Bamboo for Urban Density And Permanent Construction

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Urban scenarios in the world...

<table>
<thead>
<tr>
<th>UN-ECA:</th>
<th>Popul 2012</th>
<th>2025</th>
<th>Annual</th>
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</thead>
<tbody>
<tr>
<td>Kinshasa</td>
<td>10 million</td>
<td>16.8 m</td>
<td>+4.85%</td>
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<tr>
<td>Luanda</td>
<td>5 m</td>
<td>8.2m</td>
<td>+6%</td>
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<tr>
<td>Lagos</td>
<td>11.5 m</td>
<td>14.1 m</td>
<td>+3.74%</td>
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Urbanization is accelerating with climate change and aggravated rural conditions.

Conventional bungalow style housing, squatter settlements and other one level development create unprecedented urban sprawl and mega-cities without the necessary infrastructure.
• Cost of urban land increases dramatically

• Construction on steep hills, swamps ...
  >> landslides, unhealthy environment
Transport systems and infrastructure networks, totally insufficient today, will further deteriorate
Urban density offering service facilities, public transport, green spaces, waste recycling, biogas etc
Urban density implies multi-storey structures = steel beams and reinforced concrete, building materials subject to rocketing price rises... highly energy consuming... and CO$_2$ heavy
Innovative architecture with renewable materials is needed.

One possible option for multi-storey is design based on fast growing bamboo.
Most issues associated with bamboo (insects, fungi, connections...) are resolved today, as seen in Colombia,...
...or in Brazil...
advanced, expressive architecture...

Eco-cultural center, Pardinho, SP, Brazil
Architect: Leiko Motomura
...excellent space frame structures ...

Architect: Leiko Motomura, São Paulo
Space frames of any shape can be designed with parametric CAD; individual bamboo elements may have different lengths and tagged with ID for production and assembly on construction site.
Multi storey?

Bamboo pole 15 x 200 cm sustaining 11 ton load at Structural Engineering Lab, Gadjah Mada Univ, Yogyakarta, Indonesia
Bamboo components replacing reinforced concrete and steel
Combined with a few key components, bamboo provides earth quake safe connections.
Prefab construction in small workshops allows for quality control and adequate assembly on site.
Weather protective exterior skin of ferro-cement on a bamboo honeycomb structure. Excellent bracing effect and impact strength.
Urban style = flush, planar walls, floor tiles, modern bath rooms, AC thermal insulation...
all of it is possible to combine with bamboo loadbearing structures
In Sweden multistory structures in wood are now becoming competitive and could inspire to similar concepts based on bamboo.
Multi story, urban density housing in bamboo is entirely feasible with new design concepts.