

# The Low Impact Environmental Partner: An Innovative Model for Steep Slope Urbanization “Slope Smart Cities”

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Construction of buildings and development of cities on steep-slope terrain has been problematic through the ages. The rapidly expanding urban population is confronted by steep slope areas which have been generally unbuildable, except at very high cost with difficult construction procedures or with environmental destructive and risky squatter settlements. The impact on the environment can be severe from the disturbance of the fragile slopes, particularly when poor soil conditions prevail. Mud slides are a risk with appreciable loss of life and high costs, and in earthquake prone areas the potential for disaster increases.

An MIT study has developed an innovative approach



traditional approach



proposed approach



combined approach

for construction on steep slopes, which balances construction on sloped areas with development on the horizontal terrain, maximizing the bearing potential of subsoil conditions. The concept has three aspects: Structural – It offers high loading conditions, with bearing distribution related to soil capacity. Building design – It uses standard systems and provides centralized single-point access, with a building design that respects the soil bearing capacity of the slope. Construction – No despoliation of slopes, no heavy equipment on slopes and uses standard construction methods and equipment. Expansion is facilitated, and allows a continuous means of growth on steep sloped terrain. It is particularly appropriate for multi-story, high density forms, and offers an opportunity to innovate with creative design.

The MIT approach is appropriate for single buildings, as well groups of buildings in a new urban paradigm.

“Let a Thousand  
Cities Touch the Sky”

*“I look with envy at the hills beyond. We are living in cramped spaces, in constant fear of the mountains around us who are ready to punish us when we touch it. And I worry about my children, where will they live? Our valley is full - no more land! Why can't we make friends with nature, instead of seeing it as the enemy?”*

Prime, flat land may be preserved, while the steep sloped areas become the dominant development locations. The inherent linear circulation concentrates transportation and encourages and makes feasible high-density routes. More options in city growth and form result from a composite of standard low-rise slope construction with the multi-story designs. Cultural issues are the same as in other high-rise, high-density urban areas. Debates on use of hillsides vs maintaining their untouched state would arise, but areas with no options for development other than steep slopes suggest the use of an environment-partnering approach.

The recent earthquake in China offers a worthy challenge to build prototypes that explore the concept under actual conditions. The rebuilding in China is ideal: the steep, poor soil terrain, the prevalence of relatively narrow valleys, the immediate need to rehouse large numbers, the propensity to build multi-story buildings, and the interest in mass transit.

Use of the innovative approach – which draws on structural, construction, and design strengths – offers a new paradigm for urban development. It is an environmental friendly partner which avoids destruction of the fragile slope terrain while supporting sustainable urban expansion.

*Note: This paper is drawn from an MIT study prepared by Professor Waclaw Zalewski, Reinhard Goethert, and Robert Kirby. Although prepared in 1970, it is only now that urban growth challenges have renewed interest in building on slopes.*

