area: 132 sqkm
population: 1,450,000
density: 11,000/sqkm

(the above data refer to Doha in year 2010)

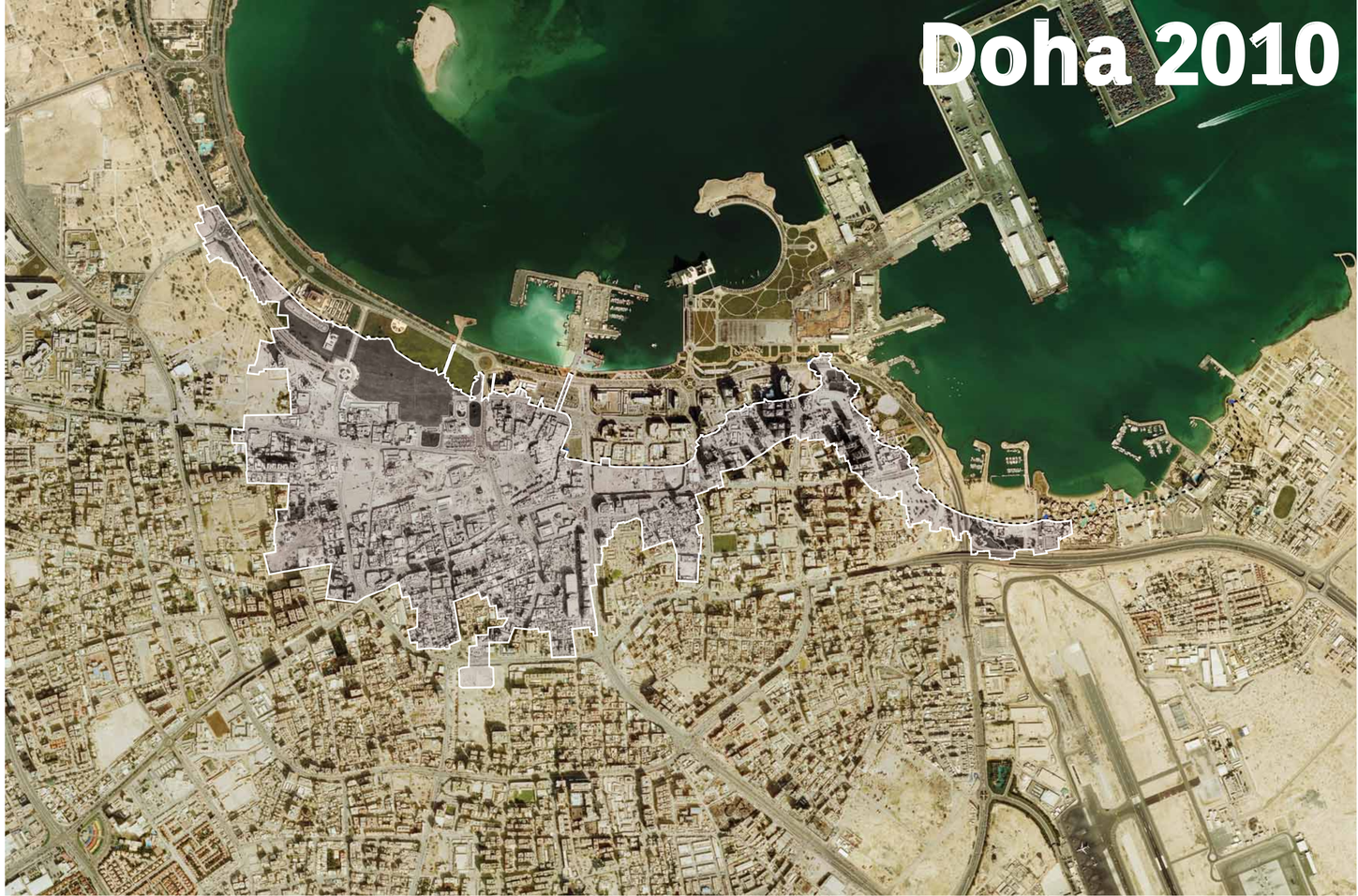
Introduction

This study aims to document, analyze, and understand the historic urbanization of Doha. It presents the first phase of the Gulf Sustainable Urbanism research project related to the pre-hydrocarbon period of the city. The past is analyzed in a holistic manner to understand how the traditional urbanization process was sustained and adapted within a demanding environmental context, specific societal needs, and with relatively limited resources. Sustainability in the Gulf historical context is defined as the adaptation and careful management of natural resources. Within this condition, the underlying concept is that future urban growth should be informed by the past while being conscious of the needs of the present as well as future development trajectories in the region.

As with the other cities studied in the Gulf Sustainable Urbanism project, the analysis of Doha develops from the subregional scale to those of city, neighborhood, and individual unit. The research approach examines historical influences, climate, natural systems, human ecological impacts, sociocultural and economics dimensions, and public health effects as indicators and results of urbanization. The historical study of the past surveys the work of key Gulf scholars and historical archives of the region to create a powerful framework. Within this integrated framework, a timeline defines Doha's urbanization dynamics and the transition from the past to present times.

The topics of urbanization, landforms, and architecture are the central part of this publication, bringing together all subjects in an interdisciplinary fashion. Data was gathered from extensive research in archival material from the Harvard libraries, the British archives, and several regional local libraries that the researchers were able to access. An extensive documentation of the information followed the data collection, using various digital drawing tools. Maps and diagrams were created to decipher urban performance along several metrics and dimensions, explaining qualitative and quantitative aspects of the city of Doha, its urban and architectural components, and its surroundings. The findings become lenses through which to understand the adaptability achieved throughout every level of urbanization, defining sustainable urbanization during the pre-hydrocarbon era.

The content of this chapter is based on the collected resources and the subsequent understanding of the study context. Every effort has been made to ensure that the sample set used for the various analyses was as representative as possible. However, a different, more focused or even broader sample set of data could be used for similar research purposes and lead to new and surprising results. As such, we envision that the specific methodologies presented in this chapter will become helpful tools for future researchers.



Configurational Analysis

Five units were chosen from each city under study, and attempts were made to unravel the relationships between different metrics that represent the characteristics of a traditional architectural unit in the region. There are very few traditional houses remaining due to widespread modernization. The selection of units was intended to cover almost all existing traditional house models in the Gulf region. Various metrics were compiled for each of the selected units, and a database of building-specific metrics was populated. This database encompasses macro-level metrics such as plot areas, built/unbuilt areas, semi-open areas, etc., and micro-level metrics such as room dimensions, room heights, etc. Information regarding the orientation of buildings, rooms, and courtyard(s) is also included in this database.

These unit-scale databases would allow us to delineate the character of a typical traditional house for each of the Gulf cities under study. These also allow us to project, with acceptable accuracy, the identified relationships and metrics at the neighborhood (*farij*) scale. Such metric analyses enable us to develop a hypothetical or projective model representing a typical traditional unit. This then enables a common ground of comparable parameters that connect past, present, and future sustainability models while being specific to the individual cities being studied. This metric analysis feeds directly into the process of building a parametric model of the different cities as delineated in the subsequent sections. There exists a direct correlation between the benefits of a parametric city model and the ability to accurately decode the "genes" of the traditional Gulf architecture. Hence it is intended that this process should remain continuously open through the creation of an open library of digital tools, which would empower many other researchers to contribute to the database and hence to the subsequent modeling process itself.

Through the use of a regression analysis to compare the different metrics, two main relationships have been observed in the sample under study.
1. The built area of a house, given its plot size, can be predicted with an accuracy of 93.4% using the relationship y = 0.89 * x-221 where x represents the plot area and y indicates the built area.
2. The room area of a house, given its plot size, can be predicted with an accuracy of 96.3% using the relationship y = 0.4 * x - 100 where x represents the plot area and y indicates the area occupied by rooms in the house.
3. The third correlation indicates the relationship between the room area and the total built area with an accuracy of 99.5%. The expression is y = 0.44 * x where x indicates the total built area and y indicates the room area. In short, the area under rooms is approximately 44% of the area of the house in the units sampled for this study.

The database of information for each unit is used to develop a representative or prototypical architectural model of the traditional house in Doha. Similar models were developed for each city, and these models were used to understand differences and similarities across the different cities. This information, in combination with the average models developed for the environmental and sociospatial studies will help develop a comprehensive comparative study of architecture and urbanism across the different cities.

The diagrams at right show initial attempts to quantify the climate responsiveness of a typical *farij* in Doha. Series of metrics have been compiled for the existing built fabric. A parametrically projected model for the built form has been developed following the methodology described above; then a new set of metrics has been compiled and the model has been used to "optimize" the *farij* for different volumetric and environmental conditions or performance metrics.

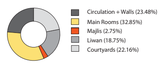
For example, a simulation tested a hypothetical increase in floor area ratio by a factor of 2 for each house in the *farij* and its effects on the environmental performance of the buildings at the urban scale. This process could be repeated by systematically altering individual parameters of the urban model and a final optimized version of the *farij* could be developed for a given set of parameters. It has to be noted that this model does not intend to create any idealized sustainable version of the *farij*, but rather to act as a suggestive model for guidelines and decision-making for future urban design in the region.

Habib Ali Hassan House

ground floor

ground floor

spatial distribution diagram

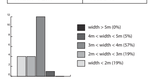


Ratio of Areas - closed /semi open / open

	Approx. Area	% of plot area
Courtyards	206.08 m2	22.16 %
Liwan	174.36 m2	18.75 %
Majlis	25.61 m2	02.75 %
Rooms	305.50 m2	32.85 %

built - unbuilt diagram

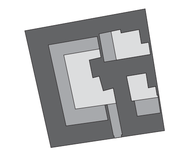
	% of all rooms
Width > 5m	0.00 %
4m < Width < 5m	5.00 %
3m < Width < 4m	57.0 %
2m < Width < 3m	19.0 %
Width < 2m	19.00 %



Room width distribution

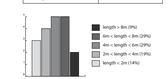
Ratio of Areas - closed /semi open

	Approx. Area	% of plot area
Plot Area	930.00 m2	100.0 %
Built Area	724.00 m2	77.84 %
Un-Built Area	206.08 m2	22.16 %
Closed Spaces	528.92 m2	56.87 %
Semi-Open Spaces	195.00 m2	20.96 %
Open Spaces	206.08 m2	22.16%



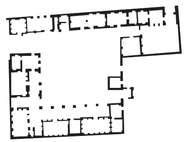
open - semi open - closed diagram

	% of all rooms
Length > 8m	9.00 %
6m < Length < 8m	29.0 %
4m < Length < 6m	29.0 %
2m < Length < 4m	19.0 %
Length < 2m	14.00 %

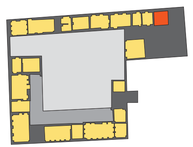


Room length distribution

Naser Bin Ahmed House



ground floor

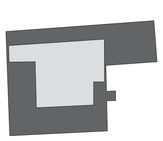


ground floor

spatial distribution diagram

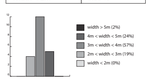
Ratio of Areas - closed /semi open / open

	Approx. Area	% of plot area
Courtyards	372.80 m2	37.00 %
Liwan	88.70 m2	09.00 %
Majlis	10.90 m2	01.00 %
Rooms	276.75 m2	28.00 %

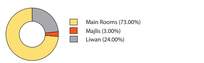


built - unbuilt diagram

	% of all rooms
Width > 5m	0.00 %
4m < Width < 5m	19.00 %
3m < Width < 4m	57.0 %
2m < Width < 3m	24.0 %
Width < 2m	0.00 %

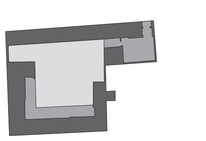


Room width distribution



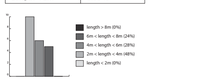
Ratio of Areas - closed /semi open

	Approx. Area	% of plot area
Plot Area	1005.00 m2	100.0 %
Built Area	633.25 m2	63.00 %
Un-Built Area	372.80 m2	37.00 %
Closed Spaces	457.80 m2	45.55 %
Semi-Open Spaces	174.40 m2	17.45 %
Open Spaces	372.80 m2	37.00%



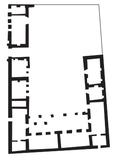
open - semi open - closed diagram

	% of all rooms
Length > 8m	0.00 %
6m < Length < 8m	24.0 %
4m < Length < 6m	28.0 %
2m < Length < 4m	48.0 %
Length < 2m	0.00 %

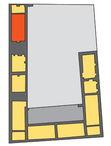


Room length distribution

Al Karaani House



ground floor

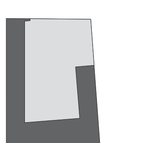


ground floor

spatial distribution diagram

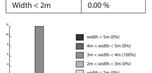
Ratio of Areas - closed /semi open / open

	Approx. Area	% of plot area
Courtyards	330.70 m2	51.10 %
Liwan	48.00 m2	07.00 %
Majlis	20.00 m2	03.00 %
Rooms	151.00 m2	22.90 %



built - unbuilt diagram

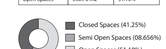
	% of all rooms
Width > 5m	0.00 %
4m < Width < 5m	0.00 %
3m < Width < 4m	100.0 %
2m < Width < 3m	0.00 %
Width < 2m	0.00 %

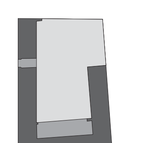


Room width distribution

Ratio of Areas - closed /semi open

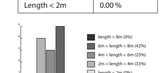
	Approx. Area	% of plot area
Plot Area	660.00 m2	100.0 %
Built Area	329.30 m2	49.90 %
Un-Built Area	330.70 m2	51.10 %
Closed Spaces	272.25 m2	41.25 %
Semi-Open Spaces	57.00 m2	08.65 %
Open Spaces	330.70 m2	51.10%





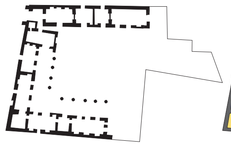
open - semi open - closed diagram

	% of all rooms
Length > 8m	0.00 %
6m < Length < 8m	42.0 %
4m < Length < 6m	25.0 %
2m < Length < 4m	33.0 %
Length < 2m	0.00 %



Room length distribution

Noura Bint Saif House



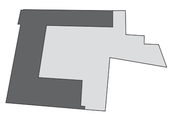
ground floor

ground floor

spatial distribution diagram

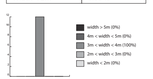
Ratio of Areas - closed /semi open / open

	Approx. Area	% of plot area
Courtyards	568.75 m2	54.40 %
Liwan	116.80 m2	11.00 %
Majlis	21.80 m2	02.00 %
Rooms	188.25 m2	18.60%

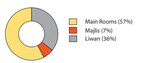


built - unbuilt diagram

	% of all rooms
Width > 5m	0.00 %
4m < Width < 5m	0.00 %
3m < Width < 4m	0.00 %
2m < Width < 3m	0.00 %
Width < 2m	0.00 %

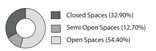


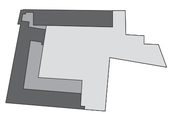
Room width distribution



Ratio of Areas - closed /semi open

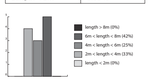
	Approx. Area	% of plot area
Plot Area	1045.00 m2	100.0 %
Built Area	476.30 m2	45.60 %
Un-Built Area	568.75 m2	54.40 %
Closed Spaces	343.60 m2	32.90 %
Semi-Open Spaces	132.70 m2	12. 70 %
Open Spaces	568.75 m2	54.40 %





open - semi open - closed diagram

	% of all rooms
Length > 8m	0.00 %
6m < Length < 8m	42.0 %
4m < Length < 6m	25.0 %
2m < Length < 4m	33.0 %
Length < 2m	0.00 %



Room length distribution

Abdul Rahman House

ground floor

ground floor

spatial distribution diagram

Ratio of Areas - closed /semi open / open

	Approx. Area	% of plot area
Courtyards	374.20 m2	30.68 %
Liwan	152.65 m2	12.50 %
Majlis	29.80 m2	02.45 %
Rooms	379.00 m2	31.00 %

built - unbuilt diagram

	% of all rooms
Width > 5m	10.0 %
4m < Width < 5m	3.00 %
3m < Width < 4m	59.0 %
2m < Width < 3m	3.00 %
Width < 2m	0.00 %

Room width distribution

Ratio of Areas - closed /semi open

	Approx. Area	% of plot area
Plot Area	1220.00 m2	100.0 %
Built Area	845.80 m2	69.32 %
Un-Built Area	374.20 m2	30.68 %
Closed Spaces	667.60 m2	54.72 %
Semi-Open Spaces	178.25 m2	14.60 %
Open Spaces	374.20 m2	30.68 %

open - semi open - closed diagram

	% of all rooms
Length > 8m	7.00 %
6m < Length < 8m	31.0 %
4m < Length < 6m	28.0 %
2m < Length < 4m	34.0 %
Length < 2m	0.00 %

Room length distribution