# (106) Documentation of Complex Building Enclosures

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## ABSTRACT

Modern buildings are a combination of high performance materials, assemblies, and sub-systems that must function together as a complete and interrelated system. The solutions must be tailored to the needs of the client, environmental conditions, and the design vision for the project. How can architects organize and document the various components of the building to ensure they will work seamlessly together? Perhaps more importantly, how can we convey that information to the owner, third party reviewers/approvers, and the contractor in a way that clearly conveys the dependencies and interrelationships of a high performance building enclosure while also supporting the overall design of the building? This paper discusses methods for communicating the prescriptive requirements and the “Design Intent” of the building enclosure.

In construction, the phrase “Design Intent” is considered taboo. Contractors carry scars from architects who have relied upon this phrase to make the contractor perform work they do not consider within their scope. The inherently diagrammatic nature of design documents and the precise nature of a bid environment, make this scenario far too common. “Design Intent”, though, does not have to be a dirty word. We have reconsidered the use of “Design Intent” and propose that it can actually benefit all parties involved in a project if used correctly. If one acknowledges that contractors can’t bid or build what they don’t understand then it follows that they can bid and build what they do understand. We have spent the last several years developing a methodology for explaining the project priorities and critical design criteria that will set the contractor up to successfully implement the designer’s vision and meet the owner’s expectations.

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## INTRODUCTION

The construction industry is slow to change. Contractors and sub-contractors spend years perfecting their craft and refining their methods to work efficiently and effectively. The prevalence of a bid environment demands this streamlined approach. When contractor's bid on work they create estimates of cost and time based on their understanding of the contract documents and assumptions from past experience. Architects designing on the leading edge often employ new detailing approaches and technologies to meet project goals. This can present challenges to contractors who are preparing a bid if they do not fully understand the degree to which they are being asked to change their methodologies. It benefits the contractor, owner, and designer to reduce these misunderstandings.

Architects and contractors have a symbiotic relationship. Neither can function without the other. This mutual need is often obscured by the inherently adversarial nature of the construction process, which is why a positive relationship should be nurtured beginning with the bid process. As designers, it is incumbent on architects to not only share ideas with each other, but also to communicate and share ideas with the contractors who will ultimately execute the work.

Drawings should be produced to categorize the building assemblies in a clear and legible manner. "Design Intent" and "assembly" drawings can aid this effort by describing the overall approach to systems integration at a fundamental level. These documents should not be boilerplate, but must convey the actual Design Intent for the specific project. Additional details must also be created that show the application of this intent at unique conditions in the building so that the means of constructing the final desired result is clearly explained. These should all be based on, and reference, the assembly details and Design Intent details.

Likewise, specifications should also convey an overall design intent with regard to system results and quality expectations. These documents traditionally describe individual work products, or components, that must clearly convey the requirements of each specific scope of work. By deciding on a clear strategy for the overall systems, appropriate information can be coordinated into the individual specification sections and related back to the assembly and Design Intent drawings.

Meetings can also be a valuable tool for continuing to foster the symbiotic relationship between contractor and architect and can help with executing complex information into a common result. In a negotiated, or CM delivery, the overall approach to the design of the building enclosure can be determined collaboratively during the design process. A similar benefit can also be provided for jobs that are bid by a general contractor. During the bidding phase, an element of the pre-bid meeting can include a presentation to bidders of the design intent behind the building enclosure along with an explanation of the documentation and expectations. Once construction contracts are awarded, a more detailed presentation can be made to review basic scientific principals and

resulting methodologies behind the design decisions. This training should be done for the actual installers who will be working for all trades involved in the building enclosure. Additional meetings to coordinate and review shop drawings are useful and should be similarly employed. Finally, meetings should be held to discuss the mock up and testing as a group to ensure that all parties work collaboratively and understand the overall objectives and design intent.

## HISTORY AND APPROACH

In 2007, we began planning for a firm migration to BIM. We recognized that BIM was not just another drafting software, but represented a fundamental paradigm shift in project documentation. Rather than force the BIM software to conform to our methodologies, we used this opportunity to rethink our approach to our documentation as a whole.

We began to create a Manual Of Practice (MOP) for the firm which clearly defined our process. The move to BIM was the perfect opportunity to retrain our entire staff to a more sophisticated documentation approach. We used the National Cad Standard as a baseline guide for organization and followed the traditional CSI mantra “Say it once. Say it in the right place. Never say it again”. We looked at all aspects of what we do beyond just the building enclosure.

Throughout this process, we talked to contractors, sub-contractors, suppliers, estimators, owners, and other architects. We learned that as our designs have become more sophisticated and our documents more complex, there was something missing. Our documents were technically accurate and defensible, but other parties didn’t understand the overall intention of our design. We found ourselves addressing change order claims not from errors in our documents, but from errors in the bidding. Sub-contractor’s stated that they didn’t understand how differently we expected them to work.

As a result, we began to develop methodologies for defining our Design Intent in a way that was clearly communicated and fully enforceable without creating confusion. In order to accomplish this, we had to create clear boundaries. We would not use Design Intent documentation as a way of pushing our responsibilities onto other parties. We would instead use Design Intent documentation as a way of allowing contractors flexibility where it was appropriate while still maintaining the desired outcome. This leeway is employed in a coordinated way throughout all of the documents, including both drawings and specifications, to the greatest extent possible.

**WHAT IS "DESIGN INTENT"**

A search for an industry accepted definition for this term yielded no positive results, so we created our own definition:

> *Design Intent Documentation is a method of communicating project requirements in which boundaries are clearly defined in terms of performance, aesthetics, sequence, and expectations, while allowing for a variety of products and installation methods to achieve the desired result. A wider range of graphic techniques can be employed in design intent documentation than in traditional construction drawings.*

In general, Design Intent Documentation:

1. Can be 2D or 3D
    a. Traditional 2D drawings still work well. In many cases, Design intent documentation looks similar to scope of work drawings even though they convey information differently and at a more fundamental level.
    b. BIM facilitates working in the 3D world by making it easier to convey design intent in 3D if that is more appropriate. Caution should be used, not to show information in 3D if the added depth of view does not provide additional clarity.
2. Is different from "delegated design"
    a. Delegated design actually cedes responsibility for a portion of the design to a licensed design professional employed by the contractor who is an expert in that particular specialty. The formal submission must be signed and sealed. There are several areas where this is traditionally done and we don't recommend trying to expand upon that core approach.
    b. Design intent maintains the responsibility for the design with the design team, but allows the contractor some flexibility to use their knowledge and experience to adjust means and methods. Signed and sealed drawings are not required and the architect maintains final approval as the design professional.
3. Usually addresses sequence and/or means and methods
    a. Design intent documentation may demonstrate that the intent is for the work to be installed in a particular sequence, or it may explain that multiple options for sequence exist, demonstrating that the contractor has an option.
    b. Design intent documentation often will allow for different means and methods to be employed, communicating the end results which are the priority for the design.
4. Is tied to minimum performance requirements
    a. Specifications and drawings will list the requirements that help us to measure the viability of any proposed approach. This can be a dimension, water or air tightness, configuration, degree of thermal bridging or other critical criteria.

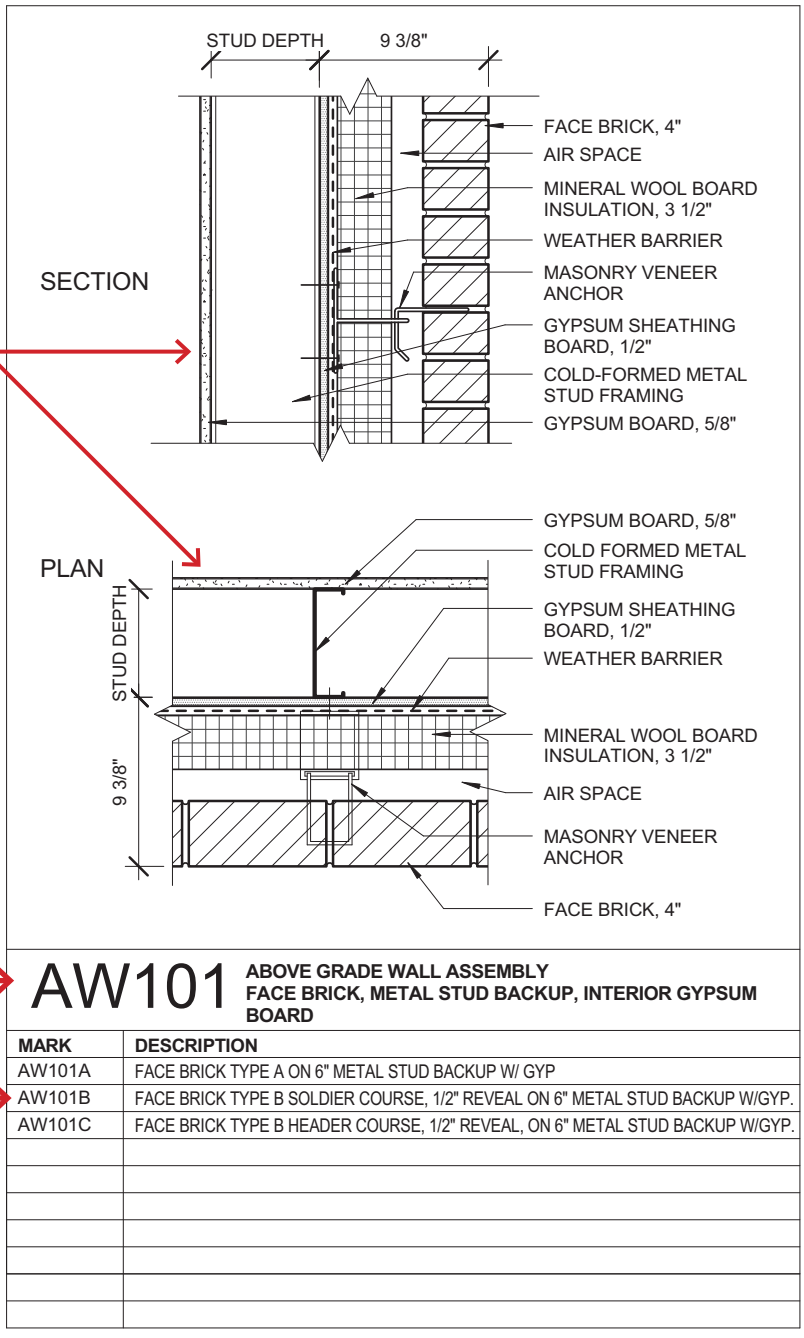
5. Should be vague only where the vagueness is intentional.
    a. Design intent documentation by its nature will often leave out some information in order to allow for multiple approaches to sequence or means and methods. The “missing” information should be intentionally omitted for greater clarity, not simply undefined criteria.
    b. The overall expectation should be very clear. It is often necessary to fully document all expectations in some form and then edit out what is to be intentionally left vague.
6. Should be known to work.
    a. Design intent documentation requires the design team to fully vet their proposed solution to know that it is viable and can be executed in various building conditions and with each of the specified products. This is more work than traditional documentation, though the point is to improve quality, not to reduce effort.
    b. Design intent documentation should not be used to design a project during shop drawings. The submittal process is about verification, not creation. Do not issue Design Intent drawings hoping that the contractor can work it out.

**DRAWINGS**

Drawings should of course include plans, sections, elevations and details to show how the building is to be built. However additional drawings can be provided that illustrate the Design Intent for the project. These drawings globally describe the end product that is desired in several ways. While these are very valuable in bidding and construction documents, they can also be helpful in the early design stages. Design intent documents can be used to clearly illustrate the designer’s proposed approach to the owner, estimator or CM to achieve buy in at early stages.

1. Assembly Drawings: We maintain a library of Assembly Details. These details have been prepared to reflect good practice, comply with firm recommendations and coordinate with the firm’s Master Specifications.
    a. Each assembly is defined by a detail which shows all of the elements of that assembly in plan and section so that it can be referenced throughout the documents without the need to repeat any of the notes. (Figure 1).
    b. Assembly details are used to define the elements of construction throughout plans, elevations, sections and details. (Figure 2).

Graphic Illustrations




Assembly Name and Description

**AW101** **ABOVE GRADE WALL ASSEMBLY**
**FACE BRICK, METAL STUD BACKUP, INTERIOR GYPSUM BOARD**

Schedule of Options and Variations

| MARK | DESCRIPTION |
|---|---|
| AW101A | FACE BRICK TYPE A ON 6" METAL STUD BACKUP W/ GYP |
| AW101B | FACE BRICK TYPE B SOLDIER COURSE, 1/2" REVEAL ON 6" METAL STUD BACKUP W/GYP. |
| AW101C | FACE BRICK TYPE B HEADER COURSE, 1/2" REVEAL, ON 6" METAL STUD BACKUP W/GYP. |
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Figure 1

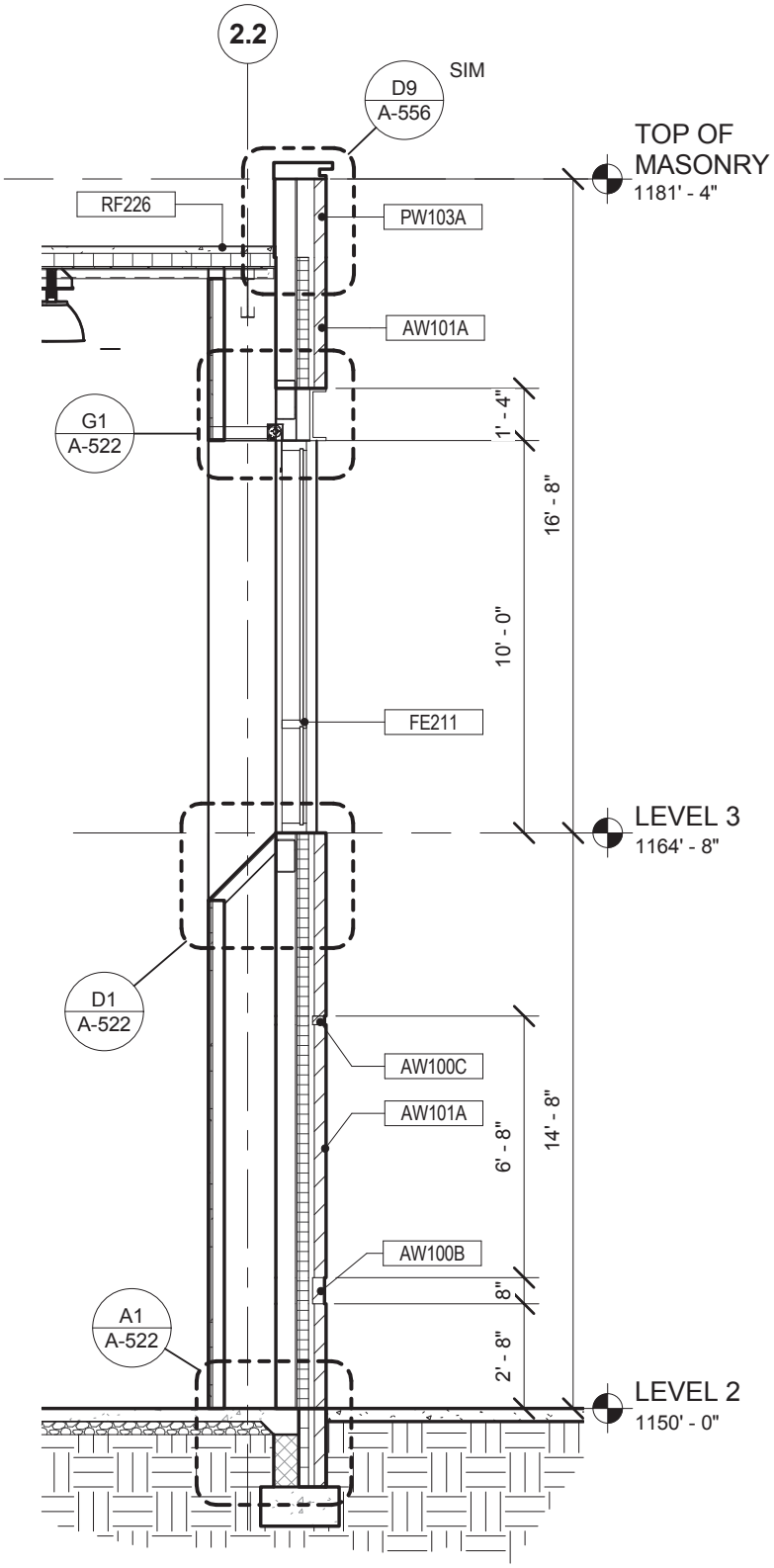

2.2
D9
A-556
SIM
TOP OF
MASONRY
1181' - 4"
RF226
PW103A
AW101A
G1
A-522
1' - 4"
16' - 8"
10' - 0"
FE211
LEVEL 3
1164' - 8"
D1
A-522
AW100C
AW101A
6' - 8"
14' - 8"
AW100B
8"
A1
A-522
2' - 8"
LEVEL 2
1150' - 0"

Figure 2

2. Design Intent Drawings: We use Design Intent Drawings to illustrate the project objectives for a variety of building systems. The following are examples of some systems we have defined using Design Intent Drawings:
    a. Flashing details. This sheet illustrates how a window opening is to be sealed to the weather barrier for a masonry wall. It includes a description of each component along with diagrams to show the proper sequencing of the work to achieve the desired final effect. Notes are included that explain the purpose of these drawings and how they are to be applied in construction. Each exterior detail on the project refers back to this sheet for proper installation of flashing. (Figure 3).

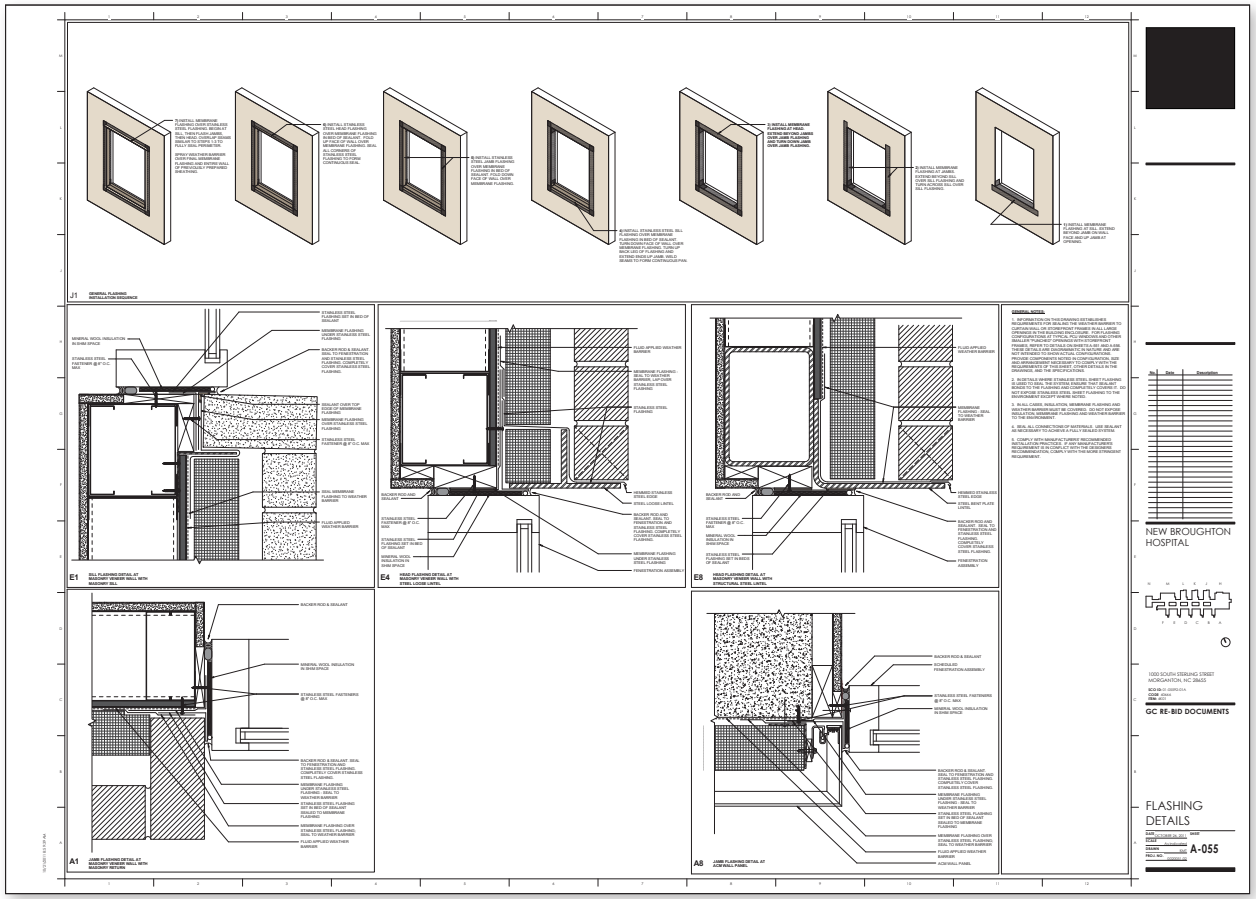



Figure 3

b. Masonry Coursing: This sheet illustrates how individual pieces of stone are to be installed to achieve the desired pattern. Another sheet defines the dimensions of each stone shape so that the contractor can fully understand how the desired look is to be achieved. The work shown on this sheet was extensively reviewed with each of the specified suppliers to ensure that it was achievable considering differences between manufacturers, tolerances, and installation techniques. (Figure 4).

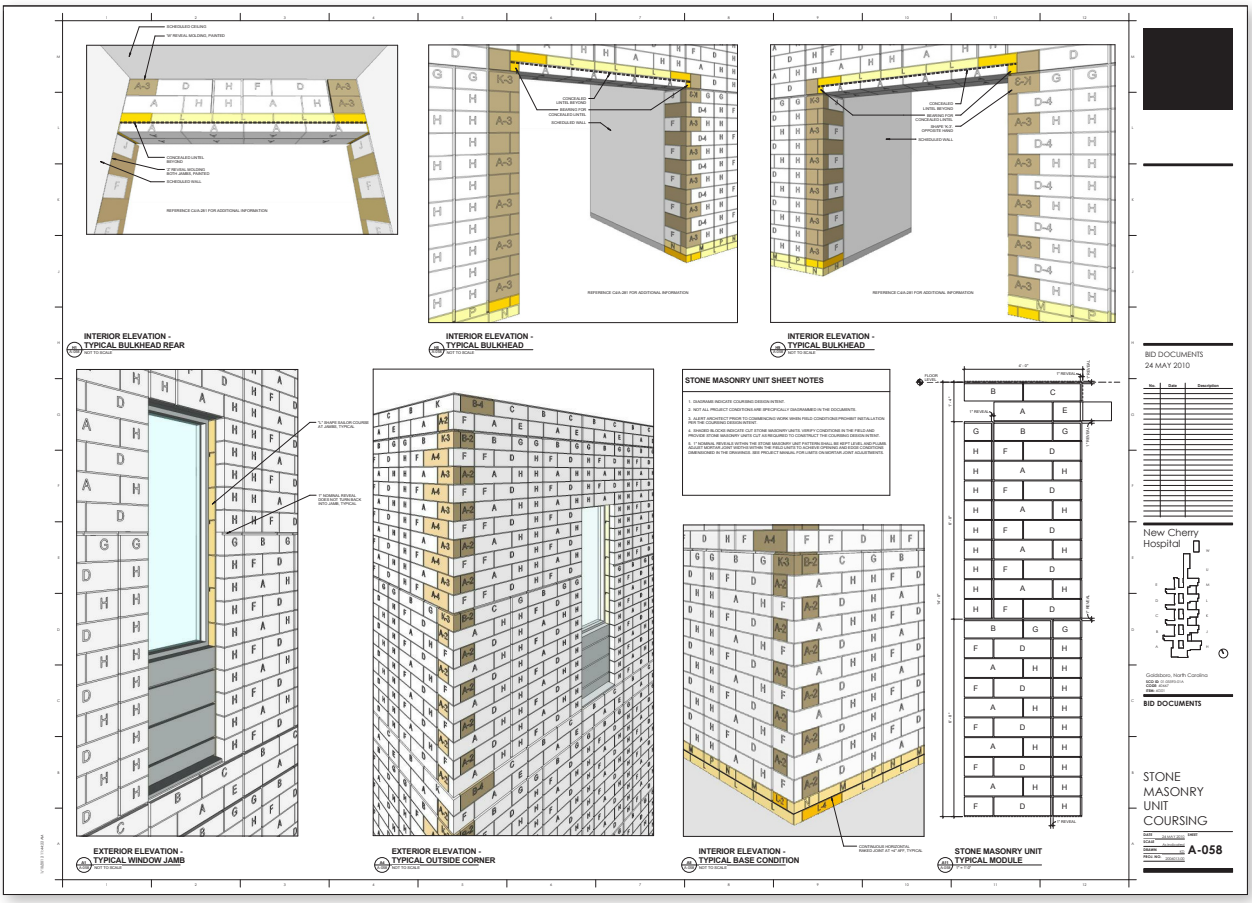



Figure 4

c. Metal Panels. This sheet illustrates how the sheet metal trim is to be configured to achieve the desired look for a zinc clad wall. Each of the specified manufacturers had a different approach to how they install trim. Rather than detail around one option, leaving the others to worry that their details may not be acceptable; we left the details vague enough to allow for multiple approaches by illustrating the desired finished product. The work shown on this sheet was extensively reviewed with each of the specified suppliers to ensure that it was achievable. (Figure 5).

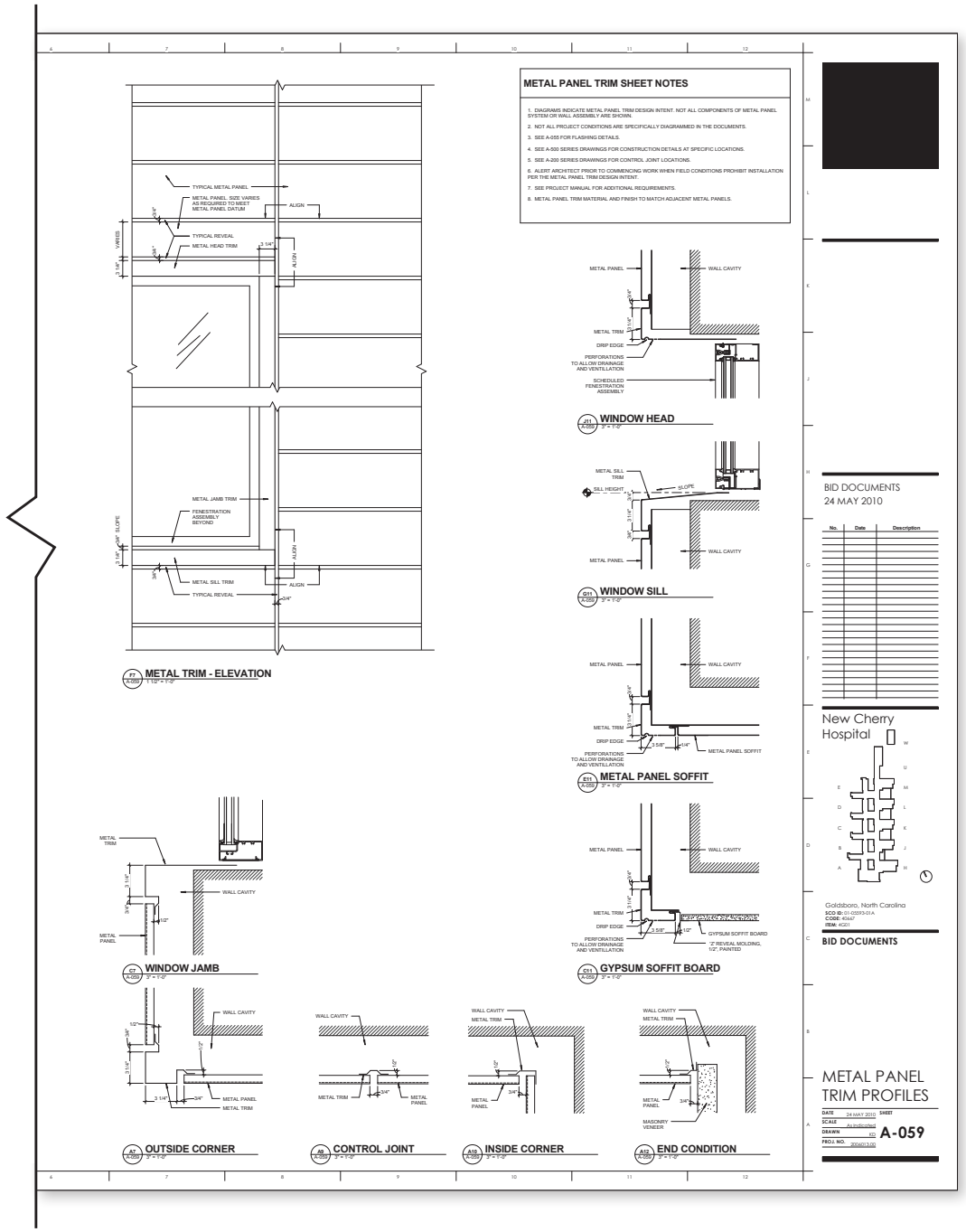



Figure 5

d. Mock up. This sheet illustrates the configuration of a project mock up that connects the requirements for the mock up to the actual project details. Doing so ensures that the intent for the mock up is clearly conveyed as being directly tied to the actual building conditions and details. Once the mockup is constructed, the appropriate details have been constructed, discussed, and are ready for the contractor to execute within the building with an understanding of the design intent. (Figure 6).

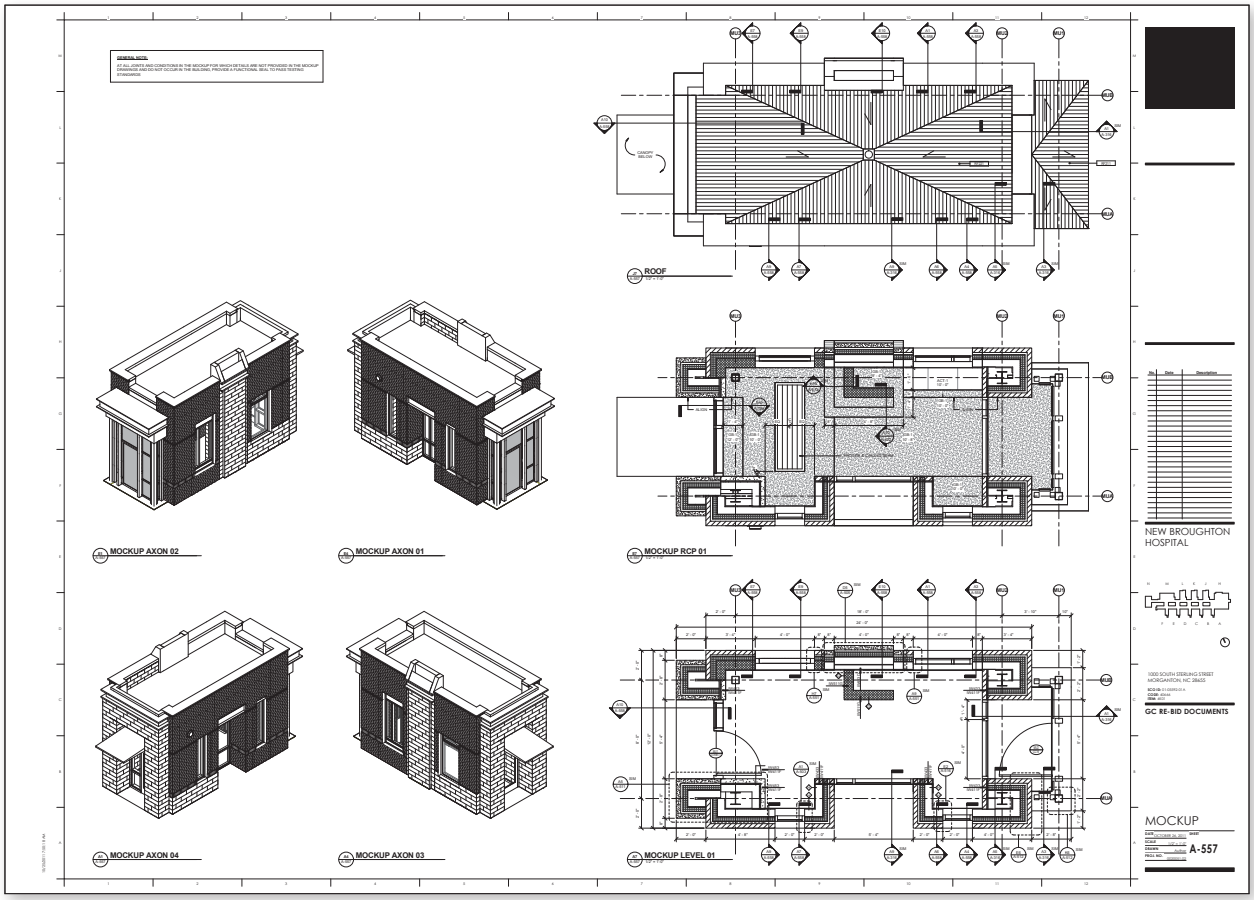
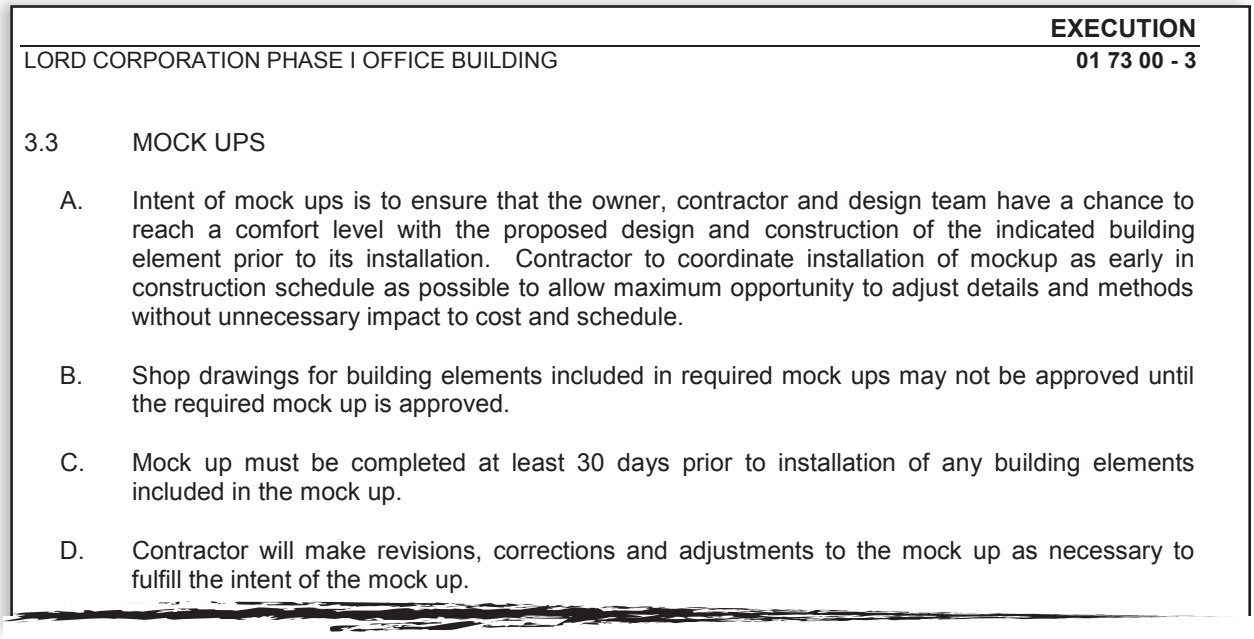



Figure 6

## SPECIFICATIONS

Project specifications can do more than just list the products and materials to be used in the project. They should complement the drawings to fully communicate the Design Intent. By thoroughly describing the desired outcome of systems, the contractor can fully understand the Design Intent in order to bid and plan the work effectively.

1. Division 1
    a. Work that is described using Design Intent drawings should be referenced in division one.
    b. Requirements for testing should be referenced.
    c. Requirements for sequencing should be described.
    d. If the project will include Building Enclosure Commissioning, those requirements should be included and coordinated with Design Intent documents
2. Mock up (Figure 7)
    a. Work that is described using Design Intent documents should be included in a building enclosure mock up.
    b. Specifications should include requirements for timing of mock up
    c. Specifications should include requirements for testing of mock up
    d. Specifications should include a description of the Design Intent of the mock up.



**EXECUTION**

LORD CORPORATION PHASE I OFFICE BUILDING **01 73 00 - 3**

3.3 MOCK UPS

A. Intent of mock ups is to ensure that the owner, contractor and design team have a chance to reach a comfort level with the proposed design and construction of the indicated building element prior to its installation. Contractor to coordinate installation of mockup as early in construction schedule as possible to allow maximum opportunity to adjust details and methods without unnecessary impact to cost and schedule.

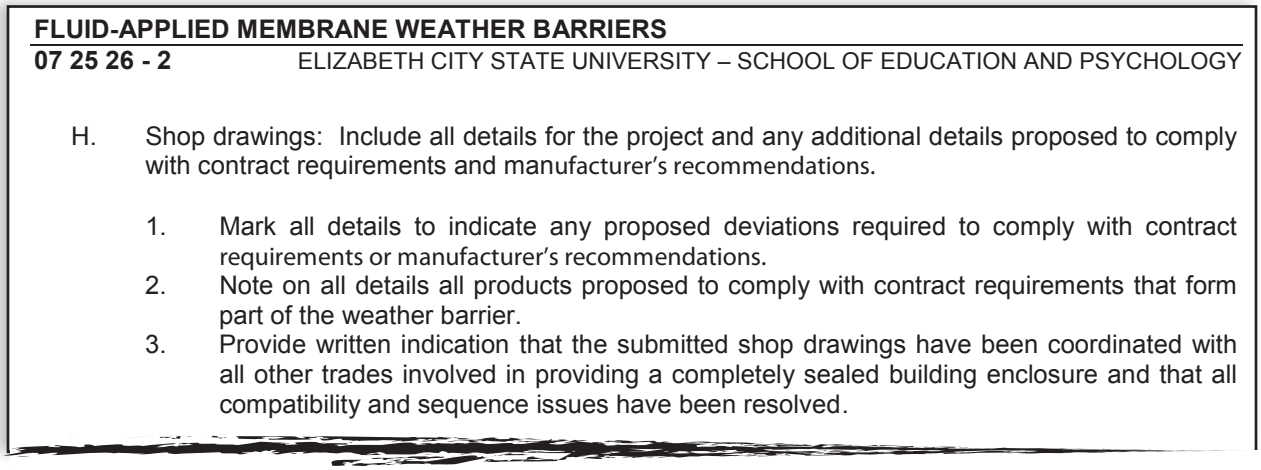
B. Shop drawings for building elements included in required mock ups may not be approved until the required mock up is approved.

C. Mock up must be completed at least 30 days prior to installation of any building elements included in the mock up.

D. Contractor will make revisions, corrections and adjustments to the mock up as necessary to fulfill the intent of the mock up.

Figure 7

3. Specification sections coordinated with Design Intent Drawings (Figure 8).
    a. Each section describing work that is documented using Design Intent drawings should include minimum performance requirements as appropriate to the scope of work. This may include thickness of material, minimum loads or spacing of attachments, tolerances or other critical information that has been reviewed and vetted with all specified suppliers.
    b. Each section describing work that is documented using Design Intent drawings should require shop drawings. The shop drawings illustrate how the contractor will comply with the minimum performance requirements and the illustrated Design Intent. In many cases, the contractor may not be accustomed to providing these shop drawings, so the submittal requirements should be very clearly communicated.



**FLUID-APPLIED MEMBRANE WEATHER BARRIERS**
**07 25 26 - 2** ELIZABETH CITY STATE UNIVERSITY – SCHOOL OF EDUCATION AND PSYCHOLOGY

H. Shop drawings: Include all details for the project and any additional details proposed to comply with contract requirements and manufacturer's recommendations.

1. Mark all details to indicate any proposed deviations required to comply with contract requirements or manufacturer's recommendations.
2. Note on all details all products proposed to comply with contract requirements that form part of the weather barrier.
3. Provide written indication that the submitted shop drawings have been coordinated with all other trades involved in providing a completely sealed building enclosure and that all compatibility and sequence issues have been resolved.

Figure 8

**MEETINGS**

While documentation is the key to bidding and enforcement, meetings can have a key role in fully communicating the Design Intent to contractors.

1. Pre-bid
    a. If a Construction Manager is involved during the design and documentation phases, the Design Intent of the building enclosure should be discussed and collaboratively resolved to ensure that all parties are comfortable with the approach to sequencing and installation. On a recent project the CM determined that the most efficient schedule would allow the cladding to start before the fenestration, but that the fenestration would quickly overtake the cladding and be held up by it. In response to this, we designed a window sealing approach that allowed either the cladding or the fenestration to be installed first so that the fenestration could continue and get ahead of the cladding. This not only helped the schedule, but also reduced the cost of both the fenestration and cladding because both sub-contractors knew that they would be able to work efficiently without starting and stopping to wait for the other.
    b. When the project will be bid to General Contractors, the pre-bid meeting is an excellent opportunity to explain the Design Intent for the building enclosure and also to explain how Design Intent documentation has been used to document the project.
    c. Pre-bid meetings should be carefully documented so that a record exists of any decisions or notifications given. This will help with enforceability later and will ensure that due attention is given to the issue.
2. Pre-submittal. Before the contractor begins assembling the submittals for the mock up and project, a meeting can be held to explain the Design Intent and make sure that everyone understands it. This is similar to the pre-bid meeting, except that it can be more collaborative. You can discuss the specifics of each product and verify that all parties understand the Design Intent and how they are to document that understanding through shop drawings.
3. Mock up. The mock up is the ideal opportunity to make sure that all parties fully understand how to provide a complete building enclosure that meets the Design Intent. Meetings and reviews should be held during and following installation of the mock up and the results should be checked against initial expectations. It is common to find that several parties were using the same words, but still not all understanding the same thing. Through the mock up process, the Design Intent becomes more real and it can serve as a tangible example of the Design Intent.
4. Pre-installation. Once the mock up is complete and all issues have been resolved, a meeting can be held to discuss what was learned and make sure that all sub-contractors have a clear plan on how they will implement the project per the Design Intent. The contractor will then have a more clear understanding of the final result and quality control procedures. As the designer we can use our understanding of the systems to help the contractor make decisions that will set them up to be successful.

## CONCLUSION

We are all aware of the often cited statistic that the majority of claims against designers are related to moisture related failures, many of which are blamed on designer's errors and omissions. However, not all errors and omissions are a result of the designers failure to understand the building enclosure. Many are a result of the designer's failure to fully document or explain the building enclosure.

The key to reducing construction errors and claims is good communication. As designers, we must do all that we can to make sure that the contractor fully understands what is expected when they bid the work and when they perform the work. It is likewise in the contractor's best interest to do a good job on the building enclosure to eliminate rework, reduce call backs and avoid being involved in claims. While it runs counter to long standing traditions in the design community, clearly and intentionally documenting Design Intent is an effective way of giving the contractor what they need to perform the work well, thereby achieving a successful job that benefits the owner, contractor, and designer.