Designing resilient cities: good practice guidance

Civil engineers create the infrastructure on which cities depend, with design lives stretching towards 100 years. The question of whether these are good investments can only be answered with “it depends on how the future develops”. However, predicting the future is complicated: perhaps the only certainties are change and that we must live within our planetary boundaries. Current influencing factors include climate change, the UK Government’s emphasis on localism, the global recession, peak oil, rising world populations, and the continuing urbanisation trend. How civil engineers respond to these factors will underpin the resiliency of our cities and how we live, work and play in the future.

The Urban Futures research programme has provided a means to address these challenges by focusing on the likely long-term performance of today’s urban design solutions. It aims to change the way that engineers deal with long design lives, and thus the way they think about the relevance and shape of their projects.

Urban Futures is a four year research project which started in May 2008, funded by the Engineering and Physical Sciences Research Council. The project consortium is led by Professor Chris Rogers at the University of Birmingham and includes researchers from Birmingham, Exeter, Lancaster, Birmingham City and Coventry Universities. Professor Rogers is also Chair of the ICE’s Innovation & Research Expert Panel, which has created a vision for the future research needed to advance the industry: “Engineering to Live within Planetary Boundaries: Civil Engineering Research Needs”. The initiatives are wholly complementary.

The Urban Futures Method provides a way to assess the resilience of today’s engineering solutions, many developed in the name of sustainability, by exploring their ability to continue to deliver their function in the face of future change. If the solution works across a range of alternative futures, the investment is likely to prove robust; if not, the solutions can be altered in an informed way, or they can be implemented in the knowledge that they might prove a risky investment. Either way, enhanced confidence in urban design should result.

By incorporating a scenarios analysis based upon four distinct, extreme-yet-plausible, future scenarios, the Method guides the user through the complexities of thinking about the impacts of changes in society, technology, economy, environment and policy. This is made possible because the characteristics of all four futures have been established in considerable detail, and thus it is possible to ‘enter’ each future to explore a solution’s performance.

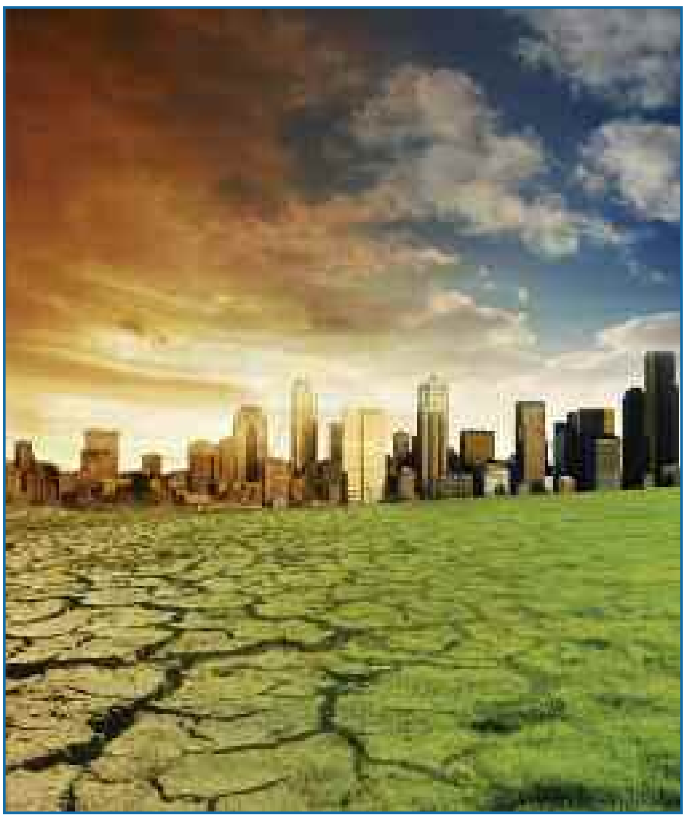
The four futures build on the work of the Global Scenarios Group:

New Sustainability Paradigm, in which individuals and communities share common values around sustainable living within the resource limitations of the planet;

Policy Reform, in which strong governance and policy directives forces society to operate more sustainably even though values remain largely unchanged;

Market Forces, in which the market is freely allowed to dictate policies and behaviours;

Fortress World, in which a wealthy elite secure the resources they want inside fortresses and the impoverished majority live outside the fortresses subsisting on whatever resources remain.



One of many futurologists’ views of the infrastructure challenges ahead.

The basis of the Method is that, for each sustainability solution, the intended benefits are defined and the conditions necessary for their continued delivery are determined. Each necessary condition is then assessed in the four futures.

Consider a relatively simple example of implementing rainwater harvesting (RWH) as a sustainable local water management strategy for a redevelopment project. This has an intended benefit of reducing the volume of potable water required by the site and, for this example, would mean that the existing supply capacity might be sufficient whereas without RWH additional supplies and associated infrastructure would be needed. There would, of course, be infrastructure costs associated with the use of rainwater for toilet flushing, for example, but in areas of water scarcity this could prove attractive. There might be other intended benefits (e.g. mitigating flooding); these would be assessed separately.

The table opposite lists four necessary conditions that must be maintained in the future if RWH solution is to remain effective, and their assessment in the four futures. The outcomes are listed in the table, yet the reasoning can only be definitively established by consulting the detailed characteristics of the futures.

Each assessment reflects the far future (say 40 years hence) and is done in isolation, i.e. without consideration of how the current situation morphs into the future. Other influences, such as climate change, will alter the context in which a solution is judged (e.g. higher temperatures, more intense rainfall events, longer periods of drought); it is simply a matter of overlaying high, medium and low impact variants to elucidate what the changes might be.

In this case RWH will likely work well in three scenarios as long as the tanks are large; it will only likely work in the Market Forces scenario if pricing controls regulate water use.

The Urban Futures Method is the subject of a new BRE publication: Designing Resilient Cities: a Guide to Good Practice that will be launched in April 2012. It sets out the framework for implementing robust, future-proofed solutions at any regeneration scale.

If you are interested in attending the launch, or if you would like more information about the Urban Futures research project, please contact Joanne Leach, Project Manager, University of Birmingham (0121 414 3544 or 07785 792187; E-mail: j.leach@bham.ac.uk, or visit www.urban-futures.org).

Necessary Conditions	New Sustainability Paradigm (NSP)	Policy Reform (PR)	Market Forces (MF)	Fortress World (FW)
Non-potable water demands must exist	Sustainable water using behaviour and willing adoption of highly water efficient technologies greatly reduce non-potable water demands	Policy requires adoption of highly water efficient technologies, but behaviours remain unchanged; non-potable water demands reduce	No change in user behaviour and no adoption of water efficient technologies; non-potable water demands remain high	Non-potable demands are high inside the fortress (technology and behaviour mirror MF) and low outside the fortress (poverty and scarcity drive very low water use)
Enough water must be collected to meet non-potable water demands	Even with relatively low volumes of water collected in summer months demands can be met all year round	Ability to meet non-potable demands in summer months (when daily collection < supply) requires large RWH tanks	Ability to meet non-potable demands in summer months (when daily collection < supply) is unlikely to be practical: very large RWH tanks needed	In dense high occupancy areas outside fortress both demand and potential for collection are low. Large RWH tanks inside fortress might not be adequate to meet demand
Enough water must be available (from existing supplied and stored water) to meet non-potable water demands	Supplies are unchanged and demands greatly reduced; there is surplus potable water to cover for summer water shortages, but it is unlikely to be needed	Supplies are unchanged and demands reduced; there would be some surplus potable water to cover for summer water shortages; small RWH tanks might run dry	If potable water supplies remain unchanged and since demand is high, RWH tanks are likely to run dry for long periods in the summer	Inside fortress the situation is as for MF if potable water supplies remain unchanged. Outside fortress limited collection and storage might not meet demand, even though it is low
System must be acceptable to the community	Highly acceptable solution, since people accept sustainability arguments and are willing to change their behaviours	Variable acceptability, but wide uptake; policy dictates this	Low acceptability and little uptake of RWH as water is relatively cheap and systems are expensive (unless the cost of water increases)	High acceptability and uptake as security of supply is important both inside and outside the fortress

Key: red = condition does not continue in the future, amber = condition is at risk of not continuing in the future, green = condition does continue in the future