INTERNATIONAL CODE COUNCIL®

Adaptation and Mitigation of Buildings in Emerging Economies:

The Importance of a Focused Approach to Regulatory Compliance

www.iccsafe.org

In many emerging economies, the greatest barrier to achieving safe buildings is not access to strong building codes and standards, but the capacity to successfully implement and enforce those building codes. The same principle is true for achieving energy efficient and green buildings, which are frequently touted as important elements in achieving Nationally Determined Contributions (NDCs), and which can mitigate the impact of climate change and result in more resilience. In emerging economies and the Global South, it can be argued that investing in a strong regulatory infrastructure and capacity building for enforcement could be more effective in achieving cleaner, more resilient buildings, than updating building regulations to the most advanced energy efficiency standards. Furthermore, so-called vernacular, or traditional, construction should be addressed in a manner that reflects its mitigation benefits and unique character.

INTRODUCTION

Buildings are at the core of economies and 75% of Nationally-Determined Contributions (NDCs) identify building policy as a primary climate mitigation measure (the second highest measure behind deployment of renewable energy).[1] Furthermore, 82% of the population that will be added by 2030 will live in countries that currently have no building energy codes or only voluntary codes. Of this additional world population growth, 34% is expected to occur in African countries with no current codes, and an additional 33% will occur in African and Asian countries that currently have only voluntary codes.[2]

Decisions on how these buildings are constructed will lock in performance for decades. Regulatory policies like building codes and their supporting enforcement infrastructure have been identified as key mechanisms to realize the resilience and sustainability levels required. However, codes and the associated regulatory process must recognize the unique needs of the communities where they are being applied. While lessons learned from developed economies are valuable, the policies deployed in emerging economies must be appropriate and relevant to the context within each particular country.

In discussing the various pathways to addressing climate change adaptation and mitigation in the buildings and construction sector, focus is often placed on improving the energy efficiency of buildings and utilizing more sustainable construction solutions to reduce both the operational and embodied carbon in buildings, coupled with designing structures that will be more resilient to the increasingly frequent and severe weather hazards that the building will face in its expected service life. This combination of approaches, while comprehensive, is appropriate primarily for jurisdictions which already have a comprehensive regulatory environment in place to ensure the effective implementation and enforcement of the proposed solutions, as well as ample availability of the resources and materials required to construct more sustainable structures.

This discussion necessarily overlooks many of the emerging economies located in the so-called Global South, in which it is common for jurisdictions to experience one or more limitations in implementing these pathways, including:

- Absence of modern and appropriate building regulations
- Absence of a comprehensive building regulatory infrastructure
- Lack of trained independent plan reviewers and inspectors
- Limited availability and relative cost of building materials required to adhere to international standards and specifications
- Broad use of vernacular construction[3]

---

[1] United Nations Framework Convention on Climate Change (UNFCC). Nationally Determined Contributions Under the Paris Agreement: Synthesis Report by the Secretariat. September 17, 2021. https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf.

[2] United Nations Environment Programme (2021). 2021 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. https://globalabc.org/resources/publications/2021-global-status-report-buildings-and-construction.

[3] Vernacular construction is defined by the International Building Quality Centre to refer to "buildings constructed in rural areas in accordance with traditional construction methods characteristic of that culture where mediums such as mud brick, mud and stick frames and facia, thatched roof, local habitat and vegetation is used to generate the construction materials."

In emerging economies and the Global South, therefore, it is important to modify the discussion so that residents of jurisdictions facing one or more of these limitations have equitable access to safe and resilient buildings. The principles remain the same, but the context must be changed.

The International Code Council (ICC), based in the United States but with a global building safety mission, has developed a construct to define the "key ingredients" of a building code regulatory system – that is, all of the elements necessary to facilitate the safe design, construction and operation of buildings to a level that is acceptable to society. In the ICC description, "the system typically includes enabling legislation, a building code (or building regulation) and an enforcement mechanism. In most cases the system is supplemented by a wide range of materials, design, test and installation standards, a products-approval framework, an education system, and certification of professionals."[4] An illustration of the ICC construct can be found below.

Building Code Regulatory System Key Ingredients

Without all of these elements in place, a jurisdiction will not achieve the level of building safety and resilience benefits that are expected from the building code in place. Likewise, the anticipated level of energy efficiency and mitigation benefits expected from adopting an energy efficient building code will not be realized without building the necessary capacity to effectively implement, enforce and maintain that code. Suggesting or assuming that the solution to improving the safety, resilience, and energy efficiency of buildings around the world is to simply utilize advanced building and energy codes is

[4] International Code Council, Building Department Administration, page 582.

insufficient. More focus on creating effective systems for enforcement, as well as ongoing maintenance of the adopted building code, is required.

This paper draws heavily on the excellent work undertaken by prominent international organizations on subjects related to climate change adaptation and mitigation and/or essential components of building regulatory systems, including the Global Alliance for Buildings and Construction (namely in its Regional Roadmaps[5] publications), the World Bank Group's Global Facility for Disaster Reduction and Recovery (namely through its Building Regulation for Resilience program), and the International Building Quality Centre (namely through its Good Practice Guidelines[6] designed specifically for emerging economies). It explores the essential requirements for achieving building safety in general, followed by consideration specific to achieving the climate mitigation benefits anticipated through the use of building energy codes.

1. ENFORCEMENT CONSIDERATIONS

It is by design that a consideration of enforcement capacity is discussed before the actual regulation that will be enforced. Enforcement capacity includes having a properly developed system for enforcement of building codes at a local level, including the building department as well as qualified practitioners and a regulatory regime that empowers officials with actual enforcement authority to correct non-compliance. Frequently the budget required to build this capacity far exceeds the budget required to adopt a building code in the first place. Therefore, the existing competencies (or those that can reasonably be developed), and overall resources available to enforce building regulations should be carefully considered up-front, as this may inform how comprehensive and complex of a building regulation can effectively be enforced. While this is the case for developed and emerging economies alike, it is a particular challenge for jurisdictions in emerging economies that have defaulted to adopting or referencing an advanced building code or set of standards that has been developed in and for a country with a much more established regulatory infrastructure. Without significant modifications, this approach is unlikely to result in effective implementation and enforcement.

The Global Facility for Disaster Reduction and Recovery (GFDRR), managed by the World Bank, has a mission to support low- and middle-income countries to understand, manage and reduce their risks from natural hazards and climate change. In its *Building Regulation for Resilience* publication, the GFDRR offers three basic tenets which it considers essential components of a building regulatory framework:

1. *A legal and administrative framework at the national level, including national legislation that mandates strong building regulations and investment in hazard mapping.*
2. *A building code development and maintenance process which facilitates the use of appropriate standards that can be easily implemented at a local level.*
3. *A set of implementation mechanisms at the local level, which include plan review, inspection, data management and ICT [information and communications technology] applications, and training of practitioners, among other aspects.*[7]

The GFDRR's framework, which notably aligns with the ICC construct, places high importance on consideration of the downstream implications of legislating strong building regulatory policies at the national level – particularly on how or whether those policies can be enforced at the local level, especially in the context of emerging economies.

In its pathway publications addressing Africa, Latin America and Asia, the Global Alliance for Buildings and Construction (GlobalABC) acknowledges, similarly to ICC and the GFDRR, the importance of building the regulatory capacity of

[5] The GlobalABC's Regional Roadmaps for Buildings and Construction in Africa, Asia and Latin America are available as free downloads on the GlobalABC website at https://globalabc.org/our-work/forging-regional-pathways-global-and-regional-roadmap.

[6] The IBQC guidelines are available as free downloads on the IBQC website at http://www.ibqc.org.au/ibqc-guidelines/.

[7] GFDRR, Building Regulation for Resilience: Executive Summary, page 7.

jurisdictions to implement and enforce compliance with building codes, including energy codes. GlobalABC notes that this task "is crucial yet challenging, as it is often up to subnational governments to enforce, despite variations in human and financial resources."[8] As one potential solution, GlobalABC suggests that "a monitoring framework for compliance checking, accessible tools and extensive capacity building will facilitate compliance and even enable compliance within sectors such as the informal sector and the social housing sector."[9]

The International Building Quality Centre (IBQC) is a global think tank comprised of volunteer experts in good practice building regulation. The IBQC's first publication, *IBQC Principles for Good Practice Building Regulation* was followed by a modified version that addresses the specific circumstances of emerging economies: *Good Practice Guidelines and Principles for the Development of Building Regulations in Low Income Countries*. This second publication, like the GlobalABC's consideration of the informal sector and social housing sector when promoting a framework and tools for compliance, was particularly notable in its identification and unique treatment of three distinct paradigms of construction, defined as engineered, vernacular and informal.

1.1. ENGINEERED CONSTRUCTION

Engineered construction is the paradigm that will require the most robust regulatory capacity. Just as in the largest and most advanced metropolitan areas in the world, engineered buildings constructed in the Global South require adherence to appropriate building codes, for which competent plan reviewers and inspectors with enforcement powers, at a minimum, are necessary. The regulatory system for engineered buildings should include plan review and permitting according to zoning regulations, a system of building classifications according to risk and function, mandatory inspections throughout the construction process that can result in enforced requirements for correction of non-compliance, and a final approval resulting in the issuance of an occupancy permit.

It should be noted that some jurisdictions outsource some or all of these functions to private third-parties, which is a method that can potentially reduce the budget and required staffing needs of the building department. However, when considering the use of third-party plan reviewers or inspectors, the authority having jurisdiction (AHJ) should always be clearly defined and free from conflicts of interest. In some jurisdictions, third-party providers are hired by and report directly to the local governmental authority, which has ultimate responsibility for auditing the work of the third-party. In other jurisdictions, third-parties are licensed by the governmental authority and directly perform many of its duties, essentially holding the responsibility of the AHJ.

In its *Building Department Administration* publication, ICC outlines the essential functions of an effective building regulatory system (reprinted to the right) which are aligned with the IBQC recommendations for the engineered solutions paradigm.[10]

1. Management
   a. General Manager, Director of the Building Department or Chief Building Official.
2. Administration
   a. Budget: prepares annual budget.
   b. Personnel: is responsible for employment or dismissal of personnel.
   c. Training: provides training and verifies minimum standards of production for department are met.
   d. Records: provides maintenance (storage) of approved plans and permits as required by state or other laws.
   e. Information Technology: oversees automation of record keeping, permit issuing, distribution of information to staff and public, Internet and/or intranet and website.
3. Plan Review
   a. Examines buildings (architectural and structural), electrical, mechanical, plumbing, energy and green plans and specifications and verifies facilities' compliance with accessibility requirements per state or local law.
   b. Reviews all matters pertaining to the science of civil, electrical, mechanical or structural engineering.
   c. Oversees public counter services and permit issuance (these services could also be part of Administration).
   d. Reviews geotechnical and soils reports.
   e. In some jurisdictions may examine architectural plans for zoning requirements.
4. Inspection
   a. All inspection activities and combination and specialty inspections, including building, electrical, plumbing and mechanical inspections.
   b. Coordination of specialty inspectors, including joint inspection of fire alarm and fire protection systems with the Fire Department, for example.
   c. Issuance of certificate of occupancy (this service could also be part of Administration).

[8] GlobalABC, Regional Roadmap for Buildings and Construction in Africa, page 50. This same finding is noted in the roadmap documents for Asia and Latin America.

[9] Ibid.

[10] International Code Council, Building Department Administration, pp. 229-230.

In its third guideline publication, *Good Practice Building Inspector Guidelines for Emerging Economies*, the IBQC recommends that building inspectors in an emerging economy engineered solutions paradigm should capture the same construction milestones that an inspector in a high-income economy overseeing the construction of a building designed in accordance with advanced construction design and engineering principles. The problem identified by the IBQC in emerging economies is that, while many buildings are constructed based on advanced designs, the enforcement infrastructure is often not in place, resulting in greater risk of building failure, coupled with potential injury and loss of life. The flowchart designed for engineered solutions inspections in the IBQC publication aims to simplify the process that jurisdictions can use to determine a 'right-sized' inspection regime for its jurisdiction, based on the essential building control features to be inspected. These essential elements of an engineered building that require inspection[11] include:

- Site conditions (pre-construction)
- Structural safety (frame, walls, floors, roof)
- Occupant safety system (prevention of slips, trips, falls)
- Fire safety design/systems (prevention, alarms, egress, firestopping)
- Amenity (comfort/energy efficiency)
- On-site sanitation & water supply (hot/cold water supply, drainage, sewerage)
- On-site power sources (connection to network, solar/wind generation on-site)
- Health (sanitation, habitation, indoor air quality)

1.2. VERNACULAR CONSTRUCTION

The IBQC has noted that in some emerging economies, up to 80% of buildings are not constructed by professionals with formal training, licenses or credentials to any mandated building standards that would be commonly used in developed countries.[12] This is not to say that the large proportion of buildings in the Global South are unsafe, but rather that vernacular construction warrants a different type of oversight to ensure its safety than engineered construction. The GFDRR likewise notes that organizations providing post-disaster financing should not ignore traditional building practices, such as the dhajji dewari method used in the seismically-active regions in the western Himalayas.[13] To do so simply, because the structures built in these rural areas do not comply with building codes designed for engineered solutions misses, an opportunity to improve building safety in a hazard-prone region.

Rather than exempting vernacular construction from building safety considerations, or deeming it to be non-compliant with engineered construction methods, a different approach is needed. Specifically, different regulations and guidelines will need to be considered, and the enforcement infrastructure must recognize the role of local, community and tribal leaders who frequently have jurisdiction in the largely rural areas where vernacular settlements abound. These local leaders become the AHJ, sometimes in conjunction with regional government representatives or nearby municipal authorities.

Because it is important for traditionally-built structures, like engineered structures, to provide a basic level of safety and protection from the greatest risks to human life and injury, the approach to building inspection needs to be highly localized. The same eight essential elements of buildings that should be inspected remains the same as in the engineered solutions paradigm discussed above, but the expectation of each of those items shifts according to the local context. For instance, rather than inspecting the foundation of a building in the category of site conditions, the inspector may instead prioritize ensuring that the building site is not prone to flooding or mudslides. Likewise, there is not likely to be a great need for fire alarm systems and egress in small rural dwellings, so the fire safety considerations in a vernacular context will be focused

[11] IBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 6.

[12] IBQC, Good Practice Guidelines and Principles for the Development of Building Regulations in Low Income Countries, page 2.

[13] GFDRR, Building Regulation for Resilience: Executive Summary, page 4.

on preventing the risks of fire outbreak and spreading.[14] The role played by inspectors of vernacular construction is therefore more of an educator or one providing guidance about how to improve the safety and health of the inhabitants of vernacular buildings, including safe construction and separation of waste facilities, compartmentalization of cooking facilities, access to fresh water that will not be contaminated by waste, and safe access to energy supplies where available.[15] The IBQC inspector guidelines note that the inspectors should have the express authority to evacuate habitants of vernacular buildings in the event of an emergency and to issue emergency orders for demolition of structures that pose a risk to life safety.[16]

1.3. INFORMAL SETTLEMENTS

There is a third category of construction identified by the IBQC, which is informal settlements. By definition, informal settlements are not legally permitted, approved or regulated, so there is not a regulatory capacity to enforce the construction itself. Nonetheless, people who live in informal settlements are particularly exposed to hazardous conditions and authorities in jurisdictions in which these settlements are located should do what they can to offer emergency protections to these residents. The IBQC inspector guidelines suggest that in situations of imminent danger or potentially ruinous informal building, enforcement powers should exist to enable inspection of unsafe sanitation, potable water contamination, or structural or fire safety, and then to issue emergency orders which could include:

- Prohibiting access to the settlement
- Evacuating the settlement
- Demolishing the settlement
- Posting signage warning of the danger
- Conducting emergency works
- Otherwise managing occupants of the settlement[17]

Organizations such as BuildChange[18] are actively working to improve the safety and resilience of homes in emerging economies, often retrofitting existing structures and using locally-available and affordable materials as much as possible. While this approach is neither a function of a building regulation nor a means of enforcement, it is worth exploring as a means to reduce the number of people living in unsafe informal housing. Providing basic education for residents on informal housing can help to address some of the most common points of failure and lead to improved living conditions and reduced risk of harm.

1.4. PERMITTING AND LAND USE

Since enforcement presents a challenge in many jurisdictions and particularly with respect to certain types of construction paradigms, in a discussion that involves building safety, and particularly the resilience of buildings to the impacts of climate change, jurisdictions considering their regulatory frameworks would be well advised to also consider the function of land use planning. Recognized by the GFDRR and the IBQC, as well as the Global Resiliency Dialogue,[19] as a key element in the resilience of all building typologies to climate change, land use planning is often overlooked as part of the building safety regulatory framework.

---

[14] IBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 8.

[15] IBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 9.

[16] IBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 9.

[17] IIBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 11.

[18] https://buildchange.org/

[19] The Global Resiliency Dialogue is a collaborative of building code development and research organizations, along with interested government and non-government stakeholders from Australia, Canada, New Zealand and the United States, working to advance the integration of climate science into building codes and encourage construction of buildings to be resilient to the weather hazards anticipated throughout their serviceable life.

The Global Resiliency Dialogue notes in the Global Building Resilience Guidelines, "factoring the implications of permitting development in areas likely to be prone to future natural hazard events may otherwise rule out such development or recommend that more stringent levels of construction would be warranted."[20] The IBQC also specifies that, regardless of the construction paradigm, any building regulation or guideline "will provide that buildings cannot be built in disaster prone areas in light of the enhanced risk to the life and safety of vulnerable citizens in developing economies to disaster events." Zoning is addressed in the GlobalABC roadmaps, but primarily in the context of urban planning and the potential mitigation benefits. In all cases, the adoption of and capacity to enforce land use planning and zoning regulations should be considered as an ancillary to a building code enforcement infrastructure, with the two elements having "significant interdependency."[21]

1.5 ENERGY CODE ENFORCEMENT

When considering the challenge that many jurisdictions, especially those in emerging economies, face in creating an effective regulatory ecosystem and building the capacity to enforce building safety codes, it is difficult to envision enhancing those systems to also incorporate implementation and enforcement of building energy codes, which are often more technical and require additional specialized expertise. This is important because national governments are being encouraged and incentivized to adopt advanced building energy or green building codes as a critical pathway to achieving NDCs, but little thought is being given to how the local jurisdictions, which are largely responsible for ensuring their implementation and enforcement, can at the same time be best equipped to succeed in achieving the overall policy goals.

In many jurisdictions, the greenhouse gas mitigation and building adaptation goals may be achieved through the diligent work of designers and construction professionals who are committed to voluntary or otherwise unenforced compliance with regulations, often coupled with incentives that facilitate financing. While this can help to reach stated objectives, the extent of achievement of the desired outcomes is far from guaranteed, risking a disconnect between national and local ambitions and actual results. Furthermore, reliance on voluntary compliance and the availability of incentives is not a best practice.

Therefore, the adoption of energy codes in emerging economies should be coupled with additional capacity building and training to enable regulatory officials to understand and enforce them in addition to the other building codes that are being used in the engineering solutions context. Contemplation of building capacity to overlay energy efficiency requirements in the guidelines applicable to vernacular construction may be overly ambitious in the early stages, and may also not achieve a high degree of greenhouse gas reduction on top of what can be achieved in the engineered paradigm, in which a more robust and technical regulatory capacity is applicable.

2. ADOPTING AN APPROPRIATE BUILDING CODE

According to findings reported in the GlobalABC *Regional Roadmap for Buildings and Construction in Asia*, stakeholder feedback included comments that "monitoring and enforcement was adequate but not widespread, due to the codes being voluntary. A focus on broader mandatory codes would help ensure 'most' new buildings reach compliance by 2050."[22] This focus will necessitate that any code – whether it is an energy conservation focused code, or one that addresses structural safety, fire safety, plumbing, mechanical or other aspects of building safety – be right-sized and appropriate for the jurisdiction that will have responsibility for its oversight, implementation and enforcement.

As the entity that develops and publishes the International Codes (I-Codes), the International Code Council frequently advocates working from an established model code, rather than "reinventing the wheel." However, ICC also recognizes that

[20] Global Resiliency Dialogue, Global Building Resilience Guidelines, page 20.

[21] GFDRR, Building Regulation for Resilience: Executive Summary, page 2.

[22] GlobalABC, Regional Roadmap for Buildings and Construction in Asia, page 50.

a building code that is developed largely based on a North American experience is not positioned to be an ideal solution for an emerging economy unless it is modified. Model codes, such as the I-Codes, anticipate modification when being adopted by jurisdictions around the world, but the work of modification is a substantial undertaking that requires technical knowledge. Jurisdictions that have adapted the International Building Code without adequate knowledge, for example, are sometimes left with a building code that has so many internal conflicts that it is too confusing to be enforceable.

Modifications of model building codes, especially for use in what the IBQC refers to as the Engineered Solutions paradigm in the Global South, particularly need to consider the availability of materials that will meet the standards referenced in the model code. If a particular type of structural steel or a specific plumbing pipe size or accredited laboratories to undertake prescribed tests are not available in the local market, then often the referenced standards that support the prescriptive solutions underpinning the building code are not helpful. Depending on the standards adopted within a country's construction sector and the availability of building products, the referenced standards may need to be adjusted for the code to be applicable in that country. Whenever this type of standards adjustment is made, the objectives identified in the code must also be reviewed to ensure that the standard appropriate for the market will still achieve the defined aim of the code.

Model building codes – especially those designed for application across a wide range of geographies, climate zones and hazard threats such as in the United States – are often more comprehensive than what is required in emerging economies. For example, when the Caribbean Community (CARICOM) Regional Organization for Standards and Quality (CROSQ) undertook the adaptation of the International Energy Conservation Code (IECC) for the fifteen CARICOM member states, the climate zones were modified as were a handful of other factors, such as winter heating for cold climates, when the CARICOM Regional Energy Efficiency Building Code (CREEBC) was developed for use in the region. The CREEBC, which is applicable for all jurisdictions in tropical climates, is an example of thoughtful modification of a model code that was done with significant input from technical experts.

The Saudi Building Code, which is also based on ICC's model building codes, does not require snow loading in its structural provisions, nor is wood construction given much consideration, as concrete and steel construction are far more prevalent in the region. Many of the referenced standards were also replaced to conform with the local regulations and mandatory compliance of some construction products to Saudi national standards. This also was done with much consideration and technical input.

In both of these examples, the resulting codes are contextually appropriate and enforceable. This is certainly a prerequisite to making codes mandatory, as was suggested by the stakeholders interviewed for the GlobalABC Roadmap.

Having a central and consolidated building act and one uniform building code are also recommendations made by the IBQC with respect to good practice regulation for engineered solutions buildings in emerging economies. While the IBQC recommendations do not address the use of a model building code as the basis for a jurisdiction's building regulation, they do contain many fundamental elements similar to what are found in a strong model building code, such as building classification according to risk profile, a process to create or update the code that enables wide stakeholder input and a system to regularly update the code.

Even a customized, right-sized code requires regular updating. Advancements in construction technology, including building materials and methods of construction are constant and rapid. Innovations can help to improve building safety, energy efficiency and resilience more affordably and effectively. Lessons are continually being learned from building and regulatory failures. All of this should be captured in revisions to the building codes so that they are also constantly evolving and improving. Jurisdictions should be looking well beyond adoption of a first building code to what process will be followed to ensure that the code remains current, and on what time cycle.

In addition to the codes used to govern engineered solutions, the IBQC recommends that guidelines be developed to ensure the safety of buildings included those under the vernacular construction paradigm. Rather than ignoring traditional

forms of construction or attempting to force the awkward compliance of vernacular construction to a building code designed for engineered solutions, the IBQC suggests that a regulatory guideline would be more appropriate. Such a guideline would be written to ensure that:

- *Buildings are built with materials and methodologies that are structurally sound and fit for purpose so as to ensure that there is no prejudice to life or harm from serious injury*
- *Buildings will not be built in disaster prone areas, or where the entire jurisdiction or region is a disaster prone area*
- *Buildings are close to water supply facilities to ensure that citizens can avail themselves of fresh and clean water*
- *Water provision, living, eating and communal facilities are sufficiently distant from toilets and laundries, polluted or contamination areas to prevent waterborne or airborne disease spread*
- *Cooking areas are separated from living and sleeping areas so as to prevent the risk of fire spread*[23]

Energy codes, likewise, need to be right-sized and able to be enforced in emerging economies. However, building energy codes are, for all practical purposes, applicable for engineered buildings but not the vernacular or informal paradigms proposed by the IBQC. Engineered buildings are likely to have the greatest impact on energy use, the greatest necessity to protect occupant safety and the greatest likelihood to support important community functions. They typically house medium to large businesses (including utility, banking and other commerce), are multi-unit residential buildings or support governmental functions (including administrative activities, healthcare and other social services).

While advanced energy codes are not necessarily appropriate for vernacular construction, it is important to acknowledge that the type of traditional construction often found in smaller villages in the Global South is often quite sustainable and not frequently a significant contributor to greenhouse gas emissions.

3. PRACTITIONER COMPETENCY

To gain benefit from building regulation, jurisdictions need to think beyond the cost of adopting or creating building codes and standard to the budgets that will be required to train and compensate an adequate staff to effectively carry out all of the functions necessary to enforce those regulations. This requires long-term commitment by the governmental leadership to create and maintain a robust enforcement infrastructure and staff that understands their role in protecting the public and has the soft skills training to successfully avoid ethical conundrums and conflicts of interest.

In its publication, *Good Practice Building Inspector Guidelines for Emerging Economies*, the IBQC recommends that all building inspectors across jurisdictions, regardless of whether they are charged with enforcing codes in an engineered solutions paradigm, guidelines in a vernacular construction paradigm or basic health and safety in informal settlements, are properly trained to understand the following four core skill sets:

- *The general duties of a building inspector*
- *Soft skills such as communication*
- *How to conduct inspections*
- *Ethical considerations*[24]

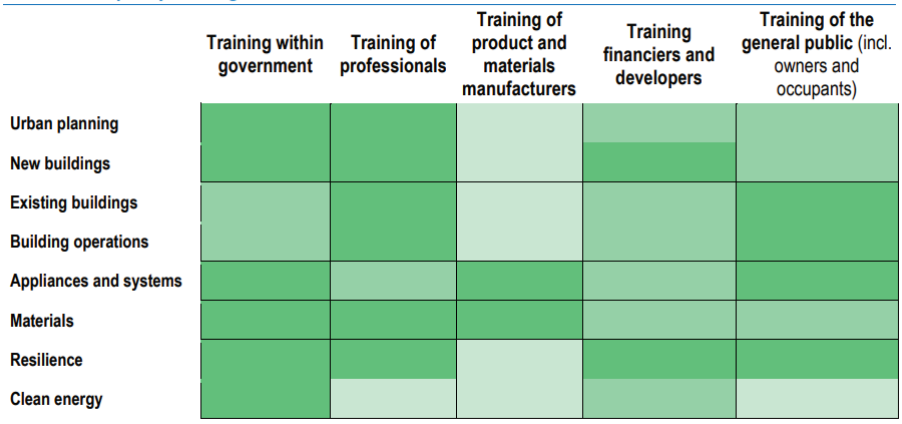
One effective approach to ensuring that practitioners are properly trained is to institute a licensing system which requires some demonstration of required competency before practitioners are allowed to perform their duties. This necessarily involves the establishment of education programs at the front end and ongoing oversight and auditing at the back end, the latter of which can be buttressed by sunsetting provisions or renewal processes that require participation in continuing education programs.

[23] IBQC, Good Practice Guidelines and Principles for the Development of Building Regulations in Low Income Countries, page 10.

[24] IBQC, Good Practice Building Inspector Guidelines for Emerging Economies, page 4.

Training programs need not stop at the practitioner level. The GlobalABC highlights in each pathway the important role to be played by various "enablers" which facilitate the cross-cutting activities that are necessary to successfully implement adaptation and mitigation measures, most often embodied in building energy codes and regulations (but which are equally applicable to more general building safety regulations). In addition to training, financing and multi-stakeholder engagement are identified as key enablers. Setting finance aside as a topic for a different discussion, the multi-stakeholder training needs are nicely displayed in the figure below (reproduced from the *GlobalABC Regional Roadmap for Buildings and Construction in Africa*).

Table 26 • Capacity building across activities



Note: The darker the colour, the higher the impact that capacity building type has for that activity.

This table demonstrates the importance of training governmental officials as well as professionals as the most high-impact investment that a jurisdiction can make in capacity building. In encouraging more widespread use and enforcement of building energy codes, providing education to developers and the general public is also extremely important. The same conclusion is drawn by the Global Resiliency Dialogue, which identifies Implementation as its twelfth principle, noting that any regulatory measures taken to enhance the resilience of buildings need to be complemented with "a wide range of education and practitioner capacity building tools."[25]

The GFDRR also highlights the importance of training in the larger context of an effective building regulatory framework, noting that most developed countries are buttressed by supporting institutions, including:

- *accredited building professional education*
- *professional societies and related codes of practice*
- *accredited training institutions for the construction labor force*
- *licensing procedures for building professionals*
- *quality control processes for building materials*[26]

The training and credentialing of personnel is a function that can be delegated to third-party entities. Indeed, the professional societies mentioned in the GFDRR list above may be in a better position to offer technical training and credentialing on codes and standards relevant to their specialty than a government entity or even a university or technical school. Some independent code development organizations, such as the International Code Council, also offer a wide range of training courses to help practitioners and enforcement officials to understand the content and administration of the building codes. Many training programs and credentialing exams are available online, and some training is available

[25] Global Resiliency Dialogue, Global Building Resilience Guidelines, page 32.

[26] GFDRR, Building Regulation for Resilience: Executive Summary, page 5.

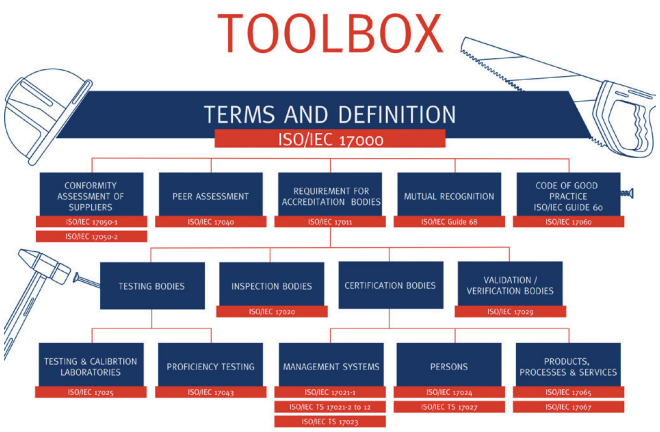
in a self-paced format from international organizations. Some also have arrangements in place to make their training programs and credentialing exams available locally throughout the world.

Training can also be provided through a collaboration with universities or technical schools that could offer a curriculum to train building safety professionals and construction practitioners. Professionalization of the skilled building safety workforce can help avoid conflicts of interest or corruption. Licensing and credentialing could be part of a local or national licensing scheme that is executed through universities and technical schools. Authorities having jurisdiction have the right to require training and/or certification in key areas for practitioners and enforcement officials, and having such a program in place will likewise result in stronger implementation of building regulations and better outcomes.

In the context of resilience, which applies equally to the Global North and the Global South, as is noted in the GlobalABC table above, much of the education does need to be targeted to developers, builders and homeowners, who will be challenged with rethinking what is important particularly in a home when resilience to climate change becomes a top concern. It is a process that necessitates de-emphasizing aesthetic elements, particularly interior finishes, and increasing the emphasis, importance and investment placed on resilience elements. It also necessitates considering affordability as something that is beyond the cost of acquiring a home (i.e. the cost of purchase), and instead a potential homeowner needs to undertake a holistic calculation of the cost of ownership of the property through the time that the owner expects to live there – including efficiency elements that will reduce the use and cost of energy, as well as the cost savings through integrated resilience measures that will necessitate fewer repairs or displacement in the event of an extreme weather event. A similar paradigm must be explored for renters.

4. CONFORMITY ASSESSMENT

Once a code has been adopted and the jurisdiction has built the capacity to enforce it effectively, having strong supporting institutions to provide conformity assessment services will aid in the delivery of safe buildings. Conformity assessment can be simply explained as the function of independently ensuring that "a product, service, process, claim, system or person meets the relevant requirements...stated in standards, regulations, contracts, programmes, or other normative documents."[27] Conformity assessment activities broadly include testing and certification (of products, personnel or management systems), laboratory and manufacturing site inspections, and accreditation. The ultimate resource for best practice can be found in the ISO 17000 series of standards. These standards, displayed in the graphic below (reproduced from the ISO website)[28] are commonly referred to as the ISO Committee for Conformity Assessment (CASCO) Toolbox.



[27] International Organization of Standardization definition offered on the ISO conformity assessment resources website: https://www.iso.org/conformity-assessment.html

[28] https://casco.iso.org/toolbox.html

Conformity assessment services, most notably a system for the independent product testing, inspection and certification of materials and systems used in the construction of buildings – as well as the issuance of Environmental Product Declarations (EPDs) to verify a product's impact on the environment – can be used to enhance the regulatory oversight and enforcement of building regulations. In many cases, conformity assessment tools can be leveraged at little to no cost to the government body responsible for enforcement, provided the staff is trained to understand the conformity assessment reports, such as product listings, and the jurisdiction enforces complete compliance with the ISO standards contained in the CASCO Toolbox. Here too, capacity building is essential.

Insisting on compliance with the ISO conformity assessment standards is essential, especially in a privatized or semi-privatized environment. Many countries have national accreditation bodies that are responsible for accrediting calibration and testing laboratories, and many are signatories to Mutual Recognition Agreements (MRA), such as the ILAC MRA. Some, however, are not. For a regulator, understanding the difference between a laboratory report issued by a lab accredited by an ILAC member versus one with less rigorous accreditation or no accreditation is critical for certification bodies to understand in order to produce a reliable product evaluation report. Likewise, it is critical for product certification bodies to comply with the ISO/IEC 17065 standard in its entirety, including implementing a system for factory inspection in accordance with the ISO/IEC 17020 standard, as well as for continuous compliance, in order to ensure that any products that have received certification continue to be safe and compliant with the building regulations in place.

The fissures in the system that have been uncovered through the recent public inquiry related to the Grenfell Towers fire that occurred in 2017 serve to highlight the importance of both having clear regulation that is understood enough to enable compliance by industry players throughout the product manufacture, testing, delivery and installation process, and holding to account the conformity assessment bodies involved in product testing and certification. With global supply chains and production processes proliferating, it is very important for jurisdictions to have strong compliance systems in place for products, whether those systems are built in-house and performed by government employees or whether the responsibility is delegated to a third party.

Authorities having jurisdiction have the right to demand proof of competence of their third-party providers and to demand proof of product compliance with mandated codes and standards. Failure to do so can compromise construction safety or can result in a lower degree of energy efficiency than what may have been intended in a building design. The cost to provide such proof is borne by the conformity assessment body or the product manufacturer and should not impact the budget of the enforcement authority, except for the investment that must be made to educate the enforcement personnel of the necessity of these certifications and any necessary oversight.

CONCLUSION

Adopting strong building energy codes and standards is an important component in decarbonizing the buildings and construction sector, including and especially in the Global South which is experiencing urbanization at a faster growth rate than the world as a whole, and where construction in cities is booming. The Regional Roadmaps produced by the GlobalABC provide an excellent resource to help develop national and subnational strategies to better enable the inclusion of building decarbonization in the NDC's required under the Paris Climate Agreement. For the recommended actions and timelines to be both achievable and meaningful, the overall building safety ecosystem, including the ability to enforce building regulations, must be strong and well developed. Focusing on capacity building in the area of regulatory enforcement will have benefits that extend beyond building energy codes to all aspects of safely constructed and resilient buildings.

The key ingredients of an effective building regulatory system as defined by the International Code Council are supported by organizations focused on improving building safety and resilience in emerging economies including the World Bank's Global Facility for Disaster Reduction and Recovery and the International Building Quality Centre. Investment in the development of a strong building safety ecosystem will enable better outcomes through enhanced compliance.