

MICHIGAN STATE UNIVERSITY

Setting a Precedent: Mass Timber at Michigan State University's new STEM Facility

Presented by

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ELLENZWEIG

GRANGER

ADVANCE THE ART OF BUILDING

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Course Description

Michigan State University's new 121,290-sf STEM teaching facility is breaking new ground with the first significant use of cross-laminated timber (CLT) in the state. The University and design team chose an exposed mass timber structure of CLT floors and walls supported by a glue-laminated timber frame to realize the University's goals of innovation and sustainability while functioning as a visual learning tool. The design encourages cross-pollination of ideas, by drawing students through vibrant and active common spaces, seamlessly connecting disciplines, and supporting evolving curriculum and pedagogies. In this presentation, the architect will share drivers for the use of mass timber, highlight design strategies that are code-compliant while maximizing its visual appeal, and discuss lessons learned from preconstruction coordination through field coordination and erection.

Learning Objectives

1. Explore the design team's approach to material and construction selection for a mass timber building in lieu of traditional steel systems.
2. Review the code approval and local permitting steps taken to achieve compliance for a first-of-its-kind mass timber building.
3. Discuss the construction process of mass timber buildings, highlighting items such as speed, inspections, and erection.
4. Demonstrate the benefits realized by tenants of a mass timber building, including aesthetics and occupant comfort.

MICHIGAN STATE UNIVERSITY: STEM

PROGRAM GOALS

1

Improve and enhance the undergraduate learning experience, support teaching and learning, attract more students in STEM disciplines, and better prepare them for professional careers in STEM fields

2

Bring together outdated teaching laboratories and instructional support spaces; support changes in STEM curriculum and teaching methods.

3

Create a campus hub for teaching and learning across the sciences, arts and humanities.

BUILDING PROGRAM

- Undergraduate Teaching Laboratory space of approximately 120,000 GSF
- Modular, flexible active learning teaching labs
- Student breakout spaces, project labs in support of curriculum innovation
- STEM Gateway courses in:



Biology



Chemistry



Computer Science



Materials Science



Physics

MICHIGAN STATE UNIVERSITY: STEM

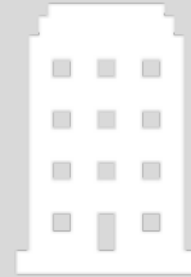


\$110.1

MILLION BUDGET

SCHEDULE
COMPLETION DATE:

Spring 2021



120,000 Sq. Ft.
new construction



40,000 Sq. Ft.
renovation space



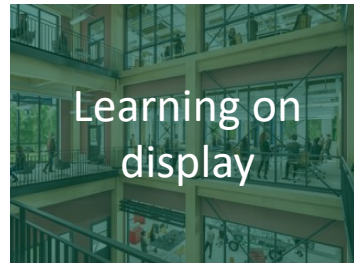
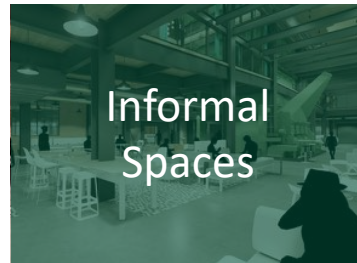
16,000 Sq. Ft. new
classroom space

Inquiry Based



STEM

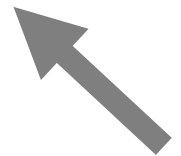
Innovative Teaching



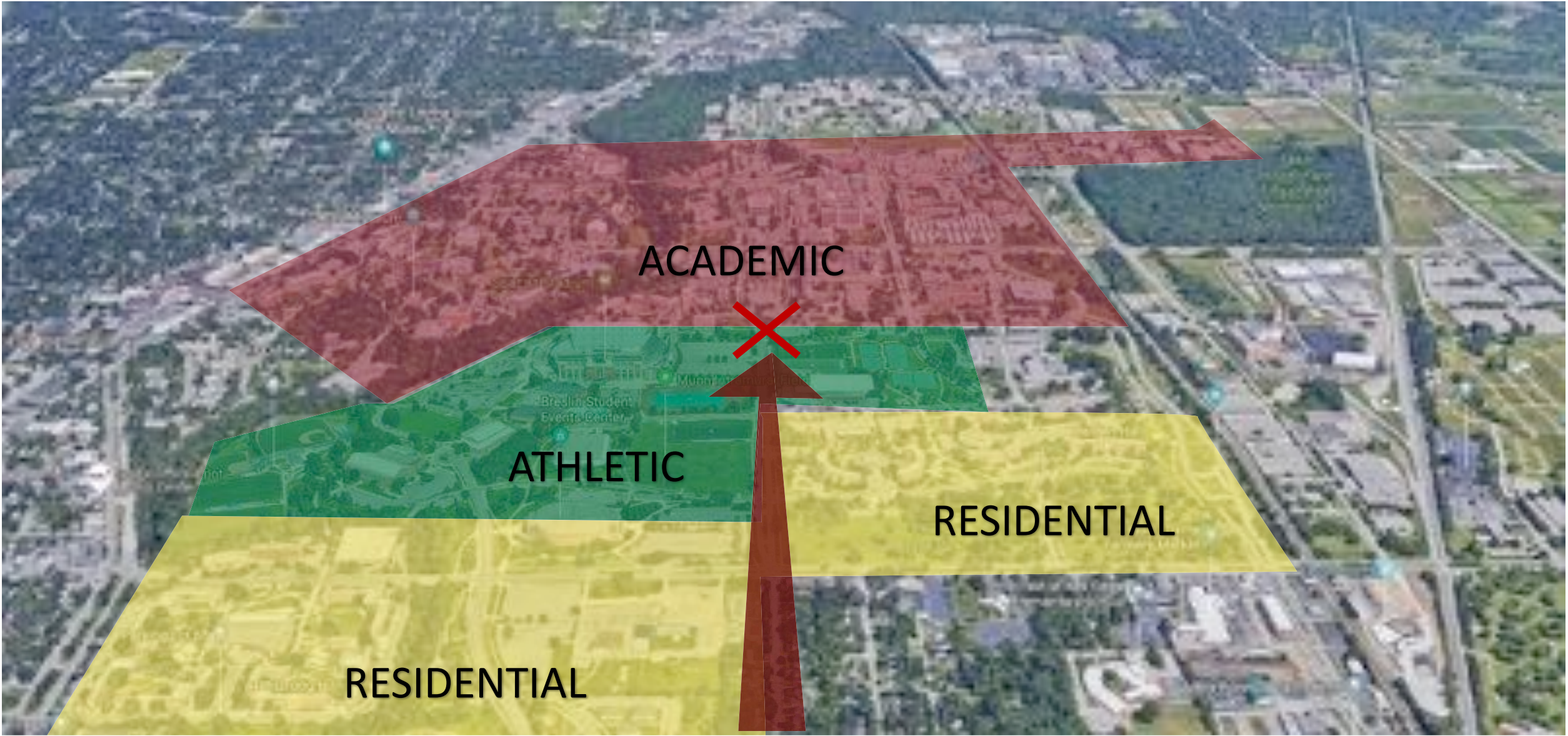
Interactive



Interdisciplinary







ACADEMIC



ATHLETIC

RESIDENTIAL

RESIDENTIAL







Shaw Lane Powerplant

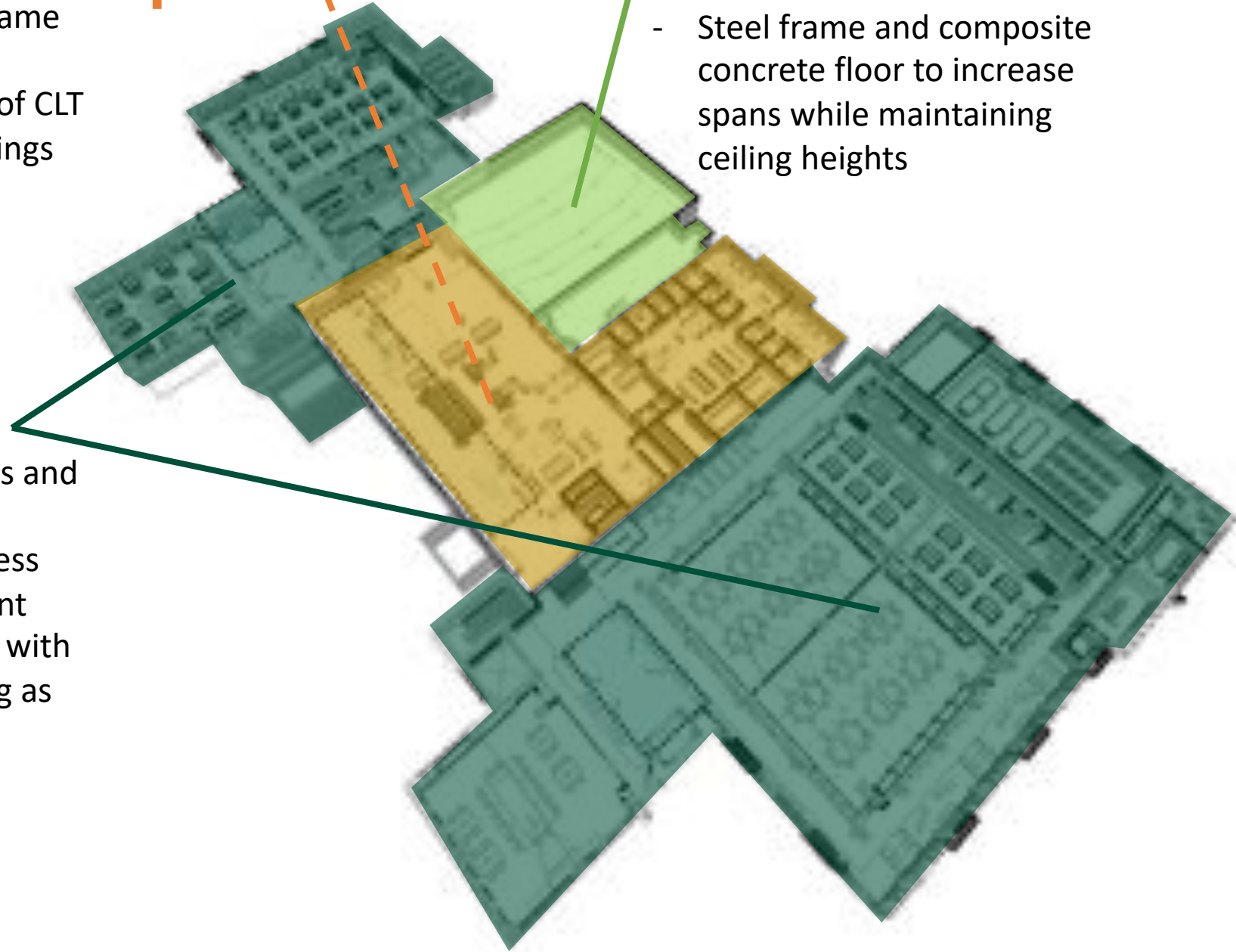
- Existing Steel Building Frame
- Existing concrete Floors
- New Floors constructed of CLT to connect with STEM wings

Classroom Addition

- Steel frame and composite concrete floor to increase spans while maintaining ceiling heights

STEM Wings

- Exposed Glu-Lam columns and beams to highlight wood construction and yet be less industrial than Power Plant
- Floors constructed of CLT with polished concrete topping as walking surface





Why Timber?

- Integration with MSU School of Planning, Design & Construction and Department of Forestry
- Building as a teaching tool
- Stimulates MI timber industry
- Embraces sustainability
- Demonstrates innovation
- Creates a showcase “WOW” facility



Mass Timber Challenges



- Longer Preconstruction Process
- Potential Cost Concerns
- Non-Traditional Procurement
- Regional Availability
- Qualified Erectors
- Protecting Finished Installed work

BACKGROUND

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STUDY TEAM

Eligible, Spanish-Speaking

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

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Journal of Maritime Law & Commerce

Keywords: child sexual abuse; disclosure; self-blame; social support

1. *Journal of Management Education*
 2. *Journal of Management Inquiry*
 3. *Journal of Management Research*

Author's address: Department of Psychology, University of Illinois at Chicago, Chicago, IL 60607, USA.
E-mail: shawn.walker@uic.edu

1000

Keywords: *depression; mood disorder; bipolar disorder*



PROCESS Summary

Workshop 41 September 14, 2017

Warning: In some parts of the water table, a groundwater flow may be observed. This is due to the fact that the water table is not always at the same level. It may be higher in some areas and lower in others. This is due to the fact that the water table is not always at the same level. It may be higher in some areas and lower in others.

Monday, 20th May 2013, 10:00 AM

Abstract Little is understood about the development of the differences between well-adjusted and troubled adolescents across cultures. Several factors may be relevant, including (a) socialization practices (active vs. passive parenting), (b) parental play interactions (more playful or more serious parenting), and (c) parenting style (permissive, authoritarian, or authoritarian-inductive and authoritarian-conditional parenting).

References Cheng, Y. and H. Li. 2009. *Journal of Management Education* 33(1): 100-112.

© 2004 Blackwell Publishing Ltd *Journal of Internal Medicine* 255: 103–110

Abstract. In making long-term capital budgeting decisions, managers identify key concerns and make judgments about:

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Limitations: In addition to the group's focus on coded papers related papers from all planning sessions attended, the significant historical references were identified, however, this provides a snapshot for knowledge, rather than a full history. The research was limited to the group's knowledge using secondary literature rather than an active interview, as large and a number of other a building (interview).

Indexing: Manuscriptally entered subject words and numbers to discuss internally. Complete text is digitized and indexed.

[illegible]

Warning: Structures engineering consult a structural engineer and other design professionals, including, but not limited to, structural engineering consultants.

Address: 401-401 4th, Germany 10, Chicago, America. E-mail: depression@univ.edu

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Indexing: Further examples are having measures (un)rounded and perhaps signed. Further examples use of the context is not informative.

Summary Conclusion

Factor	Steel	WALL THINER	Advantage
Construction Schedule	4-6 months design & build 12-18 months build	4-6 months design & build 4-6 months build	WALL THINER is substantially shorter time to build
Code Compliance (101)	Type I construction, 20% reduction in floor plate, special inspection, 20' clear	Type I construction, 20% reduction in floor plate, special inspection, 10' clear	Steel has small structural efficiency in code compliant ICB approach
Seismicity	Unstated required lateral 10% Required vertical 4-5%	Seismicity that would prohibit an ICB construction	WALL THINER difference is substantial reduction
Seismicity	Steel could be exposed in compressed framed moment-resisting	WALL THINER could be exposed in perimeter, moment-resisting in 7-point bays	Seismicity important
Structure & Building Systems Configuration	4-6" steel floor joists over steel deck 27" clear height required	10-12" steel floor joists over composite floor slab 27" clear height	Steel has small structural efficiency in perimeter construction
Crack Resistance	Wider span steel joists over steel deck smaller wall thickness	Wider span composite joists over concrete at least 10% in depth	Steel has some structural efficiency in example of exterior column
Seismicity	Wider joists available, 20' in seismicity not required	At least 10% steel joists perimeter moment-resisting with column	WALL THINER has some structural efficiency in perimeter column
Technology	Typical moment-resisting for other building	Knowledge and skill the challenge in agriculture and industry	WALL THINER has some structural efficiency in example of other buildings
Cost & Economic Impact	Reduction and reduction are required by the building owner. Steel increases required, but not expensive as some other building	Wider joists could be used in other buildings. Majority of joists required to be moment-resisting. Reduction likely to be non-building level	Seismicity provided a positive impact on construction
Seismicity	Wider joists are required for the project team	Wider joists are required for the project team. Knowledge is not available in building of this size	Seismicity

FINAL CONCLUSIONS

Abstract This study is concerned with the construction of a class of fuzzy metrics (2.3) - (2.4) (Mordukhai, 1997) (Mordukhai, 1997).

ART 001420007 - 01/14/2014 (transmission costs are assigned to be negligible for either unit or class)

FINANCIAL: No financial or commercial interest has yet been identified which pertains to the use of either drug in any trial for the entire T2DM subgroup or gestational diabetes.

CONCLUSIONS & REMARKS

- * Stage additional work under partner's estimate conceptual estimate (may include budget based on estimate of work effort, and final 100% participant signed design to be used and revised to show).

How the Code Authority sees it....

- Type III or Type IV Construction?
- Concealed Spaces.
- Fire Rating of CLT.



Now What?

- Wood or Steel primary structure?
- Structural wood floor deck?
- CLT, NLT, DLT?
- What about walls and shafts?
- Combustibles in the exterior wall?
- Heavy mechanical loads?



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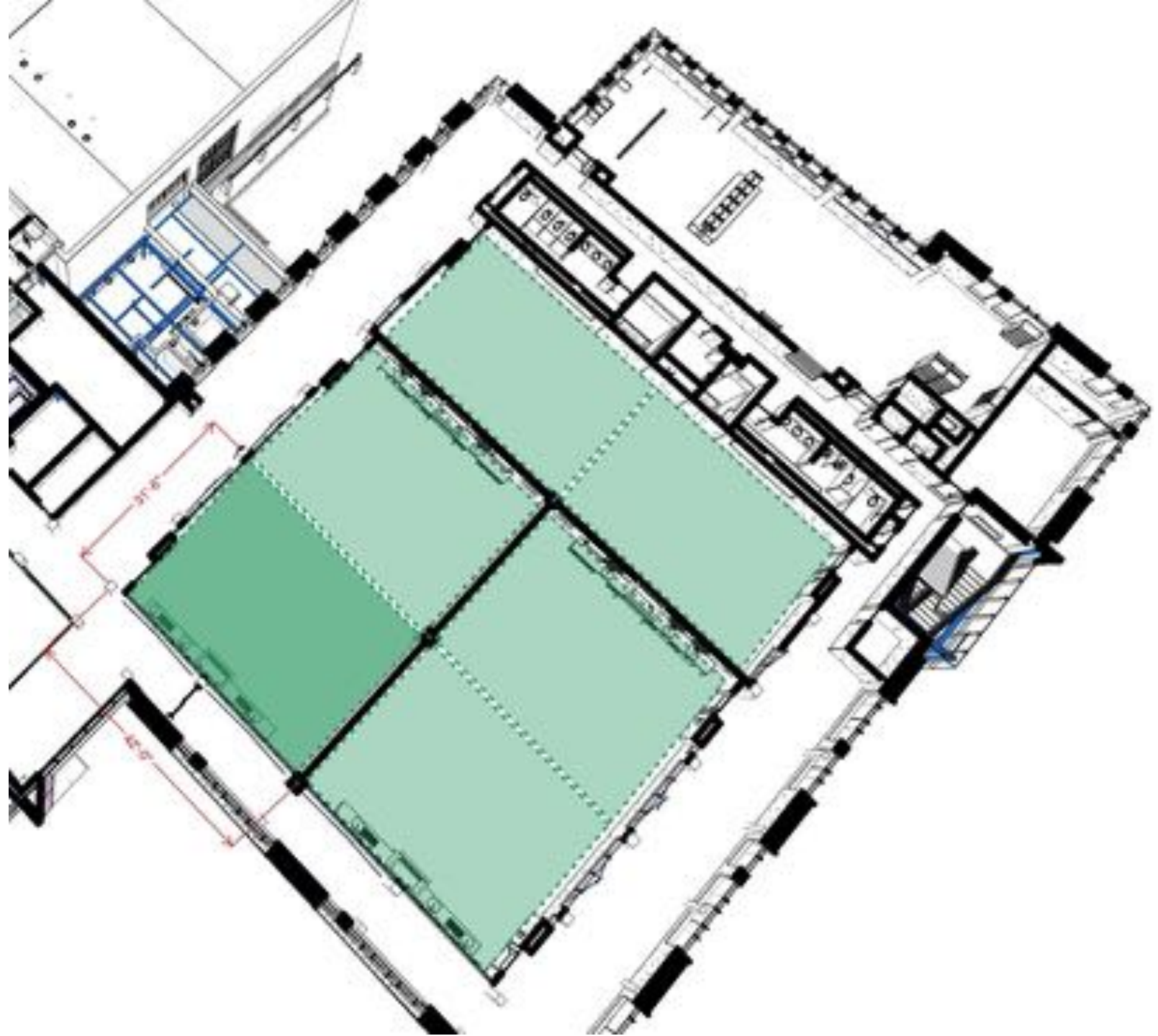


Now What?

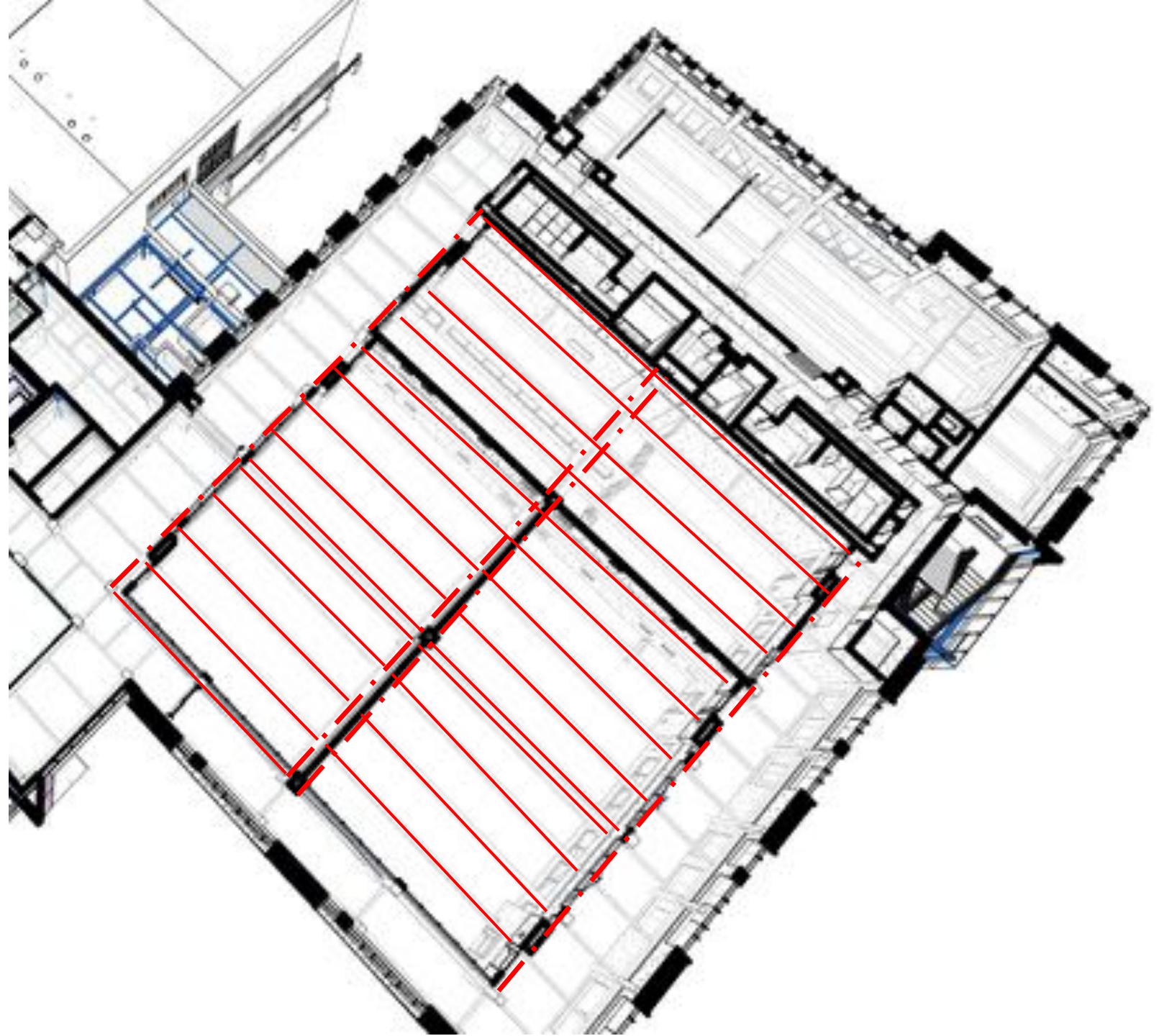
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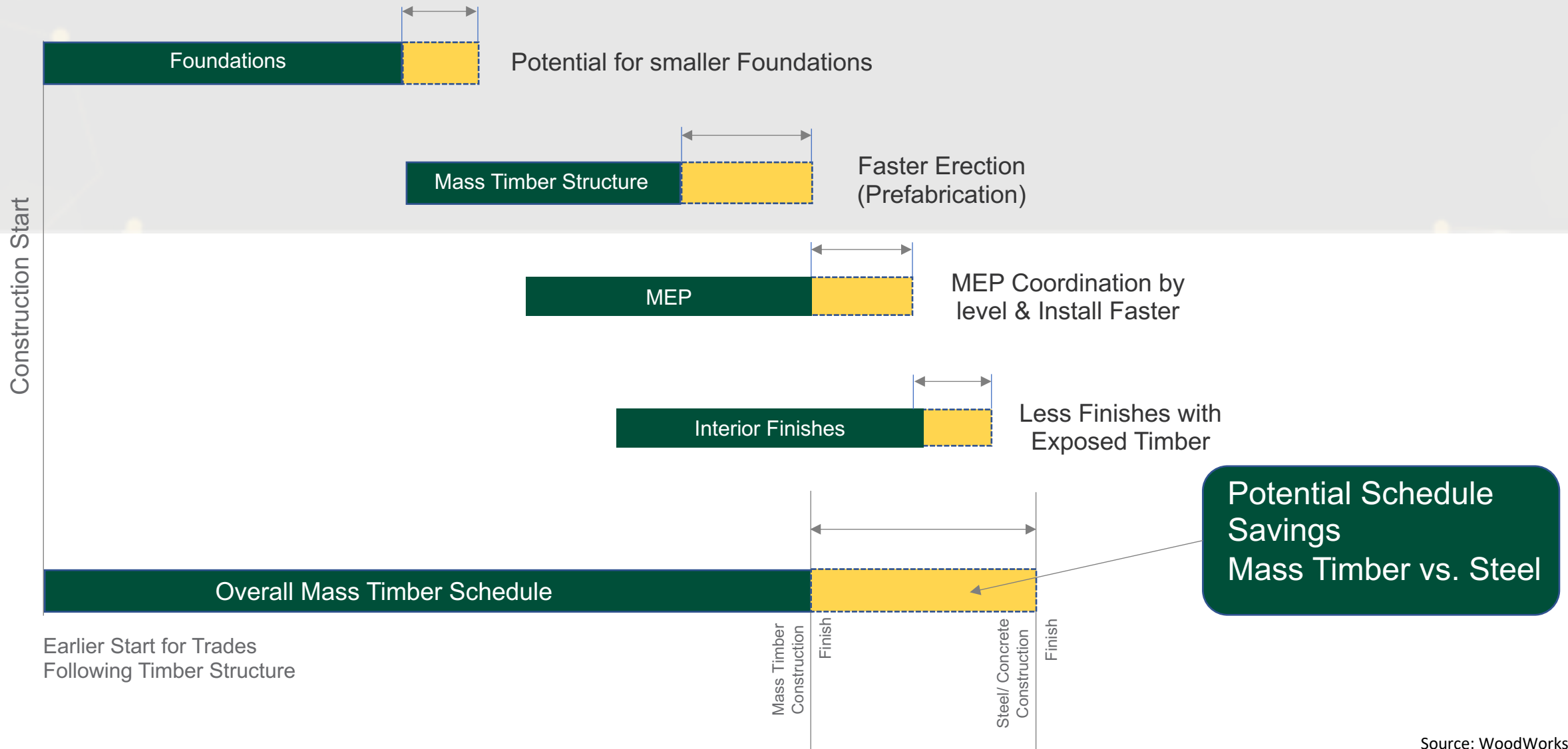
Typical Lab Module



Typical Lab Module



Mass Timber Schedule



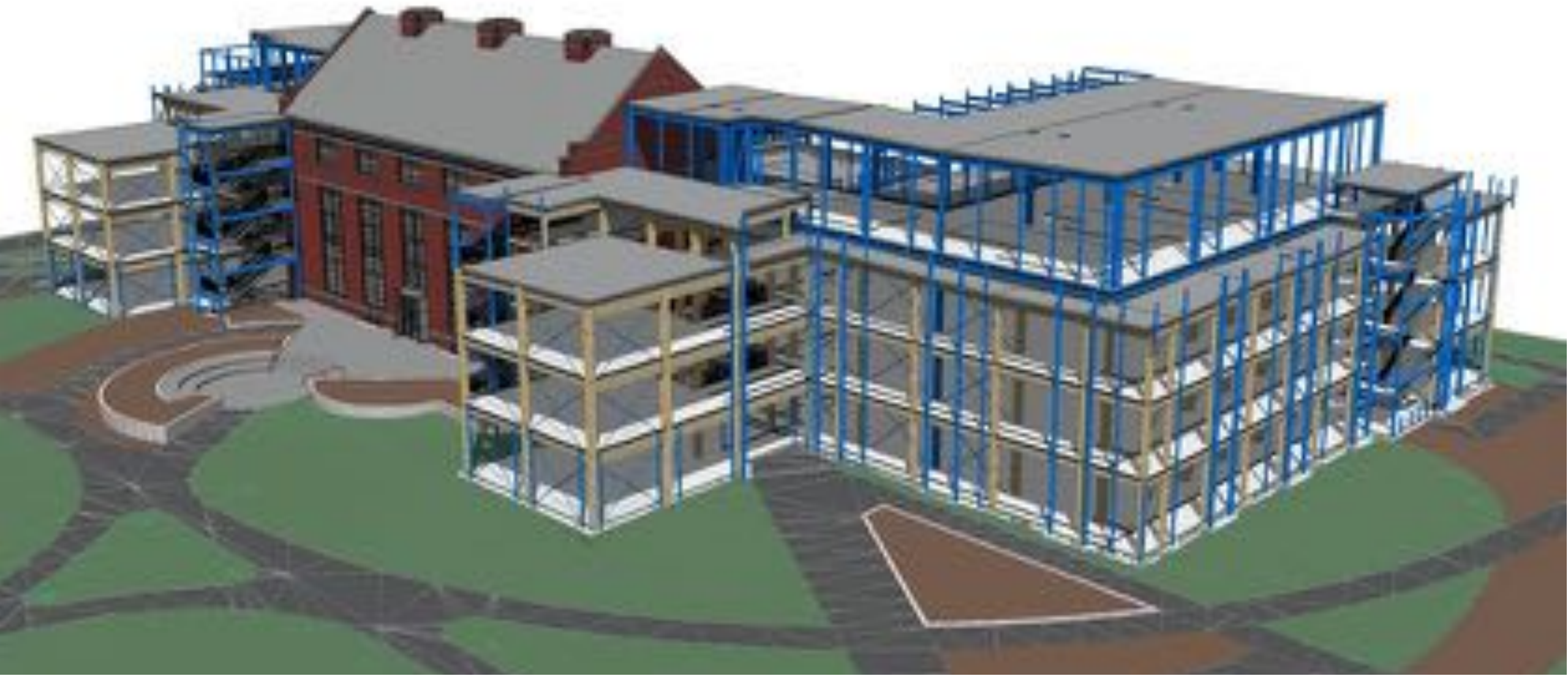
STEM Teaching and Learning Facility



STEM Teaching and Learning Facility



STEM Teaching and Learning Facility



STEM Teaching and Learning Facility



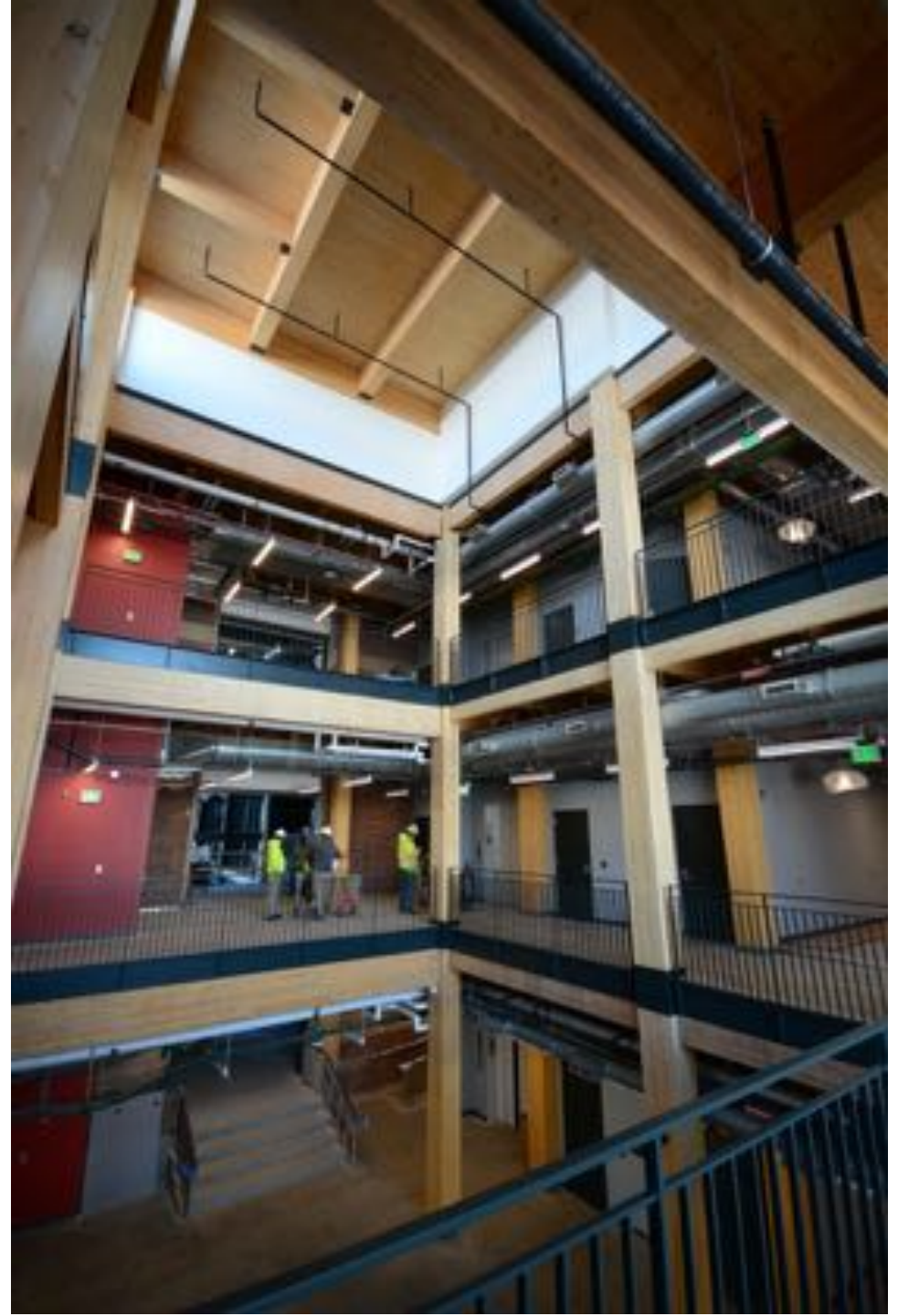


Entering STEM from
Southwest





South STEM 2nd floor
Commons

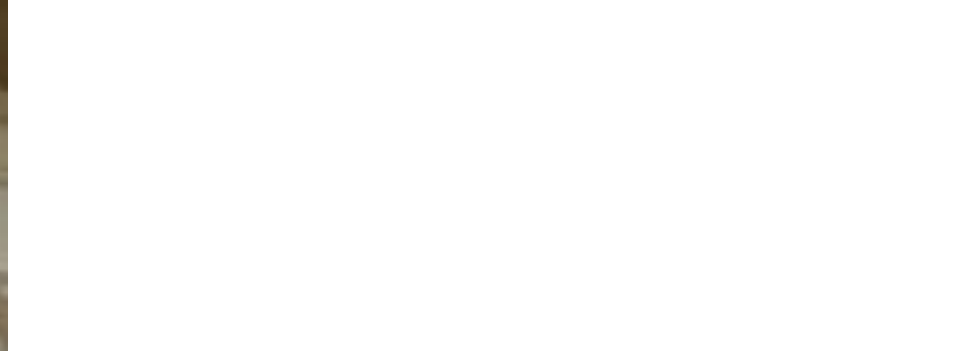




Active Learning Chemistry Lab



















WHAT DID WE LEARN?

Mass Timber Considerations



Mass Timber Considerations: Structural Design

University Standards vs.
Building Code

Vibration Analysis

Right Sizing Timber

Fire Resistance/Panel Thickness



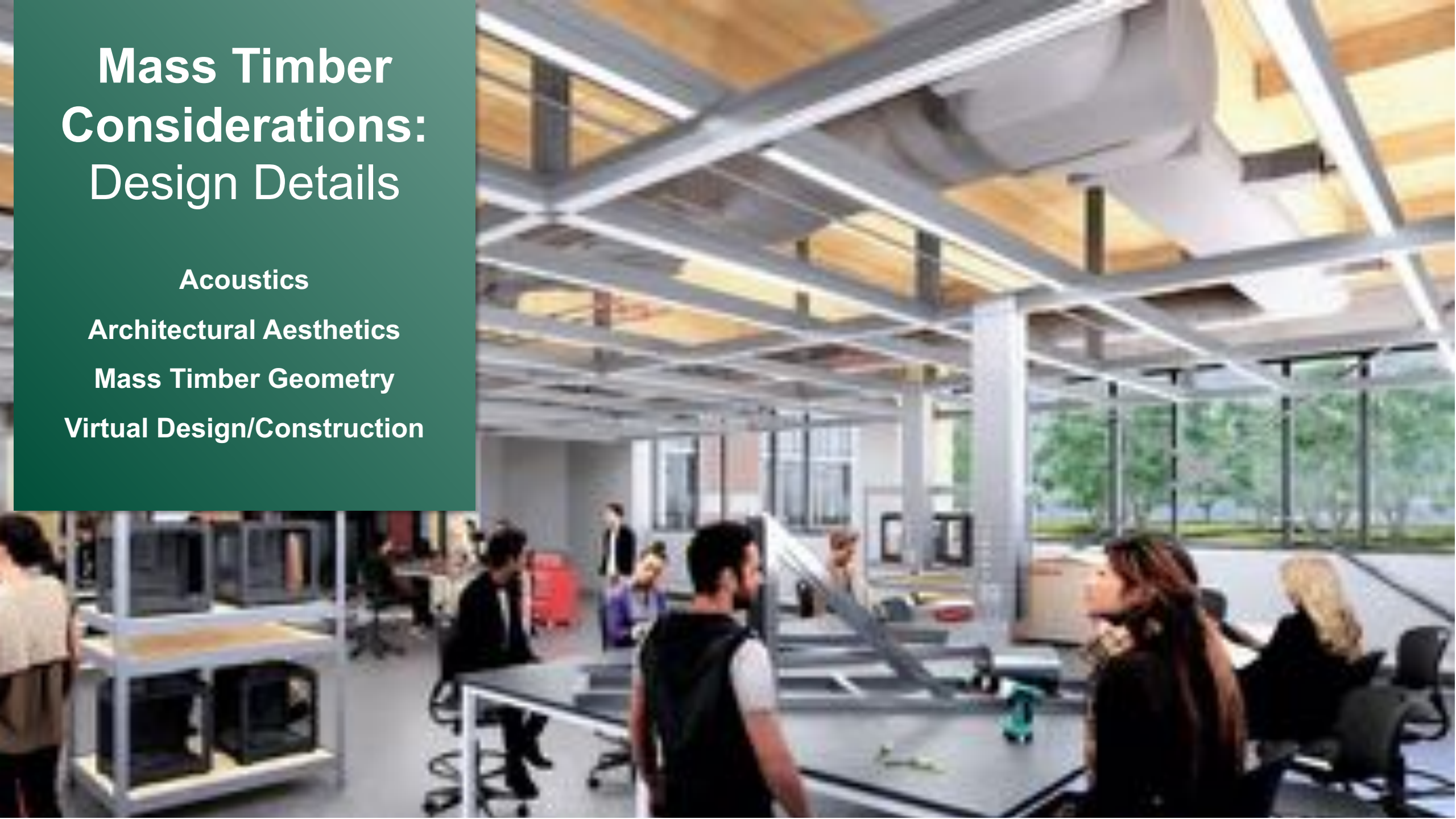
Mass Timber Considerations: Design Details

Acoustics

Architectural Aesthetics

Mass Timber Geometry

Virtual Design/Construction



Mass Timber Considerations: Installation

Hoisting/Sequencing
Moisture Management
Protection of Material













This concludes The American Institute of Architects Continuing Education Systems Course



QUESTIONS?

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