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Creating disaster-resilient communities: Evaluating the promise and performance of new urbanism

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ABSTRACT

Conventional low-density development patterns have been cited as a partial explanation for increasing per capita losses from natural hazards in the United States. There is an emerging appeal for New Urbanist design as an alternative to conventional low-density development, and particular features of New Urbanist design make it theoretically amenable to reducing natural hazard losses. However, because New Urbanist developments are built at relatively high densities, they can exacerbate hazard risk when they locate in areas subject to natural hazards and do not incorporate sufficient hazard mitigation techniques such that hazard risk is adequately reduced. We present a comparative evaluation of 33 matched pairs of New Urbanist and conventional developments located in floodplains to evaluate whether New Urbanist developments are incorporating hazard mitigation techniques at a greater rate than are conventional developments. We find that New Urbanist design does not appear to make a difference in the use of hazard mitigation techniques. While New Urbanist developments use more hazard mitigation techniques on average than do conventional developments, this difference appears to stem not from the difference in design type but rather from increased local government technical assistance in the review of New Urbanist relative to conventional developments. We recommend that New Urbanist designers and local governments engage in more proactive land use planning and take more responsibility to make sure that hazard mitigation techniques are integrated into New Urbanist project site designs.

1. Introduction

Natural hazards cause average annual economic losses between $25 and $30 billion in the United States, and losses have been rising relative to increases in population and gross national product (Cutter, 2001). While hazardous events such as floods and earthquakes are naturally occurring phenomena, the amount of damage they cause has been exacerbated by the conventional land use pattern of decentralized sprawl, which has fostered a massive buildup of development in areas subject to natural hazards (Burby, 2006).

New Urbanist design has been promoted as an alternative to possibly counter certain adverse societal outcomes of conventional sprawling development (Duany et al., 2000; Calthorpe and Fulton, 2001; Talen, 2005). Based on a set of design principles that are intended to foster more intentional delineation of open space, a better mixture of land uses built at relatively high densities, and pedestrian-oriented transportation networks, New Urbanist design has also drawn increasing attention for its potential to reduce natural hazard vulnerability (Thompson, 2005; Miller, 2007).

Despite this potential, however, when a New Urbanist development locates in a hazardous area, its relatively high development densities can mean that more people and property are placed at risk than would have been the case with a low-density development on the same parcel of land (Berke and Campanella, 2006; Berke et al., 2009). Song et al. (2009) show that more than one-third of all New Urbanist developments in the United States that were completed or under construction as of December 2003 are located in areas subject to flood hazards, and because of relatively high development densities, these New Urbanist developments can pose a greater risk than conventional low-density developments if flood hazards are not anticipated and flood hazard mitigation is not promoted in project design.

Recent research has compared New Urbanist developments with conventional low-density developments to determine whether local communities put forth more effort in reviewing proposals for New Urbanist developments, and whether that effort appears to translate into design that is more resilient to natural hazards. Berke et al. (2009) found that, on average, in comparison

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with conventional developments, New Urbanist developments (1) were subject to stronger local government development management regulations, (2) involved greater levels of public participation and local government planning staff technical assistance during the development review process, and (3) incorporated more natural hazard mitigation techniques.

In this paper, we expand upon previous research by utilizing analytical techniques that allow us to control for potential confounding factors that might explain some (or all) of the apparent differences between New Urbanist and conventional developments with respect to the incorporation of hazard mitigation techniques that are highlighted in previous research. In particular, we use multiple regression analysis to examine whether New Urbanist developments incorporate more hazard mitigation techniques than conventional developments, while controlling for other potentially relevant factors. Answering this question can help assess whether the potential of New Urbanist design is being translated into neighborhoods and communities that are resilient to natural hazards.

To help answer this question, we first identify and describe particular features of New Urbanist design that we hypothesize will foster the incorporation of hazard mitigation techniques, as well as additional factors that have been found by previous researchers to influence the use of hazard mitigation techniques in development projects. After describing our research design, variables, and methods, we then present a comparative evaluation of 33 matched pairs of New Urbanist developments and a control group of conventional low-density developments located in flood-prone areas throughout the United States, including the results of regression modeling intended to evaluate the importance of New Urbanist design for the incorporation of hazard mitigation techniques. We conclude with a discussion of our findings and their implications for planning practice and natural hazard mitigation.

2. Designing neighborhoods and communities that are resilient to natural hazards

Increasing losses from natural hazards have inspired significant effort on the part of researchers to identify potential solutions. Scholars have recently emphasized the concept of resiliency as a guiding principle for designing new development in hazardous areas. Within the context of natural hazards, resilient neighborhoods and communities are those that can withstand natural hazard events without experiencing devastating losses and without needing significant assistance from external entities (Mileti, 1999; Godschalk et al., 2003; Mileti and Gailus, 2005; Berke and Campanella, 2006). To achieve this kind of resiliency, communities must be proactive in controlling how development proceeds (Mileti and Gailus, 2005). In particular, the concept of resiliency should be intentionally built into the planning and building process through the use of design and construction techniques that help to mitigate the effects of natural hazards (Bosher et al., 2007).

Because they are likely to place more people and property at risk on an equivalent land unit exposed to hazards, it is particularly important for New Urbanist developments to incorporate hazard mitigation techniques into their design. To gauge whether existing New Urbanist developments actually incorporate more hazard mitigation techniques than conventional developments, we focus on both types of developments located in floodplain areas and the degree to which they incorporate flood hazard mitigation techniques. Floodplain areas are the low-lying lands adjacent to rivers, lakes, and oceans that are flooded periodically at intervals of varying frequency (Interagency Floodplain Management Review Committee, 1994). While New Urbanist and conventional developments may be subject to other types of natural hazards as well, we choose to focus on floods because of their pervasive occurrence and the level of damage they cause. Floods accounted for 90% of all natural hazards in the United States from 1992 to 2001 (GAO, 2005), contributing to roughly 900 deaths and $55 billion in property damages (GAO, 2004).

The most effective approach to reducing flood losses is to keep people and property out of harm's way by keeping floodplains free from development (Federal Emergency Management Agency, 1986: III-IV). Furthermore, there has been an increasing awareness among floodplain managers, planners, environmentalists, and local officials that protecting the natural functions of floodplains from development can help to reduce flood risk and preserve natural ecosystems (Morris, 1997: 24). With this in mind, we draw on prior conceptualizations of flood hazard mitigation that specify the following four broad categories of mitigation techniques (Godschalk et al., 1999; Federal Emergency Management Agency, 2002):

- *Environmentally sensitive area protection* involves preventing development in floodplains and protecting flood mitigation services provided by floodplain ecosystems, upland wetlands and natural drainage systems.
- *Stormwater best management practices* (BMPs) are used to store runoff that reduces on-site and downstream flooding, as well as to filtrate pollutants in runoff and infiltrate runoff to groundwater.
- *Stream channel modification* is used to clear, enlarge, and stabilize stream channels in or near the development site to facilitate conveyance of stormwater off the site quickly as possible.
- *Structural protection* involves techniques to reduce structural vulnerability to floods if development is located in or near the floodplain.

2.1. The potential advantages of New Urbanist design for hazard mitigation: in concept

Scholars have argued that New Urbanism offers a model urban design framework for creating resilient communities, in part because New Urbanist design affords opportunities to maximize open space within a development site without necessarily reducing the number of dwelling units that can be built (Berke and Campanella, 2006). Increasing development densities on certain portions of development sites while setting aside other portions as open space can enable project designers to steer construction away from the most hazardous areas while simultaneously protecting environmentally sensitive features (e.g. wetlands, sand dunes, and riverine floodplains) that provide flood hazard mitigation services.

Previous researchers have used three particular New Urbanist site design features to compare the effects of New Urbanist design (relative to conventional low-density development) on watershed protection (Berke et al., 2003), transportation (Crane, 1996), and sense of place (Brown and Cropper, 2001), respectively. Berke et al. (2009) describe these design features, which we expect to also enhance the integration of flood hazard mitigation techniques:

- *High net density* provides more opportunities to create open spaces that can be used to avoid development in environmentally sensitive areas, install BMPs, and reduce reliance on structural protection practices. Compact development patterns concentrate stormwater runoff rather than spreading runoff across the landscape, which is likely to increase the need for stream channel modification to accommodate increased runoff volume and velocity.
- *Street network design* (e.g. narrow streets, pedestrian orientation, and on-street parking) offers more opportunities to avoid development in sensitive areas and to use BMPs, and reduces the need for structural protection because more development space is freed up due to reduced demand for wide driveways and parking lots. Reduced project footprints can mean that stormwater