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**O**ver the past couple decades, building codes have responded to disasters, rather than averting them. Resilience is now an essential design element needed to withstand our changing climate.

# The Effect of Our Changing Climate on Building Design

In the immortal words of Bob Dylan “the times they are a-changin’”—intensified and more frequent hurricanes on the East and Gulf Coasts, more devastating wildfires on the West Coast and more frequent, powerful tornados

in the heartland. Mother nature has been particularly cruel to the United States since the new millennium. Putting aside the politics involved with climate change, the bare facts from the past twenty years reveal that we have seen more frequent category 5 hurricanes, F5 tornados, 100-year floods, and devastating wildfires. As with most devastating events we, as a society, have to learn from past experience and improve our society both culturally and physically in the

world we inhabit. This means that building codes will continue to evolve, the standard of care for design professionals will change, and the historical data that is used by various government entities for permitting, zoning, and city planning will have to take into account climate change as it advances.

How does the legal system play a role in climate change? As with all changes in our society, from women’s emancipation to the civil rights movement and the develop-

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ment of the information age, our legal system will be the battleground and place of adaption as our climate changes. It will be the evolving building codes and standards of care for design professionals that will be directly affected and indeed are already feeling the effects of climate change.

We are already seeing considerations associated with climate change make their way into the court system. While the following cases do not directly implicate design professionals, they do provide a glimpse into how the courts are recognizing climate change as a legitimate phenomenon that merits consideration.

### Climate Change in the Courts and Legislation

The courts have yet to take up the issue of climate change directly as an effect on the standard of care that applies to design professionals, but the following cases provide a glimpse into various decisions by the judiciary in which climate change was an issue in the case.

In *Cole v. Collier*, inmates in a Texas state prison brought a class action suit seeking relief from heat-related conditions in the prison that resulted in preventable health issues and deaths. *Cole v. Collier*, No. 4:14-cv-1698, 2017 WL 3049540, (S.D. Tex. July 19, 2017). The prison's housing area was not air conditioned, so the prison imple-

mented several measures intended to help with the heat during the summer months. This included providing ice water, cool-down showers, fans, a relaxed dress code, open windows, and increased access to other areas with air conditioning. *Id.* at \*5. Despite these cooling measures, the plaintiffs argued that more action must be taken to counteract the effects of extreme heat. United States District Court Judge Keith Ellison granted a preliminary injunction that ordered the prison to take actions to provide relief to individuals prone to heat-related illness, including lowering the temperature in the housing units that housed those inmates and installing window screens "with gauges that block insects" in

the housing units. *Id.* at \*46. Importantly, the court’s decision was based in part on its taking judicial notice of the fact that “heat waves will become more frequent, more severe, and more prolonged” because of climate change. *Id.* at \*31.

The U.S. Supreme Court has noted that “[t]he harms associated with climate change are serious and well recognized”

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and “the severity of [the resulting injuries] will only increase over the course of the next century.” *Massachusetts v. EPA*, 549 U.S. 497, 521, 522–23 (2007).

Most recently, in *Kelsey, et al. v. United States of America*, et al., the Ninth Circuit held that

[t]he record leaves little basis for denying that climate change is occurring at an increasingly rapid pace. It documents that since the dawn of the Industrial Age, atmospheric carbon dioxide has skyrocketed to levels not seen for almost three million years... Absent some action, the destabilizing climate will bury cities, spawn life-threatening natural disasters, and jeopardize critical food and water supplies.

*Kelsey, et al. v. United States of America*, et al., No. 6:15-cv-01517, (Jan. 17, 2020).

In January 2020, Governor Phil Murphy of New Jersey signed an executive order that requires design professionals and contractors to account for rising sea levels and other effects of climate change when apply-

ing for permits for buildings and other infrastructure.

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Resiliency will be of greater concern as climate change progresses. Indeed, given the generally accepted fact that climate change is occurring and the associated information that is being disseminated on this point, we have possibly reached a point that resiliency considerations will take a more prominent role for design professionals—shaping the standard of care for future design and construction projects.

**Building Codes Lag behind Climate Change**

Codes have adapted to perils, but have they changed fast enough? Table 1 lists several hazards that recent disasters brought to light and the corresponding building code changes. See Table 1.

Design professionals must account for *resilience* when designing and constructing buildings or structures. The National Infrastructure Advisory Council defines resilience as

**The 4-Rs**

**Robustness:** the ability to maintain critical operations and functions in the face of crisis.

**Resourcefulness:** the ability to skillfully prepare for, respond to and manage a crisis or disruption as it unfolds.

**Rapid recovery:** the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption.

**Redundancy:** there are back-up resources to support the originals in case of failure.

**Tornados in the Heartland**

A closer look at the devastating effects that recent tornadoes have had in America’s heartland further demonstrates the urgent need for resilience in building design

**Table 1: Code Changes React, Not Act**

Hazard	Event	Code Change
Flood	Cedar Rapids Floods of 2008: Cedar River crested at 31 feet—11 feet higher than the historical high.	Cedar Rapids Municipal Code, floodplain regulations instituted.
Wind	Hurricane Andrew in 1992, Category 5, one of the most destructive hurricanes to hit Florida; Orlando, 2004, three consecutive hurricanes.	Florida Building Codes initiated in 2002 and updated every three years to be more restrictive.
Fire	Woolsey–Camp Fire, 2018, Worst fatality fire in California history, 56 fatalities.	Local code ordinances and amendments such as Santa Barbara’s requirement for sprinklers in all new construction.
Seismic	Northridge Earthquake, 1994, highest peak ground acceleration in urban area in North America.	Emergency update to 1993 IBC building code.

**Table 2: Moore, Oklahoma, Tornadoes 1999–2013**

Category	Date	Fatalities/ Injuries
F5	May 3, 1999	44 fatalities/ 583 injuries
F4	May 8, 2003	0 fatalities / 134 injuries
EF4	May 10, 2010	2 fatalities / 49 injuries
EF5	May 20, 2013	25 fatalities / 212 injuries



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and construction. Moore, Oklahoma, is one American city that has seen this need firsthand. This information is excerpted from the *ASCE Journal of Performance of Constructed Materials*, Volume 30, Issue 4. See Table 2.

The Enhanced Fujita Scale (EF5) tornado that hit the city of Moore, Oklahoma, on May 13, 2013, caused over \$2 billion in damages and tragically claimed the lives of twenty-five individuals. Briarwood Elementary School and Plaza Tower Elementary School were both subject to extreme damage due to the May 13, 2013, tornado. As a result of this damage, seven fatalities occurred at the Plaza Tower Elementary School. This large loss of life and extensive building damage at both schools warranted

a forensic engineering investigation. The goal of this investigation was to determine whether structural damage and fatalities could have been reduced. The investigation evaluated the failures and failure mechanisms that were observed in both schools, with the purpose of determining structural inadequacies and proposing design, fabrication, and construction practices to create a more robust system. This investigation identified numerous shortcomings that might have lessened the structural damage and potentially also reduced the loss of life.

Evidence showed the rebar in the concrete masonry unit walls of the school were insufficient; one such wall fell on the children. This failure of the rebar was a construction flaw that led to litigation.

As a direct result of this tornado, Moore voters approved a \$209 million bond issue to put safe rooms in schools that can withstand winds up to 250 miles per hour.

### **Climate Change—What Does It All Mean?**

It is reasonable to expect that designing for climate change will play a bigger role in the next decade. Also, claims associated with extreme weather events that are affected by climate change will come to the fore in our court system. This means that counsel, insurers, and representatives of construction professionals must brace for the rising tide of this evolving climate effect on the construction industry. 