinforcing Fabric:** STO mesh is a reinforcing fabric with symmetrical interlaced glass fiber made from twisted multiend strands and treated for compatibility with the other materials. The mesh weighs approximately 4.8 ounces per square yard with a 6 by 6 thread count per inch width. It has a minimum 169 and 191 pounds per inch width tensile strength for the warp and weft directions, respectively. When protected from moisture, STO mesh has a one-year shelf life.

5. **Primer Coat:** STO primer is a latex-based primer used as an adhesion intermediary between the STO BTS-B base coat and finish coat. STO primer is packaged in 60-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F.

6. **Plaster Finish:** Plaster finish is STOLIT finish which is a premixed acrylic-based textured wall coating of hardened air-cured material made with marble particles of a graded size. STOLIT is packaged in 60-pound pails with a one-year shelf life when protected from freezing and extreme heat.

C. **Application:** 1. **General:** All substrates are limited to planar irregularities not exceeding $^1/_4$ inch. They must be structurally sound, clean, dry and smooth with all dust and deleterious materials removed. All materials are installed by applicators certified by STO. Typical installation details are in Figure No. 2.

2. **Masonry, Concrete or Exterior Plaster Substrates:** Sixty pounds of STO BTS-B field mixed with 7 to 9 quarts of clean water is applied to the entire back surface of the insulation board with a STO $^5/_8$-inch stainless steel notched trowel. Before the adhesive has dried, the board is applied to the wall with firm pressure over the entire surface to ensure uniform contact.

All joints are tightly butted and vertical joints staggered. Areas where the board joins other material or where it terminates are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76.

3. **Steel Studs:** Minimum $^1/_2$-inch-thick water-resistant core gypsum sheathing complying with ASTM C 79-82a, minimum $^1/_2$-inch-thick Dens-Glass Gold or minimum $^5/_8$-inch-thick Dens-Glass Gold Firestop Type X are applied in accordance with the code as water-resistant core gypsum sheathing to minimum No. 18 gauge (0.0478-inch base metal thickness) steel studs spaced 16 inches on center, maximum. STO Dispersion Adhesive is then applied to the entire back surface of the insulation board with a STO $^3/_{16}$-inch stainless steel notched trowel. As an alternate adhesive, STO BTS-B is applied to the back of the insulation board with a STO $^1/_2$-inch-notched stainless steel trowel. Before the adhesive has dried, the board is applied to the sheathing with firm pressure over the entire surface to ensure uniform contact. All joints are tightly butted and vertical joints staggered. Board joints with other material and board terminations are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76.

4. **Wood Studs:** Exterior grade plywood complying with the code shall be attached to wood studs spaced 16 inches on center, maximum, in accordance with the requirements of the code for plywood wall sheathing. As an alternative, Exposure 1 grade oriented strand board recognized in a current ICBO ES or NES evaluation report is attached in accordance with the evaluation report to wood studs spaced 16 inches on center, maximum. STO Dispersion Adhesive is applied to the entire back surface of the insulation board with a STO $^3/_{16}$-inch stainless steel notched trowel. Before the adhesive has dried, the board is applied to the sheathing with firm pressure over the entire surface to ensure uniform contact. All joints are tightly butted and vertical joints staggered. Board joints with other

material and board terminations are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76. Horizontal control joints are required at each floor level in wood-frame construction. The joints must be installed as specified by the architect, designer, builder or exterior coating manufacturer, in that order

5 **Coatings:** Prior to application of coatings, the entire surface of the installed insulation board is leveled with a rasping board or power rasper. A base coat of either STO RFP or STO BTS-B is applied with a stainless steel trowel to the entire board surface to a uniform thickness of approximately $^1/_{16}$ inch The glass-fiber mesh is immediately placed against the wet base coat and troweled from center to edge The mesh is continuous around corners and lapped at least $2^1/_2$ inches along edges Wrinkles must be avoided and the mesh fully embedded and covered. The base coat is allowed to dry for 24 hours.

When STO BTS-B is used, STO primer is applied as an adhesive intermediary. The primer may be diluted with up to 10 percent clean water by weight before application with a roller. STO primer is dried for approximately two hours prior to application of selected STO finish material

After the STO RFP base coat or STO primer has dried, the factory-prepared STOLIT plaster finish material is thoroughly mixed with a high-speed mixer until a uniform workable consistency is obtained. Small amounts of clean water may be added for workability. STOLIT plaster finish is then applied directly to the STO RFP or the STO primer coat, using a clean stainless steel trowel. The final texture is achieved with a plastic or stainless steel trowel. The finish coat thickness is no greater than the diameter of the largest aggregate, approximately $^1/_{16}$ inch

D. **Wind Design:** 1. **General:** Allowable transverse wind pressures for systems installed in accordance with this report are set forth in this section

Adequacy of the steel framing or concrete/masonry/exterior plaster wall must also be considered Maximum allowable deflection of structural wall components is 1/240 of span.

2. **Steel Studs:** a. Where the system is applied to $^1/_2$-inch-thick water-resistant core gypsum sheathing or $^1/_2$-inch-thick Dens-Glass Gold fastened to minimum No. 18 gauge steel studs spaced a maximum of 16 inches on center with No 6 self-drilling corrosion-resistant steel bugle-head drywall screws, allowable positive and negative wind loads are 36 and 20 psf, respectively The screws are installed at 6 inches on center, maximum, along the sheathing perimeters and 8 inches on center, maximum, in the field of the sheathing

b Where the system is applied to $^5/_8$-inch-thick Dens-Glass Gold Firestop Type X sheathing fastened to minimum No 16 gauge steel studs spaced a maximum of 16 inches on center with No. S-12 buglehead drywall screws spaced up to 6 inches on center, allowable positive and negative wind loads are 54 psf. Horizontal blocking spaced 4 feet on center shall be installed in each stud space

3. **Wood Studs:** Where the system is installed in accordance with Section II C 4 of this report, allowable positive and negative wind loads are 36 and 20 psf, respectively.

4 **Concrete, Masonry or Exterior Plaster:** Allowable positive and negative wind pressure for the system adhesively applied to concrete, masonry and exterior plaster substrates as described in Section II C 2 is 54 psf

E. **Special Recognition:** The following STO Exterior Wall Finish and Insulation System may be used where noncombustible construction is required:

1. **Interior Finish:** One layer of $^1/_2$-inch-thick Type X gypsum wallboard complying with ASTM C 36-76a applied to steel studs with No 6 by $1^1/_4$-inch-long buglehead drywall screws spaced at 6 inches on center, maximum

2. **Steel Studs:** No. 18 gauge (0.478-inch base metal thickness), $3^5/_8$-inch-deep steel studs spaced at a maximum of 16 inches on center

3 **Stud Cavity:** Unfaced R-11 fiberglass insulation

4 **Exterior Finish:** One layer of $^5/_8$-inch Type X, water-resistant core gypsum sheathing complying with ASTM C 79-82a applied to steel studs with No 6 by $1^1/_4$-inch-long buglehead drywall screws spaced 6 inches on center, maximum. STO Dispersion Adhesive is then applied to the entire surface of the insulation board with a stainless steel notched trowel. Before the adhesive has dried, the board is applied to the wall with firm pressure over the entire surface to ensure uniform contact All joints are tightly butted and vertical joints staggered. Application of the STO RFP base coat, glass-fiber mesh and STOLIT finish are the same as described in Section II C 4 See Figure No. 3 for detail at head of wall openings.

F. **One-hour Fire-rated Nonbearing Wall Assembly:** 1 **Interior Face:** One layer of full height $^5/_8$-inch-thick Type X gypsum wallboard is applied parallel to the interior face of steel studs spaced 16 inches on center, maximum. The steel studs are No. 18 gauge and have a depth of $3^5/_8$ inches. The wallboard is attached with No 6 by $1^1/_4$-inch-long drywall screws spaced 8 inches on center at board perimeter and 12 inches on center in the field Wallboard joints must be taped and along with fastener heads, treated with joint compound

2. **Exterior Face:** One layer of full height $^5/_8$-inch-thick Type X, water-resistant core gypsum sheathing complying with ASTM C 79-82a is applied parallel to studs The gypsum sheathing is attached as described for the gypsum wallboard attached to the interior face STO Dispersion Adhesive is applied to the back of 4-inch-thick STO insulation board and the board applied to the wall. Application of the STO RFP base coat, glass-fiber mesh and STOLIT finish are the same as described in Section II C 4

G **Repair:** Areas are to be cut out and patched with the same materials and techniques used in the original application.

H. **Identification:** Containers of adhesives, base coats, reinforcing mesh, primer and finish coat bear a label noting the manufacturer's name, address, product name, evaluation report number, production date, batch number, quantity of material and storage, mixing and curing instructions

STO insulation boards are identified by a label on the edge of each insulation board and both faces of one board in every bag bearing the company name (STO), plant identification number, evaluation report number and the name of the quality control agency (RADCO NERQA-204) as noted in Figure No 1

The WSG Insulation board is identified in accordance with ICBO ES Evaluation Report No. 4169 In addition, when used on walls required to be of noncombustible construction, each board is labeled on one edge, and both faces of one board from every package bears the following additional information:

1. Inspection agency name (Underwriters Laboratories Inc NERQA-403).

2 Product name (STO) and Evaluation Report No 3906

3 Insulation manufacturer (AFM Corporation) and Evaluation Report No 4169

III. **Evidence Submitted:** Data in accordance with the ICBO ES Acceptance Criteria for Exterior Insulation and Finish Systems, dated January, 1993

Findings

IV. Findings: That the STO Exterior Wall Finish and Insulation System described in this report complies with the 1991 Uniform Building Code and 1992 Supplement, subject to the following conditions:

1. **Construction is as set forth in this report and manufacturer's instructions.**
2. **The insulation board is separated from the building interior with a thermal barrier complying with Section 1713 (d) of the code.**
3. **The system may be installed on walls of nonrated noncombustible construction, provided the exterior wall and insulation finish system are installed as described in Section II E of this report.**
4. **The system may be installed on nonbearing one-hour fire-rated walls of noncombustible construction, provided the exterior wall and finish system is installed as described in Sections II E and II F of this report.**
5. **Installation is by applicators approved by STO Industries, A Division of STO Corporation. An installation card, represented in**

Figure No. 4, must be completed at the end of each project and filed with the building official.

A sealant application card represented in Figure No. 5, must be filed with the building official after sealant application.

6. The system may be attached to the surface of an exterior combustible fire-resistive assembly without affecting the rating.

7. The insulation board is labeled in accordance with this report and manufactured under a quality control program with inspections by the proper quality control agency noted in Section II H of this report.

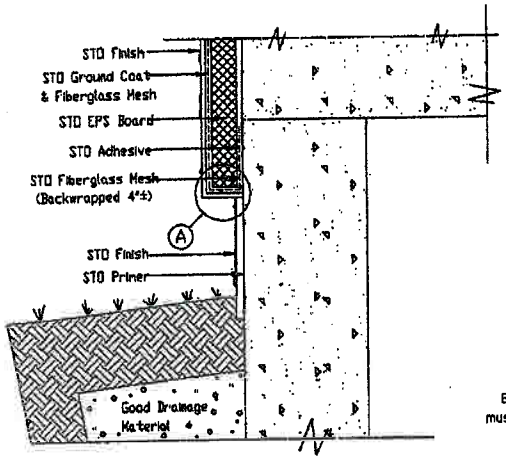
This report is subject to re-examination in one year.

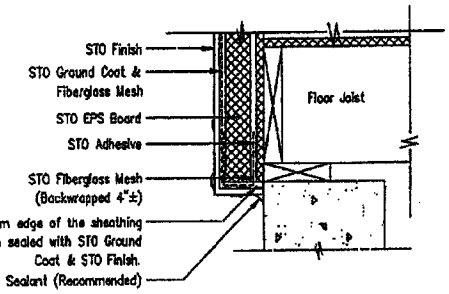
LISTING NO.

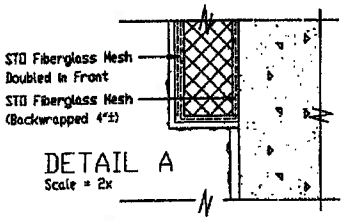
STO (xxxx-xx) ICBO ES ER# 3906 AND 3617 RADCO (NER-QA204)

PLANT I.D.

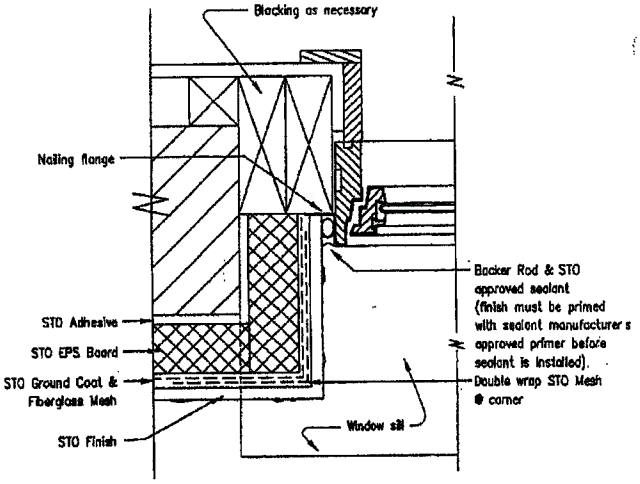
FIGURE NO. 1—TYPICAL STO INSULATION BOARD LABEL

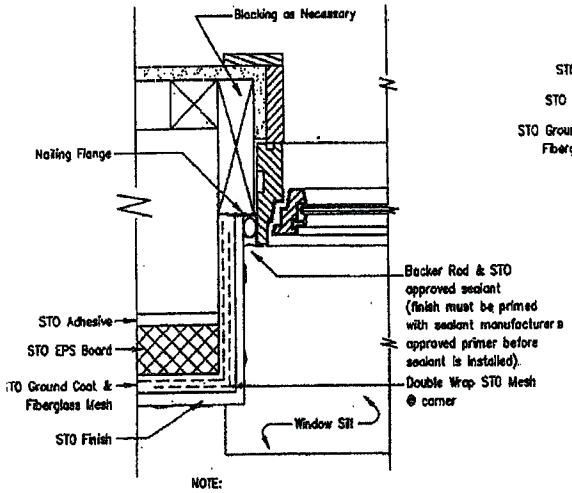






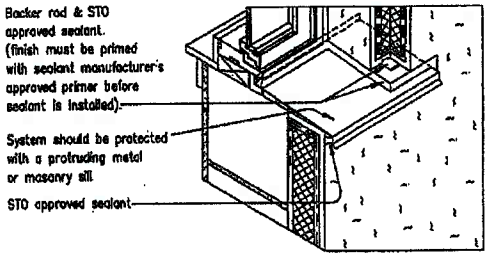
ABOVE GRADE DETAILS



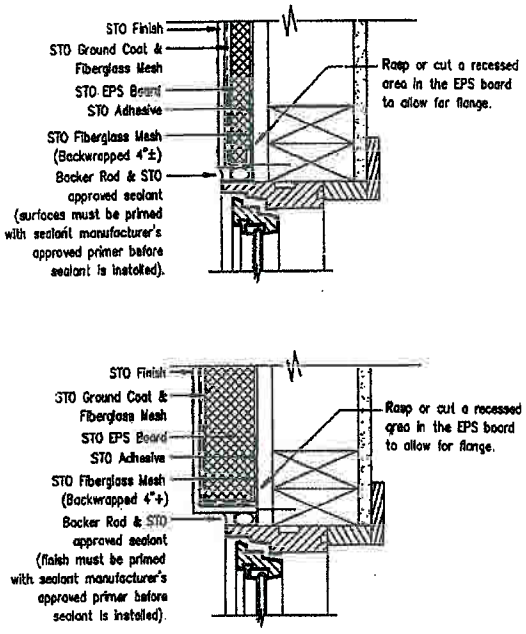


NOTE:
System Should be Protected by a Protruding Metal or Masonry Sill

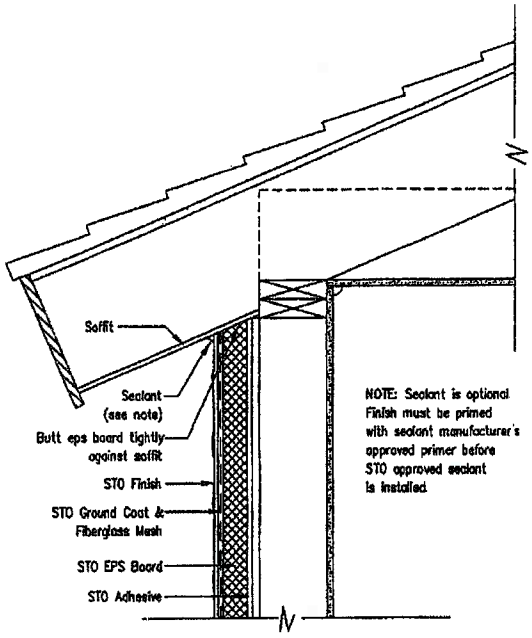
UNINSULATED RETURN DETAIL



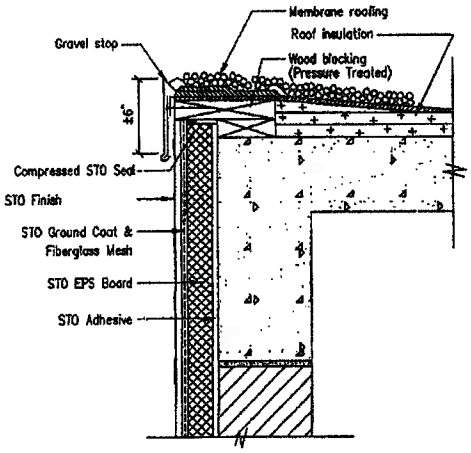
INSULATED RETURN AND SILL DETAIL



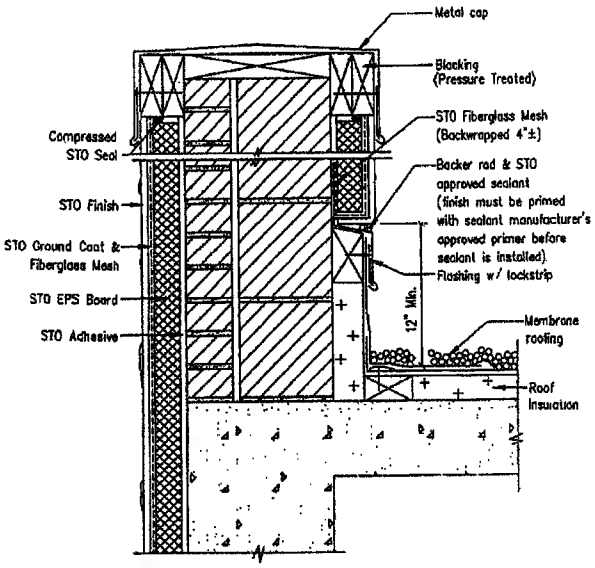
CASINGS WITH NAILING FLANGES



SLOPED SOFFIT



FLAT ROOF FASCIA



PARAPET

FIGURE NO. 2—(Continued)

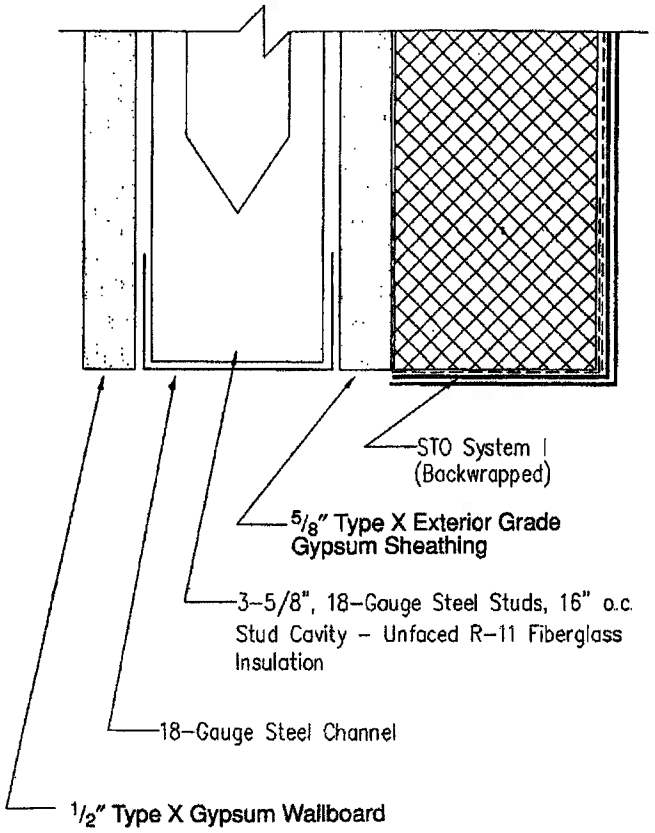


FIGURE NO. 3—WINDOW AND DOOR HEAD

(EIFS CONTRACTOR NAME)

Completion Date:_____

THE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Adhesive(s) _____
Fasteners (mech) _____
Base Coat_____
Reinforcing Fabric_____
Finish Coat(s) _____

INSTALLATION	CONFORMS
A. Substrate Type and Tolerance	_____
B. EIFS	
1. Adhesive and/or Fasteners	_____
2. Insulation	_____
3. Reinforcing Fabric	_____
4. Base Coat	_____
5. Finish	_____

C. The information entered above is offered in testimony that the EIFS installation conforms with the EIFS manufacturer's installation methods and procedures, and the EIFS manufacturer's ES report.

NOTE: An installation card shall be received from the Sealant Installer indicating that the sealant installation conforms with the EIFS evaluation report and sealant manufacturer's installation methods and procedures must accompany this declaration.

EIFS Contractor Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (___)_____

cc: Original: Building Department (Must be submitted with sealant
Copy: EIFS Manufacturer installer declaration.)

FIGURE NO. 4

(SEALANT INSTALLER NAME)

Completion Date:_____

THE SEALANT INSTALLED IN CONJUNCTION WITH AN EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) AND (SEALANT MANUFACTURER'S NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Primer(s) _____
Sealers _____
Bond Breakers _____
Sealant Materials _____

	INSTALLATION	CONFORMS
A.	Designer's requirements, details and instructions	_____
B.	Sealant manufacturer's details and requirements	_____
C.	Exterior insulation manufacturer's requirements	_____

D. The information entered above is offered in testimony that the Sealant installation conforms with the sealant manufacturer's installation methods and procedures, and the EIFS manufacturer's evaluation report.

Sealant Installer Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (____)_____

cc: Original: Building Department (Must be submitted with EIFS contractor declaration.)
Copies: EIFS Manufacturer
EIFS Contractor
Sealant Manufacturer

FIGURE NO. 5

ICBO Evaluation Service, Inc.
A subsidiary corporation of the International Conference of Building Officials

EVALUATION REPORT

Report No. 3906
November, 1994

Filing Category: EXTERIOR COATINGS (060)

STO EXTERIOR WALL FINISH AND INSULATION SYSTEM

STO INDUSTRIES,
A DIVISION OF STO CORPORATION
6175 RIVERSIDE DRIVE, S.W.
ATLANTA, GEORGIA 30331

I. **Subject:** STO Exterior Wall Finish and Insulation System.

II **Description:** A. **General:** The exterior wall finish and insulation system is a six-component system that may be applied to vertical substrates of masonry, concrete, exterior plaster, water-resistant core gypsum sheathing, Dens-Glass Gold™ or Dens-Glass Gold Firestop Type X over steel framing. The system is also applied to vertical wood framing over substrates of sound, unpainted, exterior grade plywood or Exposure 1 grade oriented strand board. The system components are an adhesive, rigid expanded polystyrene, ground coat, a woven fiberglass fabric, primer and a synthetic plaster finish. Dens-Glass Gold and Dens-Glass Gold Firestop Type X are manufactured by Georgia-Pacific Corporation and recognized in Evaluation Report No 4305.

B. **Materials:** 1. **Adhesives:** STO Dispersion Adhesive is a ready-mixed copolymer packaged in 50-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F. STO Dispersion Adhesive is used on water-resistant core-treated gypsum sheathing, Dens-Glass Gold, Dens-Glass Gold Firestop Type X and exterior grade wood-based sheathing other than fiberboard.

STO BTS-B is a polymer-based adhesive in 60-pound bags that is field mixed with 7 to 9 quarts of clean water per bag. STO BTS-B has a one-year shelf life when stored off the ground in a dry area and protected from moisture STO BTS-B is used on masonry, concrete, exterior plaster, water-resistant core gypsum sheathing, Dens-Glass Gold and Dens-Glass Gold Firestop Type X

2. **Insulation Board:** STO insulation board is a rigid expanded polystyrene insulation board with an average density of 1 pound per cubic foot, Class I flame-spread rating and a smoke-density rating of 450, maximum. The board is 24 inches wide and 48 inches long, maximum, with a $^3/_4$ inch to 4 inch thickness

Rigid expanded polystyrene board identified as WSG board produced by AFM Corporation (Evaluation Report No. 4169) as described for the STO insulation board is an alternate to the STO insulation board

3 **Base Coat:** Base coat is either STO RFP which is a ready-mix synthetic-resin compound or STO BTS-B field mixed with water as described in Section II B 1. STO RFP is packaged in 65-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F

4. **Reinforcing Fabric:** STO mesh is a reinforcing fabric with symmetrical interlaced glass fiber made from twisted multiend strands and treated for compatibility with the other materials. The mesh weighs approximately 4.8 ounces per square yard with a 6 by 6 thread count per inch width. It has a minimum 169 and 191 pounds per inch width tensile strength for the warp and weft directions, respectively. When protected from moisture, STO mesh has a one-year shelf life.

5 **Primer Coat:** STO primer is a latex-based primer used as an adhesion intermediary between the STO BTS-B base coat and finish coat STO primer is packaged in 60-pound pails with a one-year shelf life when stored at temperatures ranging from 38°F. to 90°F

6 **Plaster Finish:** Plaster finish is STOLIT finish which is a premixed acrylic-based textured wall coating of hardened air-cured material made with marble particles of a graded size. STOLIT is packaged in 60-pound pails with a one-year shelf life when protected from freezing and extreme heat

C **Application:** 1. **General:** All substrates are limited to planar irregularities not exceeding $^1/_4$ inch. They must be structurally sound, clean, dry and smooth with all dust and deleterious materials removed All materials are installed by applicators certified by STO Typical installation details are in Figure No 2.

2. **Masonry, Concrete or Exterior Plaster Substrates:** Sixty pounds of STO BTS-B field mixed with 7 to 9 quarts of clean water is applied to the entire back surface of the insulation board with a STO $^5/_8$-inch stainless steel notched trowel. Before the adhesive has dried, the board is applied to the wall with firm pressure over the entire surface to ensure uniform contact

All joints are tightly butted and vertical joints staggered Areas where the board joins other material or where it terminates are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76.

3. **Steel Studs:** Minimum $^1/_2$-inch-thick water-resistant core gypsum sheathing complying with ASTM C 79-82a, minimum $^1/_2$-inch-thick Dens-Glass Gold or minimum $^5/_8$-inch-thick Dens-Glass Gold Firestop Type X are applied in accordance with the code as water-resistant core gypsum sheathing to minimum No. 18 gauge (0 0478-inch base metal thickness) steel studs spaced 16 inches on center, maximum. STO Dispersion Adhesive is then applied to the entire back surface of the insulation board with a STO $^3/_{16}$-inch stainless steel notched trowel As an alternate adhesive, STO BTS-B is applied to the back of the insulation board with a STO $^1/_2$-inch-notched stainless steel trowel. Before the adhesive has dried, the board is applied to the sheathing with firm pressure over the entire surface to ensure uniform contact. All joints are tightly butted and vertical joints staggered. Board joints with other material and board terminations are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76.

4. **Wood Studs:** Exterior grade plywood complying with the code shall be attached to wood studs spaced 16 inches on center, maximum, in accordance with the requirements of the code for plywood wall sheathing. As an alternative, Exposure 1 grade oriented strand board recognized in a current ICBO ES or NES evaluation report is attached in accordance with the evaluation report to wood studs spaced 16 inches on center, maximum. STO Dispersion Adhesive is applied to the entire back surface of the insulation board with a STO $^3/_{16}$-inch stainless steel notched trowel. Before the adhesive has dried, the board is applied to the sheathing with firm pressure over the entire surface to ensure uniform contact. All joints are tightly butted and vertical joints staggered. Board joints with other

material and board terminations are protected from moisture by an acrylic latex caulking material complying with ASTM C 834-76 Horizontal control joints are required at each floor level in wood-frame construction. The joints must be installed as specified by the architect, designer, builder or exterior coating manufacturer, in that order.

5. **Coatings:** Prior to application of coatings, the entire surface of the installed insulation board is leveled with a rasping board or power rasper A base coat of either STO RFP or STO BTS-B is applied with a stainless steel trowel to the entire board surface to a uniform thickness of approximately $^1/_{16}$ inch. The glass-fiber mesh is immediately placed against the wet base coat and troweled from center to edge The mesh is continuous around corners and lapped at least $2^1/_2$ inches along edges Wrinkles must be avoided and the mesh fully embedded and covered. The base coat is allowed to dry for 24 hours.

When STO BTS-B is used, STO primer is applied as an adhesive intermediary. The primer may be diluted with up to 10 percent clean water by weight before application with a roller. STO primer is dried for approximately two hours prior to application of selected STO finish material

After the STO RFP base coat or STO primer has dried, the factory-prepared STOLIT plaster finish material is thoroughly mixed with a high-speed mixer until a uniform workable consistency is obtained. Small amounts of clean water may be added for workability. STOLIT plaster finish is then applied directly to the STO RFP or the STO primer coat, using a clean stainless steel trowel. The final texture is achieved with a plastic or stainless steel trowel. The finish coat thickness is no greater than the diameter of the largest aggregate, approximately $^1/_{16}$ inch

D. **Wind Design:** 1. **General:** Allowable transverse wind pressures for systems installed in accordance with this report are set forth in this section.

Adequacy of the steel framing or concrete/masonry/exterior plaster wall must also be considered. Maximum allowable deflection of structural wall components is 1/240 of span

2. **Steel Studs:** a. Where the system is applied to $^1/_2$-inch-thick water-resistant core gypsum sheathing or $^1/_2$-inch-thick Dens-Glass Gold fastened to minimum No. 18 gauge steel studs spaced a maximum of 16 inches on center with No 6 self-drilling corrosion-resistant steel bugle-head drywall screws, allowable positive and negative wind loads are 36 and 20 psf, respectively. The screws are installed at 6 inches on center, maximum, along the sheathing perimeters and 8 inches on center, maximum, in the field of the sheathing

b. Where the system is applied to $^5/_8$-inch-thick Dens-Glass Gold Firestop Type X sheathing fastened to minimum No. 16 gauge steel studs spaced a maximum of 16 inches on center with No. S-12 bugle head drywall screws spaced up to 6 inches on center, allowable positive and negative wind loads are 54 psf. Horizontal blocking spaced 4 feet on center shall be installed in each stud space

3. **Wood Studs:** Where the system is installed in accordance with Section II C 4 of this report, allowable positive and negative wind loads are 36 and 20 psf, respectively

4. **Concrete, Masonry or Exterior Plaster:** Allowable positive and negative wind pressure for the system adhesively applied to concrete, masonry and exterior plaster substrates as described in Section II C 2 is 54 psf

E. **Special Recognition:** The following STO Exterior Wall Finish and Insulation System may be used where noncombustible construction is required:

1 **Interior Finish:** One layer of $^1/_2$-inch-thick Type X gypsum wallboard complying with ASTM C 36-76a applied to steel studs with No. 6 by $1^1/_4$-inch-long bugle head drywall screws spaced at 6 inches on center, maximum

2. **Steel Studs:** No 18 gauge (0 478-inch base metal thickness), $3^5/_8$-inch-deep steel studs spaced at a maximum of 16 inches on center

3. **Stud Cavity:** Unfaced R-11 fiberglass insulation.

4 **Exterior Finish:** One layer of $^5/_8$-inch Type X, water-resistant core gypsum sheathing complying with ASTM C 79-82a applied to steel studs with No. 6 by $1^1/_4$-inch-long bugle head drywall screws spaced 6 inches on center, maximum. STO Dispersion Adhesive is then applied to the entire surface of the insulation board with a stainless steel notched trowel Before the adhesive has dried, the board is applied to the wall with firm pressure over the entire surface to ensure uniform contact. All joints are tightly butted and vertical joints staggered. Application of the STO RFP base coat, glass-fiber mesh and STOLIT finish are the same as described in Section II C 4. See Figure No. 3 for detail at head of wall openings

F. **One-hour Fire-rated Nonbearing Wall Assembly:** 1. **Interior Face:** One layer of full height $^5/_8$-inch-thick Type X gypsum wallboard is applied parallel to the interior face of steel studs spaced 16 inches on center, maximum. The steel studs are No 18 gauge and have a depth of $3^5/_8$ inches The wallboard is attached with No 6 by $1^1/_4$-inch-long drywall screws spaced 8 inches on center at board perimeter and 12 inches on center in the field. Wallboard joints must be taped and along with fastener heads, treated with joint compound.

2. **Exterior Face:** One layer of full height $^5/_8$-inch-thick Type X, water-resistant core gypsum sheathing complying with ASTM C 79-82a is applied parallel to studs The gypsum sheathing is attached as described for the gypsum wallboard attached to the interior face STO Dispersion Adhesive is applied to the back of 4-inch-thick STO insulation board and the board applied to the wall. Application of the STO RFP base coat, glass-fiber mesh and STOLIT finish are the same as described in Section II C 4

G. **Repair:** Areas are to be cut out and patched with the same materials and techniques used in the original application.

H. **Identification:** Containers of adhesives, base coats, reinforcing mesh, primer and finish coat bear a label noting the manufacturer's name, address, product name, evaluation report number, production date, batch number, quantity of material and storage, mixing and curing instructions.

STO insulation boards are identified by a label on the edge of each insulation board and both faces of one board in every bag bearing the company name (STO), plant identification number, evaluation report number and the name of the quality control agency (RADCO NERQA-204) as noted in Figure No. 1

The WSG insulation board is identified in accordance with ICBO ES Evaluation Report No. 4169 In addition, when used on walls required to be of noncombustible construction, each board is labeled on one edge, and both faces of one board from every package bears the following additional information:

1. Inspection agency name (Underwriters Laboratories Inc. NERQA-403).

2. Product name (STO) and Evaluation Report No 3906

3 Insulation manufacturer (AFM Corporation) and Evaluation Report No 4169

III. **Evidence Submitted:** Data in accordance with the ICBO ES Acceptance Criteria for Exterior Insulation and Finish Systems, dated January, 1993

Findings

IV. **Findings: That the STO Exterior Wall Finish and Insulation System described in this report complies with the 1991 *Uniform Building Code*™, subject to the following conditions:**

1. **Construction is as set forth in this report and manufacturer's instructions.**
2. **The insulation board is separated from the building interior with a thermal barrier complying with Section 1713 (d) of the code.**
3. **The system may be installed on walls of nonrated noncombustible construction, provided the exterior wall and insulation finish system are installed as described in Section II E of this report.**
4. **The system may be installed on nonbearing one-hour fire-rated walls of noncombustible construction, provided the exterior wall and finish system is installed as described in Sections II E and II F of this report.**
5. **Installation is by applicators approved by STO Industries, A Division of STO Corporation. An installation card, represented in**

Figure No. 4, must be completed at the end of each project and filed with the building official.

A sealant application card represented in Figure No. 5, must be filed with the building official after sealant application.

6. The system may be attached to the surface of an exterior combustible fire-resistive assembly without affecting the rating.
7. The insulation board is labeled in accordance with this report and manufactured under a quality control program with inspections by the proper quality control agency noted in Section II H of this report.

1993 Accumulative Supplement to the U.B.C.: This report is unaffected by the supplement

This report is subject to re-examination in one year.

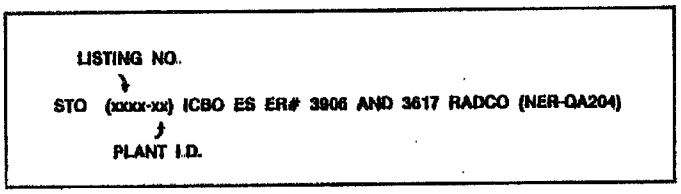
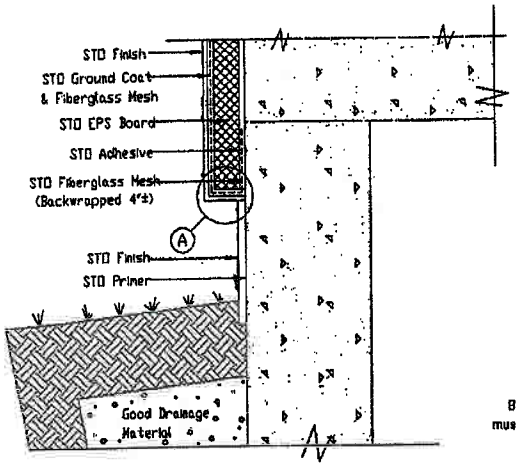
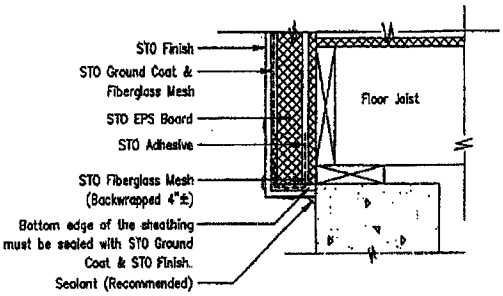
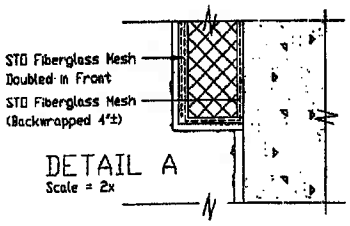


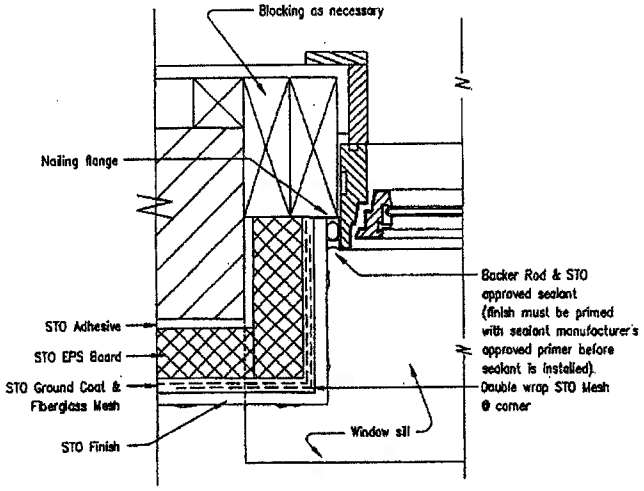
FIGURE NO. 1—TYPICAL STO INSULATION BOARD LABEL

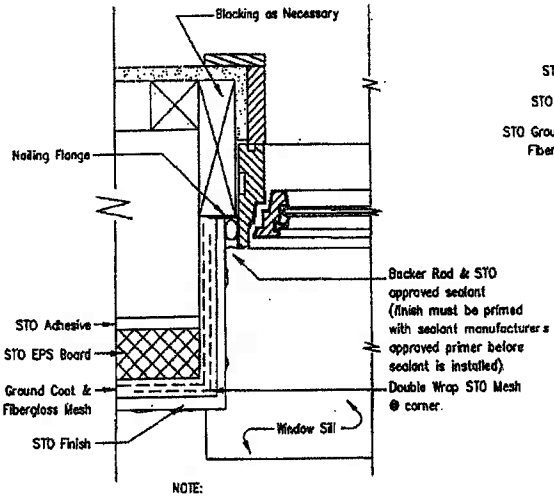






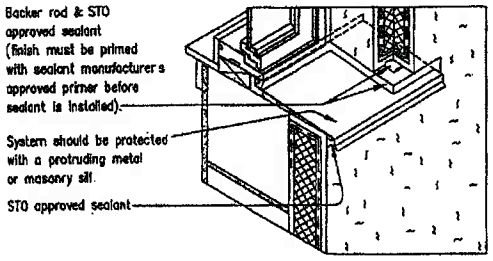
ABOVE GRADE DETAILS





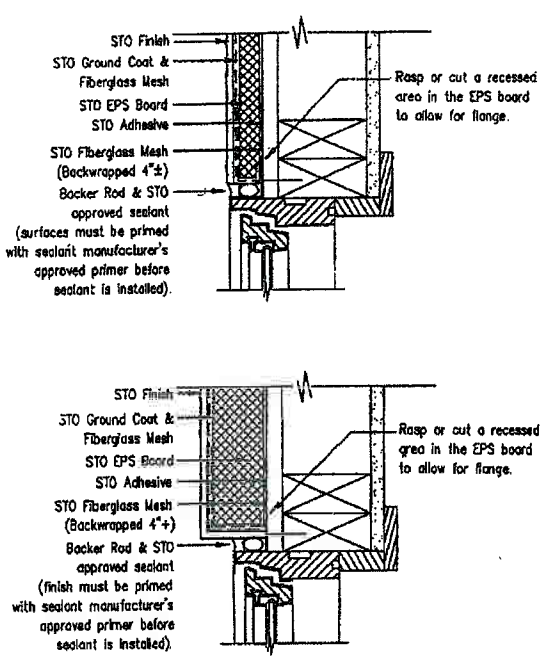
NOTE:
System Should be Protected by a Protruding Metal or Masonry Sill

UNINSULATED RETURN DETAIL

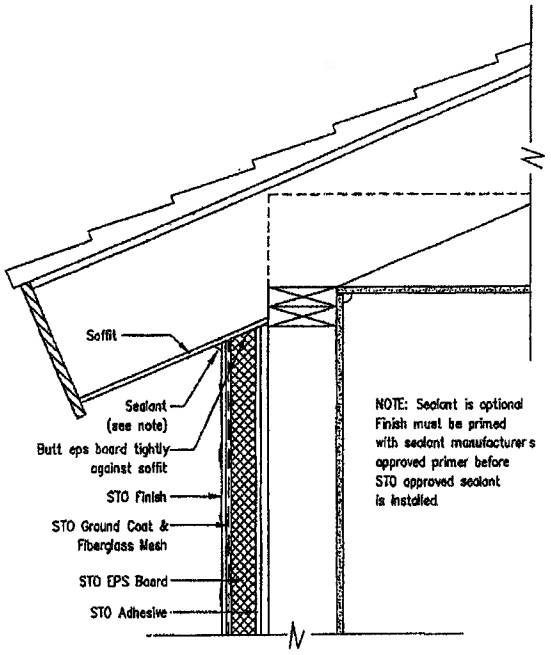


INSULATED RETURN AND SILL DETAIL

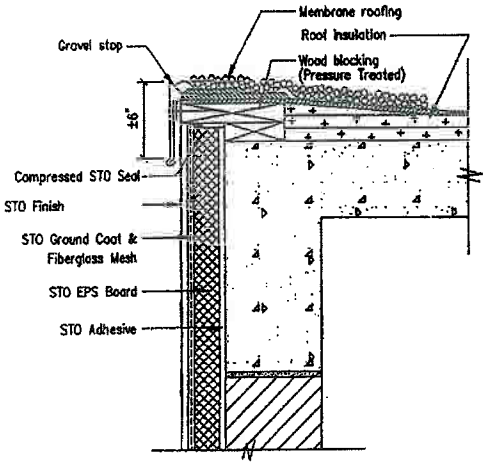
FIGURE NO. 2



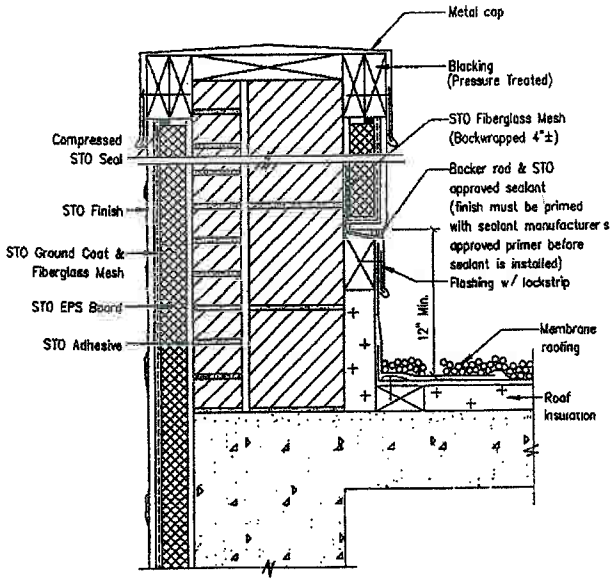
CASINGS WITH NAILING FLANGES



SLOPED SOFFIT



FLAT ROOF FASCIA



PARAPET

FIGURE NO. 2—(Continued)

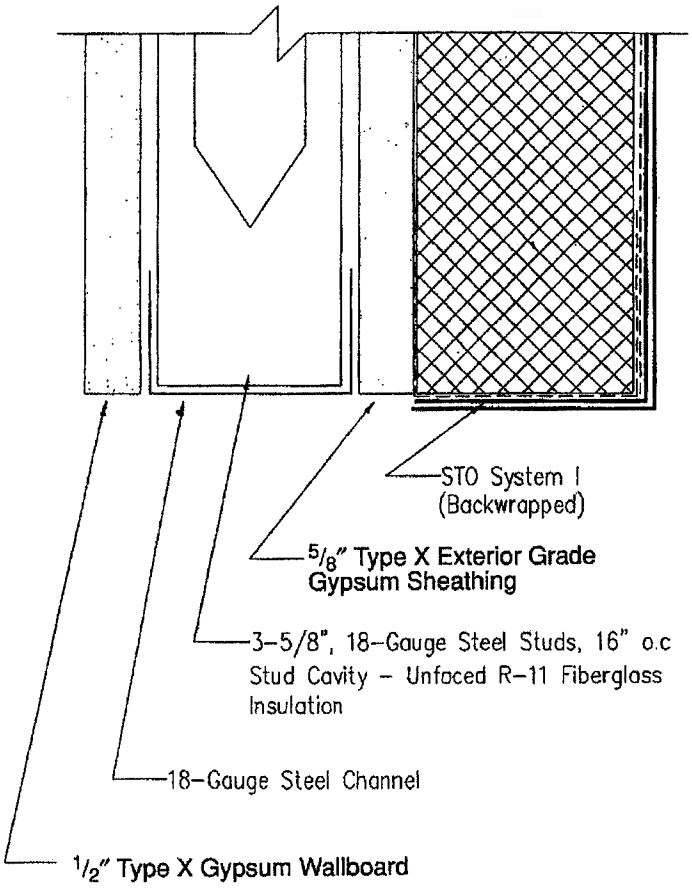


FIGURE NO. 3—WINDOW AND DOOR HEAD

(EIFS CONTRACTOR NAME)

Completion Date:_____

THE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Adhesive(s) _____
Fasteners (mech) _____
Base Coat_____
Reinforcing Fabric_____
Finish Coat(s) _____

	INSTALLATION	CONFORMS
A.	Substrate Type and Tolerance	_____
B.	EIFS	
	1. Adhesive and/or Fasteners	_____
	2. Insulation	_____
	3. Reinforcing Fabric	_____
	4. Base Coat	_____
	5. Finish	_____

C. The information entered above is offered in testimony that the EIFS installation conforms with the EIFS manufacturer's installation methods and procedures, and the EIFS manufacturer's ES report.

NOTE: An installation card shall be received from the Sealant Installer indicating that the sealant installation conforms with the EIFS evaluation report and sealant manufacturer's installation methods and procedures must accompany this declaration.

EIFS Contractor Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (___)_____

cc: Original: Building Department (Must be submitted with sealant
Copy: EIFS Manufacturer installer declaration.)

FIGURE NO. 4

(SEALANT INSTALLER NAME)

Completion Date:_____

THE SEALANT INSTALLED IN CONJUNCTION WITH AN EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) AND (SEALANT MANUFACTURER'S NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Primer(s) _____
Sealers _____
Bond Breakers _____
Sealant Materials _____

	INSTALLATION	CONFORMS
A.	Designer's requirements, details and instructions	_____
B.	Sealant manufacturer's details and requirements	_____
C.	Exterior insulation manufacturer's requirements	_____

D. The information entered above is offered in testimony that the Sealant installation conforms with the sealant manufacturer's installation methods and procedures, and the EIFS manufacturer's evaluation report.

Sealant Installer Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (____)_____

cc: Original: Building Department (Must be submitted with EIFS contractor declaration.)
Copies: EIFS Manufacturer
EIFS Contractor
Sealant Manufacturer

FIGURE NO. 5

APPENDIX C – PROGRESSION OF FIRE

On Friday January 25, 2008 a fire broke out at the Monte Carlo Hotel and Casino in Las Vegas, Nevada. The first alarm was called in at 10:58 a.m. ABC Channel 13, the local ABC affiliate, started broadcasting at 11:03 and KVBC Channel 3, the local NBC affiliate, started broadcasting between 11:15 and 11:20 a.m. The video from ABC is currently the earliest known footage available. Several other news agencies arrived later and started broadcasting footage of the Monte Carlo. Table C-1 contains a list of video clips which were referenced in this document. Throughout the document, a video will be reference by a clip number which corresponds to the number listed in the first column of Table C-1.

General Notes Regarding Time

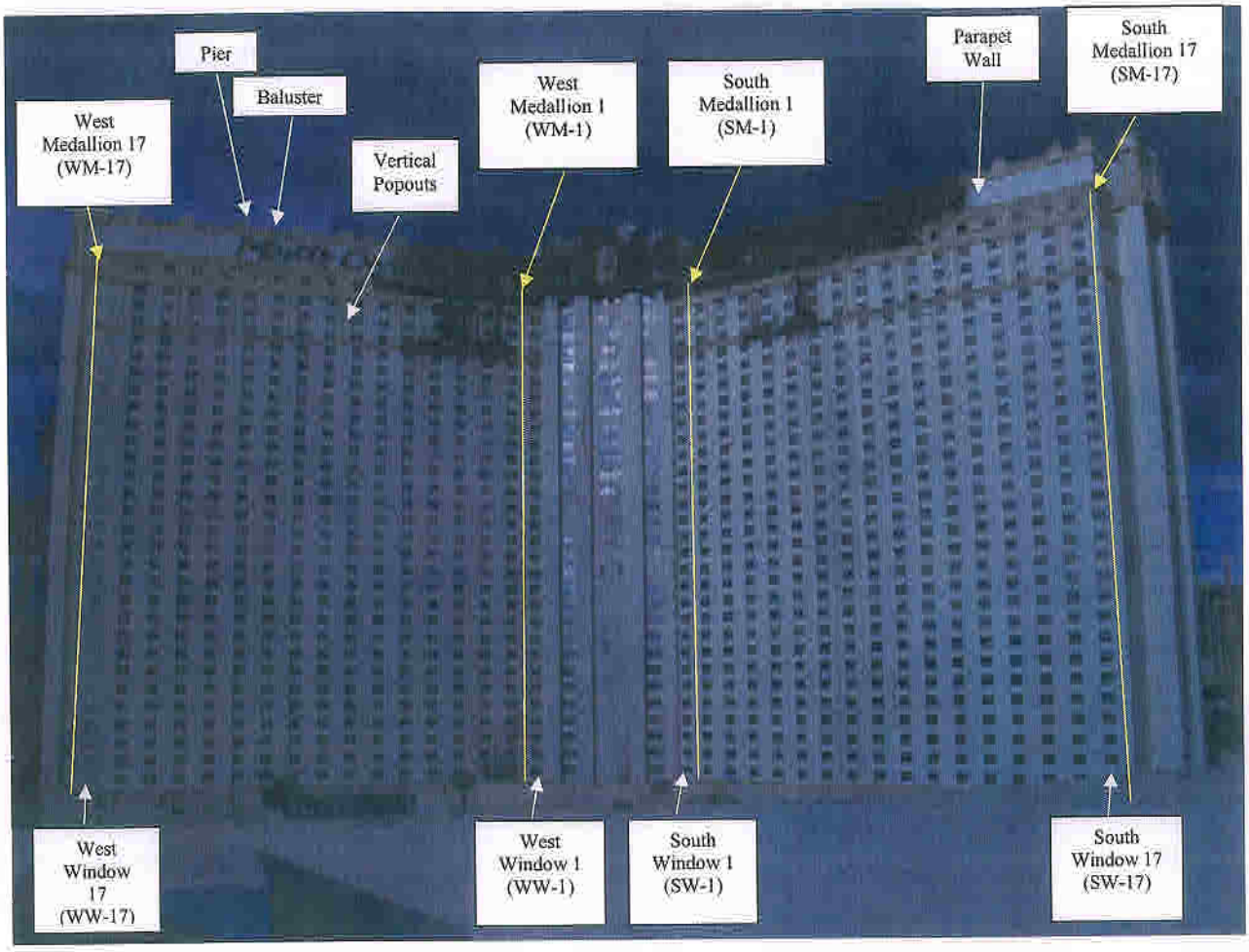
The time of day before 11:15 is based on the ABC footage while the time of day after 11:15 is estimated based on the KVBC video clips. The ABC footage included the time of day in their broadcast while the KVBC clips did not broadcast the time of day in their footage. Therefore the times from the KVBC videos should be considered approximate.

Building Features

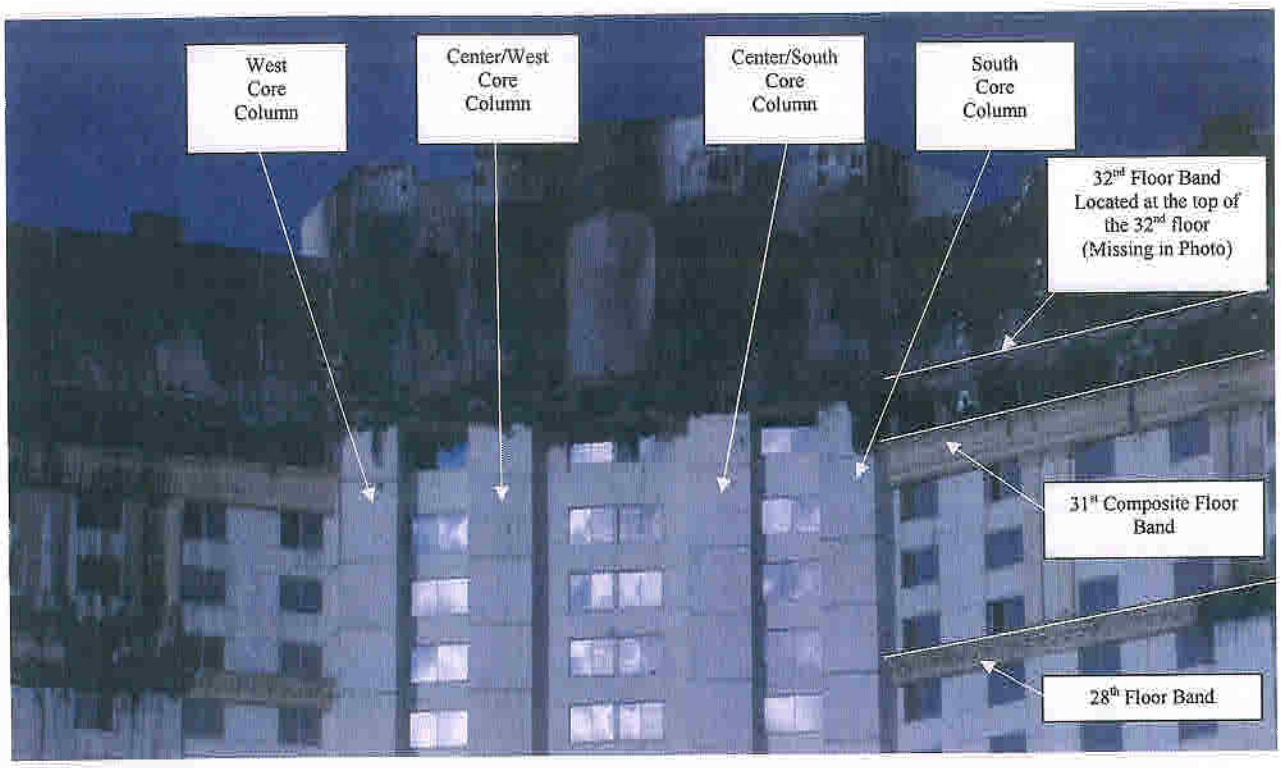
The figures below are annotated with the naming convention used in this document for the vertical window lines and the medallions. The pictures also contain the terminology used for the various building features. There are 17 window lines and 17 medallions on each wing and they are numbered starting with 1 located next to the central core and increase in the direction away from the central core. For the west face, the first west window (WW-1) is located adjacent to the central core and the last window (WW-17) is located at the west edge of the building. For the south face, the first south window (SW-1) is located next to the core and the last window (SW-17) is at the southern edge of the building.

The window medallions are identified in the same manner and are used to reference columns lines as well as the individual medallions. The first west medallion (WM-1) is located between WW-1 and WW-2 and the last medallion (WM-17) is located after WW-17. The same convention is used for the south face with the first south medallion (SM-1) located between SW-1 and SW-2 and the last medallion (SM-17) located after SW-17.

Building Nomenclature



Central Core Nomenclature



Before 11:20 a.m.

Clip 1 from ABC is identified as starting at 11:03 a.m. and running for 56 minutes and 38 seconds. The first close-up of façade is shown at 11:05 a.m. The west wing shows burning from the central core to the edge of the WW-2 line. Flames are visible on the band located at the top of the 32nd floor as well as under WM-1. Black smoke obscures the parapet wall on the west wing, but flames are visible intermittently on the pier above WM-1. The fire beneath WM-1 appears to be from melted materials dripping down and pooling on the composite band running across the top of the 31st floor. The 32nd floor band appears on fire from the WM-2 edge to the Center/West core column. The central core is burning with the façade between the Center/West and Center/South core columns showing visible flames. The region from the Center/West to the West core column is obscured by black smoke or is burnt out. The fires show flammable materials dripping down on to the 32nd floor band and the 31st floor composite band.

Shortly after the pier above the south core column is seen burning (around 11:10 a.m.), the decorative columns below the pier begins to shows visible flames. The fire on the west wing has progressed to the column at WM-2 with the parapet wall and pier at this column showing visible flames. There is also a fire along the 31st floor composite band at WW-2 and WM-1.

By 11:13 a.m. the fire has spread from the central core to the south wing. The west wing flame front is located at the WW-3 column line with visible flames on and above the 32nd floor band, WM-2, and the pier above WM-2. Black smoke obscures the parapet wall at this location. The 31st floor composite band appears to have flames under WM-2 and WW-3.

At 11:14 a.m. a piece of flaming debris falls off the 32nd floor band, hits the 31st floor composite band, and then falls to the 28th floor band between WW-3 and WW-2 where is continues to produce black smoke.

At 11:16 a.m. part of the parapet wall between the columns at WM-3 and WM-2 detaches and falls out of view of the camera.

Clip 2 from KVBC is estimated to be before 11:20 a.m. based on the footage contained within the other KVBC video clips. The clip has a runtime of 1 minute and 49 seconds and is a mix of footage from a helicopter and from a camera located on the Rio Hotel which shows the opposite side of the Monte Carlo. The clip shows the fire has progressed to the west wing with flames visible on the horizontal band above WM-1. Flames are also visible on WM-1. The baluster (the railing located at the top of the parapet wall) is on fire with flames on the spindles (the individual vertical posts of railing) between WW-2 and WW-3. The top rail and bottom rail of the baluster are burning as well. Thick black smoke obscures the façade from WM-1 to the center of the central core. On the south wing, a vertical flame extends from the horizontal band along the top of the 32nd floor to the top of the pier (decorative support between sections of the baluster railing) at the center/south core column. The flame front is on the first of the two vertical popouts (faux columns) at the center/south core column. There are also visible flames along the horizontal band at the top of the 32nd floor extending from the west core column to the center/west core column.

Between 11:20 a.m. to 11:40 a.m.

Clip 3 from KVBC is has a runtime of 19 minutes and 18 seconds. The clip is estimated to start around 11:20 a.m. and runs till 11:40 a.m. The start of the clip shows WM-3 on fire as well as the horizontal band at the top of the 32nd, parapet wall and balusters above the medallion. There is also a visible smoke plume coming from the top surface of the 28th floor band near the west base of the vertical popouts along the column at WM-2 that is likely ignited by the burning of materials dripping down from the fires on and above the 32nd floor band. On the south wing, the fire has progressed to the column between SW-1 and SW-2, with SM-1, 32nd floor band, and balusters showing visible flames while the parapet wall is obscured by black smoke. In the first 17 seconds of the clip, only thick black smoke is visible and appears to be originating from the top surface of the 28th floor band at the column between WW-2 and WW-3 at the base of the vertical popouts.

On the west wing, approximately 2 minutes and 50 second into the clip, a piece of the 28th floor band can be seen falling off the building and bursting into flames. By 4 minutes and 35 second into the clip, the fire on the 28th floor band has spread westward by about half the width of the adjacent window. The fire on and above the 32nd floor band and parapet wall has progressed to include parts of WM-4 as well the 32nd floor band, parapet wall, and the pier above WM-4. The south wing fire is moving much slower and the flame front is at SW-2.

By 7 minutes and 4 seconds into the clip, a third fire appears to be developing at the base of the vertical popouts below WM-4 which again appears to be the result of materials dripping down from the fire on and above the 32nd floor band. The fire on and above the 32nd floor band of the west wing has grown to include the entire WM-4. The fire has also passed the pier above WM-4

to include the baluster above WM-4 and WM-5. The flame front is approaching the letter "O" in the parapet wall. The south wing fire has progressed and the flame front is at SM-2 with everything between SM-2 and the pier above SM-2 showing flames.

By 9 minutes and 50 seconds into the clip, WM-4 is burning and flames are clearly visible. There are three separate fires on the west wing burning simultaneously. The fire on and above the 32nd floor band has grown to include the 32nd floor band over the windows at WW-5. The fire has also reach the letter "O" on the parapet wall and the balusters above WM-5. The fire on the south wing has moved a little past SM-2 but has not reached SM-3.

By 13 minutes and 10 seconds into the video, the fire on the 28th floor band under the vertical popouts below WM-4 has burned though the 28th floor band. The fire near the roof has moved to include WM-5 as well as the band along the top of the 32nd floor. Thick smoke obscures the parapet wall and the balusters located above WM-5. On the south wing, a change in wind direction cause the fire spread rate to increased and the flame front is between the columns at SM-4 and SM-6. There is also a large burning region extending the length of about 3 sets of windows. Flames are visible above the band at the top of the 32nd floor and on the medallions, parapet wall, balusters and the pier.

At 15 minutes and 5 seconds into the clip, visible flames can be seen extending several feet above the pier above SM-6. The fire on the parapet wall of the west wing is noticeably smaller which is likely a result of the fire department efforts and the change in wind conditions. The two fires on the 28th floor band between WM4 and WM-5 are moving closer together.

At 17 minutes and 48 seconds into the clip, the flame front on the south wing has reached the column at SM-8 with visible flames extending above the pier at the same column line. A small smoke plume appears to be forming on the 28th floor band of the south wing between the columns at SM-5 and SM-6. The west wing fire on and above the 32nd floor band has reached the column at WM-6 and thick black smoke obscures the façade above the fire. The two fires on the 28th floor band on the west wing have merged into a single fire with the flame front at the west edge of WW-5.

Between 11:40 a.m. to 12:00 p.m.

Clip 4 from KVBC is labeled as being between 11:40 a.m. and 12:00 p.m. and has a runtime of 17 minutes and 14 seconds.

By 1 minute and 40 seconds into the clip, the fire on the 28th floor band between columns at SM-5 and SM-6 appears to have burned through the 28th floor band. The fire on the south wing has progressed to the column at SM-9 with visible flames from the medallion extending to the balusters above. The fire on the west wing is still at the column at WM-6, with the 32nd floor band at this column showing flames but the flames do not extend up to include the parapet wall or the pier at this column. The 28th floor band fire on the west wing is still burning with the flame front at the column at WM-5.

By 10 minutes into the clip, the flame front of the south wing appears to have been knocked down by the fire department. There are still small fires which are visible on top of the 32nd floor

band. The fire on the 28th floor band has grown to include the region of the band from the column at SM-5 to the column at SM-7.

By 11 minutes and 33 seconds, the fire on and above the 32nd floor band of the west wing, including the parapet wall, appear to be suppressed with no visible flames in the video. The 28th floor band fire on the west wing also appears suppressed with no visible flames at this location however a small smoke plume is still visible.

By 15 minutes and 30 seconds into the video, flames reappear on the 32nd floor band and parapet wall of the south wing, but the fire progression has been halted. Flames at the base of the vertical popouts at the column at WM-4 are still visible on the 28th floor band of the south wing.

Active burning on the 28th floor band at the column at WM-6 appears at 16 minutes and 30 seconds into the video.

Between 12:00 p.m. to 12:20 p.m.

Clip 5 from KVBC is labeled as being between 12:00 p.m. and 12:20 p.m. and has a runtime of 19 minutes and 30 seconds. All fires appear to be contained at the start of the video.

A zoomed in view of the column at SM-12 at 2 minutes and 32 seconds into the video, shows the parapet wall and pier at this column are still burning. This fire is knocked down again by 6 minutes and 15 seconds into the video. All fires appear to be suppressed by this time as the remainder of the video does not contain any more footage of the fires.

Table C-1—List of Video Clips

Clip No.	Filename	Source	Run Time	Estimated Time of Day
1	Channel 13 footage of the Monte Carlo fire	ABC	0:56:38	11:03 a.m.
2	Channel 3 footage of the Monte Carlo fire	KVBC, NBC	0:01:49	Before 11:20 a.m.
3	Channel 3 footage of the Monte Carlo fire	KVBC, NBC	0:19:18	11:20 a.m.
4	Channel 3 footage of the Monte Carlo fire	KVBC, NBC	0:17:14	11:40 a.m.
5	Channel 3 footage of the Monte Carlo fire	KVBC, NBC	0:19:30	12:00 p.m.

Photographic Timeline

Table C-2—Images from Clip 2 (KVBC)

00:00:10

00:01:46

Table C-3—Images from Clip 3 (KVBC)

00:00:00

00:00:44

00:02:50

00:04:35

Table C-3—Images from Clip 3 (KVBC) (Continued)

 00:07:04	 00:09:50
 00:13:10	 00:15:05
 00:17:48	 00:19:10

Table C-4—Images from Clip 4 (KVBC)

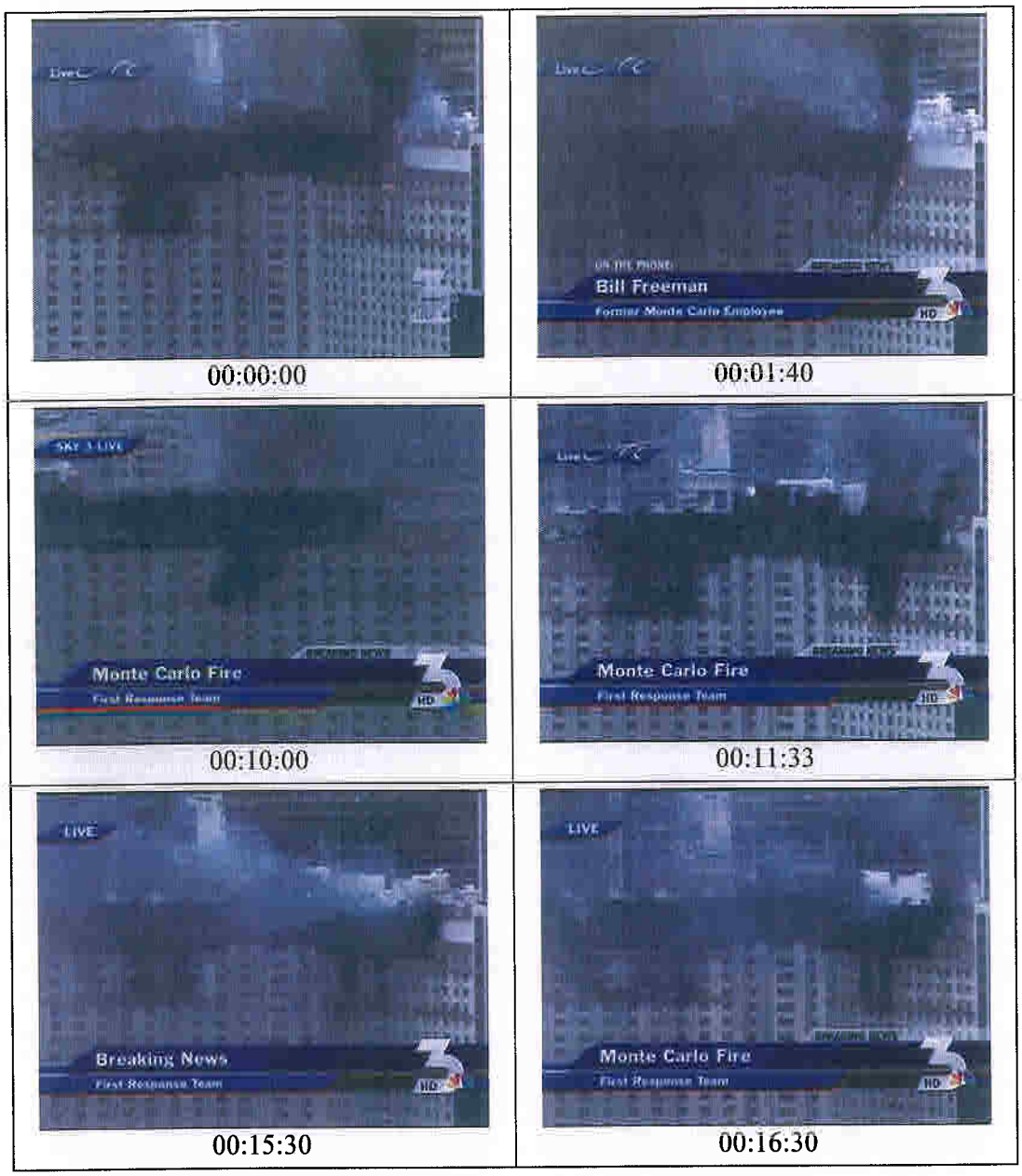


Table C-5—Images from Clip 5 (KVBC)

 00:00:11	 00:03:11
 00:06:15	

APPENDIX D – DONALD BELLES LETTER TO ROGER CONDIE

koffel associates, inc.
FIRE PROTECTION ENGINEERS • CODE CONSULTANTS
2203 Castelow Road Greenbrier, Tennessee 37073
615-643-5588 • 615-643-5589 (FAX) • firpro@aol.com

Donald W. Belles, P.E.
Senior Principal

December 21, 1999

RECEIVED
DEC 27 1999
BY:

COPY

Mr. Roger Condie, Manager
Department of Building
Building Plans Check Services
500 S. Grand Central Pky, 1st Floor
P.O. Box 553530
Las Vegas, NV 89155-3530

Subj: EIFS

Dear Mr. Condie:

I am a fire protection engineer with Koffel Associates, Inc. and serve as consultant to the EIFS Industry Members Association (EIMA). We are in receipt of a letter signed by Peter Bahlo, P.E., Senior Staff Engineer of ICBO Evaluation Services dated December 3, 1999 with subject "Discussion Concerning the Acceptance Criteria for Exterior Insulation and Finish Systems, Subject MISC2-0100 (PB/PVM)". The Bahlo letter of December 3rd was prompted by your letter to C. P. Ramani dated October 13, 1999.

Your letter raises questions about the performance of exterior insulation and finish systems (EIFS) because of three recent fires in Reno and Las Vegas. You state in the opening paragraph "Nevada has experienced three fires at major hotel-casinos which involved exterior insulation and finish systems (EIFS) such as Dryvit". Your letter refers to fires at the Luxor, Palace Station and Eldorado hotels.

We respectfully disagree with the characterization of the three fires as involving or being attributable to EIFS. It has been conclusively established that no EIFS was present in the Luxor façade suffering the fire in July 1999 – see Attachment 1. In the Palace Station fire, flames spread across polyurethane foam panels, polyurethane foam shapes and urethane coated expanded polystyrene – see Attachment 2. None of the assemblies spreading flame in the Palace Station fire are used in EIFS.

Further, it would not be accurate to describe the "signage façade" at the Eldorado as being an EIFS. The fire at the Eldorado involved a 126 ft. by 40 ft. "sign" constructed of urethane coated expanded polystyrene up to 9-inches thick installed over a conventional EIFS. In addition to the urethane coated expanded polystyrene, the "signage façade" at the Eldorado included three foam plastic torch like structures that ran from a marquee to several feet above the top of the wall. The full height sign was also equipped with two large doors that could be closed or opened to expose the sign to view. The doors were covered with an ornately designed set of foam plastic shapes. Flames originated in the large foam plastic sign on the Eldorado and quickly spread to involve all the materials in the "signage façade".

In summary, an EIFS was not used in the Luxor façade and neither the Eldorado or the Palace Station fires could justly be described as being attributed to EIFS. In fact in both these fires flames spread over non-code-complying foam plastic assemblies. Fire spread stopped abruptly when flames reached the adjacent complying EIFS façade. The abrupt line of demarcation between the area heavily burned and the undamaged EIFS provides confirmation of the good performance of a code complying EIFS, unencumbered by add-on materials and special shapes.

We are preparing detailed descriptions of the facades for the three hotels referenced in your letter. We are also preparing a written analysis of the mechanisms leading to flame spread in the three fires. This information will be forwarded to ICBO ES for distribution to the Evaluation Committee when complete. We will also send a copy to the Clark County Building Department.

The repercussions from your letter are being felt across the United States. Your letter and attachments have already been distributed by competitive interests. In one case, the materials were forwarded to the architect of a large New Mexico project in an effort to have EIFS (specified for the project) replaced with a competitive product. It is critically important you clarify your request of ICBO Evaluation Service. We are able to show that EIFS were not involved in the spread of flames in the three fires being cited. Actually two of the fires dramatically illustrate the ability of a code complying EIFS to resist flame spread. We, therefore, assume your principal concern has to do with the use of non-code-complying foam plastic shapes being used on building facades. These non-code-complying foam plastic shapes often involve urethane coatings over expanded polystyrene and in some cases are prefabricated polyurethane foam panels and shapes.

Assuming your concerns are directed at the non-code-complying special shapes, we share your concerns. In fact, over a year ago EIMA established and distributed a formal policy statement specifically recommending against the use of untested materials – see Attachment 3. Our uneasiness with the use of the special shapes goes back even further and we expressed reservations about the use of non-code-complying special shapes (especially the urethane coated expanded polystyrene) during a meeting with the Clark County Building Department in June of 1997. The problem with special shapes is exacerbated by the fact that many persons can not visually differentiate between a conventional EIFS and the special shapes. We intend to request ICBO Evaluation Service consider developing acceptance criteria for foam plastic shapes on exterior facades of noncombustible buildings. Since the special shapes are frequently used on buildings with an EIFS, we will also request a cross-reference to the new acceptance criteria for special shapes be included in the acceptance criteria for EIFS.

If you concur with our findings on the performance of the code complying EIFS and share our concerns about the use of the non-code-complying special shapes, we would appreciate a written response confirming that view. A written clarification of your intent is urgently needed to offset the damaging inferences relative to EIFS performance in your earlier letter.

Should you wish to discuss this matter further, please feel free to call.

Very truly yours,

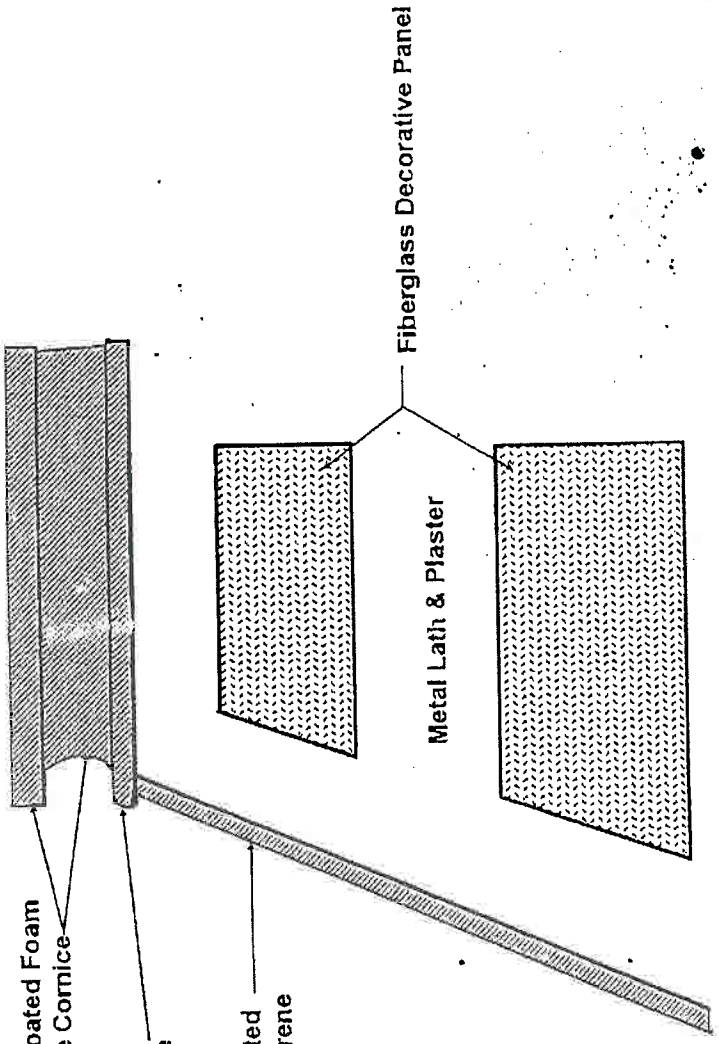
Donald W. Belles, P.E.
Fellow-Society of Fire Protection Engineers

Encls.

cc: R. Weber, Director, Clark County Building Department
D. Evans, FPE, Clark County Building Department
R. Foell, Clark County Building Department
C. Ramani, ICBO Evaluation Services
P. Bahlo, ICBO Evaluation Services
P. McCullen, ICBO Evaluation Services
T. Wolf, EIMA
R. Kroll, Dryvit
J. Beitel, Hughes Associates
R. Thomas, CMD Associates

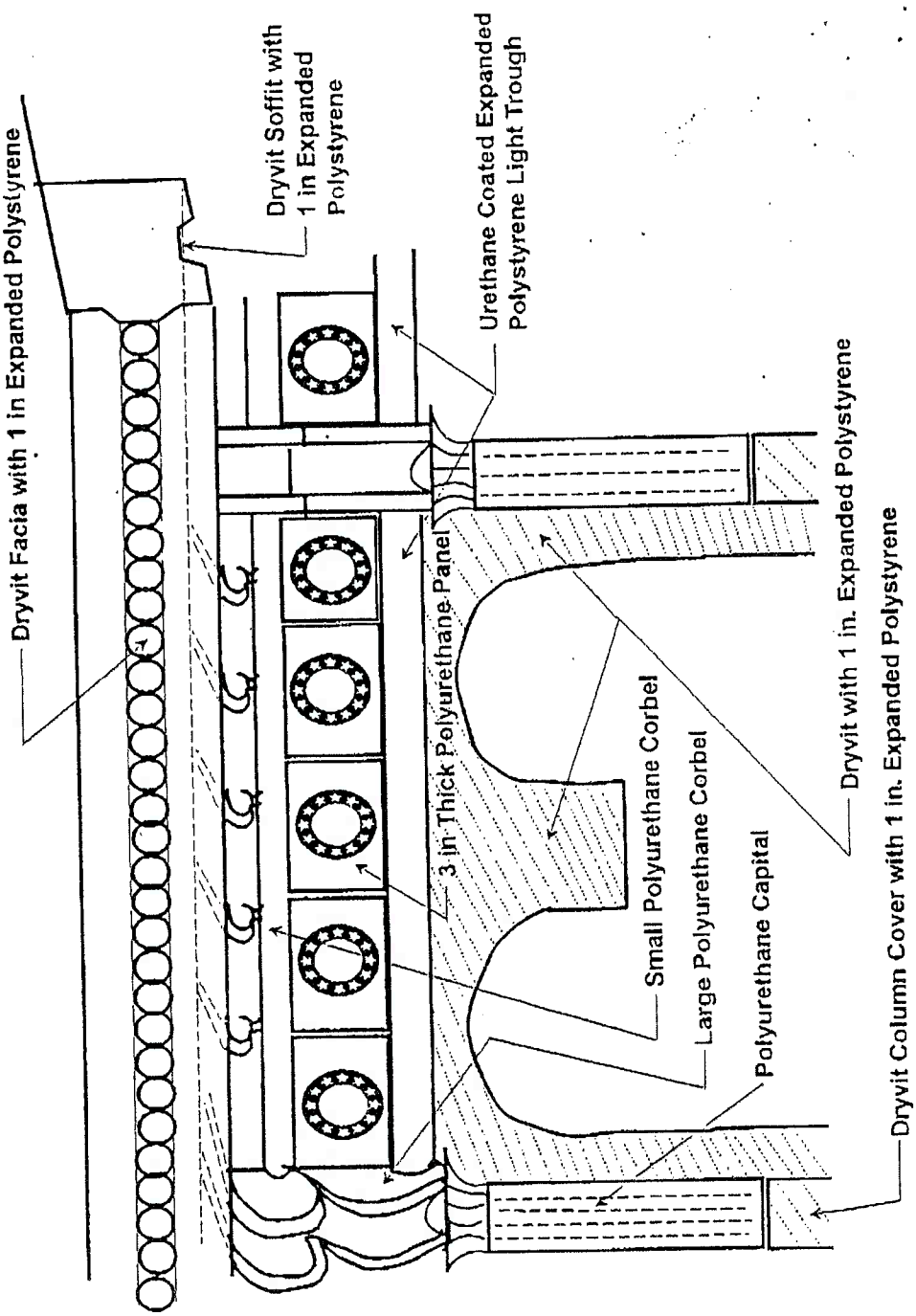
Dwb/bd

koffel associates, inc.



Elevation of Luxor Facade

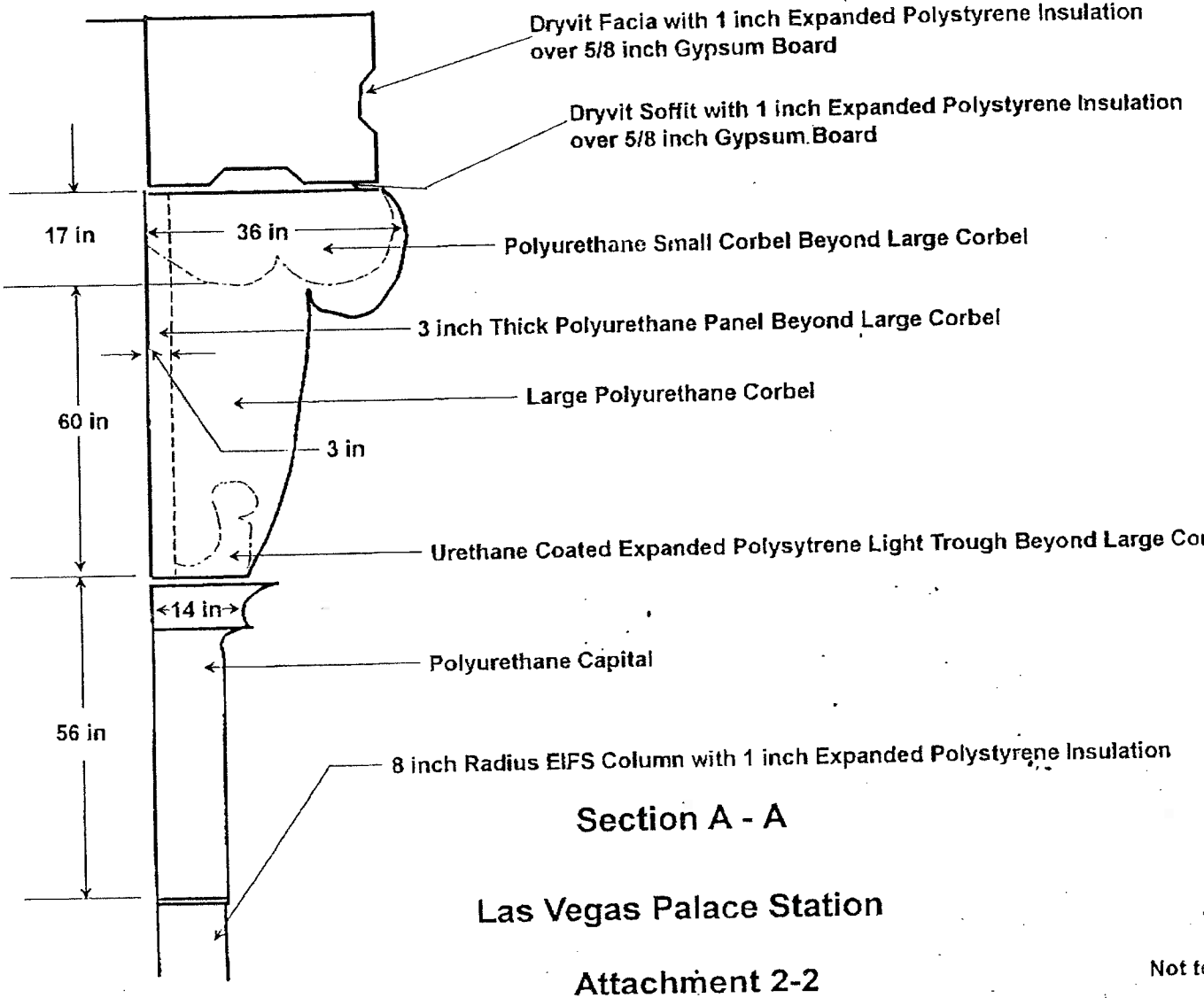
Attachment 1



Not to Scale

Las Vegas Palace Station

Attachment 2-1

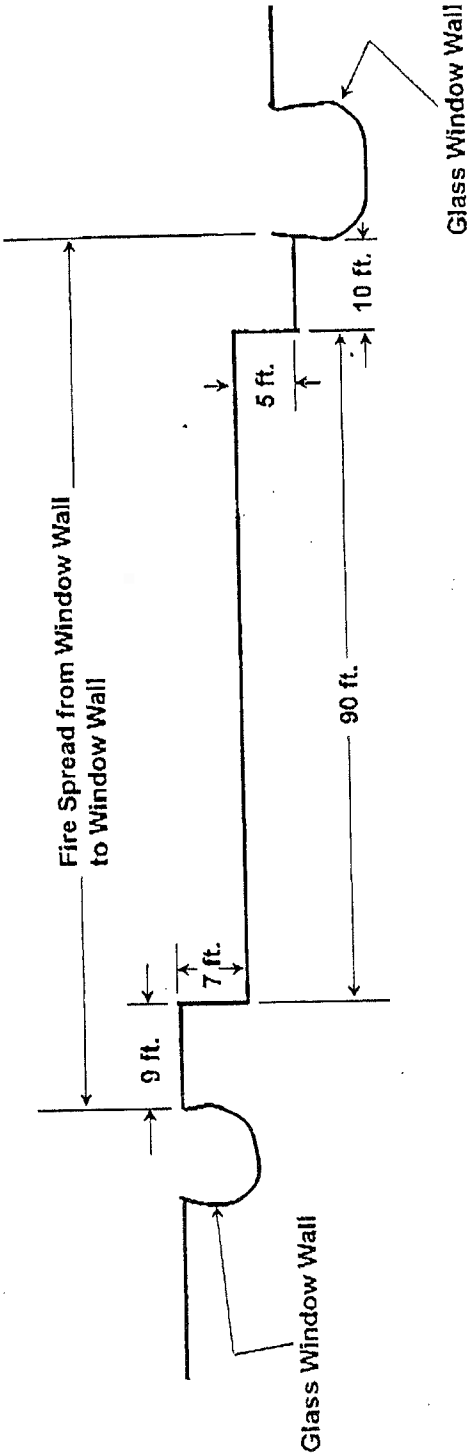


Section A - A

Las Vegas Palace Station

Attachment 2-2

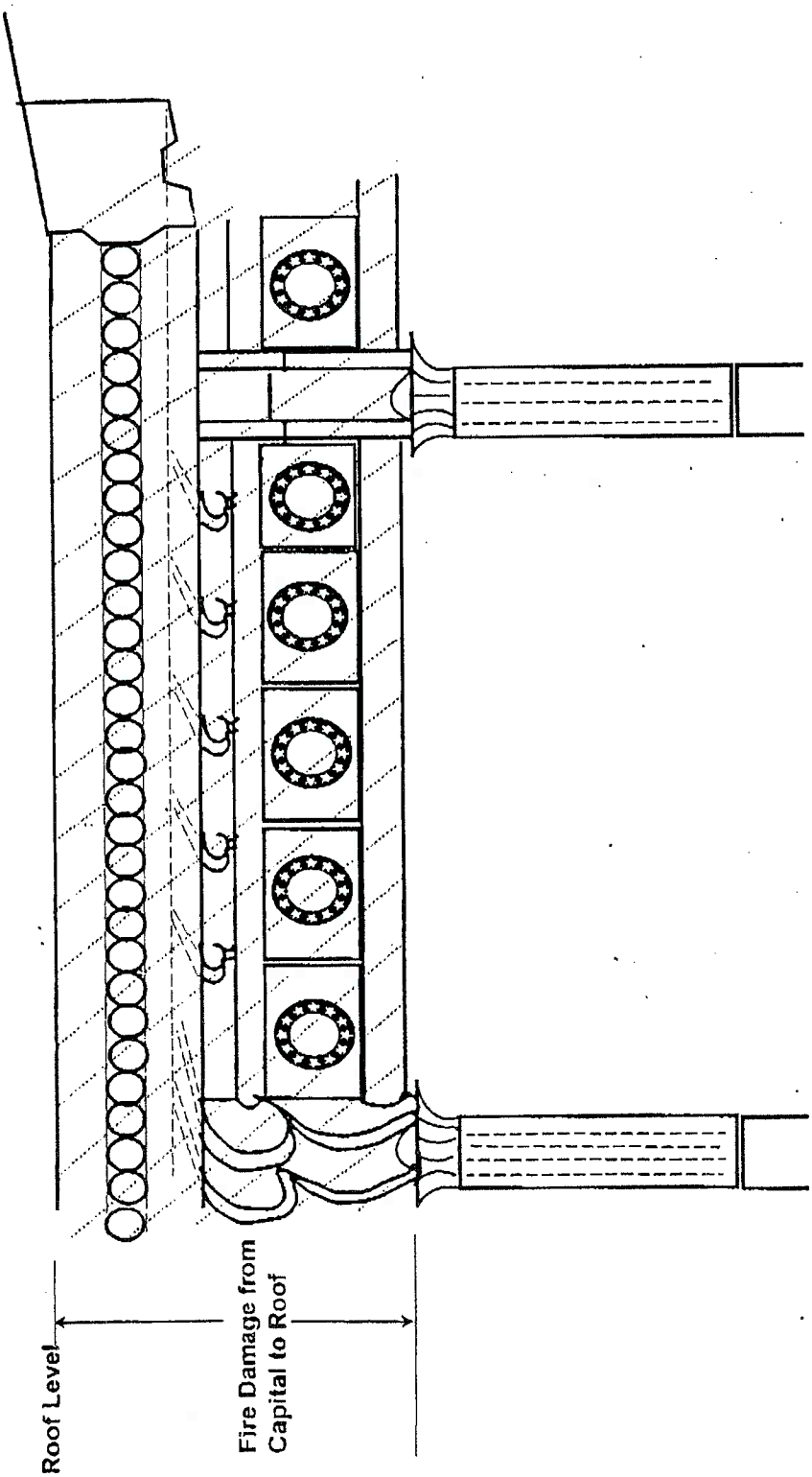
Not to Scale



Las Vegas Palace Station

Attachment 2-3

Not to Scale



Las Vegas Palace Station

Attachment 2-4

EIFS Industry Members Association
3000 CORPORATE CENTER DRIVE • SUITE 270 • MORROW, GA 30260 • 770-968-7945
FAX 770-968-5818 • WATTS 800-294-3462

THE DANGERS OF UNTESTED MATERIALS

By Stephan E. Klamke
Executive Director
EIFS Industry Members Association

All bona fide EIF systems(EIFS) consist of foam insulation board, a base coat on the face of the insulation, a glass fiber reinforcing mesh and a textured, protective finish coat. These systems have been tested for their ability to effectively resist fire, as required by all U.S. model building codes, and have performed as expected in actual fires.

However, recent fires in Atlantic City, Reno and Las Vegas involved untested materials that failed to meet the model building code requirements. Unfortunately, these materials cannot be readily distinguished by observation from fire-tested, code-approved systems.

Why might the use of untested, non-approved materials increase the risk of a fire? EPS insulation is traditionally attached to a gypsum board or concrete/masonry substrate. In a fire, these substrates act as a heat sink by slowing the temperature increase and delaying ignition. When the traditional EIFS substrate is removed, an area of combustion is created through which fire can spread rapidly. The base coat and reinforcing mesh also help to retard ignition by forming a protective barrier over the EPS. Substituting a traditional base coat and finish with untested, polyurethane-based coatings can further increase the flammability of these systems in a fire.

The type of insulation board used in an EIFS applications can also have an impact on the product's performance in a fire. For example, resistance to fire could be lowered by employing a foam plastic other than a traditional EPS board. Regardless of the type of foam insulation installed, it should never exceed the maximum thickness allowed, and it should be identical to that used in the system that was fire tested.

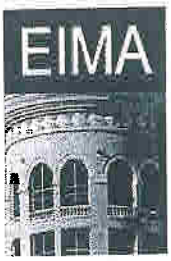
To avoid the prospect of a fire, architects and contractors who specify and install EIFS should employ only fire-tested, code-approved full EIFS on their projects.

Attached is a complete advisory report on the possible effects of using untested materials/designs.

Adopted 11/18/98

Attachment 3

APPENDIX E – EIMA POLICY–
THE DANGERS OF UNTESTED MATERIALS – 6/20/02



EIFS INDUSTRY
MEMBERS
ASSOCIATION

THE DANGERS OF UNTESTED MATERIALS

By Stephan E. Klamke
Executive Director
EIFS Industry Members Association

All bona fide EIF systems (EIFS) consist of foam insulation board, an adhesive and/or mechanical attachment of the insulation board to a substrate, a base coat on the face of the insulation, a glass fiber reinforcing mesh and a textured, protective finish coat. These systems have been tested for their ability to effectively resist fire, as required by all US model building codes, successfully passing required tests and exhibiting desired performance in actual fires. To assure good fire performance, installed assemblies must be comprised of the same components to that tested.

Sometimes assemblies are installed using untested materials and practices. Unfortunately, many untested materials and practices that resemble EIFS cannot be readily distinguished by observation from fire-tested, code-compliant EIFS systems. Such untested configurations and/or materials may fail to meet building code requirements.

Why might the use of untested, non-code complying materials increase the risk of a fire? To illustrate, EPS insulation used in noncombustible construction is traditionally attached to a gypsum board or concrete/masonry substrate. In a fire, these substrates act as a heat sink slowing the temperature increase and delaying ignition. When the traditional EIFS substrate is removed, ignition of the EPS can occur more quickly and may result in flame propagation. The base coat and reinforcing mesh have been shown to resist flame spread and also help to retard ignition by forming a protective barrier over the EPS. Substituting untested coatings such as polyurethane or polyurea for traditional EIFS base coat and finish has been shown to increase the flammability of these applications in a fire. Any modification to a tested and approved design, such as the use of polyurethane based coating or trim accessories at the heads of wall penetrations and at horizontal termination's (expansion joints) should only be undertaken after appropriate fire test(s) have been conducted to verify no adverse affects on fire performance.

The type of insulation board used in an EIFS application can also have an impact on the product's performance in a fire. For example, employing a foam plastic other than a traditional EPS board could lower resistance to fire. Regardless of the type of foam insulation installed, it should never exceed the maximum thickness allowed, and it should be identical to that used in the system that was fire tested (or listed in manufacturer's current evaluation reports.)

To avoid the potential for unsatisfactory performance in a fire, architects, and contractors who specify and install EIFS should employ only fire-tested, code approved full EIFS on their projects.

For further information, please contact EIMA's office at 800.294.3462.

www.EIMA.com
3000 Corporate Center Dr.
Suite 270
Morrow, GA 30260
Tel 770-968-7945
Toll Free 800-294-3462
Fax 770-968-5818

Adopted June 20, 2002

- EXHIBIT B -

(SEALANT INSTALLER NAME)

Completion Date:_____

THE SEALANT INSTALLED IN CONJUNCTION WITH AN EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) INSTALLED ON THE STRUCTURE LOCATED AT THE ADDRESS INDICATED BELOW:

_____ CONFORMS

TO (EIFS MANUFACTURER NAME) AND (SEALANT MANUFACTURER'S NAME) RECOMMENDED INSTALLATION PRACTICES AND SECTION(S) _____ OF ICBO ES, INC., REPORT NO. _____.

Address of Structure:

_____
_____
_____
_____

Product Component Names:

Primer(s) _____
Sealers _____
Bond Breakers _____
Sealant Materials _____

	INSTALLATION	CONFORMS
A.	Designer's requirements, details and instructions	_____
B.	Sealant manufacturer's details and requirements	_____
C.	Exterior insulation manufacturer's requirements	_____

D. The information entered above is offered in testimony that the Sealant installation conforms with the sealant manufacturer's installation methods and procedures, and the EIFS manufacturer's evaluation report.

Sealant Installer Company Name and Address:

_____
_____
_____
_____

Signature of responsible Officer: _____
Typed Name and Title of Officer: _____
Telephone Number (____)_____

cc: Original: Building Department (Must be submitted with EIFS contractor declaration.)
Copies: EIFS Manufacturer
EIFS Contractor
Sealant Manufacturer