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# Tourism Carrying Capacity Assessment for Historical Sites - Isfahan Imam Mosque

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## ABSTRACT

Isfahan as cultural capital of Islamic world is the most important tourism destination in Middle East and a profitable economic sector in Iran. Naghsh-E Jahan Square (Emam Square) was certified as a [World Heritage Site](#) in 1979. Among the tourist sites in Naghsh-E Jahan Square, Emam mosque is a place which attracts the largest number of visitors. The unplanned tourism activities, daily prayer and religious events in this site have been creating various physical and social concerns. If appropriate planning measurements are not derived from the consideration of the carrying capacities of this site, tourism center will be overloaded, tourism quality will be degraded and therefore the benefit obtained from tourism activities will be reduced. For the first time in the history of this site, in this paper, we demonstrate an applicable method which is used for calculating the physical carrying capacity for this historical mosque. Also the result of SWOT model analysis regarding opportunities and limitations on number of the tourists can be used as the preliminary benchmarks for later tourism planning of the Emam mosque.

*Keywords:* Tourism, Carrying capacity, Sustainable tourism, Heritage sites, Isfahan, Emam mosque

## INTRODUCTION

In the early 1970s, tourism was considered as a “smokeless industry,” largely dependent on using and developing a country’s resources as a way to stimulate economic development [1]. Rapid development of tourism and large increases in the number of tourists have the potential to degrade historical landmarks and the natural environment [2]. The growing interest in sustainable development and sustainable tourism has been paralleled with an equally accelerating concern about the social and biophysical effects of tourism. A burgeoning global economy in tourism coupled with the transition of local communities away from traditional resource extraction to tourism have led to expanding concerns about the effectiveness of tourism as a tool to advance the social, economic and environmental welfare of the people it is supposed to benefit. At the same time, the appeal of the concept of carrying capacity as a paradigm for addressing and limiting the amount of tourism development and use at a destination has clearly emerged, leading to calls to establish carrying capacities in terms of specific numbers of tourists over a specified time period. Various tourism-related factors can be identified to have impact on resources, among which the number of tourists would be the most important one. The article tries to build an improved conceptual carrying capacity framework, which can be applied to a historical site.

## LITERATURE REVIEW OF TOURISM CARRYING CAPACITY

The “modern” emergence of carrying capacity dated back to an essay published in 1798 by Thomas Malthus. The essay hypothesizes that human population tends to grow in an exponential fashion, but that food production is limited to arithmetic growth [3]. Malthus’ ideas about limits to population and economic growth have become foundational concepts of contemporary environmental movement. The phrase “carrying capacity” was first proposed by Verhulst (1838) [4], a Belgian statistician interested in population growth. It is now applied to a wide range of disciplines, including biology, ecology, anthropology, geography and business management.

Increased interests in sustainability of tourism development have triggered expanding concerns about carrying capacity of both tourism destinations and protected areas, which can be called recreational carrying capacity, TCC, or simply carrying capacity. Mathieson and Wall (1982)[5] defined TCC, in terms of the environmental and experiential impacts of tourism at a particular location, namely as “the maximum number of people who can use a recreational environment without an unacceptable decline in the quality of the recreational experience.” WTO/UNEP (1992)[6] defined carrying capacity as “the level of visitor use an area can accommodate with high level of satisfaction for visitors and few impacts on resources”. Based on our perception of sustainable tourism development, our concept proposed to be applied to Emam mosque as follow: Assessing the highest bearing capacity of the Emam mosque based on the maximum number of visitors (including tourists and ordinary people) that can be physically let in there without getting the integrity of assets affected.

According to this definition, the tourism carrying capacity includes two components: social carrying capacity and physical carrying capacity.

*Social carrying capacity:* Acceptance level of local community which is reflected by the maximum number of tourists which does not make local residents unpleasant.

*Physical carrying capacity:* The maximum number of users that can physically fit into or onto a defined water resource, over a particular time.

### Purpose of the study

Isfahan ([Persian](#): Esfahān), historically also rendered in English as Ispahan, Sepahan or Hispahan, is the capital of [Isfahan Province](#) in [Iran](#), located about 340 km south of [Tehran](#). It is famous for its Islamic [architecture](#), with many beautiful boulevards, covered bridges, palaces, mosques, and minarets. It has a population of 1,583,609, Iran's third largest city after Tehran and [Mashhad](#). The Isfahan metropolitan area had a population of 3,430,353 in the 2006 Census, the second most populous metropolitan area in Iran after Tehran. [7]

The [Naghsh-E Jahan Square](#) in Isfahan is one of the biggest [city squares](#) in the world and an outstanding example of Iranian and Islamic architecture. It has been designated by [UNESCO](#) as a [World Heritage Site](#) in 1979. The city also has a wide variety of historic monuments. The Shah Mosque, recently known as Imam Mosque is a [mosque](#) in [Isfahan](#), [Iran](#) standing in south side of [Naghsh-E Jahan Square](#). Its construction began in 1611, and its splendor is mainly due to the beauty of its seven-colour mosaic tiles and [calligraphic](#) inscriptions. The [mosque](#) is one of the treasures featured on [Around the World in 80 Treasures](#) presented by the architecture historian [Dan Cruickshank](#)[7]. Imam Mosque, Isfahan as part of Naghsh-E Jahan square, has been recorded in the World Heritage List, and hosts many different political- religious events including the Friday Prayers, and Atkaf ceremony (a religious gathering). According to the World Heritage Convention rules, National Cultural Heritage Administrations are responsible for protecting the global heritage sites, and if any slight damage happened to the sites, they would be asked by UNESCO World Heritage Centre about the

incident. The table below shows the number of visitors from 21th march 2010 until 20 jan 2011.

Table1. The Number of Visitors on Emam Mosque

Month	Domestic Tourists	Foreign Tourists	Free Visitors
Farvardin (21 Mar / 20 Apr)	88197	1468	26032
Ordibehesht (21 Apr / 21 May)	14798	2149	7307
Khordad (22 May / 21 Jun)	6316	957	2550
Tir (22 Jun / 22 Jul)	7867	622	2655
Mordad (23 Jul / 22 Aug)	12725	4590	954
Shahrivar (23 Aug / 22 Sep)	10090	1275	2215
Mehr (23 Sep / 22 Oct)	11549	811	6855
Aban (23 Oct / 21 Nov)	10247	1283	1360
Azar (22 Nov / 21 Dec)	4130	433	901
Dey (22 Dec / 20 Jan)	3575	833	308

Resource: Center of Statistics of National Cultural Heritage Administration

Recently, occurring some physical factors such as:

The metal scaffolding that is installed every Muharram month in the mosque courtyard space,  
Installing many massive speakers on the walls by staff to hold Friday prayer in the mosque, which produce high dB noise, could loosen the mosaics and make cracks in the body of mosque,  
The inflation the tiles of the dome,  
Restoration of monuments by unqualified people,

have caused some damages to Emam mosque, especially during the peak seasons. As a matter of fact, lack of wise planning on proper conduction of the demand will lead to more destruction.

#### Research method and Expected outcome

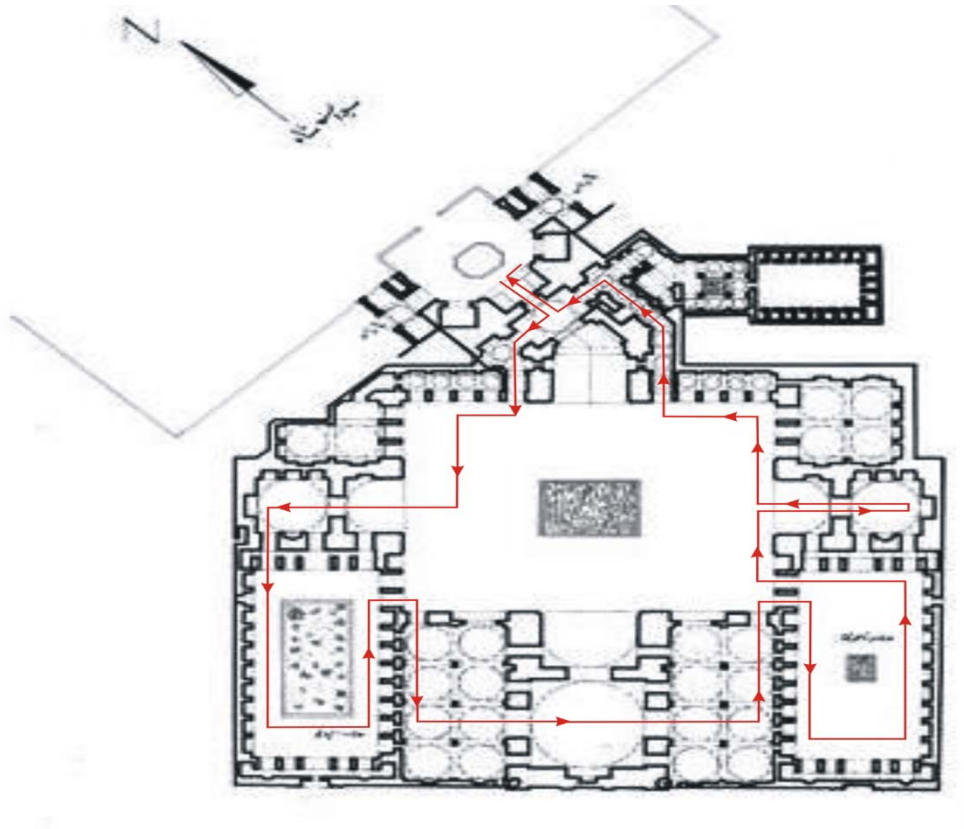
In this paper, as the first step, we designing a tourism route, so we assess the PCC and ERCC of Emam square apply the actual statistic data from the site and the following formulas. This article contains applicable methods of calculating carrying capacity, which can be so effective on future executive planning in different sites. By changing the limitations of each site according to the location and type of the site, presented model in this paper can be generalized to any other sites. To calculate carrying capacity of some tourism activities in Emam mosque, the formulae of Cifuentes [8] and Ceballos – Lascurain [9] will be used with some adjustments.

#### *Designing a Tourism Route in Isfahan Emam mosque*

Regarding:

1. large number of visitors particularly during the Iranian new year's holidays
2. crowd of people in the southern porch
3. concurrent religious and tourist use of this mosque

Tourism route is measured and desined in this mosque as follows:



### General formulae

#### Physical carrying capacity (PCC) &

Formula:  $PCC = A \times U/a \times Rf$  (1)

Where: A = available area for public use  
U/a = area required per user  
Rf = rotation factor (number of visits/day)

A is determined by particular conditions of the considered area. The tourist density or the area required per tourist  $U/a$  is the area needed for a tourist who can undertake activities comfortably. Rotation factor is the number of permissible visits over a specified time (usually calculated by daily open hours) and expressed by:

$Rf = \text{Open period} / \text{average time of visit}$  (2)

#### Effective Real Carrying Capacity (ERCC)

Definition: ERCC is the maximum number of tourists that is permitted by the local conditions and management capacity without influencing the tourists' demand:

Formula:  $ERCC = PCC - Cf1 - Cf2 - \dots - Cfn$  (3)

Where: Cf = a corrective factor expressed as a percentage are factors which have negative impact on tourism activities and assessed by limiting threshold which used for identifying impact level of a factor

(%):

$$ERCC = PCC \times (100 - Cf1)\% \times (100 - Cf2)\% \times \dots (100 - Cfn)\% \quad (4)$$

where limiting factors can be determined by:

$$Cf = [M1 / Mt] \times 100 \quad (5)$$

Where: Cf = corrective factor

M1 = limiting magnitude of variable

Mt = total magnitude of variable

These factors are selected based on tourism activities and local conditions of the study area.

### *Carrying capacity of the Isfahan Emam mosque.*

To calculate Physical carrying capacity (PCC) factors that affect tourist's comfort such as the necessary distance between two people and the distance between two groups on a route should be considered. It is a limitation of the previous formulae proposed in the literature. Therefore, to improve Ceballos-Lascurain formula, the following physical parameters are included:

Length of sightseeing route in Emam mosque: 700m

Average distance between two people: 1m

Average time for a tour: 1 hour

Distance between two groups in Emam mosque: 100m

Maximum number of people on one group: 15 visitors (include tour guide)

Open period: 9 AM - 17 PM (8 hours).

Weekends holiday: Friday

"Etekaf" ceremonies and other religious ceremonies: 12 days

Time for prayers: 2 hours a day (12-14)

Let x to be the maximum number of groups in. From entrance to the last visiting point, the number of groups is expressed by equation:

$$x \times 15 + (x - 1) \times 100 = 700 .$$

The above equation gives: x = 6 group.

Open period is 8 hours/day; each tour is about 1 hour. Thus the number visits per day is 8 (Rf = 8/1). Therefore, the maximum number of visits per day is:

$$PCC = (x) \times 15 \times 8 = 720 \text{ visits/day (21600 visitors/ month).}$$

Corrective factors:

Friday days: The site is closed every Friday during the year.

There is 53 days in the year that the site is closed for weekend,

"Etekaf" ceremonies and other religious ceremonies that it takes 12 days during the year

Time for prayers: 2 hours a day (from 12 to 14)

So these parameters are limiting factors:

M1: 53 days (Friday days)

Mt : 365 days (one year).

Limiting factor for Friday days ( Cf1 ):  $53/365 \times 100 = 14.5\%$

M2: 12 days ("Etekaf" ceremonies and other religious ceremonies)

Mt : 365 days (one year).

Limiting factor for "Etekaf" ceremonies and other religious ceremonies ( Cf2 ):  $12/365 \times 100 = 3.2\%$

M3: 2 hours\*365 (Time for prayers)

Mt : 8\*365 hour (Total hours in one year).

Limiting factor for Time for prayers ( Cf3 ):  $730/2920*100=25\%$

$ERCC=720*(100-14.5\%/100)*(100-3.2\%/100)*(100-25\%/100)=446$  visitors / day (13380 visitors/month)

In the next step, the **Strengths**, **Weaknesses**, **Opportunities**, and **Threats** involved with the system will be assessed using SWOT Analysis.

*Analysis of factors affecting tourism in Imam Mosque, Isfahan according to SWOT strategic model*

*Internal factors affecting tourism in the region have been studied:*

The purpose of this phase is to measure the internal environment to identify its strengths and weaknesses. To achieve this, we need to assess four factors within the site: The Building, the Rules and Regulatives, Foreign Tourists and Domestic Tourists. These factors are considered and evaluated as strengths and weaknesses of the site regarding its tourism development potentials.

*External factors affecting on tourism in the region have been studied:*

The purpose of this stage is to analyze the affective environment surrounding the site in order to determine the opportunities and threats associated with the expansion of tourism.

**Table 2. Analysis of the strenghts and weaknesses of Imam Mosque, Isfahan according to SWOT strategic model**

Site Factors	Strengths	Weaknesses
<b>The Building</b>	The age of building dating back to the 1611 AD and there .are seven colors used in the tile work	There is no access to .the basic building plan
	The building is located in the centre of the city and inside Naghsh-E Jahan .Square	There is .no access to raw materials and mortar
	Naghsh-E Jahan Square Was registered in UNESCO World Heritage under rgister number 115 in .1979	The heating system used in the .building has damaged the site
	The measurement of Qiblah direction has been calculated by the Iranian scholar Sheikh Bahai with only 7 degrees of .deviation	.Installed speakers with high db

	Use Lead to make .columns for earthquake-resistant building	The metal scaffolding that is installed .for religious ceremonies
<b>Rules and Regulatives</b>	There are rules for the Cultural Heritage Preservation and restoration .of historical monuments	There is a lengthy procedure in Iran for .passing legislations
	The building is registered in the Iranian National Monuments registry list and Naghsh-E Jahan Square Was registered in UNESCO World Heritage and Iranian National Monuments .registry list	There is a lack of consistency in monitoring .implementation of the regulation
	The rise of people awareness toward .sustainable development in Iran	Bureaucratic administrative .system in Iran
<b>Domestic Tourists</b>	.Site is famous for Iranian people	.Lack of information before visiting
	Site is adjacent to the Naghsh e Jahan Square and theTraditional Bazaar of Isfahan	Various types of tourists visit the site such as cultural tourists, adventurer .tourists etc
	.Low price tickets	Little awareness of tourists in recent years towards sustainable development .Monuments
	There are tourist guides in the collection .during New Year	Lack of beneficial use and profit from .the tourist places and spaces
<b>Foreign Tourists</b>	.Low cost of site visits	Absence of tour schedule from the .guides
	.Nice weather and having four seasons	The mosque is under supervision of multiple organizations (e.g. cultural (.heritage, charities, endowments etc
	Unique architecture of the mosque among .the Islamic monuments	.Lack of proper repair
	.Local arts and handicrafts	Lack of information about the site in .foreign countries
	Spirited hospitality	Lack of English-fluent local guides in .the site

Table 3. Analysis of the opportunities, and threats of Imam Mosque, Isfahan according to SWOT strategic model

<b>Site Factors</b>	<b>Opportunities</b>	<b>Threats</b>
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<b>The Building</b>	Dual functionality for public and .cultural usage	Chemical and noise pollution and acid .rain in the region
	Having suitable space for public and .cultural ceremonies	Entering public and personal transports to .the Naghsh-E Jahan Square
	Importance of the mosque for religious .and legal authorities	Heterogeneity in the selection and use of materials in comparison with the past .architecture
<b>Rules and Regulatives</b>	.Credit allocation to protect monuments	Lack of serious and careful monitoring in .the implementation of existing laws
	.There are experts in order to pass laws	Shortage of trained experts in tourism industry to correspond with relevant .organizations
	Possible relationship with the international community and UNESCO .to promote the rules	Lack of organizing tourism and tourist attractions, and poor management of .tourism sites
<b>Domestic Tourists</b>	Increase of public awareness by .cultural plans	.Inappropriate use of the site by tourists
	.Rail, road and air transportation	Inappropriate use of the time (at the New .Year holidays because of crowds
	There are restoration workshops and .there is higher education space	There are uninformed people in relevant .organization
	Proximity to the capital in order to hire .experts and facilities	.Excessive exploitation from the site
<b>Foreign Tourists</b>	.Site is being visited by cultural tourists	.Damaging local cultures
	Creating income for low-income people and creating employment and .reducing unemployment	.Cheap admission rates
	.Improving infrastructure and facilities	Lack of under-cover monitoring and .CCTVs
	Preserve historical and cultural .heritage	Increased population and decreased power .of purchase
	People get familiar with the manner of .life of indigenous peoples	Erosion and loss of complex if not .organized properly

## CONCLUSIONS AND SUGGESTIONS:

According to the SWOT analysis and also the carrying capacity of this site, the following items are recommended:

Shutting the site down for 3 months to organize the current situation, renovation and constructing new entries and exits through the site.

Create and distribute visitor's brochures and maps and install warning signs in the courtyard area.  
 Determine a reasonable number of groups (30 groups) of visitors and also the number of individuals in each group (15 visitors+ guide tour) per day and allocate a limited time to each group (1 hour).  
 Each group interval 10 Minutes compared to the previous login and maximum number of visitors per day is 446 people.  
 Creating electronic booking facilities and the possibility of canceling a booking.  
 Make the entrance ticket price for domestic visitors \$5 and \$15 for foreign visitors.  
 Transfer Friday Prayers from Imam Mosque, to the Isfahan Mosalla.  
 Use the mosque for tourism purposes and hold the mid-day prayer only.  
 Create subtle hidden camera control.  
 According to the weekend in Iran (Friday), this day is an opportunity to visit the site by enthusiasts, so it is better to transfer closed time from Friday to Saturday.  
 use hands-free set for the communication between the guide and the tourists.  
 Hold an International conference in Isfahan about sustainable development of the monument.

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