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Engaging contractors early in a design process can resolve apparent mismatches between budget and programme and even enrich the design. But there are further benefits when this cooperation is followed through, with architects overseeing construction from a fully informed perspective – solving rather than creating problems for builders. **Stacie Wong**, a principal at New York design–build practice GLUCK+, explains.

Stacie Wong

Dimension

Architect-Led Design–Build



GLUCK+,
Dr Orrin H Pilkey Research Laboratory,
Duke University,
Pivers Island,
North Carolina,
2014

Addressing resiliency, structural integrity and durability were paramount for longevity in a hurricane-prone coastal environment with corrosive salt air and mould-inducing humidity. The building form is a metaphor for sea-level rise (SLR), in which the laboratory containing mission-critical equipment and irreplaceable specimens is elevated well above projected SLR and storm-surge levels, with the ground floor shaped to create outdoor porches protected from sun and wind.

Building information modelling (BIM) advocates the fourth dimension, time, to alleviate conflicts between the architect and contractor. While digital information exchange may lead to more coordinated buildings with fewer change orders during construction, which is important, it still does not tap into the full potential of true knowledge exchange between these two disciplines. Architect-led design-build (ALDB) posits a fifth dimension, one not readily detectable but equally powerful, in which the social capital and tacit knowledge of architect and contractor influence the built environment for the better.

ALDB places architects in the dual role of construction manager, responsible for design and documentation, and bidding and construction. ALDB is not a formula for elegant architecture or quality construction, though that can be the result. It is a mindset that can align aesthetic and technological conflicts within the logic of construction culture. When thinking and making do not readily match up, ALDB allows investigation, re-evaluation and project transformation in ways difficult to achieve when architects are relegated to a traditional role.

Closing the Gap

A gap exists between architects and contractors, though their work depends on each other. Architects' value is limited by separation from a body of information that can strengthen design and increase its relevance. Architectural thinker Thomas R Fisher asserts that design disciplines 'perpetuate an adolescent avant-garde that too often confuses the commission of errors with creative risk' and should instead 'take educated risks and eliminate avoidable errors, which demands ... work from knowledge rather than from the heroic lore that too often guides ... actions'.¹

ALDB closes the gap using the social capital of architects and constructors working effectively together. In 1921, Austrian-British philosopher Ludwig Wittgenstein said, 'The limits of my language mean the limits of my world.'² Architects' capacity expands with proactive engagement with



GLUCK+,
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Every square foot mattered due to budget constraints, resulting in efficient and dual-purpose circulation with lab equipment maximised on wall surfaces, and mechanical, electrical and emergency power equipment protected indoors from salt air and hurricane damage. These constraints created design opportunities, allowing a level of abstraction with solid stacked boxes conveying SLR resilience, with entry demarcated as an open void at the heart of solid forms.

Duke University Marine
Laboratory Campus,
Pivers Island,
North Carolina,
2014

Situated on Pivers Island within the Outer Banks of North Carolina, Duke University Marine Laboratory Campus is a unique 'window on the sea', providing experiential learning that combines classroom with field and theory with practice, and encourages wise local land management and protection of natural resources due to engagement in the field. For the new research laboratory, every design decision reinforced the concept of providing a window on the sea, both figuratively and literally.

the messy world of construction. Subcontractors benefit from early participation, providing a forum for their technical input, for understanding project goals and their place in it. ALDB engages subcontractors early in the schematic design stage, incorporating their trade expertise to the mix. Their knowledge therefore shapes design rather than what is more typical, when they come in after the construction documents have been completed and begrudgingly find solutions to problems deeply embedded in the design.

In Evidence: Framing Problem and Solution

The Dr Orrin H Pilkey Research Laboratory, situated on Duke University's marine field campus on Pivers Island, North Carolina, is a case in point. It was completed in 2014 by GLUCK+ through ALDB, the final building solution emerging from direct engagement with the construction world.

Duke had mission-driven objectives: create a state-of-the-art laboratory enabling cutting-edge research; energise the campus and keep it competitive with a functional and programme-dense building; champion planning for sea-level rise (SLR); and demonstrate environmental responsibility through LEED Gold certification.

Duke also had programmatic and human-oriented goals: take advantage of the location's natural beauty; recognise that research is performed inside and outside the lab through debate and discussion; avoid an institutional feel; and embody the rustic sensibility of the original 1930s campus.

The location is demanding. Proximate to the Outer Banks barrier islands, environmental forces include hurricanes, high winds, corrosive salt air, withering sun and mould-inducing humidity. Situated in a small town, Duke wanted to utilise as many local subcontractors as possible despite the area's limited pool.

The building conceptually and programmatically addressed SLR by elevating the research laboratory to the first floor, thereby protecting expensive instruments and irreplaceable specimen collections well above 100-year flood and projected storm-surge levels. The ground floor was organised and specified to allow inundation without damage to service equipment or fixed building elements.



The building's solid expression was dual purpose – maximise wall space for equipment and storage while considering hurricane protection.

The ground floor is concentrated around social spaces. Coined by the then Marine Lab Director Cindy L Van Dover as the 'Collisional Commons', it is where ideas from the entire marine lab community collide informally. Visually and spatially porous, it opens to outdoor porches protected from seasonally shifting winds all times of day. The jagged footprint is better equipped than a flat facade to reduce storm-surge velocity. Surrounding landscape berms create higher ground to minimise scour along the building's edges, and the need for hard stormwater structures is removed through the promotion of infiltration at scupper discharge locations.

Meeting Duke's criteria, however, was not a linear path. The initial building concept looked very different than the end result due to ALDB.

Social Capital at Work

The dilemma: Duke's budget didn't match programmatic need. The objective: attract three new faculty members and their research teams. Designed on the heels of the 2008 economic downturn, the budget was fixed and extremely tight. The programme size was estimated to be



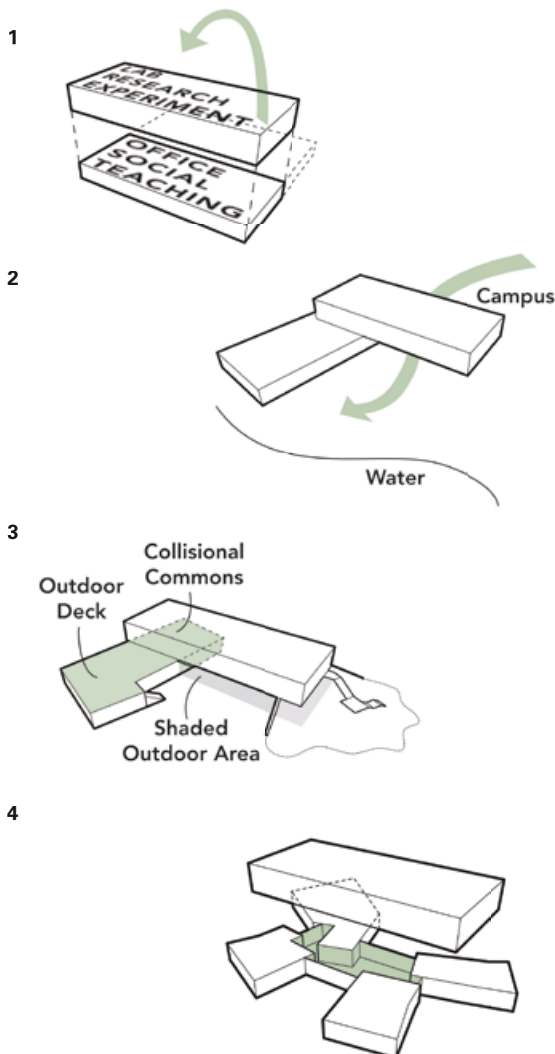
GLUCK+,
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The building envelope comprises only 17.5 per cent glazing to respond to programme, cost and resiliency demands, but glazing is strategically sized and placed for a spatially porous environment that opens up towards the water.

37 per cent greater than could be afforded by the budget, loosely translating as the space for one new faculty member.

Rather than create a no-frills building to maximise the programme or one that embodied Duke's vision at the expense of a faculty member, ALDB challenged these assumptions. A larger building fulfilling the conceptual and aesthetic vision was designed, trusting that ALDB would tease out specific ways to attack the budget-programme misalignment. In other words, enter a pressure-cooker situation to extract the most important ingredients. And the pressure cooker was real, as it involved risk. The project had to be delivered with a guaranteed maximum price (GMP). If as architects GLUCK+ wanted to preserve the design and avoid the down-and-dirty, then as construction managers they had to figure out how to achieve it.

Steven Kotler, who focuses on the intersection of science and culture with emphasis on neuroscience and evolutionary theory, says that creative people problem solve by searching for 'dimmer connections, subtler relationships, novel linkages'. He says, 'When the brain encounters unfamiliar stimuli under uncertain conditions ... baser instincts take over ... [I]n an effort to save our own butts, the brain's pattern recognition system starts hunting through every possible database ... Risk, therefore,



left: Developed on the heels of the 2008 economic crisis, the budget was fixed and modest, which made the architect-led design-build (ALDB) process critical to addressing budget and programme incompatibility. ALDB relies on access to subcontractors during the design period to obtain market feedback, and to allow early redesign without programme loss by reshaping the building and making the design better.

below: ALDB provides the design freedom to distill the building concept in direct response to market feedback from subcontractors.

ITEM	DESCRIPTION	DATE	STATUS
001	FOUNDATION	2014-08-01	COMPLETE
002	FOUNDATION	2014-08-01	COMPLETE
003	FOUNDATION	2014-08-01	COMPLETE
004	FOUNDATION	2014-08-01	COMPLETE
005	FOUNDATION	2014-08-01	COMPLETE
006	FOUNDATION	2014-08-01	COMPLETE
007	FOUNDATION	2014-08-01	COMPLETE
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049	FOUNDATION	2014-08-01	COMPLETE
050	FOUNDATION	2014-08-01	COMPLETE

causes the mind to stretch ... think in unusual ways ... be more creative.³

To discover what could be achieved in a small-town construction environment, a network of relationships with local subcontractors had to be established. The initial concept was documented via preliminary pricing sets identifying scope without getting bogged down in detail or coordination issues, and sent to local subcontractors. Once 'bids' were received, architects wearing the construction-manager hat sat with subcontractors identifying costs, trade by trade, and being open to comments and critiques of the design and suggested ways of reducing cost. The job then involved absorbing these different perspectives (understanding that something less expensive mechanically, for instance, isn't necessarily compatible with the less expensive carpentry solution), and making connections not readily apparent.

Pricing yielded a cost of \$5.5 million – \$800,000 over budget. Although the cost overrun was not as great as originally thought, cost reductions were imperative. A one-month redesign period ensued during which subcontractor comments shaped design thinking to make the building better, not just less expensive.

To reduce cost without programme loss, maximising the overlap of the ground and first floors was the most effective approach to shrink the building footprint, reduce the exterior wall area and decrease infrastructure runs. The ground floor was then reshaped to reintroduce spatial diversity. Through this back-and-forth process, the architecture team realised that the in-between spaces and not the overall building form were the essence of the design. This was only discovered through the ALDB pressure cooker. The building visually and conceptually became not only about



In addition to addressing the technical requirements for building in hurricane areas, 'soft infrastructure' solutions provided even greater resiliency. This translated to materials that can withstand flood water, and instead of presenting a flat, linear face to the water, the building's jagged edges can reduce the velocity of a storm surge, with landscaped berms creating higher ground to minimise scour along the building's edges.

below: The building structure and envelope address environmental forces, including hurricanes and wind. Analysis was complicated by decisions to 1) use wood-framed construction and concrete masonry foundations in response to dominant local construction techniques, 2) use 'stack boxes' that misaligned the ground-floor roof framing and first-floor slab framing on different elevational planes, and 3) introduce material transitions at critical heights as protection from potential water damage.

SLR, but about the collisional and collaborative nature of research. Construction knowledge, largely obtained via direct interaction with local subcontractors, honed the design.

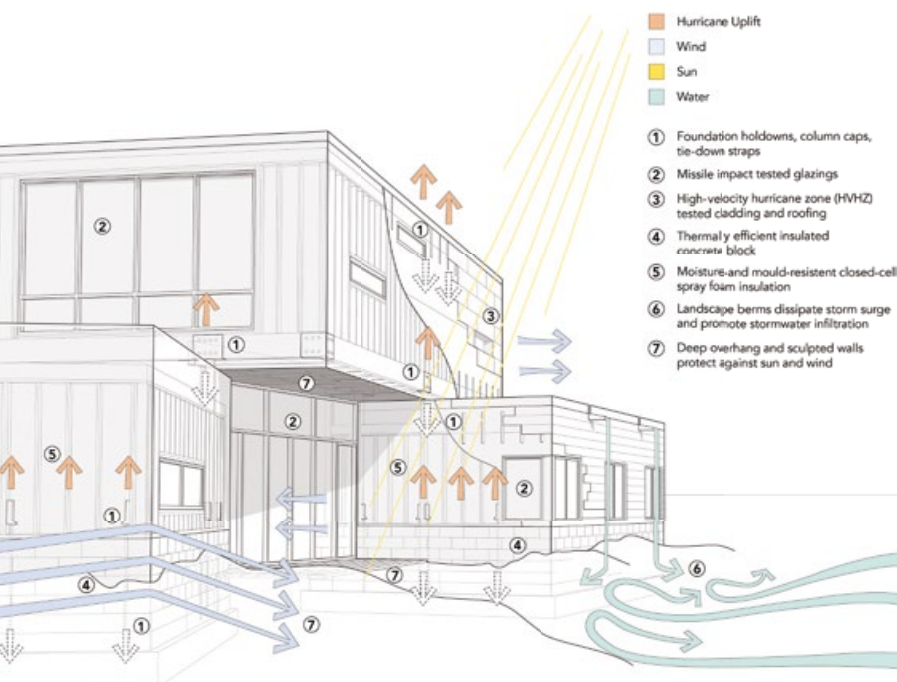
Tacit Knowledge at Work

The process, however, was not completely reductive. While paring down yields more affordable design, the best solution is not always the least expensive. There are no explicit steps to determine what to remove versus maintain. It requires nuanced evaluation of how an architectural premise is reinforced by plan, section, construction detail, material selection, building technique, and the strengths and capabilities of local builders. In the case of the laboratory, this was necessary to contend with contradictory desires.

Faculty, for example, wanted storage and equipment. Large windows were viewed as wasted space. Major savings would undoubtedly result from reducing expensive hurricane-tested glazing systems. This, however, went against optimum natural daylight and views, and conflicted with the administration's desire to engage the coastal location. Ultimately, minimising glazing created simple, almost abstract forms, and windows were strategically placed for greatest spatial impact. When walking through the building, all comment on the feeling of openness without intuiting that glazing comprises only 17.5 per cent of the building envelope.

Addressing SLR on macro and micro levels is another example. The stacked box diagram achieved the macro, but the ground plane required the micro. Wave action was a concern even though well above the predicted 2100 sea level. The newly sculpted building shape reduces water velocity from shore, and surrounding dunes further dissipate forces. Zooming in, the ground floor visually and physically demarcates SLR datum outside and inside, protecting the building with a water-repelling concrete masonry unit (CMU) stem wall below datum, and moisture- and mould-resistant closed-cell spray insulation above.

This datum also addressed scale. The series of ground-floor boxes responds to the scale of other



campus buildings, in spite of the project being the second largest on campus. The datum reduced the perceived vertical scale of walls, with the dunes further reducing scale, while doubling as effective stormwater management.

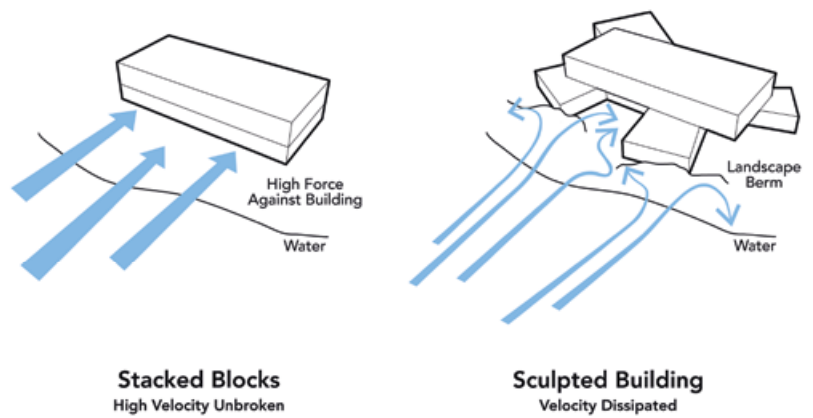
The above decisions met multiple criteria through the careful weighing of cost-effective and achievable ideas versus items impacting costs but imperative to design. Both the stacked box concept and material transitions are examples of this, being counter to hurricane resistance. The stacked boxes required double framing with lower box roof framing on a different plane to upper box floor framing. Material transitions created more situations requiring hurricane tie-downs.

Nicholas Carr, who examines technology's effect on cognition and capacity for concentration and contemplation, distinguishes between tacit and explicit knowledge. Tacit knowledge involves the things done without thinking such as eating and reading. These actions are learned, but once learned are automatically processed by the brain without conscious awareness. Carr says our ability to assess situations 'stems from the fuzzy realm of tacit knowledge. Most of our creative and artistic skills reside there too.'⁴

ALDB equips architects to evaluate and prioritise decisions. After years of experience in the office and field, designers adopting ALDB have variegated knowledge from which to distinguish big deals versus what can be accomplished with reasonable levels of detail and effort.

Hard Work and Feedback

Creative solutions require gaining knowledge, making connections and placing ourselves in pressure-cooker situations. But nothing replaces plain old hard work. Carr argues that 'immersive experiences ... actively generate knowledge rather than passively take in information. Honing our skills, enlarging our understanding ... require tight connections, physical and mental, between



Taking a cue from buttress and channel systems found in coral reefs that reduce wave energies, the building form is sculpted to dissipate velocity and divert water that may surge inland during storms.

the individual and the world.'⁵ Or, in the words of philosopher Robert Talisse, 'getting your hands dirty with the world and letting the world kick back in a certain way'.⁶

This leads to ALDB's ultimate power. It is not enough to access knowledge early on from subcontractors, but lack follow-through during construction. Social capital between architects and constructors exists only when working in two directions. Design is richer when informed by constructability. But the reality is that subcontractors, when faced with schedule pressures and field conflicts, will seek the easiest resolution possible, which isn't always best for the design, overall construction coordination or structural integrity of the building.

The architect being on-site, not as an observer but as an active participant in the supervisory role of construction manager, with full knowledge of the decision-making history and the overview on what needs to be achieved, is well-suited to resolving these conflicts. In this role, subcontractors view the architect as a problem solver, not problem creator.

With on-site responsibility for how something is built, information is collected that influences the next project. It is a knowledge-gaining feedback process that makes architects not only increasingly relevant, but increasingly creative. ▢

Programmatic requirements were paramount with every design decision having to work within the limited budget. Faculty needed maximum real estate for equipment and storage, resulting in the strategic placement of windows at desk height to create unexpected framed 'windows to the sea' without sacrificing the programme.



Notes

1. Thomas R Fisher, *In the Scheme of Things: Alternative Thinking on the Practice of Architecture*, University of Minnesota Press (Minneapolis, MN), 2000, p 10.
2. Ludwig Wittgenstein, *Tractatus Logico-Philosophicus*, trans Charles K Ogden, Dover Publications (Mineola, NY), 1998, p 88.
3. Steven Kotler, 'Einstein at the Beach: The Hidden Relationship Between Risk and Creativity', *Forbes*, 11 October 2012: www.forbes.com/sites/stevenkotler/2012/10/11/einstein-at-the-beach-the-hidden-relationship-between-risk-and-creativity/2/#760ae6823c49.
4. Nicholas Carr, *The Glass Cage: Automation and Us*, WW Norton & Company (New York), 2014, pp 9–10.
5. *Ibid.*, p 85.
6. Quoted in *Ibid.*