Hexagon Cities

By J. O. Quantaman

Cities have grown from the inside out. What once were outposts on woebegone trade routes have evolved to villages, towns and urban sprawls. Cities furnish greater creature comforts and more economic opportunities. The 21st-century will see growing numbers of rural folks migrating to cities, until 75% of the human population lives and works in networked urban milieus.

Logistics and economies of scale provide more urban amenities. Rural folks pay extra for basic conveniences, and those who feel deprived will be drawn to the bright lights. Of course, there are tolls to be paid. Newcomers must adapt to urban dynamics, for venues and workplaces are always evolving. Everyone must learn new skills at some point in their lives. Those who refuse end up on skid row.

Romantics may still yearn to go native and return to nature. In fact only the wealthy can afford to pay for rural deliveries of food, water, energy, medical services and comm links. Idealists must content themselves with cut-rate communes that lack modern conveniences. In either case, creeping urban sprawl will surely encroach on the idyllic nests.

As agriculture becomes increasingly mechanized, small family farms will be replaced by large corporate farms. Rural towns will become camps for seasonal laborers who will move back to the urban rat race when their services are no longer needed.

The depopulation of rural villages will inspire the restoration of natural ecologies and wildlife habitats. The land beyond the metropolitan sprawls will be designated as multipurpose parks that include windfarms, floral displays, photovoltaic generators, theme

parks, wildlife preserves, mineral extraction pits, hiking & camping facilities, foundries and exploratory drilling camps. Each participant must frame their activities to not infringe on others. Each participant must pay a longterm bond that will ensure the land is returned to its natural state.

With proper oversight the human community will achieve viable protocols for sustainable development. The climate will be stabilized. Forests and endangered species will be saved. Cities will continue to grow, which begs the question?

Since most of us will live in urban environments, are they livable?

Let's face it. Most cities are loud, overcrowded, stinking cesspools.

Can urbanites to improve their quality of life?

Yes, indeed.

This essay will offer a basic template for future cities. The template encompasses hexagon grids. A dramatic changeover isn't cost-effective for cities as they now stand. Later in the easy, I will show where a few opportunities exist.

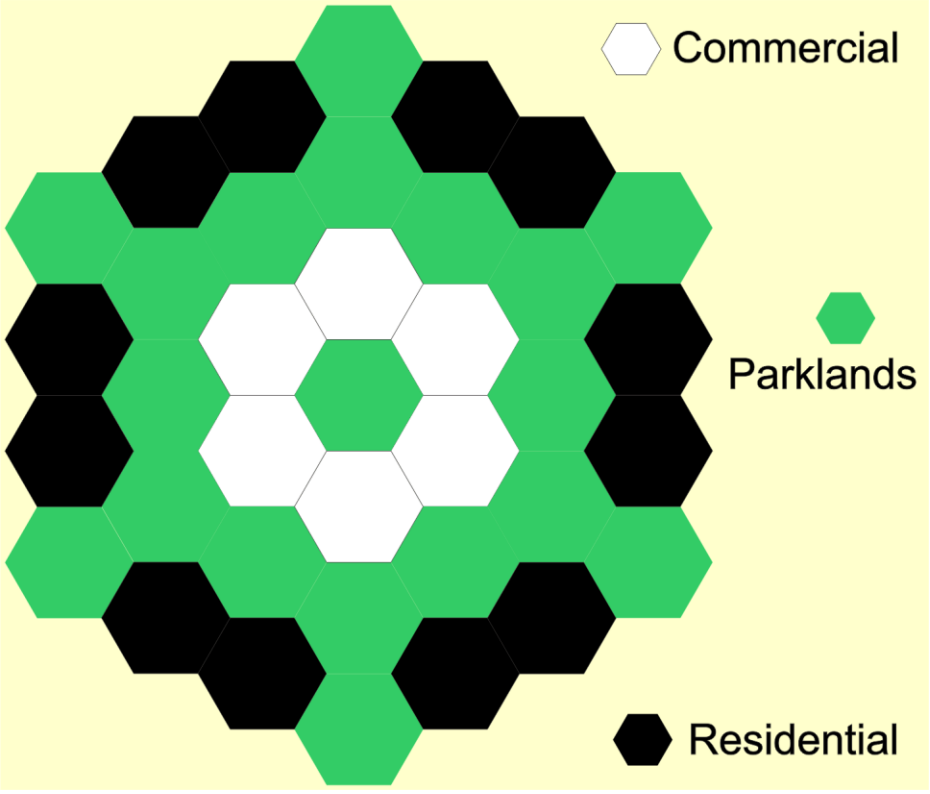
Why convert to hexagon grids?

Cities aligned in hexagon grids will improve traffic flow and create oases of peace and tranquility where folks work and recreate. The basic hexagons are 15 to 25 times larger than average urban blocks. In a sense, each nexus is a subdivision in itself. Nexes may be devoted to commercial enterprise, residential abodes or parklands. To get maximum benefits, the hexagonal grid must adhere to the principles of durability and identical modular distribution.

- New infrastructure cannot be built with substandard materials that will obstruct folks with constant repairs.
- Developers must fit their projects to the urban plan, not the

other way around.

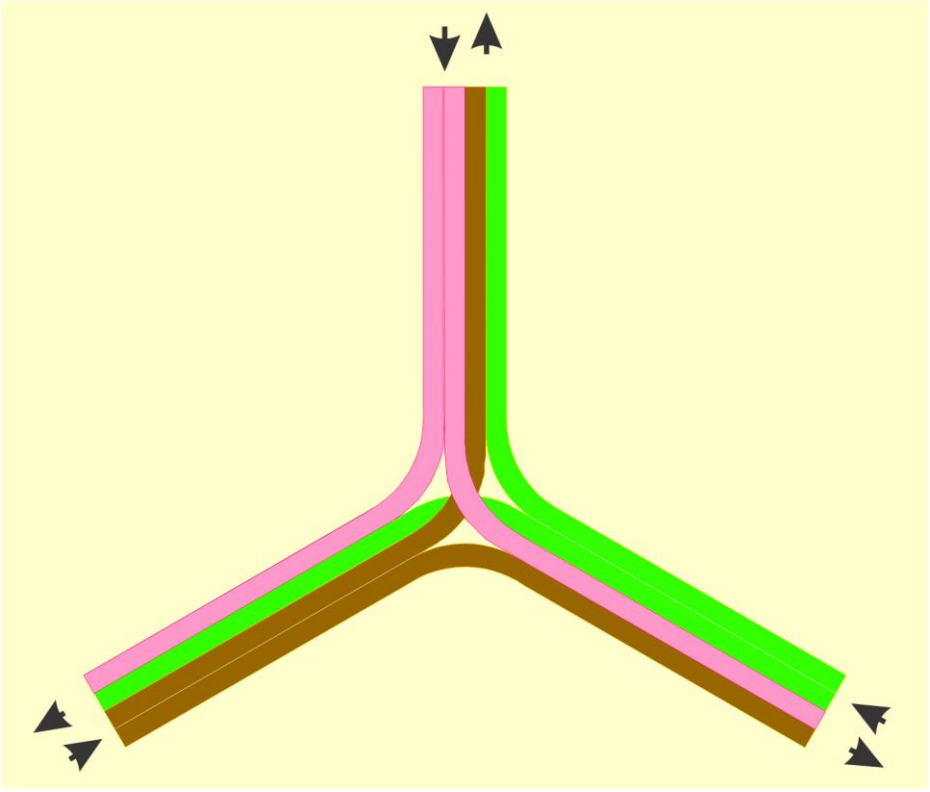
The modular 37-hex cluster which features all the goods, services and recreational opportunities that residents may desire. Major vendors will open retail outlets in each ring of commercial nexes. Products that are currently "not on the shelf" can be ordered from central warehouses. What's wrong with a small delay? Anyone who craves instant gratification has more serious problems than the lack of a special toy. Rampant consumerism is responsible for many of the endemic problems we face today.



Hexagonal grids allow for 3-way intersections and continuous traffic flow. 3-way intersections have three 60° right turns and three 60° left turns.

Travelers negotiate right turns as merging exercises, which converge on the same level as straight lengths of roadway.

Meanwhile the curved embankments are canted to reflect optimal driving speeds. 33% of left turns proceed on the same level as the straightaways; 33% of left turns form an overpass, and 33% of left turns form an underpass.

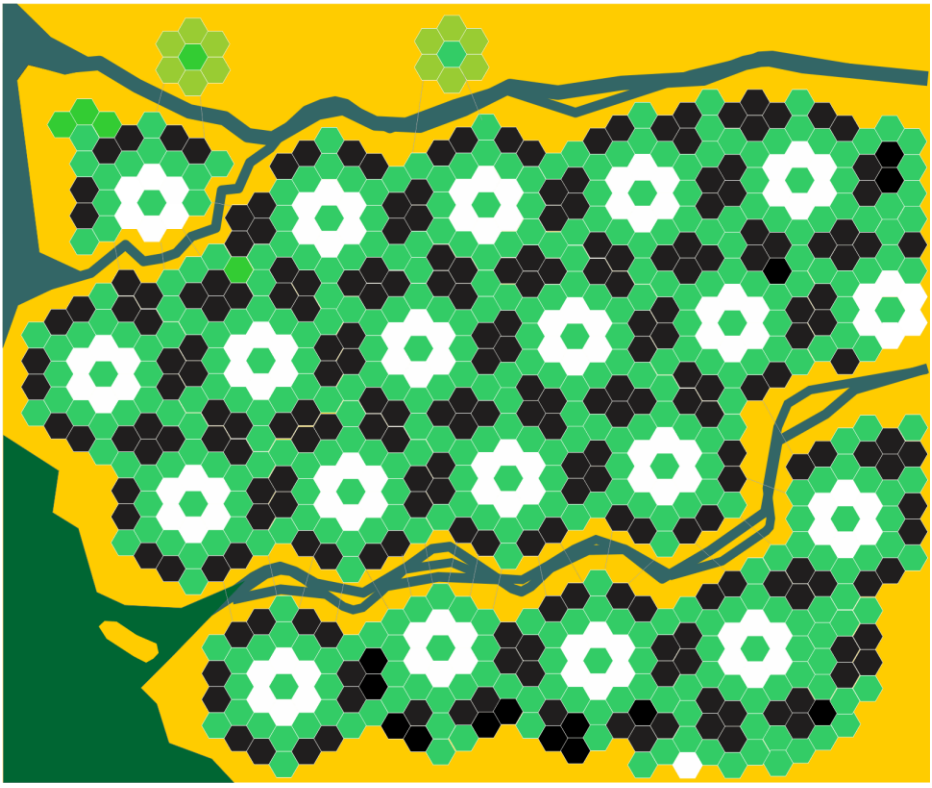


Horizontal space is conserved with a modest addition of vertical leeway. The turns do not require drastic reductions in speed, although hexagonal grids will force drivers to zigzag and negotiate frequent turns during the normal course of travel. The abundance of turns will keep drivers alert and attentive.

Hexagonal grids involve continuous zigzags, even when drivers travel to straight-line destinations. Zigzagging adds 15% more distance than rectangular-grid drivers use to reach straight-line destinations.

Hexagons meet adjacent hexagons at 3-way intersections. If you

add a crescent overpass and underpass to the left-turn options, you banish stop & go traffic. There is no need to wait for red lights because there are no red lights. Vehicles move continuously throughout the city. The byways are restricted to vehicles capable of achieving mandated urban speeds which can be anywhere from 60 kilometers per-hour to 100 kilometers per-hour. The right-turn options become simple merging exercises. One left-turn option treads on level ground, another is an overpass and the third is an underpass. Couriers and commuters move swiftly and efficiently, yet they have easy access to every nexus in the urban grid.

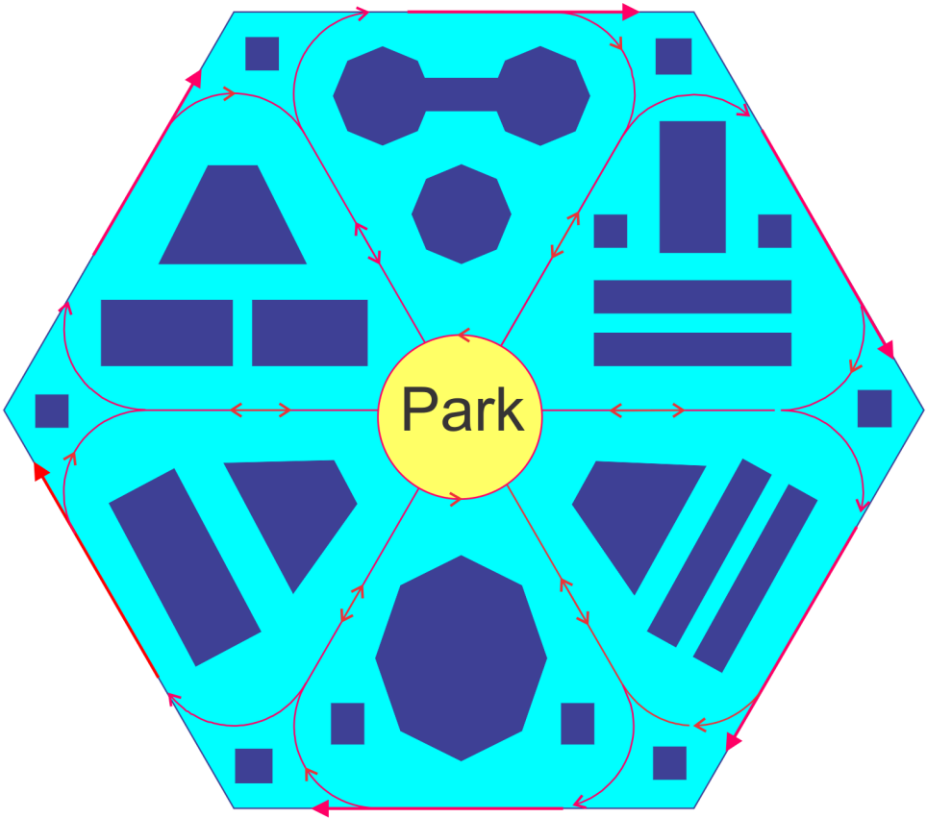


Modular urban design ensures that property values remain the same throughout the city. A retail outlet on the fringe will get similar walk-by traffic as an outlet in the city core. Residents will rarely need to travel outside their respective clusters. Physical travel will diminish because anyone can stay in touch via online

networks. Many workers will work at least part-time from home. Others will man the goods & services outlets nearest their homes. Why would anyone search across town for bargains that are available next door? Why worship the false God of Greed?

Pedestrians, bicyclists and motorized wheelchairs will have their own pathways throughout the city. They won't come in contact with the faster avenues of motor vehicles. When motor vehicles exit the hexagon byways, they will slow way down and yield to all flesh & blood travelers.

Whenever the need arises, it is easy to travel all across the city to complete one's errands.



Once folks arrive at the nexus destination, they park their vehicles and walk to sporting events or meetups with lawyers, engineers or whatever. The inner nexus is friendly to pedestrians,

cyclist or rollerbladers. Durability means that buildings needn't undergo an endless cycle of deconstruction and reconstruction. The city founders have gotten it right the 1st-time through, which allows city dwellers to embrace pleasant and unstressful lifeways.

The more observant of you will detect a flaw. Vehicles in hexagon grids may only travel straight for a few hundred meters before they must turn 60° left or 60° right. In other words, travel in hexagon grids is zigzag but never straightaway, whereas straight line travel in rectangular grids can be done if your destination is on the same compass point as your direction of travel. Let's say you deliver baked goods to a store that's straight east and 20 blocks away. Your odometer registers 20 blocks and that's as efficient as the proverbial crow. It wouldn't be possible to make this shortcut in a hexagon grid. The best you can do is to travel 15% farther than the proverbial crow.

Back to rectangular grids. Let's suppose your next delivery target is ten blocks north and ten blocks west. Your odometer will still register 20 blocks, but the proverbial crows only has to travel the square root of two times ten blocks. In other words, you've traveled 41.4% more than the proverbial crow. The worst case scenario in the hexagon grid will only force you to travel 33.3% more than the proverbial crow.

So far we've learned the hexagon grid won't let you go the shortest route from A to B. Nor will it penalize you to taking the longest distance from A to B. One question remains. Is there any difference in average travel distance between the two grid schemes?

There is a simple and straightforward method to find the distance traveled from a random point to every other point in the grid, but the method involves a lot of work. First, you have to install square or rectangular tiles across a warehouse floor. There is no

difference in using square tiles or rectangular tiles of any length ratio. You can prove this by doing the experiment. All the tiles must be of the same size. It helps if you select side lengths in whole numbers of units to simplify the calculation. Then you add all the side lengths from a random starting point to every destination on the warehouse floor. Next you use a tape measure to record and add all the distances from the start point to the destinations. At last, you calculate the ratio between the two sums. This will give you an accurate ratio of the extra distance you must travel in the rectangular scheme versus the proverbial crow.

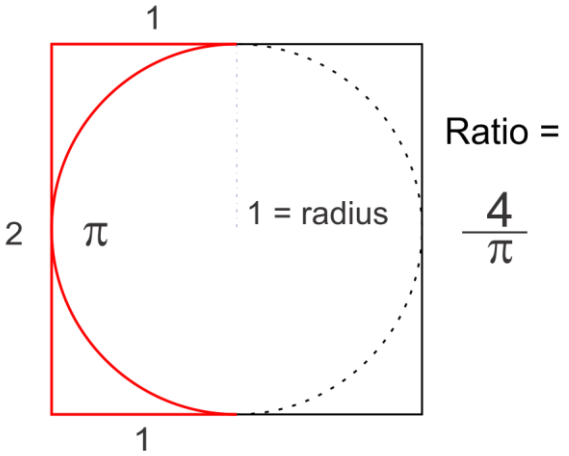
Wait a week to work out the kinks in your back. Then rip out all the rectangular tiles and install hexagon tiles. Now you can tabulate the same sums for the hexagon scheme, and then calculate the ratio between recorded travel and the proverbial crow.

There is a simpler proof that evokes mathematic analysis, but I won't burden you with arcane scribbles or hieroglyphic symbols. Instead, let me present a descriptive model that doesn't constitute a proof, unless you happen to buy Euclid's 5th-axiom with a generous grain of salt.

Let's take a cross section of earth and call it a circle, even though astronomers will tell you the earth is more like a pumpkin. Just remember that pumpkin pies are baked in circular dishes. The circle represents the distance traveled by the proverbial crow. The crow must stay close to the surface because that's where his dinner waits. We can exclude mountain ranges and lakes below sea level. Let's say the crow flies at a low altitude over calm water. To encourage the crow to fly around the earth, we'll set up floating rafts that contain of bowls of fresh water, juicy worms and unsalted French fries. Once the crow consumes the condiments at one raft, he will have the incentive to fly to the next. In effect, the crow will make the shortest possible circumnavigation of the earth.

The crow, of course, is fictional. And the model we will evoke is purely a thought experiment. Even so, scientists have long used models to mimic real life.

If you transcribe a square outside the circle so that a point on each side meets the circumference of the circle, you get the diagram below.

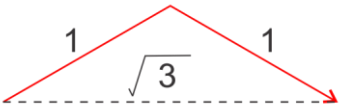


The square signifies the extra cost of travel in rectangular grids. The ratio is the average distance traveled versus the proverbial crow.

To evaluate hexagon grids in the same way, you must recall there is no straight-on travel in the hexagon scheme. To account for the lack of straight-line travel, you must add an extra penalty for the zigzags necessary when navigating in hexagon grids.

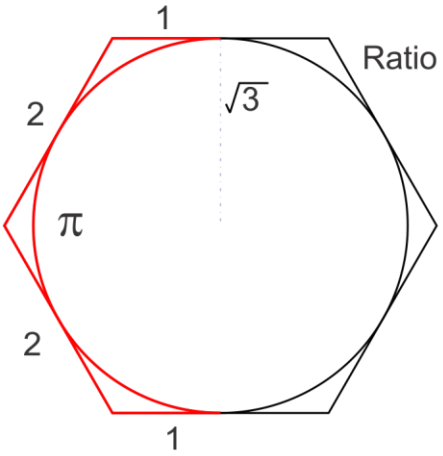
Next we transcribe a hexagon around the circle such that a point on each side of the hexagon intersects the curve of the circle. Hexagon signifies the extra distance one must travel in the hexagon grid.

But don't forget the added cost due to the zigzag travel inside hexagon grids. You need to combine both ratios to achieve the true hexagon ratio versus the proverbial crow.



Distance traveled Versus How the Crow Flies = 1.1547...

Ratio: $\frac{2}{\sqrt{3}}$



Ratio = $\frac{6}{\pi * \sqrt{3}}$

Multiplying the above ratio to the zigzag ratio, we get

HR = (6*2) / (3*π) or 4 / π

The ratio of average distance inside hexagon grids versus the proverbial crow works out to the same 4/pi, where **pi** is the English equivalent for the Greek symbol. The actual ratio in decimal terms is 127.32% versus the proverbial crow. You won't accrue extra travel distance when switching from rectangular to hexagon grids. But you will save on the wear & tear of your brakes. You will also earn a net saving in fuel consumption for whatever fuel that powers your vehicle. You can also forget about the anxiety and frustration

that comes from being caught in gridlock behind red lights. In other words, your fingernails won't become chipped from tap, tap, tapping on the dash.

Why hasn't someone adopted hexagon grids?

History gives us the answer. Before the 20th-century, urbanites traveled by foot and carried their goods in donkey carts. Even the royal carriages didn't travel anywhere as fast as motor vehicles do. Unregulated 4-way intersections caused few mishaps until the advent of the automobile. Once accidents began to occur, urbanites needed rules of the road to pin the blame for damages and injuries. Later came green & red lights which allowed traffic on the north-south axis to advance safely while traffic in the east-west axis thumbed their noses. Then the colors changed and east-west traffic advanced while north-south traffic grumbled in place.

With rare exceptions, the urban layout hasn't changed in more than 2,200 years. Cities follow the example of Alexandria where throughways extend north-south and east-west. Buildings occupy squares or rectangular spaces. Intersections are mostly four-way, where two streets crisscross at right angles.

Four-way intersections pose few problems for pedestrians, bicycles or horse-drawn carriages. Collisions at intersections have been rare until the 20th-century and the advent of motor vehicles. Since the Ford Model-A, the pace of living has increased dramatically. Few people live within a stone's throw of their workplace, so commuters face ever increasing traffic snarls.

Nowadays four-way intersections imply stoppages since the north-south traffic cannot move safely unless the east-west traffic has stopped. Likewise the east-west traffic cannot move safely unless the north-south traffic has stopped. Advanced left-turn signals may solve one problem, but they reduce the overall flow of traffic. Stop & go semaphores cut traffic flow to less than 50%.

Devastation of WWII allowed Russians to rebuild Moscow almost from the ground up. The city already had a showcase subway system, and these corridors were refurbished. City planners added an expressway around the city outskirts. The ring highway offered many exits to wide avenues leading to the downtown core. But the Russians ruined a good thing when they added special lanes reserved for government officials and drivers willing to pay huge bribes. The result widened the gap between "haves" and "have-nots." Politburo favorites got to their meetings in a breeze, whereas work-a-day Joes struggled bumper to bumper while avoiding potholes and refuse heaps.

Brazilians adopted the wheel & spokes when they carved their capital city of Brasilia from the Amazonian wilderness. The spokes were designed to speed functionaries to government buildings at the city's core, but there were no exits to other destinations. The functionaries who occupied look-alike apartments between the spokes became frustrated without access to fast lanes leading to work or recreational outlets. They moved out to the suburbs and used the spokes to commute to work. Meanwhile, poor folks and squatters claimed the look-alike apartments.

In one brilliant stroke the Brazilians have created slums that resemble those of Washington D.C.

Cities with rectangular grids are not optimized for motor vehicles. City managers are being forced to discourage or outlaw cars in the downtown cores of cities. The next step will be to eliminate motor vehicles altogether. Another solution would be to design better cities. No doubt the cost of rebuilding a major city from scratch is far too prohibitive. But who knows what the future holds? Fifty years from now, humans could be founding cities on the moon or Mars. If the ecological doomsday arrives, the ocean may rise several meters and flood the world's coastal cities. In this

case, refugees will need new places to live, and new cities will spring up on open parcels of land. It would be a shame to design these new cities on rectangular grid lines, when a hexagonal grid could ease traffic congestion as well as saving fuel and extending the life of brakes.

There is no cost-effective way to introduce hexagon grids short of WW3 or catastrophic natural disaster. No one can impose a novel grid design without destroying the one in place.

City planners add the skeleton. Inhabitants bring the flesh and blood. Inhabitants create the boutiques, the taverns, the supermarkets, the florists, the hardware stores, the travel agents, the nightclubs and coffee houses. None of these would exist without loyal customers. City planners lay out the infrastructure; natives fill in the day-to-day events.

If hexagon grids are motivated by wishful thinking or personal greed, the resulting communities will fare no better than those we have today.

Gather all the refugees from camps around the globe, and you'd fill a fair-sized city. There's no reason why we couldn't build them a hexagon city. The city could be located in some unused tract of land. The refugees would be guinea pigs for revolutionary urban design. They would be proof of concept.

It may seem like an exorbitant expense, but this would be a one-shot deal. The international community would no longer have to pay for decades upon decades of makeshift housing, counseling, nutrition, medical care and prison-style security. The long-time residents of the hexagon city would open their hearts for newcomers. I'm sure they'd handle the tasks better than overbearing do-gooders. Refugees know the score way better than idealistic newbies.

Anyway, give it careful thought...

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