SE 2050 CLASSIFICATION SYSTEM

Organization of Structural Material Quantities for the SE 2050 Commitment

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A White Paper by the Structural Engineering Institutes' SE 2050 Subcommittee

Contents

EXECUTIVE SUMMARY

Building classification systems are in wide use in many different countries and were developed and used for several different reasons at different times. In recent years, the sharing of information and tracking of environmental impacts of our buildings has increased dramatically emphasizing the need for a clear, concise, and consistent methodology to classify building components that includes consideration of those impacts. This paper presents a proposed classification system for the standardization of reporting structural material quantities for tracking embodied carbon impacts of structural building systems as well as to help with material efficiency comparisons.

The proposed classification includes a taxonomy table and unique alpha-numeric code to allow sorting of various components and storage in a structural component database. This paper presents the methodology of development, relevance, and significance to LCA results, and the rationale for not using an existing classification system. A suggested mapping between established building classification systems is provided to allow for broad adoption without disruptive changes to existing building classification standards actively in use today.

However, this is a *living document,* meaning we expect the system presented will evolve as our profession becomes more versed with embodied carbon calculations, as we find technologies and tools that improve integration and efficiencies in performing the work, and as we learn how to strengthen the feedback loop wherein *how* we report embodied carbon can help us improve our designs.

INTRODUCTION

The SE 2050 Commitment Program was launched in late 2020 in response to the SE 2050 Challenge stating that, in effect, all our structural systems shall be net-zero embodied carbon by the year 2050. The Challenge was issued as a necessary piece of the larger global push for carbon neutrality by 2050 (and now some say needed before 2050) to mitigate major irreversible and detrimental changes to our climate. With this recognition there has been a drastic, and necessary, level of attention on the global warming impact of our building materials and construction or the so-called embodied carbon impacts locked into the system on the first day of occupancy.

The main aims of the SE 2050 Commitment are to educate structural engineers on the embodied carbon impacts of the building materials they specify and the structural systems they design, provide resources of sustainable structural design best practices and advocacy and provide a means to quantitatively track the embodied impacts of real projects. To achieve net-zero embodied carbon the Program will use the collected data on structural systems and establish aggressive yet reasonable targets for reduction.

For years, the structural engineering profession was not thought to be at the forefront of sustainability. However, cross-sector data describes at least one quarter of all CO2 emissions are directly correlated to the production of structural materials. Further, some studies have suggested that at least 50% of total embodied carbon impacts for new buildings come from the structural system. Both aspects have put the structural engineers in a position of great opportunity to work with the entire building industry to find ways to design structural systems capable of achieving net-zero embodied carbon. As a result, there has been a rapidly developing focus on the embodied carbon impacts for all the parts and pieces that make up a structural system so embodied carbon hotspots can be identified and mitigated. Therefore, there is now renewed attention needed on how our structural system components are classified so that their embodied carbon can be tracked, compared, optimized, and even reimagined.

Existing Construction Classification Systems

A classification system is a standardized way to organize a series of objects into different classes of members with specific properties. The highest levels of classifications are the most general classes and are known as the root levels and every subsequent level below the root level are subclasses. Each subsequent level the properties of the subclasses become more specific. The are several values for any classification system, but in the context of SE 2050 and the structural material quantity tracking and embodied carbon assessments, it allows for a consistent organizational and data storage framework to facilitate comparative analyses.

There are several construction classification systems in use today that have all been developed for different reasons at different times and in different parts of the world. (Afsari & Eastman, 2016). And each system has a unique different structure and presents the taxonomy of building system components very distinctively. The distinction of each system is made even clearly when attempting to classify a structural framing system.

The most common classification systems appear to be OmniClass, Masterformat, Uniformat and Uniclass. The first three originated in North America with Uniclass originating in the U.K. For this paper the focus will be for North American systems with an emphasis on how the systems are implemented in the U.S. Masterformat is typically used in the U.S. for construction project specifications and primarily used to document material requirements in a structural system for bidding purposes. Therefore, Masterformat[1] and Uniclass[2] will not be discussed in any detail in this paper at this time.

There are a variety of features that differentiate classification systems, however, for SE 2050 taxonomy perhaps the most critical is how the objects are grouped and organized. This also seems to be the biggest difference between OmniClass and Uniformat discussed in subsequent sections. The following is a brief description of the two different group principles, direct or hierarchical and combinatory or faceted.

Direct or hierarchical grouping is relatively straightforward in that a specific class is identified through a combination of properties and each property based on the object purpose. Put a different way you can simply create a tree structure with the precise object component at the lowest level under a branch line of the tree originating at the root level. See Figure 1 for generic concept. Visually and systemically it is a clean system where one can create clean and clear branch lines where there is little ambiguity of how to identify something precisely. The biggest challenge to this system is that if one adds any new objects between the root level and the lowest level the system will require revisions. Therefore, if this system is chosen careful consideration is needed in identifying the appropriate objects of study.

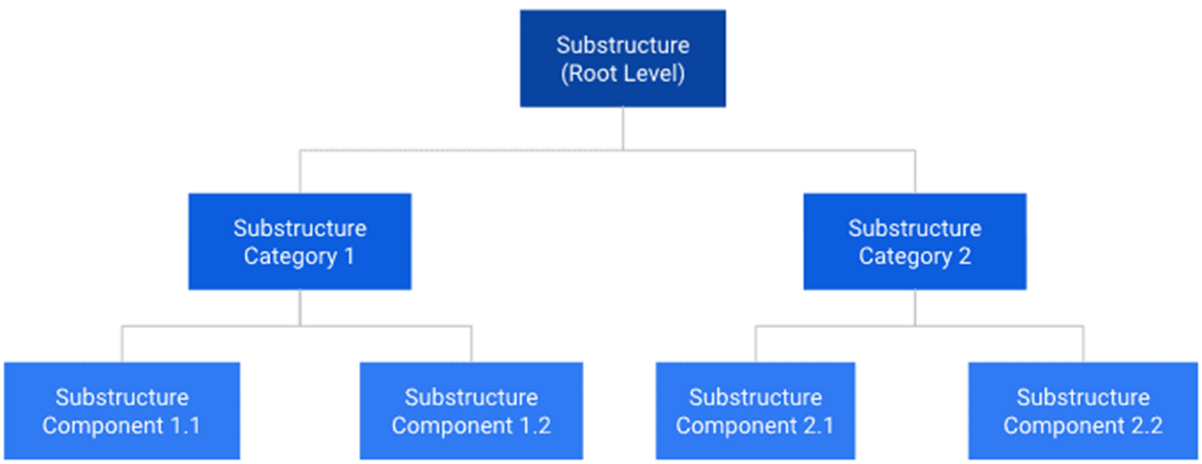

FIGURE 1: HIERARCHICAL GROUPING SHOWING OBJECTS IN MULTIPLE LEVELS IN A TREE STRUCTURE

Combinatory or faceted grouping is quite different to hierarchical in that it has multiple sets of attributes that can be combined where each facet performs a set of similar properties. The subclasses are more generic with the idea of simple subclasses combined to create a compound subclass. A new object is classified by combining existing concepts. See Figure 2 for the generic concept. In this figure a beam is classified with multiple attributes such as location, beam type and material and those attributes have multiple facets of similar properties. In the beam example the material type could be 'steel' with multiple properties based on grade of steel, source, corrosion resistance, etc.

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[1] Masterformat is widely used for Project Specifications and typically used for describing material requirements for bidding purposes. Though we understand it is an option to organize structural framing systems first by their material types using Masterformat, the focus of this paper is on construction classification systems that organize structural framing systems by their component parts first then apply a material assignment. The material assignment would likely be using a material module of Masterformat tags.

[2] Ultimately we believe comparing and/or aligning to construction classification systems on an international scale will lead to much more broad and consistent methodologies of embodied carbon and structural material quantity tracking globally we first aim to focus on North America before investigating international systems in an effort to keep things as uncomplicated as possible.

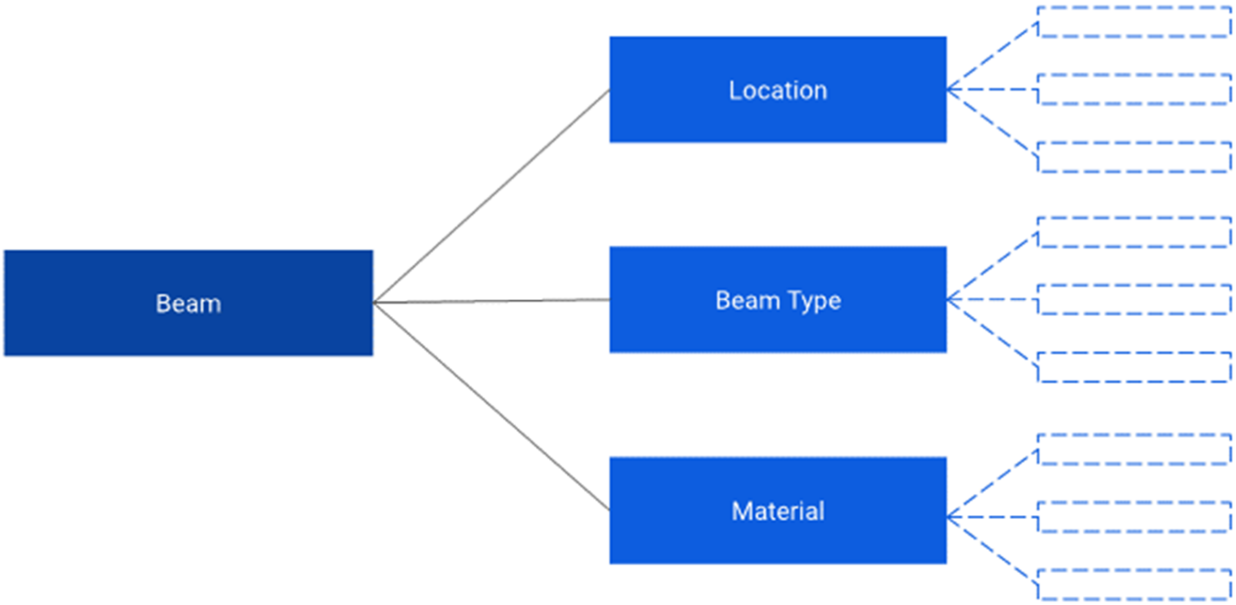

FIGURE 2: COMBINATORY OR FACETED GROUPING

Hierarchical grouping is good when the relationships are well known and established and unlikely to change. Faceted grouping is good when there are multiple aspects of an object needed to identify but not one aspect is more important than the other and no clear relationship exists between the aspects. This allows for multiple attribute modules to be applied to dissimilar objects and allows for flexibility.

Uniformat

Uniformat is a North American system established in 1973 and follows a hierarchical grouping principle. There is one table with alphanumeric designations and titles in five levels. (will need to add more and include references)

Precision is low and beyond Level 3 it is up to the user to identify which may not be an issue but when making global comparisons more consistency on refinement is desperately needed.

OmniClass

OmniClass is a North American classification system that follows a faceted grouping principle with 15 inter-related tables. Tables 21, 22 and 23 are required to classify a product precisely. (will need to add more and include references)

MasterFormat

MasterFormat is a North American classification system that follows a hierarchical grouping principle. There is one table with a series of six numbers and a name. (will need to add more and include references)

Comparing OmniClass and Uniformat

Two of the most common classification systems in use today in the US for classifying the components of structures is OmniClass and Uniformat II. Both systems are different and have benefits and drawbacks when classifying a structural system component precisely. The table below summaries

Tables	Component precision	Inter-dependence of tables	Material Type Considerations	Sufficient list of structural components	Structural engineering logic	Easy to Understand
1	Low	n/a	No	No	Medium	Yes
15	Medium	High	Yes	No	Medium	Medium

TABLE 1: COMPARISON OF UNIFORMAT AND OMNICLASS

This paper is not intended to provide a comprehensive review of existing classifications used today, however, each system has benefits and drawbacks specific to classifying structural components.

Rationale for a New Classification System for SE 2050

It is fair to question why SE 2050 would not simply employ one of the published systems in use today. We get it. If we felt that using one of the established systems would adequately and appropriately classify components of a structural system in a logical way as structural engineers think then we would do so. We do not want to give ourselves more work. However, upon a deeper dive into researching the topic of classification systems and estimating structural material quantities, we have found the following to be true:

1. There is no single consensus standardized classification in the building industry.
2. Some existing systems are not intuitive to a structural engineer and may not make most sense for a structural system.
3. Contractor estimates rarely follow an established system completely unless required by the Owner. Often Contractor estimates will include some portions of these systems or even draw from multiple systems for a single estimate.
4. Popular BIM software adds another level of complexity with their own set of component identifiers that may or may not have some correlation to an established system.
5. Current classification systems were not established with consideration for embodied carbon accounting in mind.
6. Current systems are generally for specific types of user groups to categorize entire building systems and at times lack a means to identify characteristics of the structure that would be important for a structural engineer to track.

The preceding list is not an indictment on established systems. All existing classifications appear to have been well thought out for their target user group and have been widely used in many applications. We do not want to supplant systems in place nor propose something too dissimilar from the established systems. However, we have realized that for the SE 2050 Commitment to push for substantive reductions in embodied carbon of our structural systems and to accurately track those impacts we need a system that makes sense to us. We are hopeful that with these aims, our system will gain adoption for the classification of structural components.

Goals of the Proposed SE 2050 Classification System

1. Easy to understand, primarily to structural engineers, though ideally to all
2. Mappable to other established systems
3. Can be modified and/or expanded in the future
4. System that could be used in embodied carbon databases
5. Considers relative significance of embodied carbon amongst structural components in its organization
6. Broad industry review and alignment

PROPOSED SE 2050 CONSTRUCTION CLASSIFICATION SYSTEM

To start the development process, we decided to begin with a clean slate and focus on what makes the most sense to a structural engineer, keeping in mind our collective observations of relative embodied carbon impacts of various parts of structure. As we thought about the system we decided to focus on structural components and then link them to the environmental impacts associated with the material(s) of those components. The basic idea is that it seems unlikely major changes are coming to the types of structural components we will design and therefore the structure of the classification system would also not require significant future changes. We do, however, expect technologies around structural materials to continue to evolve as attention continues to drive the need for lower environmental impact materials.

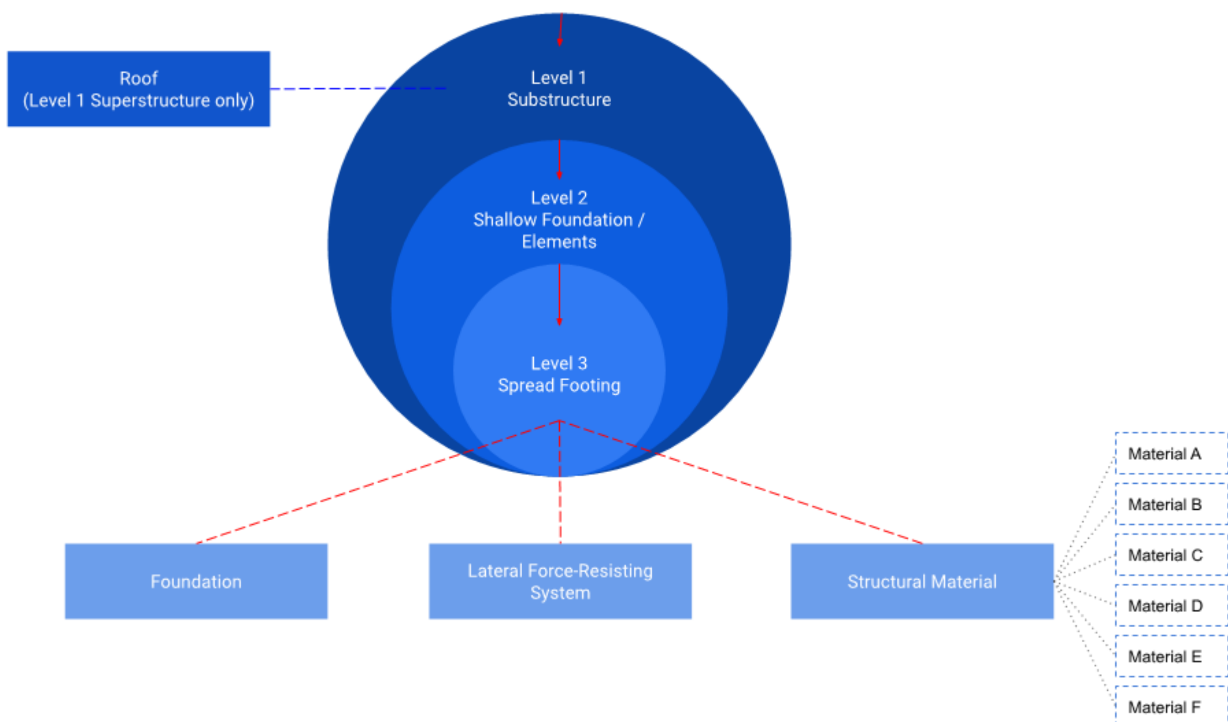

FIGURE 3: GROUPING PRINCIPLE OF SE 2050 CLASSIFICATION

As we continued to develop the system and have multiple conversations and reach out to others in the industry and using our own collective experiences, we continued to be unable to choose between a hierarchical and faceted grouping system exclusively. We simply could not 'fit' how structural engineers focused on embodied carbon as well as structural material efficiency organize their thinking around both. Table 1 includes a comparison of both Uniformat and OmniClass. Uniformat is good in that its simple and easy to understand but does not provide very good precision nor does it include material types. OmniClass is good in that it can identify a component with sufficient precision and includes materials but it's difficult to know which tables to use and feels cumbersome lacking the simplicity we are looking for.

Therefore, we chose to, in effect, employ a two-type grouping principle combining the best aspects of each to our system. Figure 3 describes our proposed classification which starts with a three-level hierarchical grouping followed by unique identifiers to the lowest level using aspects of a faceted system. The three-level hierarchical aspect makes sense when classifying structural framing components since, as noted earlier, structural system component types are well-established and unlikely to go through major updates. A beam is a beam and will continue to be a beam and a column is a column and will continue to be a column, etc. What we anticipate, and frankly hope for, is a relatively rapid change to the state-of-the-art of structural materials centered on new technologies and smart solutions to reducing their environmental impacts. Thus, we have added facets or simply put material modules associated with each structural component thereby allow for as much change in the module without impacting the hierarchical levels[3]. The same is true, albeit a much smaller scale, to identifying if a component is part of the foundation or lateral force-resisting system for example. The following are brief descriptions of each level. A more elaborate description and how we arrived to each level is included later in the paper.

Level 1 Location:
Main demarcation between substructure and superstructure of the structural framing system.

Level 2 Category:
The next level breakdown of structural components providing further refinement of the structural framing system without describing specific components requiring faceted assignments.

Level 3 Functional Class:
The specific building component that would be included in any standard bill of materials. The component itself is not refined below this level however this is the component that will be assigned faceted aspects as seen in Figure 3.

Roof construction:
A facet of Level 1 Superstructure where tracking of roof framing is under consideration.

Foundation:
A facet of Level 3 component identifying if a component is part of the foundation system. This identifier allows for future tracking of foundation system contribution to each structural system. This would be a simple 'yes' or 'no'.

Lateral Force-Resisting System (LFRS):

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[3] This is a good point to remind the reader that we a presenting a classification that is consistent and can be employed for both structural material efficiency AND embodied carbon. We understand that if embodied carbon were simply the only metric under consideration would not need to be as prescriptive with our structural component identifiers as it relates to the corresponding material impacts. We could simply just collect material impacts without knowing where or how those materials were used or placed throughout the structural system.

A facet of Level 3 component identifying if a component is part of the LFRS. This identifier allows for future tracking of LFRS contribution to each structural system. This would be a simple ‘yes’ or ‘no’.

Structural Material:
An identifier indicating the material and corresponding embodied carbon impact assigned to structural component. The material options for each component are variable with the component functional class.

Each structural component at Level 3 is assigned a unique alphanumeric code that is related to Level 1. Figure 4 describes the code for a spread footing as ‘SB-01-02 Spread Footing’ where ‘SP’ stands for ‘Substructure’ and ‘-01’ is the first category of Level 2 and ‘-02’ is simply the second in the list of Level 3 components based on functional class. It is our hope that the unique code assignment allows for easier sorting, organizing and automation for any software package.

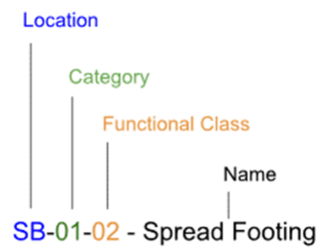

FIGURE 4: SE 2050 CLASSIFICATION NOTATION

The complete classification system is shown in graphical format in Figure 3 for context with entire taxonomy included in the Appendices. The figure[4] includes the three hierarchical levels and the anticipated material options for each component as well as a check box for if the component is part of the LFRS. Note that each object of each level is assigned a unique alphanumeric code.

[4] Please see Appendices for figures and tables of the complete list. The figure is for context and because of its size we understand it may not be easily read.

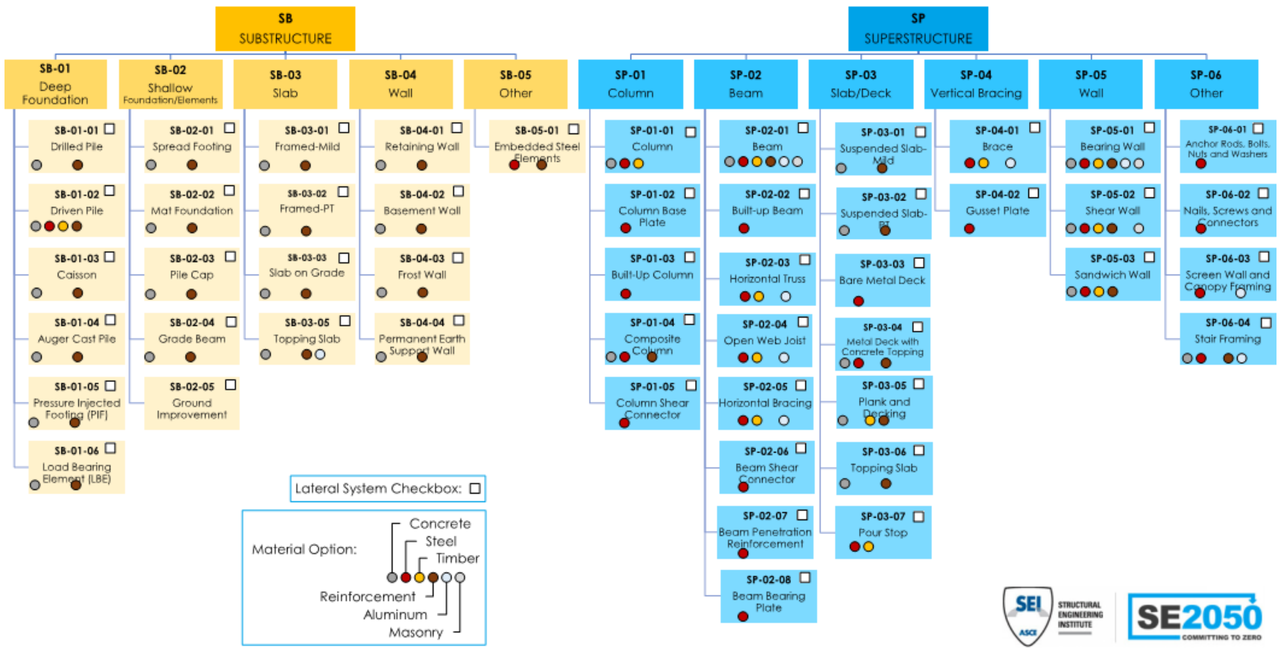

FIGURE 5:SE 2050 CLASSIFICATION SYSTEM

The substructure and superstructure are identified by SB and SP respectively with each of the categories, functional class and component having a SB or SP. The number of levels and their precision in identifying a structural component were based on several evaluations by our team and are briefly discussed below.

Level 1 - Location

The intent of Level 1 is that it represents the highest level and coarsest separation of structural components in the classification system. It is also the level that represents the absolute minimum amount of classification required if no further disaggregation of the structural system is performed or reported.

One common aspect of published classification systems is that of the demarcation between superstructure and substructure, or superstructure and foundation, or above grade and below grade, or some similar delineation between two different zones or locations of a building. Unformat II (equivalent to OmniClass Table 21 Elements) uses both Level 1 and Level 2 to identify these locations with Level 1 including Substructure and Shell and Level 2 including Foundations and Superstructure under each Level 1 respectively.

For simplicity we wanted one level and to do so, we chose to use Substructure and Superstructure. We did not create a separate identifier for Shell at this level because we consider the facade or exterior envelope system to be part of the superstructure. We do recognize the importance of tracking shell elements, including exterior enclosure and roofing, but believe these can be added as separate categories under Superstructure. These do not appear in the SE 2050 classification because they would most likely be accounted for by someone other than the structural engineer.

It is important to clarify the 'line' that delineates substructure from superstructure. Our initial thought was to simply say grade is that point and run the imaginary line straight across when looking at a building section. But this presented two challenges: 1. Some buildings have highly variable finish grade elevations (e.g. building 'benched' into slopes, etc) and 2. a straight line would cut through the vertical structural elements between the superstructure and substructure requiring a cumbersome approach to tracking those components. Instead we decided to run the 'line' as shown below. This also matches where structural component types will most likely change.

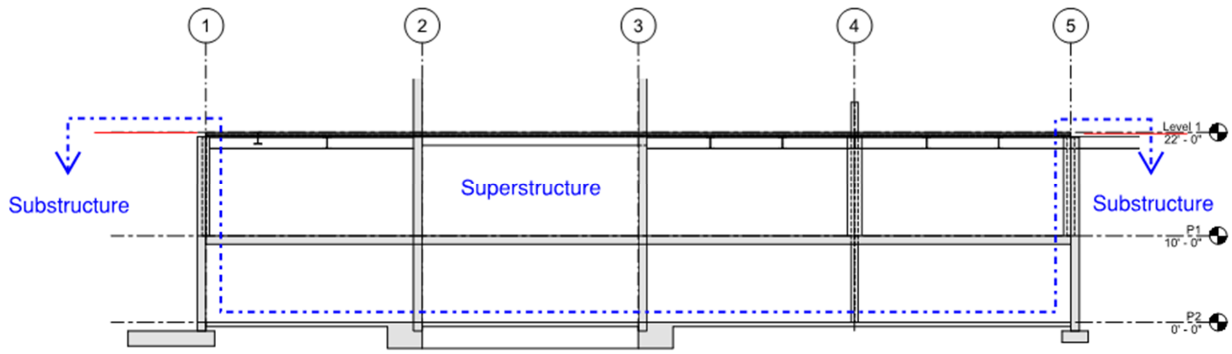

FIGURE 6: DEMARCATION OF SUBSTRUCTURE AND SUPERSTRUCTURE

Foundation Elements

Isolating the embodied carbon of foundation elements is commonplace and important to structural engineers because we can often choose from a variety of foundation options. At the same time, the soil and site conditions significantly affect selection and design of the foundation, often more than they affect the design of the superstructure. We did consider a Level 1 of Foundation and Superstructure but because not all elements below the imaginary demarcation of the two locations of Level 1 are providing structural foundation we elected to simply add the option of 'assigning' something foundation within Substructure as an facet of the component. The facet aspect allows us not to risk double counting the component or material quantities and simply assign it as such.

Level 2 - Category

The intent with Level 2 is primarily to enable identification of "hot-spots" in embodied carbon assessments. This Level allows for further breakdown of the embodied carbon impacts of various structural component categories without becoming too specific and onerous. We made our best effort to limit the number of categories and keep things as simple as possible while still maintaining enough specificity to make it valuable when assessing embodied carbon. For example, instead of simply saying 'structural frame' we elected to break this down and include 'beams', 'columns', 'deck' etc. to help the user hone-in on specific impacts. A discussion of LCA sensitivity to the classification is included later in this paper. Level 2 also serves as a bridge between Level 1 and all the individual components listed in Level 3.

There are five and six categories for Substructure and Superstructure, respectively. Although reluctant we did include 'Other' for both locations to cover the miscellaneous structural components that, albeit small, may contribute to the embodied carbon of the structural system.

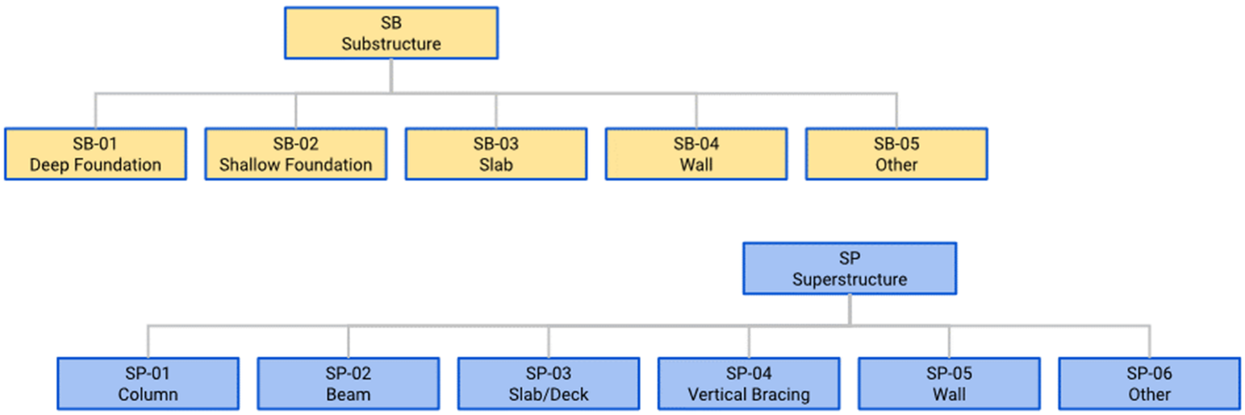

FIGURE 7: LEVEL 2 CATEGORIES

Level 3 – Functional Class (Individual Components)

Level 3 includes all the individual components of a structural system including everything from a beam to a bolt, and everything in between, and is the natural refinement of each of the Level 2 Categories. If the component exists in the structure it should be included in this list or at least be highly relatable to an item in the list. Some components have been grouped into a module in Level 3. For example, bolts, washers, nuts, etc. are all one 'component'. Another example is the 'Composite Concrete on Metal Deck' which includes multiple materials like concrete, concrete reinforcement, and deck. .

Roof construction, one-story and short buildings

Existing classification systems seem to have specific attention to roof construction. This makes sense given the unique aspects that roof construction bring to projects beyond typical floors particularly for non-structural components. There are many unique parts and pieces of a building that only apply to roofs and particularly when considering embodied carbon. However, from a purely structural standpoint there are not usually major differences between floor construction and roof construction. Yes, of course, there are differences; perhaps the use of metal roof deck instead of a composite concrete system or perhaps there is mechanical rooftop equipment and high snow drifts requiring an atypical framing solution or perhaps your building is stadium where the long span roof is a high percentage source. But as we considered that we decided in an effort to keep the hierarchical scheme as simple as possible we elected to not create a separate location for the roof but rather include it as a Level 1 facet for tracking roof-specific material quantities and impacts. For a one-story building, the roof would be classified as Level 1 Superstructure with a 'roof construction' facet applied. We feel this will satisfy those one-story or shorter buildings and stadiums where the roof does contribute significantly.

Lateral Force-Resisting System (LFRS)

All buildings designed today have explicit LFRS and for some this system can be a significant contributor to the overall structural system (e.g. tall building, building in high seismic zone, etc.) and should be able to be assessed against the total system impacts. However, in lieu of creating a separate Level we decided that one could 'assign' a component to the LFRS within the categories outlined here as a facet of the system. We consider a component as being part of the LFRS if it contributes to the LFRS, even if it is not necessarily its main function. Most components of an LFRS support gravity load, so there is often significant overlap. The facet aspect allows us not to risk double counting the component or material quantities and simply assign it as such.

Structural Material

The structural material assignment(s) to each component is critically important. Though not the focus of this paper we expect the structural material module to be based on a Masterformat organization that is easily related to project Specifications.

PRIORITY FOR INCLUSION IN LCA CALCULATIONS

Must Include				
Beams Footings	Columns	Slabs	Braces	Walls
Typical to include				
Not typically included but should be				
Not typically included and probably doesn't need to be included at this time				

TABLE 2: PRIORITY OF INCLUSION

To our knowledge none of the existing classification systems considered the sensitivity of LCA results to its development. Taking a high-level view of structural system design for buildings across the U.S. it seems acceptable to declare that

MAPPING BETWEEN CLASSIFICATION SYSTEMS

At the outset our goal was to limit disruptions to existing workflows; either by using an existing classification system or proposing our own that is easily mapped to the existing. Since we are doing the latter we offer the following proposed mapping between SE 2050 and Uniformat II and SE 2050 and OmniClass. The following is a simple example for a structural steel beam located at the 2nd level above grade of a fictitious building. Note that we chose a steel material as an example only because of the OmniClass framework for Table 23. See the Appendices for the complete list.

SE 2050 to Uniformat II

To precisely classify a beam SE 2050 requires three levels which is then following by other faceted assignments. Table 3 describes the hierarchical equivalent for a beam using SE 2050 is B1010 Floor Construction for Uniformat II. If the user wants to define more precisely, they have to create their own name. As stated previously, we do not take exceptions to the flexibility of one defining their own components below Uniformat II (in this case) but it severely limits consistent comparisons of components and material quantities.

SE 2050		Uniformat II	
Level 1	SP Superstructure	Level 1	B Shell
Level 2	SP-02 Beam Category	Level 2	B10 Superstructure
Level 3	SP-02-01 Beam	Level 3	B1010 Floor Construction
		User defined	*Beam/Joist/Girder/Purlin/etc.*

Table 3: Mapping Uniformat II to SE 2050

SE 2050 to OmniClass

Because OmniClass requires a combination of Tables 21, 22 and 23 to precisely define a structural component we have included all three here. Table 4 describes the hierarchical equivalent for a beam using SE 2050 is 21-02 10 10 10 Floor Structural Frame for OmniClass Table 21, 22-05 10 00 Structural Metal Framing for OmniClass Table 22 and 23-13 35 11 13 13 Beams for OmniClass Table 23. For OmniClass only one Table, 23, precisely defines a beam and is at Level 5. The other two tables, Tabel 21 and Table 22 require a user defined name similar to Uniformat II.

SE 2050		***OmniClass Table 21 Elements***	
Level 1	SP Superstructure	Level 1	21-02 00 00 Shell
Level 2	SP-02 Beam Category	Level 2	21-02 10 Superstructure
Level 3	SP-02-01 Beam	Level 3	21-02 10 10 Floor Construction
		Level 4	21-02 10 10 10 Floor Structural Frame
		User defined	*Beam/Joist/Girder/Purlin/etc.*
		OmniClass Table 22 Work Results	
		n/a	22-05 00 00 Metals
		n/a	22-05 10 00 Structural Metal Framing
		User defined	*Beam/Joist/Girder/Purlin/etc.*
		OmniClass Table 23 Products	
		Level 1	23-13 00 00 Structural and Exterior Enclosure Products
		Level 2	23-13 35 00 Framing Products
		Level 3	23-13 35 11 Structural Frames
		Level 4	23-13 35 11 13 Column Slab Frames
		Level 5	23-13 35 11 13 13 Beams

Table 4: Mapping OmniClass to SE 2050

LOOKING FORWARD

(to be completed)

References

(to be completed)

IFC and classification systems in the construction industry. (n.d.). Retrieved from http://biblus.accasoftware.com/en/ifc-and-classification-systems-in-the-construction-industry/

When to use hierarchical v faceted taxonomy. (n.d.). Retrieved from https://www.keypointe.com/when-to-use-a-hierarchical-or-a-faceted-taxonomy/

APPENDIX A – TAXONOMY OF SE 2050 CLASSIFICATION SYSTEM

SP-Substructure

	Level 1	Level 2	Level 3	Material Option*					
	Location	**Category**	**Functional Class**	**C**	**CR**	**S**	**T**	**CM**	**A**
SB	**Substructure**								
SB-01		**Deep Foundation**							
SB-01-01			Drilled Pile						
SB-01-02			Driven Pile						
SB-01-03			Caisson						
SB-01-04			Auger Cast Pile						
SB-01-05			Pressure Injected Footing (PIF)						
SB-01-06			Load Bearing Element (LBE)						
SB-02		**Shallow Foundation/Elements**							
SB-02-01			Spread footing						
SB-02-02			Mat foundation						
SB-02-03			Pile cap						
SB-02-04			Grade beam						
SB-02-05			Ground Improvement						
SB-03		**Slab**							
SB-03-01			Framed-Mild						
SB-03-02			Framed-PT						
SB-03-03			Slab on Grade						
SB-03-04			Topping Slab						
SB-04		**Wall**							
SB-04-01			Retaining Wall						
SB-04-02			Basement Wall						
SB-04-03			Frost Wall						
SB-04-04			Permanent Earth Support Wall						
SB-05		**Other**							
SB-05-01			Embedded Elements						

***C**=Concrete; **CR**=Concrete Reinforcement; **S**=Steel; **T**=Timber; **CM**=Concrete Masonry; **A**=Aluminum

SP-Superstructure

	Level 1	Level 2	Level 3	Material Option*					
	Location	**Category**	**Functional Class**	**C**	**CR**	**S**	**T**	**CM**	**A**
SP	**Superstructure**								
SP-01		**Column**							
SP-01-01			Column						
SP-01-02			Column base plate						
SP-01-03			Built-up column						
SP-01-04			Composite columns						
SP-01-05			Column Shear Connector						
SP-02		**Beam**							
SP-02-01			Beam						
SP-02-02			Built-up beam						
SP-02-03			Horizontal truss						
SP-02-04			Open web joist						
SP-02-05			Horizontal bracing						
SP-02-06			Beam shear connector						
SP-02-07			Beam penetration reinforcement						
SP-02-08			Beam bearing plate						
SP-03		**Slab/Deck**							
SP-03-01			Suspended slab - mild						
SP-03-02			Suspended slab - PT						
SP-03-03			Bare Metal Deck						
SP-03-04			Metal Deck with Concrete Topping						
SP-03-05			Plank and Decking						
SP-03-06			Topping Slab						
SP-03-07			Pour Stop						
SP-04		**Vertical Bracing**							
SP-04-01			Brace						
SP-04-02			Gusset Plate						
SP-05		**Wall**							
SP-05-01			Bearing wall						
SP-05-02			Shear wall						
SP-05-03			Sandwich wall						
SP-06		**Other**							
SP-06-01			Anchor Rods, Bolts, Nuts, and Washers						
SP-06-02			Nails, Screws, and Connectors						
SP-06-03			Screen Wall and Canopy Framing						
SP-06-04			Stair Framing						

***C**=Concrete; **CR**=Concrete Reinforcement; **S**=Steel; **T**=Timber; **CM**=Concrete Masonry; **A**=Aluminum

APPENDIX B – Uniformat II Classification

Level 1	**Level 2**	**Level 3**
Major Group Elements	**Group Elements**	**Individual Elements**
A. Substructure	A10 Foundations	A1010 Standard Foundations
		A1020 Special Foundations
		A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation
		A2020 Basement Walls
B. Shell	B10 Superstructure	B1010 Floor Construction
		B1020 Roof Construction
	B20 Exterior Closure	B2010 Exterior Walls
		B2020 Exterior Windows
		Exterior Doors
	B30 Roofing	B3010 Roof Coverings
		B3020 Roof Openings

APPENDIX C – OmniClass (Table 21 Elements) Classification

[Only permanent structural components shown]

OmniClass Number	Level 1 Title	Level 2 Title	Level 3 Title	Level 4 Title
21-01 00 00	Substructure			
21-01 10		Foundations		
21-01 10 10			Standard Foundations	
21-01 10 10 10				Wall Foundations
21-01 10 10 30				Column Foundations
21-01 10 10 90				Standard Foundation Supplementary Components
21-01 10 20			Special Foundations	
21-01 10 20 10				Driven Piles
21-01 10 20 15				Bored Piles
21-01 10 20 20				Caissons
21-01 10 20 30				Special Foundation Walls
21-01 10 20 40				Foundation Anchors
21-01 10 20 50				Underpinning
21-01 10 20 60				Raft Foundations
21-01 10 20 70				Pile Caps
21-01 10 20 80				Grade Beams
21-01 20		Subgrade Enclosures		
21-01 40		Slabs-On-Grade		
21-01 40 10			Standard Slabs-on-Grade	
21-01 40 20			Structural Slabs-on-Grade	
21-01 40 30			Slab Trenches	
21-01 40 40			Pits and Bases	
21-01 40 90			Slab-On-Grade Supplementary Components	
21-01 40 90 10				Perimeter Insulation
21-01 40 90 20				Vapor Retarder
21-01 40 90 30				Waterproofing
21-01 40 90 50				Mud Slab
21-01 40 90 60				Subbase Layer

21-01 60		Water and Gas Mitigation		
21-01 90		Substructure Related Activities		
21-01 90 10			Substructure Excavation	
21-01 90 10 10				Backfill and Compaction
21-01 90 20			Construction Dewatering	
21-01 90 30			Excavation Support	
21-01 90 30 10				Anchor Tiebacks
21-01 90 30 20				Cofferdams
21-01 90 30 40				Cribbing and Walers
21-01 90 30 60				Ground Freezing
21-01 90 30 70				Slurry Walls
21-01 90 40			Soil Treatment	
21-02 00 00	Shell			
21-02 10		Superstructure		
21-02 10 10			Floor Construction	
21-02 10 10 10				Floor Structural Frame
21-02 10 10 20				Floor Decks, Slabs, and Toppings
21-02 10 10 30				Balcony Floor Construction
21-02 10 10 40				Mezzanine Floor Construction
21-02 10 10 50				Ramps
21-02 10 10 90				Floor Construction Supplementary Components
21-02 10 20			Roof Construction	
21-02 10 20 10				Roof Structural Frame
21-02 10 20 20				Roof Decks, Slabs, and Sheathing
21-02 10 20 30				Canopy Construction
21-02 10 20 90				Roof Construction Supplementary Components
21-02 10 80			Stairs	
21-02 10 80 10				Stair Construction
21-02 10 80 30				Stair Soffits
21-02 10 80 50				Stair Railings

21-02 10 80 60		Fire Escapes
21-02 10 80 70		Metal Walkways
21-02 10 80 80		Ladders
21-02 20	Exterior Vertical Enclosures	
21-02 30	Exterior Horizontal Enclosures	

APPENDIX D – OmniClass (Table 22 Work Results) Classification

[Only permanent structural components shown]

APPENDIX E – OmniClass (Table 23 Products) Classification

[Only permanent structural components shown]

APPENDIX F – SE 2050 TO UNIFORMAT II

Comparison of most refined level of each classification system

Level 3 - SE 2050		Level 3 - Uniformat II
SB-01-01	Drilled Pile	A1020 Special Foundations
SB-01-02	Driven Pile	A1020 Special Foundations
SB-01-03	Caisson	A1020 Special Foundations
SB-01-04	Auger Cast Pile	A1020 Special Foundations
SB-01-05	Pressure Injected Footing (PIF)	A1020 Special Foundations
SB-01-06	Load Bearing Element (LBE)	A1020 Special Foundations
SB-02-01	Spread footing	A1010 Standard Foundations
SB-02-02	Mat foundation	A1010 Standard Foundations
SB-02-03	Pile cap	A1020 Special Foundations
SB-02-04	Grade beam	A1020 Special Foundations
SB-02-05	Ground Improvement	A1020 Special Foundations
SB-03-01	Framed-Mild	B1010 Floor Construction
SB-03-02	Framed-PT	B1010 Floor Construction
SB-03-03	Slab on Grade	A1030 Slab on Grade
SB-03-04	Topping Slab	B1010 Floor Construction
SB-04-01	Retaining Wall	A1020 Special Foundations
SB-04-02	Basement Wall	A2020 Basement Walls
SB-04-03	Frost Wall	A1010 Standard Foundations
SB-04-04	Permanent Earth Support Wall	A1020 Special Foundations
SB-05-01	Embedded Elements	A1010 Standard Foundations
SP-01-01	Column	B1010 Floor Construction
SP-01-02	Column base plate	B1010 Floor Construction
SP-01-03	Built-up column	B1010 Floor Construction
SP-01-04	Composite columns	B1010 Floor Construction
SP-01-05	Column Shear Connector	B1010 Floor Construction
SP-02-01	Beam	B1010 Floor Construction
SP-02-02	Built-up beam	B1010 Floor Construction
SP-02-03	Horizontal truss	B1010 Floor Construction
SP-02-04	Open web joist	B1010 Floor Construction
SP-02-05	Horizontal bracing	B1010 Floor Construction
SP-02-06	Beam shear connector	B1010 Floor Construction
SP-02-07	Beam penetration reinforcement	B1010 Floor Construction
SP-02-08	Beam bearing plate	B1010 Floor Construction
SP-03-01	Suspended slab - mild	B1010 Floor Construction
SP-03-02	Suspended slab - PT	B1010 Floor Construction
SP-03-03	Bare Metal Deck	B1010 Floor Construction
SP-03-04	Metal Deck with Concrete Topping	B1010 Floor Construction
SP-03-05	Plank and Decking	B1010 Floor Construction
SP-03-06	Topping Slab	B1010 Floor Construction
SP-03-07	Pour Stop	B1010 Floor Construction
SP-04-01	Brace	B1010 Floor Construction
SP-04-02	Gusset Plate	B1010 Floor Construction
SP-05-01	Bearing wall	B1010 Floor Construction
SP-05-02	Shear wall	B1010 Floor Construction
SP-05-03	Sandwich wall	B1010 Floor Construction
SP-06-01	Anchor Rods, Bolts, Nuts, and Washers	B1010 Floor Construction
SP-06-02	Nails, Screws, and Connectors	B1010 Floor Construction
SP-06-03	Screen Wall and Canopy Framing	B1010 Floor Construction
SP-06-04	Stair Framing	B1010 Floor Construction

APPENDIX G – SE 2050 TO OMNICLASS (TABLE 21 Elements)

Comparison of most refined level of each classification system

SE 2050 Level 3		Omniclass Level 3		Omniclass Level 4	
SB-01-01	Drilled Pile			21-01 10 20 15	Bored Piles
SB-01-02	Driven PIle			21-01 10 20 15	Bored Piles
SB-01-03	Caisson			21-01 10 20 20	Caissons
SB-01-04	Auger Cast Pile				
SB-01-05	Pressure Injected Footing (PIF)				
SB-01-06	Load Bearing Element (LBE)				
SB-02-01	Spread footing				
SB-02-02	Mat foundation			21-01 10 20 60	Raft Foundations
SB-02-03	Pile cap			21-01 10 20 70	Pile Caps
SB-02-04	Grade beam			21-01 10 20 80	Grade Beams
SB-02-05	Ground Improvement				
SB-03-01	Framed-Mild	21-01 40 20	Structural Slabs-on-Grade		
SB-03-02	Framed-PT	21-01 40 20	Structural Slabs-on-Grade		
SB-03-03	Slab on Grade	21-01 40 10	Standard Slabs-on-Grade		
SB-04-01	Retaining Wall			21-01 10 20 30	Special Foundation Walls
SB-04-02	Basement Wall			21-01 10 10 10	Wall Foundations
SB-04-03	Frost Wall			21-01 10 10 10	Wall Foundations
SB-04-04	Permanent Earth Support Wall			21-01 90 30 70	Slurry Walls
SB-05-01	Embedded Elements				
SP-01-01	Column			21-02 10 10 10	Floor Structural Frame
SP-01-02	Column base plate			21-02 10 10 10	Floor Structural Frame
SP-01-03	Built-up column			21-02 10 10 10	Floor Structural Frame
SP-01-04	Composite columns			21-02 10 10 10	Floor Structural Frame
SP-01-05	Column Shear Connector			21-02 10 10 10	Floor Structural Frame
SP-02-01	Beam			21-02 10 10 10	Floor Structural Frame
SP-02-02	Built-up beam			21-02 10 10 10	Floor Structural Frame
SP-02-03	Horizontal truss			21-02 10 10 10	Floor Structural Frame
SP-02-04	Open web joist			21-02 10 10 10	Floor Structural Frame
SP-02-05	Horizontal bracing			21-02 10 10 10	Floor Structural Frame
SP-02-06	Beam shear connector			21-02 10 10 10	Floor Structural Frame
SP-02-07	Beam penetration reinforcement			21-02 10 10 10	Floor Structural Frame
SP-02-08	Beam bearing plate				
SP-03-01	Suspended slab - mild			21-02 10 10 10	Floor Structural Frame
SP-03-02	Suspended slab - PT			21-02 10 10 10	Floor Structural Frame
SP-03-03	Bare Metal Deck			21-02 10 10 10	Floor Structural Frame
SP-03-04	Metal Deck with Concrete Topping			21-02 10 10 10	Floor Structural Frame
SP-03-05	Plank and Decking			21-02 10 10 10	Floor Structural Frame
SP-03-06	Topping Slab			21-02 10 10 10	Floor Structural Frame
SP-03-07	Pour Stop			21-02 10 10 10	Floor Structural Frame
SP-04-01	Brace			21-02 10 10 10	Floor Structural Frame
SP-04-02	Gusset Plate			21-02 10 10 10	Floor Structural Frame
SP-05-01	Bearing wall			21-02 10 10 10	Floor Structural Frame
SP-05-02	Shear wall			21-02 10 10 10	Floor Structural Frame
SP-05-03	Sandwich wall			21-02 10 10 10	Floor Structural Frame
SP-06-01	Anchor Rods, Bolts, Nuts, and Washers			21-02 10 10 10	Floor Structural Frame
SP-06-02	Nails, Screws, and Connectors			21-02 10 10 10	Floor Structural Frame
SP-06-03	Screen Wall and Canopy Framing			21-02 10 10 10	Floor Structural Frame
SP-06-04	Stair Framing			21-02 10 80 10	Stair Construction

APPENDIX H – SE 2050 TO OMNICLASS (TABLE 22 Work Results)

APPENDIX I – SE 2050 TO OMNICLASS (TABLE 23 Products)

APPENDIX J – GLOSSARY OF TERMS

COMPONENT	DEFINITION
ANCHOR RODS	
AUGURE CAST PILE	
BARE METAL DECK	
BASEMENT WALL	
BEAM	
BEAM BEARING PLATE	
BEAM PENETRATION REINFORCEMENT	
BEAM SHEAR CONNECTOR	
BEARING WALL	
BOLTS	
BRACE	
BUILT-UP BEAM	
BUILT-UP COLUMN	
CAISSON	
CANOPY FRAMING	
COLUMN	
COLUMN BASE PLATE	
COLUMN SHEAR CONNECTOR	
COMPOSITE COLUMN	
CONNECTORS	
CORE WALL	SHALL BE CLASSIFIED AS A SHEAR WALL UNLESS THE WALL WAS NOT INTENDED TO PROVIDE LATERAL RESISTANCE AS PART OF THE LATERAL FORCE-RESISTING SYSTEM. IN THAT CASE IT SHALL BE CLASSIFIED AS A BEARING WALL.
DECKING	
DEEP FOUNDATION	
DRILLED PILE	
DRIVEN PILE	
EMBEDDED ELEMENTS	
FROST WALL	
GRADE BEAM	
GROUND IMPROVEMENT	
GUSSET PLATE	
HORIZONTAL BRACING	
HORIZONTAL TRUSS	
LOAD BEARING ELEMENT (LBE)	

MAT FOUNDATION	
METAL DECK WITH CONCRETE TOPPING	
NAILS	
NUTS	
OPEN WEB JOIST	
OTHER	
PERMANENT EARTH SUPPORT WALL	
PILE CAP	
PLANK	
POUR STOP	
PRESSURE INJECTED FOOTING (PIF)	
PRIMARY FUNCTION	THE MAIN FUNCTION FOR WHICH THE COMPONENT WAS USED. (E.G. A WALL THAT WRAP A CENTER ELEVATOR CORE THAT ARE A PART OF A LATERAL FORCE-RESISTING SYSTEM ARE CONSIDERED SHEAR WALLS AND NOT BEARING WALLS)
RETAINING WALL	
SANDWICH WALL	
SCREEN WALL	
SCREWS	
SHALLOW FOUNDATION/ELEMENTS	
SHEAR WALL	
SLAB	
SLAB/DECK	
SLAB-ON-GRADE (SOG)	
SPREAD FOOTING	
STAIR FRAMING	
SUBSTRUCTURE	
SUPERSTRUCTURE	
SUSPENDED SLAB – MILD	
SUSPENDED SLAB – PT	
TOPPING SLAB	
VERTICAL BRACING	
WALL	
WASHERS	