Engineering Judgments

Date: April 18, 2018

Last Revised: January 2, 2023

Reason for Policy:
This policy describes the use of and requirements for fire protection engineering judgments.

Policy Statement:
The use of Engineering Judgments (EJ) should be guided by the following:

- EJs should only be used where tested and listed systems are not available
- EJs are generally applicable to single, specific projects
- The requirements of EJs, below, are based on VUSBC 2018 sections 722, 109.3, and 112.2

If a design team determines that an EJ is necessary, the team should prepare documentation as noted below. Engineering judgments should be submitted as shop drawings and will receive a 15-day review timeframe. Documentation should have at least the following three components:

1. A transmittal or cover letter from the Engineer or Architect of Record (EOR or AOR) stating the need for the EJ and noting why a listed system cannot be used. If the EJ is prepared by a third-party, the transmittal should indicate EOR/AOR review and approval of the third-party documentation.
2. A summary statement outlining the contents of the supporting documentation. This statement may originate from a manufacturer's technical personnel, a Professional Engineer, or an independent third-party testing agency depending on the degree of deviation from existing tested assemblies.
3. Supporting documentation for the proposed design should include locations of the installation, relevant testing information, interpolation from existing tests, expected performance criteria, and detail(s) of the installation.

Refer to the following for more information on how EJs are considered by other agencies.

- Attachment A: "Engineering Judgments Demystified." BCOM Newsletter. Issue #37. January 2018.
- Attachment B: "Recommended IFC Guidelines for Evaluating Firestop System EJs"

DEPARTMENT OF GENERAL SERVICES
BUREAU OF CAPITAL OUTLAY MANAGEMENT
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BCOM NEWSLETTER

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In this issue:

Introducing the New CR-1 Project Planner

BCOM and DPB want to simplify and facilitate the capital budget development process for other state agencies. Extremely accurate cost estimates are not as important during the conceptual budgeting phase under the "pool process" as is the need to convey the scope, program and "intent" of a project at this stage. The budget can, and will be, fine-tuned as a project progresses through the Schematic and Preliminary design phases. For pool process projects, individual project estimates just need to be "in the ball park" to help build the overall bond pool appropriation. With this in mind, BCOM has made a new tool available to assist agencies in building their project descriptions and conceptual construction cost budgets.

The new "Project Planner" form (Form # DGS-30-199 or "CR-1", for short) has been designed to assist agencies with project planning during the Capital Budget Request (CBR) development phase. The CR-1 has been formatted for consistency with DPB's Performance Budgeting (PB) System to facilitate subsequent data entry into PB. As the CR-1 is a stand-alone Excel worksheet, agencies can develop their CBRs well in advance of the date each Spring when DPB opens PB to agencies for CBR data entry. The CR-1 can be easily uploaded as an attachment in PB or archived and updated in future years simply by updating the current date. A blank CR-1 form and a completed example are both available on the DGS Forms Center. All or part of the CR-1 may be used.

The CR-1 enables agencies to "build" a project inside the form. At the heart of the CR-1 is the "Blender". As many buildings have multiple functions, the Blender blends up to three different building types (e.g.: 1/3 classroom, 1/3 dry labs, and 1/3 office) to form one composite building. Agencies simply specify the square footage of each building type and the Blender blends the costs for these different building types proportionally. The CR-1 additionally allows "lump sum" entries to make other adjustments to complete the building estimate.

Behind each of the three building types are the following:

Program: This is a simple architectural program where agencies can outline the net square footage of spaces needed. The Building Efficiency Ratio is entered for the project use, per CPSM 6.1.2.4, and the form calculates the gross square footage automatically.

Attributes: The Attributes tabs are organized into Level 1 Uniformat II categories as follows:

A. Substructure
B. Shell
C. Interiors
D. Services
E. Equipment & Furnishings
F. Special Construction & Demolition
G. Soil Conditions
H. Other Distinguishing Features

Through the use of drop-down options, agencies select the attributes of various Uniformat II categories that characterize the agency's intent for the building. For example, there are three fields in which agencies may quickly describe the key components of building shell. For example, the drop-down for this category includes these choices:

- CMU
- Stone
- Brick
- Concrete
- Curtain Wall
- Not Required (as may be the case for an interior renovation project)

There is also an open-field text box to insert additional comments relevant to each category.

Comps: The Comps tabs allow agencies to use up to three comparable projects per building type to build that portion of the project construction cost estimate. Through the use of RS Means' HCI (Historical Cost Index)*, comps are brought forward to the current date and designated city. Don't know of any comps for this project? No problem. On the "Comps" tab agencies can alternately use the square foot costs that are available for many building types in the Virginia Building Construction Cost Database. This Cost Database is available on the BCOM website.

The CR-1 is flexible too. A project can be built from numerous comps or simply by referencing one cost per square foot from the database. Alternatively, a project may be based solely on the "simple estimate" tab. The latter is particularly useful for utility-type projects where unit costs per SF are not generally relevant.

There's even a tab to include images. Images might include a photo of one or more of the comps, other buildings on campus to match in style, or simply picture of a building from the internet to represent the desired intent for the project.

The CR-1 is an easy way to document the cost and intent of your capital budget requests. For more information or assistance, please contact the BCOM Cost Reviewer assigned to your agency. ❑

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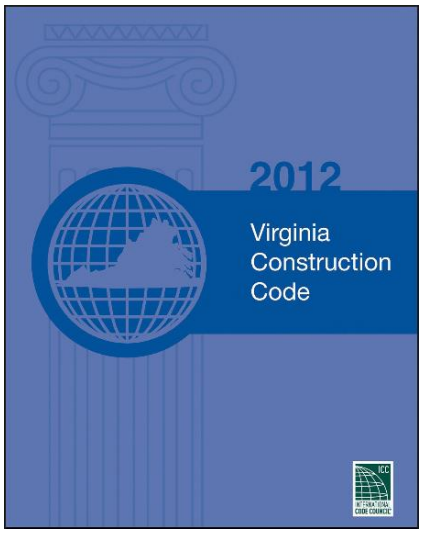
Engineering Judgments Demystified

The majority of building projects inevitably present unique design challenges where systems and construction methods fall outside of the box from a code perspective. Rather than surrendering the design intent on account of an unavoidable constraint, or worse yet, ignoring the challenge altogether and proceeding down a noncompliant path, an Engineering Judgment (EJ) could be a well-suited tool to demonstrate an equivalent level of safety to that required by the governing codes and/or assembly listings. This article is intended to remove some of the mystery by helping designers and agencies understand the premise as well as the key components of a well-documented Engineering Judgment, particularly in the realm of fire rated construction. *A/E NOTE: Straightforward code compliance is always the primary objective. Engineering Judgments, while permissible in certain circumstances, should never be thought of as a means to bypass the code as it is written. In fact, an EJ may be rejected solely due to the fact that code compliance is readily attainable without one.*



VCC 703.2 (2012 Edition) serves as the baseline for the determination of available fire resistance of building elements, components, or assemblies by requiring them to be tested in accordance with ASTM E 119 or UL 263. The resulting documentation from these fire endurance tests is referred to as a "listing" which includes specific product details and construction parameters associated with the tested specimen. When a rated wall or floor system is constructed in strict accordance with an assembly listing and in the manner specified by the relevant section of VCC Chapter 7 (e.g. VCC 707 for Fire Barriers, VCC 711 for Horizontal Assemblies, etc.), then the system is deemed to be acceptable.

In the real world, there are cases where one or more criterion included in an assembly's listing cannot be readily accommodated for a variety of different reasons. Similarly, circumstances may exist where one or more of the prescriptive requirements of VCC Chapter 7 cannot be easily achieved. Some of the most common examples of these types of scenarios are:

- A wall assembly listing is applicable only to gypsum board manufactured by the United States Gypsum Company, but the Contractor purchased National Gypsum Company gypsum board products.
- A required fire barrier wall is unable to extend to the underside of the deck above as required by VCC 707.5 due to substantial HVAC congestion within the existing ceiling space.
- A floor assembly listing utilizing spray-applied fire resistive material (SFRM) on the structural members is applicable only to wide-flange shapes, but the designer has specified HSS floor framing members.

To account for nonconforming situations such as these, VCC 703.3 contains a list of five alternative methods for the determination of available fire resistance of building elements, components, or assemblies which are either not listed or are not constructed in strict accordance with the listing criteria:

703.3 Alternative methods for determining fire resistance.

The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E 119 or UL 263. The required fire resistance of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:

1. Fire-resistance designs documented in sources.
2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in Section 721.
3. Calculations in accordance with Section 722.
4. Engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E 119 or UL 263.
5. Alternative protection methods as allowed by Section 104.11 [112.2 as modified in the VCC].

Methods 4 and 5, in conjunction with the general provisions of VCC 109.3 & 112.2, permit the registered design professional (RDP) to perform engineering analyses in order to demonstrate an equivalent level of performance for a given assembly based on the fire exposure and acceptance criteria of ASTM E 119 or UL 263. These engineering analyses form the basis of the resulting Engineering Judgment. In general, Engineering Judgments shall consist of the following three primary components:

1) Statement from the Architect of Record

A signed and sealed cover letter from the Architect of Record (AOR) shall be provided to describe the reason for and the intent of the enclosed EJ. It should define the specific code basis for the required fire rating and explain why the proposed condition cannot be constructed in accordance with the prescriptive provisions of the code and/or the assembly listing criteria. The AOR shall attest that all conditions described in the EJ are consistent with the actual conditions in the building and that, in their professional opinion, the proposed assembly will meet or exceed the required fire resistance rating.

2) Statement from the Professional Engineer responsible for the Analysis

The registered professional engineer responsible for the technical analysis shall provide a signed and sealed letter describing the nature of the analysis as well as a summary statement. This person may be the structural engineer of record, a fire protection engineering consultant, or other RDP who is qualified to address the structural performance of building components under extreme heat conditions associated with fire. This letter must state that, in the engineer's professional opinion, the proposed building element, component, or assembly will perform structurally for a period not less than the required rating duration based on the fire exposure and acceptance criteria of ASTM E 119 or UL 263.

3) Supporting Documentation

All calculations, sections, details, etc. prepared by the RDP during the engineering analysis shall be appended to the EJ in support of the proposed design. There is no specific format or list of items that must be included, but the data submitted must be sufficient to clearly support the outcome of the analysis. In certain scenarios it is necessary to include documentation from manufacturers of SFRM, fire sealants, gypsum board, etc. in order to support the types and required thicknesses of certain materials used. A common misconception is that a letter or detail from a material manufacturer can serve as a complete EJ. On the contrary, they must always accompany the responsible RDP's formal evaluation.

Ideally, conditions requiring an EJ are known during the design phase of the project. Documentation can then be incorporated into the Working Drawings package either directly onto the drawing sheets or as an appendix to the Project Manual. However, it is not uncommon for conditions to surface during the construction phase, particularly in renovation projects. In this case, it is often most expeditious to submit the complete EJ to BCOM as a standalone document. On larger projects, there are typically numerous EJs, rated assembly listings, joint systems, etc. Therefore, it is highly recommended that the Contractor maintain a separate, continually updated binder of all fire rated construction details. This practice helps to ensure that all rated assemblies are constructed properly and also serves to facilitate a much smoother inspection process.

The key thing to remember when it comes to Engineering Judgments is this: **BE PROACTIVE**. The development of an EJ can be a time-intensive exercise requiring input from multiple parties, including review and approval by BCOM. Be on the lookout for potential conditions that may ultimately require an EJ and get the ball rolling as early as possible, preferably during the design phase. As always, please contact your BCOM fire safety reviewer at any time to discuss specific project scenarios. Successfully implemented Engineering Judgments can contribute significantly to a project being completed on schedule and within budget. ❑

VCCO Certifications

Congratulations to the following individuals who recently passed the VCCO Certification Exam:

- **Kim Bass**, Longwood University
- **Rachelle Black**, Virginia Tech
- **Harold Caples**, Virginia Department of Transportation
- **Kathy Pinskey**, George Mason University

Virginia Construction Contracting Officers are state and local government employees who have completed the necessary training and successfully passed a multi-part examination focused on state procurement law, policy and procedures. VCCOs perform several key functions in delivering projects including the procurement of professional services; the receipt, opening and review of bids; and in some cases the approval of CO-8 forms for recommending the award of construction contracts.

For more information on CPSM and VCCO seminars, visit the Seminars page on the Bureau of Capital Outlay Management's website. ❑

CPSM Forms Update

The following new or revised forms are available from the DGS Forms Center:

- **CPSM Forms Master List** (DGS-30-000)
- **Project Planner** (DGS-30-199, aka CR-1) and completed example

INTERNATIONAL FIRESTOP COUNCIL
THE Source of Firestop Expertise®

Recommended IFC Guidelines for Evaluating Firestop System Engineering Judgments

About the IFC

The International Firestop Council (IFC) is a not-for-profit association of manufacturers, inspectors, and users of fire protective materials and systems. IFC is *THE* Source of Firestop Expertise that provides impartial and authoritative information, knowledge, resources, affiliation, techniques, and testing, to key stakeholders with an interest in passive fire protection (e.g. AHJ's, contractors, manufacturers, other associations, fire services, owners, engineers, architects) because of our commitment and investment in industry research, development, testing, codes and standards advocacy, and manufacturing and unbiased and broad-based knowledge and representation. These recommended guidelines are presented as part of IFC's educational information program. They are intended for informational and educational purposes.

The Premise of Firestop Systems

Firestop systems deter the passage of fire, hot gases and toxic smoke through openings in walls, floors and floor/ceiling assemblies for through penetrations, membrane penetrations, joints, blanks, gaps, voids and ducts. These systems are required by building codes to be tested and rated as part of an assembly in accordance with an approved test standard. Some of these are tabulated below:

Fire Test Standards Commonly Referenced in Codes	
Application	**Test Standard**
Service penetrations (e.g. pipes, cables, ducts)	ASTM E814, UL1479, CAN/ULC-S115, EN1366-3, EN 1366-5, ISO 10295-1
Joint System	ASTM E1966, UL2079, CAN/ULC-S115, EN1366-4, ISO 10295-2, BS 476 Part 20
Perimeter Joint Firestops (e.g. exterior wall/floor intersections)	ASTM E2307, EN 1366-4
Continuity Head-of-Wall Joints (e.g. rated wall to non-rated floor/roof intersections)	ASTM E2837
Grease Ducts	ASTM E2336, UL2221, CAN/ULC-S144, EN1366-1, AS1530.4
Ventilation Ducts	ASTM E2816 (AC179), ISO 6944, EN1366-1, EN1366-8, AS1530.4

All elements of a tested and rated firestop system, including the assembly into which the system is installed, constitute a specific and inseparable engineered unit that must be utilized as such. Firestop system designs are tested and listed by independent testing agencies such as Underwriters Laboratories, Inc. (UL), Underwriters Laboratories of Canada (ULC), and Intertek. The specific elements of each design become integral to the listing.

When field conditions differ from original design or unanticipated construction hindrances are encountered and the field conditions cannot be easily or cost effectively redesigned, design recommendations are typically made to propose alternative methods that ensure performance of the firestop system is not compromised. These are sometimes referred to as “Engineering Judgments or EJs”, although other terms may apply dependent upon local practice. Since these recommendations are not based upon identical designs as that which were fire tested, it is important that they be developed using sound engineering principles and good judgment.

Construction industry professionals, building officials, fire officials, firestop contractors and other stakeholders need appropriate guidelines for evaluating and using such judgments. As such, IFC developed *Recommended IFC Guidelines for Evaluating Firestop Systems Engineering* Judgments (EJs).

IFC EJ Guidelines

EJs for firestop systems should:

1. Not be used in lieu of tested systems when available;

2. Be issued only by a firestop manufacturer’s qualified technical personnel or in concert with the manufacturer by a knowledgeable registered Professional Engineer, Fire Protection Engineer, or an independent testing agency that provides listing services for firestop systems;

3. Be based upon interpolation or extension of previously tested firestop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g. ASTM E 2032 – Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E 119, ULC Subject C263E – Criteria for Use in Extension of Data from Fire Endurance Tests, or ASTM E2750 – Standard Guide for Extension of Data from Penetration Firestop System Tests Conducted in Accordance with ASTM E814) may also be used as further support data;

4. Be based upon full knowledge of the elements of the construction to be protected and the understanding of the probable behavior of that construction and the recommended firestop system protecting that construction if it was subjected to the appropriate Standard Fire Test method for firestops for the rating indicated on the EJ;

5. Be limited only to specific conditions and configurations upon which the EJ was rendered and should be based upon reasonable performance expectations for the recommended firestop system under those conditions;

6. Be accepted only for a single, specific job and project location and should not be transferred to any other job or project location without thorough and appropriate review of all aspects of the next job or location's circumstances.

Basic Presentation Requirements

Proper EJs should:

1. Be presented in appropriately descriptive written form with or without detail drawings where appropriate;

2. Clearly indicate that the recommended firestop system is an EJ;

3. Include clear directions for the installation of the recommended firestop system;

4. Include dates of issue and authorization signature as well as the issuer's name, address and telephone number;

5. Reference tested system(s) upon which design (EJ) is based on;

6. Identify the job name, project location and firm EJ is issued to along with the non-standard conditions and rating supported by the EJ;

7. Have proper justification (i.e. UL, ULC, Intertek, SWRI or other independent laboratory system(s) and or opinions);

8. Provide complete descriptions of critical elements for the firestop configuration. These should include, but not be limited to the following:
   a. Basic, Common
      - Type(s) of assembly used or being penetrated;
      - Rating supported by the EJ.

   b. Through Penetrations
      - Penetrating item(s) (type, size, etc.);
      - Annular space requirements, (minimum, maximum, actual, nominal, etc.)
      - Opening size;
      - Firestop product(s) to be used, type and amount (thickness if applicable);
      - Accessory items(s) (i.e. anchors, backing material, etc.)

   c. Joints
      - Joint Width (installed width, nominal)
      - Movement Capability;
      - Movement Class (thermal, wind sway, seismic);
      - Accessory item(s) (i.e. insulation type, thickness and compression, etc.)

   d. Duct Enclosure Systems
      - Duct System Type (i.e. kitchen exhaust, hazardous material exhaust, ventilation, supply/return, etc.);

- Duct Construction – dimensions, material, gauge, reinforcement, connections, orientation (horizontal, vertical or both);
- Enclosure System – brand name designation, description, fire resistance rating;
- Thickness, density, number of layers, fire rating, clearance to combustibles, material joints, mechanical attachment to duct, duct support system, access door construction.
- Firestop System – annular space dimensions, floor/wall construction, design number, components, installed thickness.

e. Perimeter Fire Barrier Systems
   - Type(s) of assembly used (i.e. Glass, Aluminum, Granite, Concrete, etc.)
   - Hourly rating required
   - Closest Listed System upon which the EJ is based.
   - Joint Width
   - Static or Dynamic
   - Safing Insulation Type(s), thickness and compression, etc.
   - Curtain Wall Insulation Type(s), thickness (if required).
   - Five Basic Principles
     1. Mechanical Attachment of the Spandrel Insulation
     2. Protection of the Mullions
     3. Compression fitting and orientation of the Safing Insulation
     4. Installation of a Reinforcement Member(s), stiffener, at the safe- off area behind the spandrel insulation.
     5. Firestop Coating, type, thickness

f. Continuity Head-of-Wall Joints
   - Joint Width (installed width, nominal)
   - Movement Capability;
   - Movement Class (thermal, wind sway, seismic);
   - Accessory item(s) (i.e. insulation type, thickness and compression, etc.)

IFC recommends that these guidelines be considered when evaluating whether any firestop system EJ meets minimal requirements. Questions concerning the EJ request should be addressed to the initiator of the design recommendation.