सत्यमेव जयते

CITY LEVEL PROJECTS

GUIDELINES FOR VEHICULAR PARKING OF EDUCATIONAL INSTITUTIONS

Delhi

Delhi Urban Art Commission

The Delhi Urban Art Commission was set up by an Act of Parliament in 1973 to "advise the Government of India in the matter of preserving, developing and maintaining the aesthetic quality of urban and environmental design within Delhi and to provide advice and guidance to any local body in respect of any project of building operations or engineering operations or any development proposal which affects or is likely to affect the skyline or the aesthetic quality of the surroundings or any public amenity provided therein".

सत्यमेव जयते

Delhi Urban Art Commission

Prof. Dr. P.S.N. Rao	Chairman
Samir Mathur	Member
Abhimanyu Dalal	Member
Sonali Rastogi	Member (till 02.07.2020)
Kamran Rizvi	Member & Addl. Secretary, Ministry of Housing and Urban Affairs (w.e.f 2.01.2020)
Ruby Kaushal	Secretary (w.e.f 1.02.2019)
Vinod Kumar	Secretary (till 31.01.2019)

DUAC Officers

Rajeev Kumar Gaur, Amit Mukherji, Manju Anjali, Siddharth Sagar, Neha Chauhan

Senior Consultant

Satish Khanna, S.C. Gupta

Consultants

Shilpi Madnawat

DELHI URBAN ART COMMISSION with gratitude duly acknowledges the valuable contributions of the following in making this report:

Organisations

Ministry of Urban Development
Delhi Development Authority
Government of National Capital Territory of Delhi
New Delhi Municipal Council
North Delhi Municipal Corporation
East Delhi Municipal Corporation
South Delhi Municipal Corporation
New Delhi Municipal Council
Geospatial Delhi Limited
Delhi Metro Rail Corporation
RWAs and Area Councillors

सत्यमेव जयते

DISCLAIMER

This report is for academic purposes only and has been prepared on the basis of information gathered from various sources, in cases without any independent verification. The report can be adopted and utilized by any Government Authority/Local Body in the Country and is provided free of cost. The report is not meant to derive any kind of gain, monetary or otherwise.

Though all efforts have been made to ensure the accuracy of the information in this report, the same should not be construed as a statement of law or used for any legal purposes. Delhi Urban Art Commission (DUAC) accepts no responsibility in relation to the accuracy, completeness, usefulness or otherwise, of the information contained in the publication. Stakeholders are advised to verify/check any information with the relevant Government Department(s) and/or other source(s), and to obtain any appropriate advice before acting on the information provided in the report.

While adequate measures have been taken to acknowledge the source of the information used in the report, the nature of the process and the diverse sources from which information is collected makes it difficult for the Commission to ascertain whether each piece of information/data impinges upon any third party intellectual property rights. DUAC shall consequently not be responsible for any inadvertent and / or bonafide omission of acknowledgement of source of information.

In no event will the DUAC be liable for any expense, loss or damage including, without limitation, indirect or consequential loss or damage, or any expense, loss or damage whatsoever arising out of any person/ stakeholder using or implementing or relying on any information in this report.

Preface

The city of Delhi, capital of this vast land of diversities, is a city laden with layers of history, a place where civilizations have lived, prospered and perished over centuries. The modern city today, built over and around a rich tapestry of heritage, presents an opportunity at every turn, to allow for co-existence of the past, present and the future. In order to understand this multidimensional urban spectrum and attempt to plan the future, various city level studies have been initiated by the DUAC. I hope that these studies will help the planners of modern day Delhi to carefully articulate urban space, structure, form and environment and sensitively address future requirements.

I convey my thanks to all the Consultants and Members of the Commission who have tirelessly worked on this research project to bring out this document. I also take this opportunity to place on record my sincere appreciation of the efforts of Secretary and other staff of DUAC for providing the necessary administrative support to make this happen.

I fondly hope that the authorities of the local, state and national government take these studies seriously and implement, in right earnest, the suggestions given herein.

December, 2020

Sd/-

Prof.Dr.P.S.N.Rao

Chairman, DUAC

Foreword

The objective of this study is be to understand the current scenario across selected institutions in the city, and suggest contextual and sustainable strategies for Vehicular parking in educational institutions in Delhi. A study was conducted by DUAC. It was observed that the actual requirement for parking in educational institutions varies from what is provided. The norms call for numbers that are mostly in surplus. It was noted that public land and road was used for school parking especially for contracted vehicles. Educational institutions are utilizing the open spaces in their plots to provide vehicular parking based on the built area on the site i.e. FAR (as prescribed in the building byelaws). The playgrounds/playfields which are essential to maintain the physical well-being of the students are being used as parking areas to fulfil the norms of the building byelaws.

Often, institutions are forced to construct multiple basements that are largely unused, at an unaffordable cost. In case of extension of buildings, space for parking is not available in the plot without reducing play areas. Visitors are forced to use public roads for waiting, due to perceived security requirements. The ongoing practice is a reminder to review our policies on parking in educational institutions. The norms fail to capture the basis for the need of parking. These may include typology of institutions (private/government), modal split indicating the type and number of vehicle users, space allocated for Buses and visitor parking and other characteristics. Optimum standards for parking and other serious concerns of parking issues at peak hours of arrival/dispersal outside the premises creating chaos in the neighborhoods need to be addressed. Therefore, a holistic approach addressing the various issues including safety, traffic management and preserving our green open spaces vis-à-vis parking in educational institutions is the way forward.

December, 2020

Samir Mathur
Member, DUAC

Contents

Contents

1 INTRODUCTION

Education in Delhi is based on a three-tier model which includes primary schools, followed by secondary schools and tertiary education at universities or other institutes of same level. Education Department of the Government of Delhi is a premier body which looks into the educational affairs. Pre-primary and primary education is mainly the responsibility of the local civic bodies. Middle, secondary and senior secondary as well as tertiary education is administrated by the Directorate of Education, Government of Delhi. These are run either by government or private sector. The Govt. of Delhi has converted its 326 schools into composite schools now known as Sarvodaya Vidyalayas having classes from I to XII. At the University level, the government run Degree Colleges are being funded by University Grant Commission (UGC) and Delhi Government. NDMC, though mainly concerned with primary education, is also running a selected number of middle, secondary, senior secondary schools in its areas at present. Apart from this a number of private organizations are also engaged in imparting education at all levels of schooling. These organizations are given grant-in-aid by Govt. of Delhi to meet the expenditure on education. Besides these, recognised unaided schools are also being run in Delhi by registered trusts and societies.

As per the Economic Survey of Delhi 2017-18, the total number of schools in Delhi is 5772 in 2016-17. The number of students enrolled in schools increased from 42.68 lakh in 2012-13 to 44.43 lakh in 2016-17. Student Teacher Ratio also enhanced to 30 in 2016-17. Delhi Government has 1228 government and government aided schools in Delhi, which is 21.27% of the total number of schools running in Delhi. Number of Higher Education Institutes increased from 209 in 2012-13 to 219 in 2017-18 and Technical Institutes in Delhi has increased from 99 in 2012-13 to 104 in 2016-17. With this increase in the number of educational institutions and hence the number of students and teachers per institute, there has been an increase in the required school infrastructure and their parking requirement, as per norms. Keeping the need for expansion and diversification as brought out above, the availability of land and subsequently playfields for school children could become a major constraining factor.

For Delhi, the parking norms and standards for its educational establishments are contained within the Master Plan for Delhi (2021). With the current parking standard of 2 ECS per 100 sq m. of floor area for Senior Secondary Schools and 1.33 ECS per 100 sq m. of floor area for Nursery, Primary/ Middle School and Colleges, a lot of available open space has been consumed to provide requisite parking spaces, which may have been utilized for providing open green spaces/ playgrounds for the students. Dedicating vast expanse of land for parking which would otherwise be unoccupied would also compromise on delivering other educational facilities, such as outdoor teaching spaces and servicing areas. There have been instances where the school authority got building layout plans sanctioned by the civic bodies after showing provision for bus parking lots on their premises, while actually such spaces are being used for other purposes while traffic spills on to public roads. Instances like these lead to re-questioning the norms.

The annual parking fees paid by the schools to the local body does not legally entitle them to use public land for parking their buses. The on-site parking demand varies substantially from what is being provided as per the prevailing norms and is also different for private and government schools/ colleges as stated in the Draft Parking Policy for Delhi - 2017. Other than this, the parking requirement also varies with factors such as location of school, availability of public transport in vicinity, condition of pedestrian infrastructure etc. Automobile-dependent locations require more parking than needed in areas with good travel options, accessible land use, or transportation and parking management programs.

Source: https://www.asianage.com/metros/delhi/210117/etah-tragedy-raises-questions-about-bus-service-in-city-schools.html

Source: https://www.indiatoday.in/india/north/story/schoolbus-nightmare-poor-traffic-management-of-schools-gives-passersby-and-locals-a-tough-time-everyday-169620-2013-07-09

The above issues have highlighted the need to review the current parking standards for educational institutions, in order to avoid some of the vehicular parking problems which occur on and around such sites, and to provide guidance which is fit for current education provision. The study is in sync with and takes forward the recommendations of the Draft Parking Policy for Delhi - 2017, Transport Department, Government of NCT of Delhi, vide Notice No. SCOT/TPT/P. POLICY/2017/SCOT 2/1580-96, dated 14th June 2017, Chapter 10, Clause 10.1 which suggests change in Parking Norms for Government Buildings - "The parking norms in the city need to be reconsidered. A government school is required to keep as much parking area as prescribed for a private school whereas negligible students use cars to reach school in the case of the former, thereby resulting in wastage of public space".

1.1 Vision

These guidelines intend to identify a realistic, evidence-based level of parking provisions to be adopted for Educational Institutions in Delhi. For the purpose of the study, Educational Institutions include Nursery Schools, Primary Schools, Senior Secondary Schools and Colleges.

1.2 Objective

These guidelines intend to:

i. Optimise the vehicular parking requirement of the educational facilities.
ii. Limit the misuse of public land around such facilities for the purpose of vehicular parking.
iii. Provide for an efficient and safe transport management for safety of children to and from educational facilities.
iv. Provide for an adequate and sustainable vehicular parking solution for educational facilities.

1.3 Scope

i. The study would include parking provisions for Existing and New Educational Institutions, both under Private and under Government administration.

ii. This document intends to rationalise the parking norms for vehicular parking in Educational Institutions laid down in the Master Plan for Delhi – 2021 (Chapter 13, Social Infrastructure, Clause 13.2, Education)

iii. These guidelines intend to assist in the planning of appropriate parking facilities for schools and colleges by the Local Sanctioning Authority and other parties, and will enable undertaking sound decisions based upon relevant and up-to-date evidence.

1.4 Terminology

For the purpose of this document, the following definitions shall apply:

i. **College (including Professional College):** A premise having educational and playing facilities for students of under-graduate & post-graduate courses under a university. It includes all professional disciplines. Activities Permitted in same as per MPD - 2021 are College, Residential Flat (For maintenance staff), Hostel, Retail Shops of area 20 sqm each (confectionery, grocery and general merchandise, books & stationery, chemist, barber, launderer, vegetable), Canteen, Bank Extension Counter, Auditorium, Indoor Games Hall, Swimming Pool, Playground, Post Office Counter facility.

ii. **ECS:** Equivalent Car Space; Unitary space requirement for parking a vehicle in terms of a four wheeler as identified by Indian Road Congress and as defined in parking norms by UTTIPEC, DDA. The standards given in Equivalent Car Space shall include parking for all types of vehicles i.e. cars, scooters, cycles, light and heavy commercial vehicles, buses etc.

INDICATIVE ON-SITE PARKING REQUIREMENT FOR PROJECTS		
Mode	ECS Standard by mode	Area in Sq.m. (including circulation)
Cars/ Taxis	1	23.00
2 Wheelers	0.25	5.75
Cycles	0.1	2.30
Buses/ Shared Vans	3.5	80.50
Commercial Vehicles	3.5	80.50

Source: Master Plan for Delhi - 2021, Table 17.4

iii. **Educational Institutions:** Educational Institution means a building exclusively used for a school or college, recognised by the appropriate Board or University, or any other competent authority involving assembly for instruction, education or recreation incidental to educational use, and including a building for such other users incidental thereto such as a library or a research institution. It shall also include quarters for essential staff required to reside in the premises, and a building used as a hostel captive to an educational institution whether situated in its campus or not.
These would include include Nursery Schools, Primary Schools, Senior Secondary Schools and College and other Vocational Institutes as defined in MPD-2021.

iv. **Government Aided School:** A school receiving grant-in-aid from the Union Government/Administration of Union Territory/State Government/Local Authority.

v. **Middle School:** A premise having educational and playing facilities for students upto VIII standard. Activities Permitted in same as per MPD - 2021 are Nursery School, Middle School, Watch & Ward Residence (Upto 20 sqm), Books & Stationery Shop (Upto 20 sqm.), Soft Drink and Snack Stall.

vi. **Off-street Parking:** Vehicles parked in a designated open or closed, indoor or outdoor space, which do not lie within the entire ROW of road or street.

vii. **On-street Parking:** Vehicles parked on the road along the sidewalks, carriageway or kerb side.

viii. **Parking:** An act of stopping, disengaging a vehicle and leaving it unoccupied (***Wikipedia***).

ix. **Parking Management Plan:** A document with recommendations, actions, strategies and policies that offer improvement in mobility and performance of parking system.

x. **Primary School:** A premise having educational and playing facilities for students upto V standard. Activities Permitted in same as per MPD - 2021 are Nursery School, Primary School, Watch & Ward Residence (Upto 20 sqm). Books & Stationery Shop (Upto 20 sqm.), Soft Drink & Snack Stall.

xi. **Private School:** A school run by a Society/Trust/Company registered (under section 8 of the Companies Act 2013) duly constituted and registered under the provisions of Central/State Acts.

xii. **School:** Any recognised school imparting elementary education and includes -
a) a school established, owned or controlled by the appropriate Government or the local authority,
b) an aided school receiving aid or grants to meet whole or part of its expenses from the appropriate Government or the local authority,
c) a school belonging to specified category, and
d) an unaided school not receiving any kind of aid or grants to meet its expenses from the appropriate Government or the local authority,

xiii. **Secondary School:** A premise having educational and playing facilities for students from VI to XII standard. Activities Permitted in same as per MPD - 2021 are Secondary School, Watch & Ward Residence (Upto 20 sqm), Books and Stationery Shop, Uniform Shop (Upto 20 sqm each), Soft Drink & Snack Stall, Canteen, Bank Extension Counter, Auditorium, Indoor Games Hall, Swimming Pool, Post Office Counter Facility.

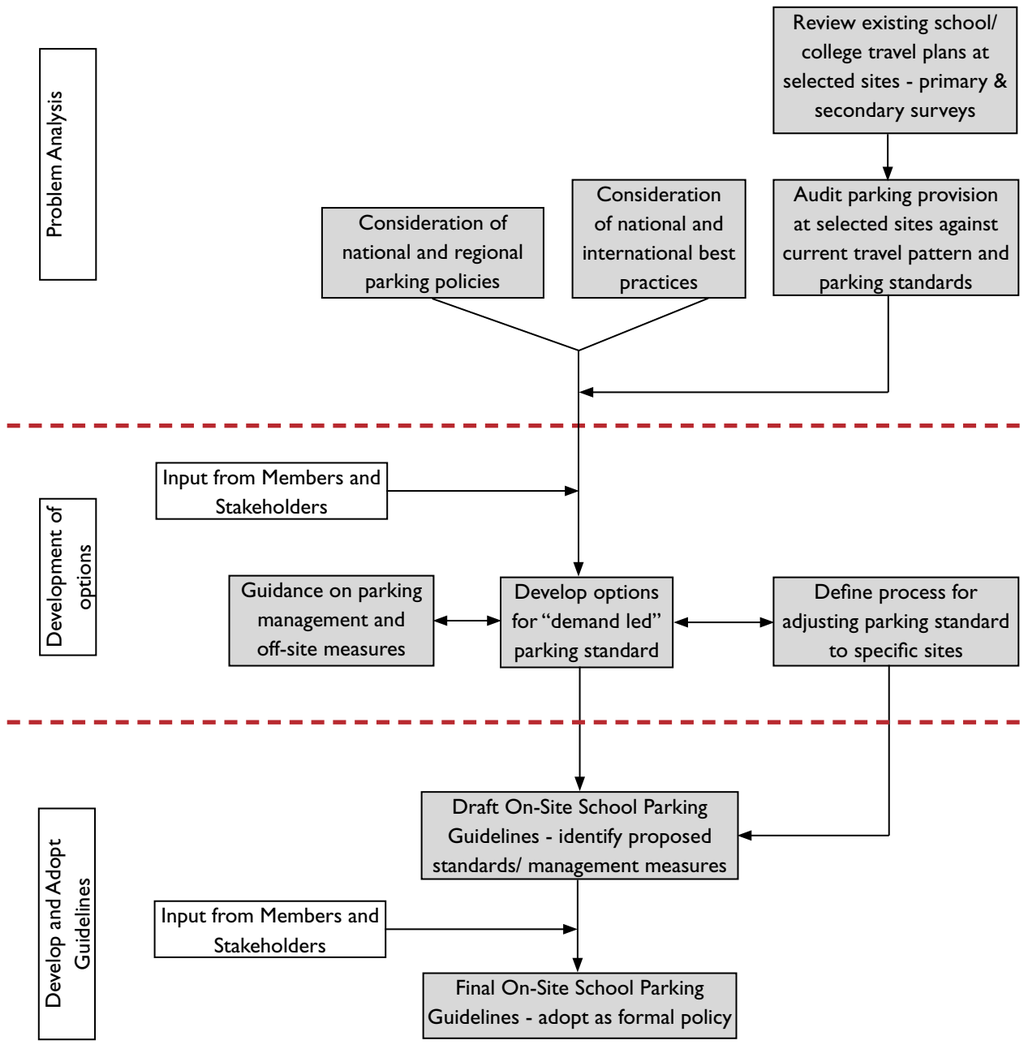
xiv. **Senior Secondary School:** A premise having educational and playing facilities for students upto XII standard. Activities Permitted in same as per MPD - 2021 are Nursery School, Sr. Secondary School, Watch & Ward Residence (Upto 20 sqm), Books and Stationery Shop, Uniform Shop (Upto 20 sqm each) Soft Drink & Snack Stall, Canteen, Bank Extension Counter, Auditorium, Indoor Games Hall, Swimming Pool, Post Office Counter Facility.

1.5 Approach To Developing The Guidelines

The review of parking norms would be based on a sample audit of Educational Institutions across Delhi to understand the travel patterns of Key Users (Students, Staff and Visitors), to measure actual parking arrangements on-site, estimate the associated parking demand and measure this demand against current parking provisions/ standards.

A survey was carried out by visiting few of the prime schools and colleges of the city and sharing questionnaire based survey forms (refer Annexure I) with the selected institutions. Based on the data collected and secondary surveys conducted, an empirical model is generated. For schools, it has been observed that these can be categorised majorly into three types depending on factors such as the fee structure, pupil teacher ratio (PTR), their governance structure etc. For each of the categories, the travel pattern of students and staff is generated in terms of modal split and actual parking requirement (bus and staff cars) is derived from the same for a particular land parcel and strength of school type.

The diagram below shows the process by which the On-Site Parking Guidelines for Educational Institutions have been developed.



Methodology used to carry out the review of current standards and develop a new parking strategy

2 EXISTING POLICY CONTEXT

2.1 National Policy

2.1.1 National Building Code (NBC) - Planning Norms & Standards for Educational Facilities

PRIMARY SCHOOLS (CLASS I TO V)		
	NBC 2016	NBC 2005
Population served per unit	5,000	5,000
Student Strength	500	500
Area Requirement	1.0 acre	1.0 acre
Area under School Building	0.5 acre	0.5 acre
Playfield Area	0.5 acre	0.5 acre
Size of Playfield	18m x 36m (min.)	18m x 36m (min.)
Parking Area/ Norm	-	-

The National Building Code of India, developed by the Bureau of Indian standard (BIS) provides guidelines for regulating building construction activities across the country. The standards given in the code and shown in side tables, serve as reference for all States and UTs, for design and construction of school infrastructure.

SECONDARY SCHOOLS (CLASS VI TO XII)		
	NBC 2016	NBC 2005
Population served per unit	7,500	7,500
Student Strength	1000	1000
Area Requirement	4.45 acre	4.45 acre
Area under School Building	1.5 acre	1.5 acre
Playfield Area	2.47 acre	2.47 acre
Size of Playfield	68m x 126m	68m x 126m
Parking Area/ Norm	0.5 acre	0.5 acre

For primary schools, the area under school building and under playfield are both 50% of the total land area. In case of secondary schools, the land division for playfield, school building and parking is approximately 55%, 34% and 11% respectively. While for Integrated schools the division is 71.5%, 20% and 8.5% for playfield, school building and parking respectively.

INTEGRATED SCHOOLS (without Hostel Facility) CLASS I TO XII		
	NBC 2016	NBC 2005
Population served per unit	90,000 to 1 lakh	90,000 to 1 lakh
Student Strength	1500	1500
Area Requirement	8.65 acre	8.65 acre
Area under School Building	1.73 acre	1.73 acre
Playfield Area	6.18 acre	6.18 acre
Size of Playfield		
Parking Area/ Norm	0.74 acre	0.74 acre

Source: National Building Code of India, 2005 & 2016

The provisions listed in 2016 code are the same as in 2005, while parameters such as students and staff intake, PTR, area of land parcel alloted for schools, accessibility and availability of public transport in vicinity, that affect the actual demand for parking on-site, have changed immensely over last 10 years.

2.2 Regional/ Local Policy

2.2.1 Master Plan for Delhi (MPD) - 2021

The planning norms and standards for Educational Facilities in Delhi are contained in Chapter 13 - Social Infrastructure, Clause 13.2 - Education. The MPD aims at enabling optimal utilisation of land and available educational infrastructure. The following planning policy parameters are proposed:

i. Differential norms and standards for various educational institutes / institutions shall be applicable in the light of the norms of the concerned controlling authorities e.g. University Grants Commission (UGC) / All India Council for Technical Education (AICTE) / Directorate of Education, GNCTD / Central Board of Secondary Education (CBSE) etc.

i. Coaching centres / vocational training centres would be permissible in school classes after school hours with (a) prior approval of Competent Authority in the case of schools run by GNCTD or local body and (b) with prior intimation to lessor and payment of fee to be prescribed in the case of schools run privately on leased land. Structured courses leading directly to degree / diploma shall however not be permitted.
ii. The educational institution premises may be permitted to function in two shifts, subject to statutory approvals and any other conditions that may be stipulated by the relevant competent authority.
iii. Nursery School may function as part of Primary School / Secondary School / Senior Secondary School, wherever needed. Separate / exclusive Nursery Schools are permitted in residential premises as per the Mixed-use policy.
iv. Requirement of schools and training centres for mentally and differently abled persons with differential development norms are given.

PLANNING NORMS AND STANDARDS FOR EDUCATIONAL FACILITIES - SCHOOLS							
S.No.	Category	Population per Unit	Plot Area (Hectares)	Ground Coverage	FAR	Height	Parking Standards
1	Nursery School			33.33%	100	15 m	@ 1.33 ECS/ 100 sq.m. of floor area
2	Primary School	10,000	0.2	30%	120	18 m	@ 1.33 ECS/ 100 sq.m. of floor area
3	Sr. Secondary School/ Secondary School	10,000	0.4 - 0.8	35%	150	18 m	@ 2.0 ECS/ 100 sq.m. of floor area
4	School for Differently-abled persons	10.0 Lakh	0.2	50%	120	18 m	@ 1.33 ECS/ 100 sq.m. of floor area

Source: Master Plan for Delhi - 2021

Other Controls:

i. Practice of providing dedicated Nursery School plots in the layout plots in the layout plan discontinued as same is permissible in Mixed use.
ii. In case of new schools, the front boundary wall shall be recessed by 6 m to accommodate visitors parking within setback area.
iii. Up to 10% variation in plot size is permitted. Differential norms will be applicable to Special Area, Regularized Unauthorized Colonies, Urban Villages and Resettlement Colonies.
iv. Playground shall be developed on pool basis in different areas at neighbourhood level.
v. The standards given are in Equivalent Car Space (ECS) which include parking for all types of vehicles i.e. cars, scooters, cycles, light and heavy commercial vehicles, buses etc.
vi. The areas earmarked for parking if misused, liable to be municipalized / taken over.

PLANNING NORMS AND STANDARDS FOR EDUCATIONAL FACILITIES - COLLEGES							
S.No.	Category	Population per Unit	Plot Area (Hectares)	Ground Coverage	FAR	Height	Parking Standards
1	General College	5.0 Lakh	As per UGC norms	35%	225	37 m	@ 1.33 ECS/ 100 sq.m. of floor area
2	Professional College (Technical)	5.0 Lakh	As per AICTE norms	35%	225	37 m	@ 1.33 ECS/ 100 sq.m. of floor area

Source: Master Plan for Delhi - 2021

Other Controls:

i. Up to 10% variation in plot size is permitted. Differential norms will be applicable to Special Area, Regularized Unauthorized Colonies, Urban Villages and Resettlement Colonies.
ii. The standards given are in Equivalent Car Space (ECS) which include parking for all types of vehicles i.e. cars, scooters, cycles, light and heavy commercial vehicles, buses etc.
iii. Up to 30% of max. permissible FAR can be used for hostel accommodation for the students in General/ Professional Colleges.

In case of old colleges (Area per college: 4.0 ha), plot will be divided as follows:

S.No.	Category	Ground Coverage	FAR	Height
a.	College Building area (45% of total land area) – 1.8 ha	30%	225	37 m
b.	Playfield area (45% of total land area) – 1.8 ha	N.A.		
c.	Residential including hostel area (10% of total land area) – 0.4 ha	i. Regulations for group housing shall apply. ii. The land shall be reserved for facilities as per residential norms.		

Source: Master Plan for Delhi - 2021

PLANNING NORMS AND STANDARDS FOR EDUCATIONAL FACILITIES (HIGHER EDUCATION) - UNIVERSITIES							
S.No.	Category	Population per Unit	Plot Area (Hectares)	Ground Coverage	FAR	Height	Parking Standards
I	University Campus including International Education Centre (IEC) - Large campus (10 ha & above) will be divided into following four parts:	4 sites in urban extension	Up to 20.0 ha				@ 1.33 ECS/ 100 sq.m. of floor area
a.	Academic including Administration (45% of total land area)			30%	225	37 m	
b.	Residential (45% of total land area)			i. Regulations for group housing shall apply. ii. The land shall be reserved for facilities as per residential norms.			
c.	Sports & Cultural activities (15% of total land area)			10%	15	26 m	
d.	Parks & Landscape (15% of total land area)			N.A.			

Source: Master Plan for Delhi - 2021

2.2.2 Planning Norms - Comparative Analysis

PRIMARY SCHOOL (CLASS I TO V)				
		DELHI MASTER PLAN		
		MPD 2021	MPD 2001	MPD 1962
Population served per unit		10,000	5,000	3,750
Student Strength			500	600
Area Requirement		0.5 - 1.0 acre	1.0 acre	1.5 - 2.5 acre
Area under School Building			0.5 acre	
Playfield Area			0.5 acre	
Size of Playfield to be ensured for effective play			18m x 36m (min.)	
Parking Area/ Norm		1.33 ECS/ 100 sqm of floor area		
Other Controls	Ground Coverage	30%	33%	
	FAR	120	100	
	Height	18 m.	14 m.	

As per MPD-2001, in case of premises - Primary schools, Secondary schools/ Senior secondary schools/ Integrated schools/ Integrated residential schools and Colleges, the total area of the plot shall be divided as per below, in the proportion of the areas as given for such premises :

i. School/college building area
ii. Playfield area
iii. Parking area
iv. Residential and hostel area

SECONDARY SCHOOL (CLASS VI TO XII)				
		DELHI MASTER PLAN		
		MPD 2021	MPD 2001	MPD 1962
Population served per unit		10,000	7,500	
Student Strength			1000	1000
Area Requirement		1.5 - 2.0 acre	3.95 acre	5 - 10 acre
Area under School Building			1.5 acre	
Playfield Area			3.95 acre	
Size of Playfield to be ensured for effective play			68m x 126m (min.)	
Parking Area/ Norm		2 ECS/ 100 sqm of floor area		
Other Controls	Ground Coverage	35%	30%	
	FAR	150	120	
	Height	18 m.	14 m.	

Observations:

- There is no defined standard for cycle parking provision and bus parking provision within the site.
- Parking for visitors and the disabled is generally included within the specified allocation.
- There is no Powered Two Wheeler (PTW) parking standard specific to schools.

INTEGRATED SCHOOL (without Hostel Facility) CLASS I TO XII			
	DELHI MASTER PLAN		
	MPD 2021	MPD 2001	MPD 1962
Population served per unit		90,000 to 1 lakh	
Student Strength		1500	
Area Requirement		8.65 acre	
Area under School Building		1.73 acre	
Playfield Area		6.18 acre	
Size of Playfield			
Parking Area/ Norm		0.74 acre	

Source: Master Plan for Delhi - 1962, 2001 and 2021

HIGHER EDUCATION - COLLEGE				
		DELHI MASTER PLAN		
		MPD 2021	MPD 2001	MPD 1962
Population served per unit			1,25,000	
Student Strength			1000 - 1500	
Area Requirement			9.88 acre	
Area under College Building			4.45 acre	
Playfield Area			4.45 acre	
Residential including hostel area			1.0 acre	
Parking Area/ Norm		1.33 ECS/ 100 sqm of floor area	1.0 ECS/ 100 sqm of floor area	
Other Controls	Ground Coverage	35%	25%	
	FAR	225	100	
	Height	37 m.	14 m.	

Source: Master Plan for Delhi - 1962, 2001 and 2021

2.2.3 Directorate of Education (DoE)

The Directorate of Education via circular dated 12th November 2014, has issued notices to all schools in the Capital, directing them to park buses inside the campus at the time of boarding and alighting of students. Some schools park their buses on the main road while students are alighting and boarding the bus. This not only creates congestion for other road users, but also endangers the safety of school children by increasing their vulnerability to road accidents.

"All the heads of schools/managers of private unaided recognized schools are hereby directed accordingly to make necessary arrangements for boarding and alighting of students inside the school premises. In no case the boarding and alighting of the students will be allowed to be done on the road in front or the side of the school," the circular dated November 12 read.

The directive implies creation of suitable infrastructure as dedicated parking bays for school buses and loading/ unloading zone within the school premises so as to facilitate this. However, suitable regulations for the same do not reflect anywhere in any of the policy or guidelines.

2.2.4 Ministry of Human Resource Development, Government of India

The Kendriya Vidyalaya Sangathan is a system of central government schools in India that are instituted under the aegis of the Ministry of Human Resource Development (MHRD). It has a total of 1204 schools in India.(as of May 2019) and three abroad.

The Centre via circular dated 23 February 2017, revised the land requirement norms for setting up new Kendriya Vidyalaya schools in the country in view of paucity of land. As per the new norms announced by Union Human Resource Development Minister, a Kendriya Vidyalaya can now be set up in 2.5 acres of land as against the current requirement of 4 acres in a metro city. Also, the current land requirement of 10 acres in rural areas and 8 acres in urban and hilly areas has been reduced to 5 acres.

2.3 Best Practices

2.3.1 International References

I) Government of UK - Parking Standards

Description	Operational Parking Space	Non-operational Parking Space	Cycle Parking Standard
Nursery Schools Day nurseries Preschool play groups	1 Lay-by or turning space as appropriate	1 space/ 3 staff 1 space/ 10 children	Minimum of 2 per unit
Primary Schools	Facilities are required for buses and cars to pick up and set down using either coach space, manoeuvring space or a turning area, all without engaging reverse gear Space can be provided using reinforced playgrounds and driveways A minimum provision for bus spaces will be required with additional provision depending on the needs of the educational facility	1 space/ teaching staff 1 space/ 2 ancillary staff One half of total staff provision for visitors	1 per 10 students
Secondary Schools		1 space/ teaching staff 1 space/ 2 ancillary staff 1 space/ 10 pupils over age 17 One third of total staff provision for visitors	
Further Education		1 space/ teaching staff 1 space/ 2 ancillary staff 1 space/ 4 pupils over age 17 One third of total staff provision for visitors	

2) Bridgend, UK - Parking Standards (2011) for Educational Establishments

Type of Development	Operational Parking Space	Non-operational Parking Space
Nursery Schools Primary Schools	1 commercial vehicle space	1 space/ each member of teaching staff, 3 visitor spaces
Secondary Schools	1 commercial vehicle space	1 space/ each member of teaching staff, 1 space/ 2 ancillary staff, 1 space/ 20 students of age 17, 3 visitor spaces Bus parking as required
Colleges of Higher/ Further Education	1 commercial vehicle space	1 space/ each member of teaching staff, 1 space/ 2 ancillary staff, 1 space/ 8 students, 5 visitor spaces

Notes:
a) In addition to the non-operational parking an area must be provided for the picking up and setting down of school children.

b) In the case of Day Nurseries in converted properties the availability of adequate kerbside capacity (i.e. unrestricted parking) should be taken account of.

c) Experience has shown that a minimum of 15 car spaces will be required for most other types of schools. Exceptions to this may be specialised secondary schools with a large catchment area where a reduced number may be adequate, or larger schools in each category where a substantial increase (up to 50) may be desirable. With regard to buses, sufficient off street spaces should be provided for all services that the operator of the new school anticipates running for pupils, with the exception of passing service buses.

d) Where there is a high level of part-time (day release) students, the standard for Colleges of Higher Education/ Universities is increased to 1 per 3 students.

e) Where the school is used for dual social and adult educational purposes, the use of hard playground surfaces for parking is acceptable.

f) Appropriate provision must be provided for use by disabled people.

g) Appropriate provision must be provided for parental drop off/pick up of children as dictated by local circumstances and any school travel plan. Drop off areas must be located so that the safety of pupils walking or cycling to school is not jeopardised.

2.3.2 National References

I) Mumbai - Parking Provisions in New Development Control Regulations (DCR) - 2034

The new DCR has mandated an independent 'Parking Authority' which will regulate on street parking and public parking in the city. Part - VIII of the DCR on General Building Requirements, Regulation No. 44, Parking Spaces, Table No. 21 on Off Street Parking Spaces, lays down the following norms for parking in educational buildings:

S.No.	Occupancy	Parking Space Required
1	Educational	One parking space for 35 sq.m. carpet area of the administrative office area and public service area

- **Other vehicles -** For all non- residential, assembly and non- assembly occupancies, 10% additional parking spaces, subject to a minimum of two spaces shall be provided in addition to what is prescribed in these Regulations.

- **Two wheeled motor cycle -** Two wheeled motor cycle parking space equal to the required number of four wheeled parking spaces may be provided. If such parking for two wheeled motor cycle is proposed, the same may be distinctly shown in the plan.

- The **parking spaces** including mechanical/ automated may be provided underneath the building, in basements, podiums, within its stilted portion, or on upper parking floors or in separate structures if exclusively used for parking.

In addition to the above, Regulation No. 38 - Special Design Requirement For Educational Building, Clause 2 for Playground, states that:
a) "In case of educational development by Educational Institution on their vacant land, at least 40% of the plot area at one place (inclusive of recreational area as required under Regulation No 27) shall be provided mandatory for Play Ground. However as per these Regulations, for the educational purpose if additional FSI is due, then while allowing said due FSI, it is not necessary to increase the area of Play Ground."

b) "In case of educational development by Educational Institution on their land, if additional FSI is due and if the existing open area is less than 40%of the plot area, additional FSI can be sanctioned as per these regulations without reducing the open area further and without increasing the plinth coverage area, by ensuring structural stability of the existing building. Further where existing open area is more than 40%, then minimum 40% of plot area shall be maintained as open area (inclusive of recreational area as required under Regulation No 27) while allowing additional FSI as per these Regulations." (The permissible FSI shall be on the entire plot.)

Also, *"If existing Municipal Play Ground/POS is abutting to the plot of Educational Institute, then the provision of 40% of play area within plot of Educational Institution may not be insisted upon if the combined play area available is at least 40% of plot area. Provided further, if ownership of Play Ground/POS having area at least 40% of area abutting to the plot of Educational Institute is vesting with the Educational Institution, then the provision of 40% of play area within plot of Educational Institution may not be insisted upon."*

II) Chennai - Development Regulations in Master Plan for Chennai Metropolitan Area - 2026

The Chennai DR stipulates separate parking norms for a) Government Schools/ Local Body Schools and b) Private Schools. Parking spaces shall be provided within the site conforming to the regulations given in Annexure XVI, No. 13 for Educational Institutions as:

(a) Government Schools/ Local Body Schools within Corporation Limit, Municipalities, IT Corridor - 1 car space for every 500 sq. m. of class room area or part thereof and 1 two wheeler space for every 50 sq. m. of class room or part thereof and one cycle space for every 10 sq. m. of class room area or part thereof.

(b) Private Schools within Corporation Limit, Municipalities, IT Corridor - 1 car space for every 100 sq. m. of class room area or part thereof and 1 two wheeler space for every 50 sq. m. of class room or part thereof and one cycle space for every 10 sq. m. of class room area or part thereof.

Note: 50% of the car spaces specified above shall be provided in the front area abutting the road so as to act as a recessed parking area for the vehicles coming for drop/pick up for students.

(c) Colleges in Chennai Metropolitan Area - 1 car space for every 100 sq. m. of class room area or part thereof and 1 two-wheeler space for every 50 sq. m. of class room area or part thereof.

3 SENIOR SECONDARY SCHOOLS

Approach

A sample audit of schools and colleges was undertaken for a better understanding of the prevalent parking conditions in and around the premises, to measure actual parking arrangements on-site against the existing policy requirements and estimated parking demand. It was conducted to understand the travel pattern of the school staff, students and visitors and hence provide an initial overview on the adequacy and suitability of the existing parking standards. Amongst various types of schools (Nursery, Primary, Senior Secondary and Special), the study has particularly focussed on senior secondary schools as schools now are integrated with nursery schools mostly not planned alone. As far as school education is concerned, the policy should be geared to encourage integrated schools from the pre-primary to the higher secondary level, rather than allocating space separately for Nursery Schools, Primary Schools and Middle Schools.

A sample list of 30 senior secondary schools and 15 colleges (refer Annexure II) was agreed to provide a typical cross-section of schools covering both government and privately-owned institutions. There are variations in the typical profile between the schools. These have been decided on factors such as their location with respect to the road section, whether on arterial road (Example: Kendriya Vidyalaya, Andrews Ganj) or on local road (Example: Apeejay school, Sheikh Sarai), the fee structure etc.

Letters were sent to the Principals and Administrative Officers of sample schools and colleges requesting consent to undertake site audits. The site audits were supplemented by questionnaires (refer Annexure I) sent to each of the sample sites, requesting information on:

- Total number and travel patterns of : Students, Teaching staff, Administrative staff and other supporting staff
- Total number of school buses and whether buses are parked inside or outside the school premises?
- Total number of cars parked inside the school premises
- Total number of two-wheelers parked inside the school premises

The focus of site audits was also to assess and note the arrangements with respect to:

- Bus pick-up/ drop-off points and their parking provision
- Parent pick up/set down points
- Identifying public transport routes in the vicinity of the school site
- Arrangement with respect to cycle parking
- Identifying walking/ cycling routes and supporting infrastructure in the vicinity of the school site
- Main barriers to the use of non-car modes for the journey to school

3.1 Case Study I - Private School

Senior Secondary School within Residential Area - Apeejay School, Sheikh Sarai, New Delhi

About:

Apeejay Senior Secondary School is located in South Delhi in Sheikh Sarai-I. It has residential pockets of Panchsheel Park, Malviya Nagar, Savitri Nagar and Khirki village in vicinity. The total area of the school campus is 6.5 acres with a strength of 2000 students and classes from nursery to XII. The school sits at the junction of Sheikh Sarai Road (24 m. ROW) and Khirki Main Road (18 m. ROW). The school has main access from Sheikh Sarai Road which is flanked by DDA flats and secondary access from Khirki Main Road along which lie a commercial area and Sant Nirankari Public School.

Map showing the site and its surroundings

Source: Google Image

Site details:

- Area of School Campus = 6.5 acres (26304.6 sq. m.)

- Development Control Norms applicable as per MPD-2021:
  i. Permissible Coverage on G.F. = 35%
  ii. Permissible FAR = 150
  iii. Permissible Height = 18 m.
  iv. Permissible Parking = 2 ECS/ 100 sq. m. of floor area

- Strength:
  i. Number of Students = 2000
  ii. Number of Teaching Staff = 84
  iii. Administrative staff = 12
  iv. Other supporting staff = 08

3.1.1 Existing Parking Arrangement (In and around the site)

Site Survey:

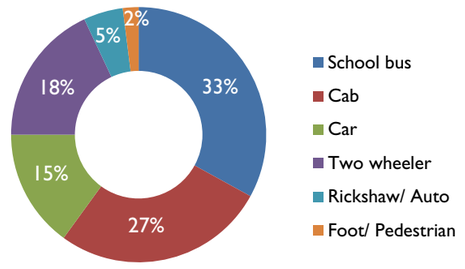
Visitor's parking outside the school with school buses parked at odd places

School authorities claim illegal parking of vehicles by Khirki village residents along the school boundary

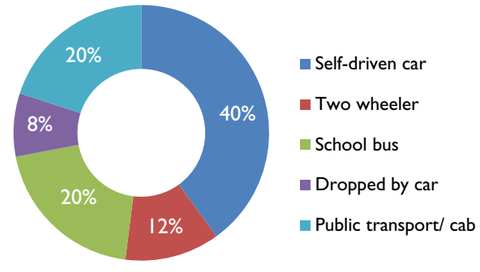
Private vehicles and vans parked illegally and often stop in the middle of the road and create chaos

Taxi stand located at corner of school site and its vehicles parked along the boundary

Travel pattern in terms of modal split - Students:



Travel pattern in terms of modal split - Teachers:



Findings:

School does not own the 12 buses, these are hired on contract and not parked inside the campus. The pick-up/ drop-off of students is managed inside the school premises. However, there are no separate bus bays or loading/ unloading zone for the same, and takes place with buses parked in the driveway.

Based on the data provided by the school, the diagrams depict the percentage of staff and students travelling to school by various modes. This would be helpful in understanding the actual parking demand on-site. The vast majority of teaching staff drive alone to the school site. The level of staff car sharing is low. It is also notable that lower levels of non-teaching staff drive alone. Private cabs are a preference amongst students due to low fares of cabs than buses.

It is notable from the site audits that the level of parking provision on-site is generally below the standards. The cycle mode share for students is very low or negligible across all school types.

Map showing division of site as per usage

Source: Google Image and Author

Site details:

- Plot Area = 6.5 acres (26304.6 sq. m.)

- Area under Playfield = 13295.64 sq. m. (50% of the plot area)
  Patch 1: 6765.799 sq. m.
  Patch 2: 1084.014 sq. m.
  Patch 3: 639.405 sq. m.
  Patch 4: 3845.744 sq. m.
  Patch 5: 960.676 sq. m.

- Area under Parking = 7126.335 sq. m. (27% of the plot area)
  Lot 1: 546.30 sq. m.
  Lot 2: 5481.79 sq. m.
  Lot 3: 1100.245 sq. m.

- Total Built-up area = 13803.88 sq. m.

Almost 50% of the plot area is under playfield.

3.1.2 On-site Parking Requirement

Comparative Study for On-site Parking Requirement at School:

As per Existing Parking Norms in MPD-2021	**Parking requirement: @ 2 ECS/ 100 sq. m. of floor area = 277 ECS**
As per Best Practices	• Total number of Students: 2000 • Number of buses: 12 (hired on contract basis) Number of students coming by bus: 12x55=660 (33% of total students) (Considering seating capacity of a medium sized school bus as 55) • Considering pick-up & drop-off for buses within the school premises: Case 1: when 100% buses are parked inside (12x3.9) = 46.8 ECS Case 2: when 50% of the total buses are parked inside with staggered timings (6x3.9) = 23.4 ECS • Car parking requirement within the school premises: @1 space/ teaching staff = 84 ECS @ 1 space/ 2 ancillary staff = 10 ECS **Total requirement of parking within the school premises (23+84+10) = 117 ECS** **Area under parking (117x23) = 2691 sq. m. (10% of the total plot area)** **This relates to the standards provided in the NBC-2016, wherein the parking area for 4.45 acre plot is 0.5 acres i.e. 11.23% of the total plot area**
As per Travel Pattern of Users (based on Primary Survey)	• Modal split – Students Students coming by School Bus: 33% Students coming by Cab: 27% Students coming by Car: 15% Students coming by Two wheeler: 18% Students coming by Rickshaw & Auto: 5% Students coming on foot/ Pedestrian: 2% • Modal split – Teachers Teachers coming by Car: 40% Teachers coming by Two wheeler: 12% Teachers coming by School Bus (on duty): 20% Teachers dropped by Car: 8% Teachers coming by Public Transport/ Cab: 20% **Findings (details overleaf) –** • **Total requirement of ECS within the school premises = 70 ECS** • **Total parking area required for parking inside school = 1610 sq. m. (6.12% of the total plot area)**

Calculation of effective parking requirement both on-site and off-site as per the travel pattern of users (based on Primary Survey)

- Number of students = 2000
- Number of teaching staff = 84
- Number of administrative staff = 20

		No. of Students by various modes	No. of Students per vehicle	No. of Vehicles	Average Waiting Time	Effective Parking Required	ECS On-site	ECS Off-site
Students coming by School Bus	33%	660	55.00	12	20 - 25 min.	6	23	-
Students coming by Cab	27%	540	8.00	68	10 - 15 min.	22	-	22
Students coming by Car	15%	300	1.00	300	7 - 10 min.	75	-	75
Students coming by Two wheeler	18%	360	1.00	360	5 - 7 min.	72	-	14
Students coming by Rickshaw & Auto	5%	100	1.00	100	3 - 5 min.	10	-	6
Students coming on Foot/ Pedestrian	2%	40	1.00	40	0	0	-	-
TOTAL	100%	2000	-	-	-	-	23	118
		No. of Teachers by various modes	No. of Teachers per vehicle	No. of Vehicles	Average Waiting Time	Effective Parking Required	ECS On-site	ECS Off-site
Teachers coming by Car	40%	34	1.00	-	-	-	34	-
Teachers coming by Two wheeler	12%	10	1.00	-	-	-	2	-
Teachers coming by School Bus (on duty)	20%	17	1.50	-	-	-	-	-
Teachers dropped by Car	8%	7	1.00	-	7 - 10 min.	2	-	2
Teachers coming by Public Transport/ Cab	20%	16	1.00	-	10 - 15 min.	4	-	2.4
TOTAL	100%	84	-	-	-	-	36	4.4
Other staff by Car	-	2	-	-	-	-	2	-
Other staff by Two wheeler	-	13	-	-	-	-	2.6	-
Other staff by Public Transport	-	5	-		-	1.25	-	0.75
TOTAL (OTHERS)	-	-	-	-	-	-	4.6	0.75
Visitor Car Park within premises				6			6	
Total ECS within school premises							70	
Total Parking Area required for Parking inside the school	1610 sq. m. (6.12% of the total plot area)							

Note:

- The seating capacity of available Indian school buses is 50 and 59. For the purpose of the study, an average seating capacity of 55 number is considered for a school bus.
- Average waiting time of a vehicle is calculated considering the time taken by the vehicle to leave a parking spot after student or staff is picked-up or dropped off.

3.2 Case Study II - Government School

Government Sr. Secondary School - Kendriya Vidyalaya, Andrews Ganj, New Delhi

About:

Kendriya Vidyalaya, a Senior Secondary School is located in South Delhi in Andrews Ganj. It has residential pockets of Lajpat Nagar, Amar Colony and Sadiq Nagar in vicinity. The total area of the school campus is 6.5 acres with a strength of 4116 students and classes from nursery to XII. The school sits at the junction of 45 m. ROW and 30 m. ROW Lala Lajpat Rai Road adjacent to the Pacific Sports Complex. Moolchand metro station is the nearest available public transport. The school has primary access from a busy arterial road.

Map showing the site and its surroundings

Source: Google Image

Site details:

:

- Area of School Campus = 6.5 acres (26304.6 sq. m.)
- Development Control Norms applicable as per MPD-2021:
  - i. Permissible Coverage on G.F. = 35%
  - ii. Permissible FAR = 150
  - iii. Permissible Height = 18 m.
  - iv. Permissible Parking = 2 ECS/ 100 sq. m. of floor area
- Strength:
  - i. Number of Students = 4116
  - ii. Number of Teaching Staff = 122
  - iii. Administrative staff = 02

3.2.1 Existing Parking Arrangement On-site

Site Survey:

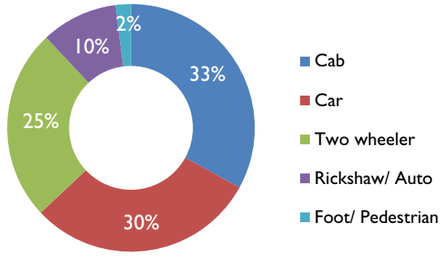
Space for staff car park within the school premises

Space for staff car park within the school premises

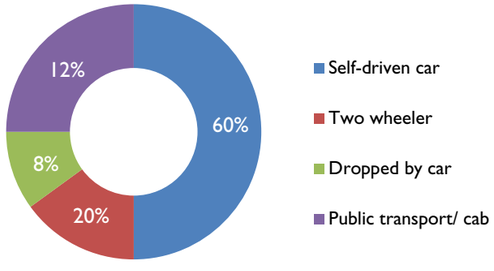
Hard play area used for parking as and when required

Primary and secondary wings separated by the playfield

Travel pattern in terms of modal split - Students:



Travel pattern in terms of modal split - Teachers:



Findings:

School does not provide transport facility (buses) for students, under the norms of Kendriya Vidyalaya. Students commute by private cabs and by own transportation with drop-off/ pick-up on road and not inside the campus. Absence of any parking lot around the school with no separate lay-by results in pick/drop of students taking place with vehicles parked on the roads. Hence safety and parking concerns are associated with the 'drop and go' zone.

Based on the data provided by the school, the diagrams depict the percentage of staff and students travelling to school by various modes. This would be helpful in understanding the actual parking demand on-site. The vast majority of teaching staff drive alone to the school site with parking provision within premises. The level of staff car sharing is low. Private cabs are a preference amongst students.

It is notable from the site audits that the level of parking provision on-site is generally below the standards. The cycle mode share for students is very low or negligible across all school types.

Map showing division of site as per usage

Site details:

- Plot Area = 6.5 acres (26304.6 sq. m.)
- Area under Playfield = 2.65 acres or 13295.64 sq. m. (40% of the plot area)
- Area under Parking = 2130 sq. m. (8% of the plot area)
  Lot 1: 370 sq. m.
  Lot 2: 975 sq. m.
  Lot 3: 785 sq. m.
- Total Built-up area = 8988.78 sq. m.

3.2.2 On-site Parking Requirement

Comparative Study for On-site Parking Requirement at School:

As per Existing Parking Norms in MPD-2021	• **Parking requirement: @ 2 ECS/ 100 sq. m. of floor area = 180 ECS**
As per Best Practices	• Total number of Students: 4116 • Number of buses: NIL • Car parking requirement within the school premises: @1 space/ teaching staff = 122 ECS @ 1 space/ 2 ancillary staff = 5 ECS **Total requirement of parking within the school premises (122+5) = 127 ECS** **Area under parking (127x23) = 2921 sq. m. (11% of the total plot area)** **This relates to the standards provided in the NBC-2016, wherein the parking area for 4.45 acre plot is 0.5 acres i.e. 11.23% of the total plot area**
As per Travel Pattern of Users (based on Primary Survey)	• Modal split – Students Students coming by School Bus 0% Students coming by Cab 33% Students coming by Car 30% Students coming by Two wheeler 25% Students coming by Rickshaw & Auto 10% Students coming on foot/ Pedestrian 2% • Modal split – Teachers Teachers coming by Car 60% Teachers coming by Two wheeler 20% Teachers dropped by Car 8% Teachers coming by Public Transport/ Cab 12% **Findings (details overleaf) –** • **Total requirement of ECS within the school premises = 86 ECS** • **Total parking area required for parking inside school = 1978 sq. m. (7.5% of the total plot area)**

Calculation of effective parking requirement both on-site and off-site as per the travel pattern of users (based on Primary Survey)

- Number of students = 4116
- Number of teaching staff = 122
- Number of administrative staff = 9

		No. of Students by various modes	No. of Students per vehicle	No. of Vehicles	Average Waiting Time	Effective Parking Required	ECS On-site	ECS Off-site
Students coming by School Bus	0%	-	-	-	-	-	-	-
Students coming by Cab	33%	1358	8.00	170	10 - 15 min.	56	-	56
Students coming by Car	30%	1235	1.00	1235	7 - 10 min.	309	-	309
Students coming by Two wheeler	25%	1029	1.00	1029	5 - 7 min.	206	-	41
Students coming by Rickshaw & Auto	10%	412	1.00	412	3 - 5 min.	41	-	25
Students coming on Foot/ Pedestrian	2%	82	1.00	82	0	0	-	-
TOTAL	100%	4116	-	-	-	-	0	431
		No. of Teachers by various modes	No. of Teachers per vehicle	No. of Vehicles	Average Waiting Time	Effective Parking Required	ECS On-site	ECS Off-site
Teachers coming by Car	60%	73	1.00	-	-	-	73	-
Teachers coming by Two wheeler	20%	24	1.00	-	-	-	4.8	-
Teachers coming by School Bus (on duty)	0%	-	-	-	-	-	-	-
Teachers dropped by Car	8%	10	1.00	-	7 - 10 min.	2	-	2
Teachers coming by Public Transport/ Cab	12%	15	1.00	-	10 - 15 min.	3.75	-	2.25
TOTAL	100%	122	-	-	-	-	77.8	4.25
Other staff by Car	-	2	-	-	-	-	2	-
Other staff by Two wheeler	-	6	-	-	-	-	1.2	-
Other staff by Public Transport	-	1	-		-	0.25	-	0.15
TOTAL (OTHERS)	-	-	-	-	-	-	3.2	0.15
Visitor Car Park within premises							5	
Total ECS within school premises							86	435
Total Parking Area required for Parking inside the school	1978 sq. m. (7.50% of the total plot area)							

Note:

- The seating capacity of available Indian school buses is 50 and 59. For the purpose of the study, an average seating capacity of 55 number is considered for a school bus.
- Average waiting time of a vehicle is calculated considering the time taken by the vehicle to leave a parking spot after student or staff is picked-up or dropped off.

3.3 Inferences

Developing a Model:

For a senior secondary school of plot size 2.0 acres and with students strength of 2500, the actual on-site parking requirement is calculated considering the MoHRD, DoE & CBSE norms on Pupil Teacher Ratio (PTR), classroom size etc. and studying the travel pattern of students and staff in terms of modal split. These are compared with the existing parking norms as in MPD-2021. The study done for both private and government schools show that a guideline based on number of students against the site area available, maybe adopted for framing the parking requirement.

* Note - A land parcel of size 2.0 acres was arrived at after considering the size of various land parcels allotted by DDA for senior secondary schools in the last 15 years.

On-site Parking Requirement for Senior Secondary School (Private)
Plot Size - 2.0 Acres
Strength – 2500 students

As per Existing Development Control Norms - MPD 2021			As per DUAC Findings
Total Plot Area	2.0 acres	8093.71 sq. m.	As per Standards (DoE, MoHRD, CBSE) – Class Room - Pupil Ratio = 1:40 Pupil Teacher Ratio (PTR) = 1:30 (As per the Guidelines for School Infrastructure and Strengthening, December 2014 by Ministry of Human Resource Development, Government of India) Number of classrooms – 60 Number of teaching staff – 85 Number of supporting staff (1:300) – 10 approx. a) 1 car parking space/ teaching staff – 85 ECS 1 car parking space/ 2 non-teaching staff – 5 ECS b) Students using School bus (35%) – 875 Number of buses – 18 (Bus occupancy @ 50 students per bus) = 70 ECS (18 X 3.9) c) Visitor's Parking @1 per 250 students – 10 ECS Total parking requirement (a+b+c) = 170 ECS
Ground Coverage	35%	2832.80 sq. m.	
FAR	150%		
Total Floor Area	1.50 x 8093.71	12140.56 sq. m.	
Height Restriction	18 m		
Proposed No. of Floors		6.0	
Playfield	50% of plot area	4046.825 sq. m.	
Parking Requirement as per existing norms for a 2.0 acres plot	@ 2 ECS/ 100 sq. m. of FAR Area	243 ECS	
Parking requirement per 1000 students = 97.2 (100 ECS approx.)			**Parking requirement per 1000 students = 68 ECS**

⇩

Parking requirement may be reduced by 30% of the existing standards in MPD-2021

As per the **Affiliation Bye-Laws - 2018 of Central Board of Secondary Education**, the School or Society/Trust/Company managing the school must have land as per the following norms:

- The land on which the school is located should necessarily be a contiguous single plot of land. If there are more than two survey numbers etc. all the survey numbers/plots should be adjacent/touching each other and shall make a single plot of land on the whole.
- The school affiliated or seeking affiliation with the Board shall have a minimum of 8000 square meters of land in general subject to the restriction of optimum enrolment (upto class XII) and number of sections (48 number from classes I/VI TO X/XII).
- The school not fulfilling the minimum requirement of 8000 square meters but having land not less than 6000 square meters may be granted affiliation, subject to the restriction of optimum enrolment (upto class XII) and number of sections (38 number from classes I/VI TO X/XII).
- For the school located in the limits of Municipal Authorities of metropolitan city of Delhi, the minimum land requirement will be 1600 square meters for a Secondary School (upto class X only and 10 number of sections)
- For the school located in the limits of Municipal Authorities of metropolitan city of Delhi, the minimum land requirement will be 2400 square meters for a Senior Secondary School (upto class XII only and 24 number of sections) and 3200 square meters for a Senior Secondary School (upto class XII only and 28 number of sections).
- Enrolment and section restriction in each class - The optimum number of students shall be 40 in each section. Availability of one square meter Built-up Floor Area per child in the class rooms is an absolute necessity in the school.

A guideline based on number of students against the site area available, maybe adopted for framing the parking requirement.

PRIVATE SCHOOLS	GOVERNMENT SCHOOLS
For Private Schools, the parking requirement on-site can be reduced by 25 - 45% of the existing standards in MPD-2021	For Government Schools, the parking requirement on-site can be reduced by 40 - 60% of the existing standards in MPD-2021

- **Parking generators in Institutions -** Parking requirement for schools is based on the 3 key user groups:

STUDENTS	FACULTY & STAFF	VISITORS (Private Vehicle Parking)
BUS PARKING	TEACHING STAFF	PICK-UP/ DROP-OFF (Short term - 2 minute duration of stay)
TWO-WHEELER PARKING	ADMINISTRATIVE STAFF	SHORT TERM PARKING (15 minute duration of stay)
CYCLE PARKING	OTHERS: CARE TAKERS, CATERING STAFF	LONG TERM PARKING: Visitors/ Special User Group

General Recommendations

- Existing norms and guidelines focus on parking within school sites, while off-site parking (primarily by parents for pick-up/ drop-off) is also a major concern.
- **The need for a holistic strategy for parking in schools covering both on and off-site parking issues is fully recognized.**
- Pick-up/ drop-off outside the school premises hampers the safety of school children in addition to hindering traffic movement.
- Government schools/ Local Body schools (Navodaya Vidyalaya) without school bus facility do not require bus parking provision within the premises, hence parking norms can be minimized or kept flexible for such institutions. pick-up/ drop-off by cars is negligible in such institutions.
- In schools, while majority of teaching staff drive to school alone, significantly lower levels of non-teaching staff drive alone.

Identified typology of schools based on travel pattern (mobility study) of students and staff:

MODAL SPLIT BY TRAVEL PATTERN OF STUDENTS				
	SCHOOL – Type 1 (Local Body School)	SCHOOL – Type 2 (Government School) Example: KVs	SCHOOL – Type 3 (Private School)	Average Waiting / Parking time
Students coming by School Bus	0%	0%	35%	20 - 25 mins
Students coming by Cab	5%	35%	25%	10 - 15 mins
Students dropped by Cars	0%	25%	15%	7 - 10 mins
Students coming by 2-wheelers	30%	25%	18%	5 - 7 mins
Students coming by Rickshaw/ Auto	25%	10%	5%	3 - 5 mins
Students coming on foot/ Pedestrian	40%	5%	2%	0

MODAL SPLIT BY TRAVEL PATTERN OF STAFF				
	SCHOOL – Type 1 (Local Body School)	SCHOOL – Type 2 (Government School) Example: KVs	SCHOOL – Type 3 (Private School)	Average Waiting / Parking time
Staff coming by School Bus	0%	0%	20%	20 - 25 mins
Staff coming by Cab	20%	10%	15%	10 - 15 mins
Staff coming by own Cars	25%	50%	40%	7 - 10 mins
Staff coming by 2-wheelers	35%	20%	10%	5 - 7 mins
Staff coming by Rickshaw/ Auto	15%	10%	5%	3 - 5 mins
Staff dropped by Cars	5%	10%	10%	0

Consideration should be given to modification of these guidelines in accordance with local circumstances and specific characteristics of individual schools such as:

i. Location of school, its type and catchment;
ii. Modes of travel available to students and staff;
iii. Availability of and opportunities for public transport;
iv. Surrounding walking and cycling network:
v. Local car ownership level

3.4 Proposed Guidelines

The recommended parking standards are tabulated below. These standards apply to new provision, whether in the form of entirely new built schools or extensions to existing facilities. In the case of the latter, the standard will only be applied to the extension and not to the school as a whole.

SUGGESTED VEHICULAR PARKING NORMS FOR SENIOR SECONDARY SCHOOLS	
TYPE	RECOMMENDED ON-SITE PARKING PROVISIONS
SCHOOL BUS	• No parking on-street. • Pick-up/drop of students should be within the school premises. • 100% parking space within premises for buses owned by school. • At least 50% of the parking space within premises for hired buses/ buses on contract. • Provision of separate entry/ exit for buses.
PARKING FOR STAFF	• 1 ECS* per Teaching Staff • 1 ECS* per 2 Non-teaching Staff * ECS includes all types of vehicles i.e. cars, scooters, cycles.
PARKING FOR VISITORS	• 1 ECS* per 250 Students • A minimum of 1 space to be allocated for parking for differently-abled. * ECS includes all types of vehicles i.e. cars, scooters, cycles.

Note:

- Teaching staff are assumed to comprise class teachers, head teachers and deputy head teachers permanently based at the school. Peripatetic specialist teachers** are not included in this definition (these staff are classed as visitors). All other persons employed at the school (including teaching assistants) are classed as non-teaching staff.
- Parking allocated for differently-abled must consist of marked spaces of sufficient size and should be located adjacent to school building entrances where possible.

3.4.1 Proposed Guidelines for Existing Schools

MANAGING ON-SITE PARKING

- No parking on-street.
- For private schools having own buses, provision of pick-up/ drop-off of students should be within the school premises.
- Parking space for total number of buses needs to be provided within the plot, eliminating any on-street parking of buses owned by school.
- For government school without own transport facility, space for bus parking within the site is not required.
- For schools (private or government) hiring buses on contract, provision of pick-up/ drop-off of students should be within the school premises to the capacity of 50% of the total buses (considering average waiting time of 20 to 25 minutes per bus).
- Provision of separate entry/ exit for buses which should not hinder students' movement.
- On-site parking for staff - Based on public transport accessibility model:

  i. For school locations where other means of transport are not possible, car parking is to be provided @ one car space for each full-time member of teaching staff (maximum).
  ii. For administrative & supporting staff, parking is to be provided @ one car space for every two member of non-teaching staff.

***A teacher who teaches in several schools within a local authority area and is employed by that authority, rather than being attached to and employed by one particular school*

MANAGING OFF-SITE PARKING

Parameters for the National Mission on Sustainable Habitat (NMSH) of 2011 state that parking management strategies should be aimed at encouraging more efficient use of existing parking facilities, reduce parking demand and shift travel to non-private modes. Also, as recommended by the Environment Pollution (Prevention & Control) Authority for the National Capital Region, the approach should be focused more on demand management (restricting vehicle numbers) through enforcement and pricing policy rather than only on increasing supply of parking.

- **Shared use parking** – parking can be shared among different business in an area to take advantage of different peak periods. Nearby parking lots, whether public or private car parks for which consent has been obtained, should be used for "Park and Stride" schemes. The information on such dedicated parking spots be made available.
- **School Travel Plan** – each school to have a Traffic Management Plan, having details on bus and their routes, entry/ exits etc.
- **Traffic Management Plan** - dedicated temporary lay byes/ bays for rickshaw/ auto rickshaw, cars and two wheelers during school peak hours.
- **Staggered hours of operation** – these can spread the "school run" over a longer time period and also facilitate the "double tripping" of school buses, minimizing the number of buses and parking requirement.
- **Safer Routes to Schools** – improvements to pedestrian and cycle infrastructure on the key access routes to schools can improve safety and increase the willingness of parents to allow their children to walk or cycle, rather than being driven, to school.

CONSTRUCTION OF PARKING LOTS ON VACANT PLOTS

As per Clause 10.2 of the Draft Parking Policy for Delhi - 2017, a number of plots are still lying vacant in developed colonies. DDA may consider formulating a policy for allowing parking lots on such plots. Either the DDA or Land Owning agencies may themselves construct the parking lots or alternatively, permission may be considered for development and management of vacant plots for use as parking lots against parking charges.

PROPOSED GUIDELINES

3.4.2 Proposed Guidelines for New Schools

	MANAGEMENT STRUCTURE
1. SITE LOCATION – GENERAL CONSIDERATIONS: • School development sites should be located adjacent to existing or planned active public transport networks. • Locate new school sites adjacent to parks/ playgrounds (as per MPD-2021) • Avoid placing schools in locations which only have access from an arterial road • An ideal site location would be based on access from a service road next to a sector/ major road to promote a safe environment to the students and not to cause hindrance to major traffic flow/ movement. • Location to be considered near Shared parking spaces which have under-utilised parking lots. These can be used in peak hours.	MASTER PLAN PROVISION (Local Area Plan)
2. SCHOOL BUS PARKING: • Provision of 100% bus parking within the plot for private schools having own buses, eliminating any on-street parking of buses. • Provision of pick-up/drop-off of students should be within the school premises whether buses are owned or hired on contract basis. • For private schools hiring buses on contract, provision of pick-up/ drop-off of students should be within the school premises to the capacity of 50% of the total buses (considering average waiting time of 20 to 25 minutes per bus).	SCHOOL AUTHORITY (Traffic Management Plan) Total number of bus bays with pick-up/drop-off area, required to be shown in sanction plan while submitting to the sanctioning authority for approval.
3. ON-SITE PARKING FOR STAFF: • A demand-led approach should be adopted for providing parking for staff. • 50% of the car spaces specified above can be provided in the front area abutting the road so as to act as a recessed parking area for the vehicles coming for drop/pick up for students.	LOCAL SANCTIONING AUTHORITY
4. SHORT TERM PARKING: • An integrated facility designed to accommodate both the pick-up/drop-off by private vehicles and short term parking (visitors) is the preferred arrangement. • Design consideration – 1. Provision of recessed parking area in the front area of school abutting the road for the vehicles coming for drop/pick-up of students. 2. On-site visitor's parking may be designed to be used as pick-up/ drop-off zone by private vehicles. 3. Appropriate parking needs to be provided giving consideration to the intent and goals of the policy to attract and facilitate the use of other modes as a preference to private vehicle use: - Short term parking (15 minutes) @ 1 space per 15 students * - Pick-up/drop-off space @ 20% of the short term supply	LOCAL SANCTIONING AUTHORITY

*** Note: It should be stressed that the recommended standards represent a "demand-led" approach to provision of parking, based on an understanding of parking needs gained from the sample school audits. They do not form maximum or minimum standards but rather a guideline which guides the parking requirement and subsequent stages in order to avoid the problems commonly associated with parking in schools.**

3.4.3 Proposed Guidelines - Traffic Management Plan

Case Study: Existing Senior Secondary School of Plot size 2.0 acres - Modern International School, Sector 19, Dwarka

About:

Modern International Senior Secondary School is located in Sector 19, Dwarka, New Delhi. The total area of the school campus is 2 acres with a strength of 1680 students and classes from nursery to XII. The school sits at the junction of 45 m. ROW and 30 m. ROW roads. The school has main access from a service road onto the 45 m. ROW road and a direct secondary access from the 30 m. ROW road.

Map showing the site and its surroundings

Primary access from a service road, also the exit for school buses

Vehicles queued along the 30 m. wide road

Secondary access gate and entry for school buses

Area Details:

- Area of School Campus = 2.0 acres (8000 sq. m.)
- Development Control Norms as per MPD-2021:
  - i. Permissible Coverage on G.F. = 35%
  - ii. Permissible FAR = 150
  - iii. Permissible Height = 18 m.
  - iv. Permissible Parking = 2 ECS/ 100 sq. m. of floor area
- Strength:
  - i. Number of Classrooms = 48
  - ii. Number of Students = 1680 (@ 35 Students/ Class)
  - iii. Number of Teaching Staff = 56
  - iv. Administrative & other staff = 8

Map showing division of site as per usage

Area Details as per Sanction Drawings:

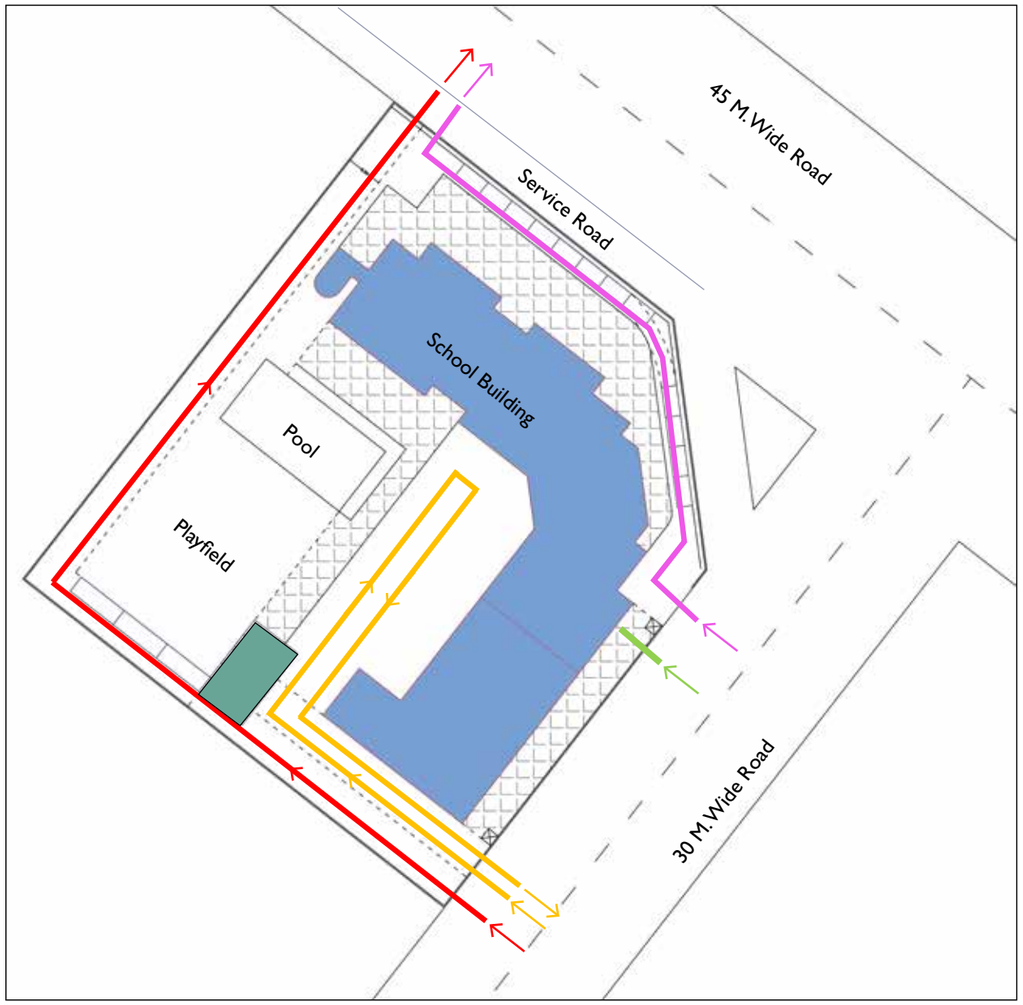
- Plot Area = 2.0 acres (8000 sq. m.)
- Area under Playfield = 2063 sq. m. (25.78% of the plot area)
- Total Built-up area = 8969.57 sq. m.
- Area under Parking = 2760 sq. m. (51.46% of the plot area)
  Total ECS = 179

Inferences:
MIS, Dwarka Sr. Sec. school was selected for study as it reflects the model developed for a 2 acre school site with 2500 students for on-site parking study. The school is suitably located with access from a service road next to the major sector road and provides a safe environment to the students and promotes seamless vehicular circulation. The vehicular circulation for the school has the advantage of it being located at the junction of two roads. Movement of school buses is segregated from the other modes of travel to school with bus drop-off and pick-up point inside the campus.

A comparative study for the parking requirement as per various policy documents is shown in the table overleaf to assess the most suited design option.

Comparative Study for On-site Parking Requirement at School:

As per the norms suggested by DUAC	• Total number of Students: 1680 • Teaching staff: 56 • Others: 8 a. 1 car park/ teaching staff = 56 ECS 1 car park/ 2 non-teaching staff = 4 ECS b. Parking requirement for school bus: Considering 35% of students (588) commuting by school bus, number of buses required = 11.76 Number of ECS: 12X3.9 = 45.86 (46 ECS) c. Visitors' parking @1 per 250 students = 6.7 (7 ECS) Total parking requirement within the school premises: (60+46+7) =113 ECS **Area under parking, considering surface parking (113x23) = 2599 sq. m. (32% of total plot area)**
As per Best Practices – MUMBAI Parking Provisions in New Development Control Regulations (DCR) - 2034	a. Administrative + Public Service Area = 1711.02 sq. m. Parking Space Required: One parking space for 35 sq. m. carpet area of the administrative office area and public service area = 48.88 ECS b. 10% additional parking space to be provided = 4.8 ECS c. Parking requirement for school bus: Considering 35% of students (588) commuting by school bus, number of buses required = 11.76 12X3.9 = 45.86 (46 ECS) Total parking requirement within the school premises (49+5+46) = 100 ECS **Area under parking, considering surface parking (100x23) = 2300 sq. m. (29% of total plot area)**
As per International Examples	**Parking norms (UK) - Education (Primary/ Secondary):** • Vehicle - 1 space per 15 pupils (maximum) • Cycle - 1 space per 5 staff + 1 space per 3 pupils (maximum) • PTW - 1 space + 1 per 20 car spaces (for 1st 100 car spaces), then 1 space per 30 car spaces (over 100 car) (minimum) • Disabled - 1 bay or 5% of total capacity, whichever is greater (minimum) **Parking requirement as per above standards:** • Parking @1 space/ 15 students = 112 ECS • PTW Parking = 6x0.2 = 1.2 ECS • Cycle Parking = (12.8+560)x0.1 = 57.28 ECS Total parking requirement within the school premises (112+1.2+57.28) = 170 ECS **Area under parking, considering surface parking (170x23) = 3910 sq. m. (49% of total plot area)**
Findings: The norms suggested by DUAC relate to the standards provided in the Development Control Regulations – 2034 for Mumbai, wherein the parking requirement is calculated not on the total floor area but the Administrative & Public Service Area only.	



Map showing Traffic Management Plan for the School

Bus Movement
Vehicular Movement - Staff
Vehicular Movement - Drop/ Pick-up
Pedestrian Entry
Bus Drop/ Pick-up & Visitors' Parking
Pedestrian Zone
Built-up

- Parents and motorists driving into the school for the purpose of dropping- off and picking-up their children are to do so at the designated drop-off point along the driveway at the Foyer.
- Adequate on-site queue storage length to accommodate parent vehicles during drop-off and pick-up operations is important.
- No car is allowed to park along the driveway at the Foyer at all times.

A well-designed school site should support the safe arrival and departure of pedestrians and bicyclists. From a traffic management perspective, increased walking and bicycling to school has the added benefit of potentially decreasing the need to accommodate and manage parking of vehicles both on and off-site.

Benefits of developing a Traffic Management Plan (TMP) may include:

- Safer school streets
- Eased traffic congestion around the school
- Efficient pick-up and drop-off periods
- Increased active travel opportunities for students travelling to and from school

SEGREGATION OF DIFFERENT TRAVEL MODES

The physical routes provided for the various travel modes (buses, cars, pedestrians, bicycles, and delivery vehicles) should be separated as much as possible to provide safe and efficient access. Physical separation of the modes is both a design issue (for example, layout of separate driveways, loading areas) and an operations issue (for example, enforcement of bus-only zones, supervision of crosswalks).

DRIVEWAYS AND INTERNAL ROAD NETWORK

School driveways should conform to the design guidelines for number, spacing, location, and layout. Suggestions specific to schools include:

- Separate driveways for parent traffic and bus traffic.
- Locate the bus area so that buses exit upstream of automobiles and gain priority, thereby reducing delay.
- Students should not be required to cross busy driveways to access the school building.
- Locate buildings, landscaping, fences, block walls, and school signs to permit adequate sight distances for drivers and pedestrians.

BUS-RELATED DESIGN AND OPERATIONS

- For efficiency, bus traffic should not share a common driveway with parent traffic.
- Drop-off area design should not require backward movement by buses.
- The design of the bus drop-off areas should not require children to walk between buses.
- The bus-loading zone should not straddle a pedestrian crossing.

DESIGN AND OPERATION OF DROP-OFF AND PICK-UP ZONE

Well-designed drop-off and pick-up zones can minimize illegal standing or parking near schools and help prevent problems such as blocking bus driveways and flow on adjacent roadways. Guidelines include:

- Drop-off/pick-up zones should be one-way with students' loading and unloading directly onto the curb/ sidewalk. This practice will minimize pedestrian/vehicle conflicts in the drop-off/pick-up zone.
- Provide an adequate driveway length for queuing cars on site. The length of the car pick-up zone should be determined as a function of the expected number of cars.
- Drop-off area design should not require backward movement by vehicles.
- Provide maps and instructions to parents on the school web sites and in newsletters to describe the location and operation of the loading zone to increase the efficiency of the traffic management plan.

IDENTIFICATION OF SHORT TERM PARKING SPACES

Short-term parking spaces should be identified beyond the student loading area and near the building entrance. These spaces can be used by parents requiring an extended time to load or unload. The availability of short-term parking keeps the loading area clear of parked vehicles and can result in safer and more efficient operations.

The school may need to consider other measures, such as enforcement, to have appropriate speeds on the adjacent street, and incentive programs to encourage walking, biking, or bus use.

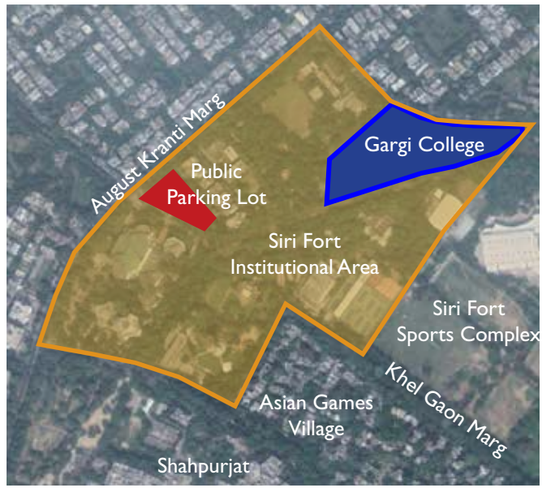
4 COLLEGES

4.1 Case Study I - College with 10 acres plot size

Gargi College, Siri Fort Institutional Area, New Delhi

About:

Gargi College, an all women's college of University of Delhi is located in South Delhi in the Siri Fort Institutional Area. It has residential pockets of Anand Lok, Gulmohar Park, Sadiq Nagar and Institutions like Siri Fort Auditorium Complex, Jija Bai Industrial Training Institute for Women, Kamla Nehru College, in vicinity. The total area of the college campus is 9.2 acres with a strength of 4324 students. The college has primary access from 18 m. wide Siri Fort Road. Green Park metro station is the nearest available public transport, at a distance of about 2.5 km.



Map showing the nearest public parking lot to the site

The Siri Fort Institutional Area parking lot located on August Kranti Marg and Khel Gaon Marg, is a common public parking area for many adjacent institutions. It is at a distance of about 1.3 km. from Gargi college. The organised car parking accommodates 93 number of cars, however, an unorganized layout would accommodate more number of cars. The parking lot is unguarded and free for everyone. Many women employees use this parking lot and find it unsafe after dark. Very few students from Gargi college use this parking lot presently. However with proper planning and upgradation of pedestrian infrastructure, this parking lot can be potentially utilised for 'park and ride' to colleges in about 10 to15 minutes walking catchment of such facilities to make it comfortable and convenient for users.

Map showing the site and its surroundings

Source: Google Image

4.1.1 Existing Parking Arrangement On-site

Site Survey:

On-site parking for faculty and staff near administrative block

Parking lot near staff residences within the college campus

Parking lot near cafeteria and basketball court within the college campus

Vehicles parked along the drive-way

Statistics:

- Area of College Campus = 9.198 acres (37224.306 sq. m.)

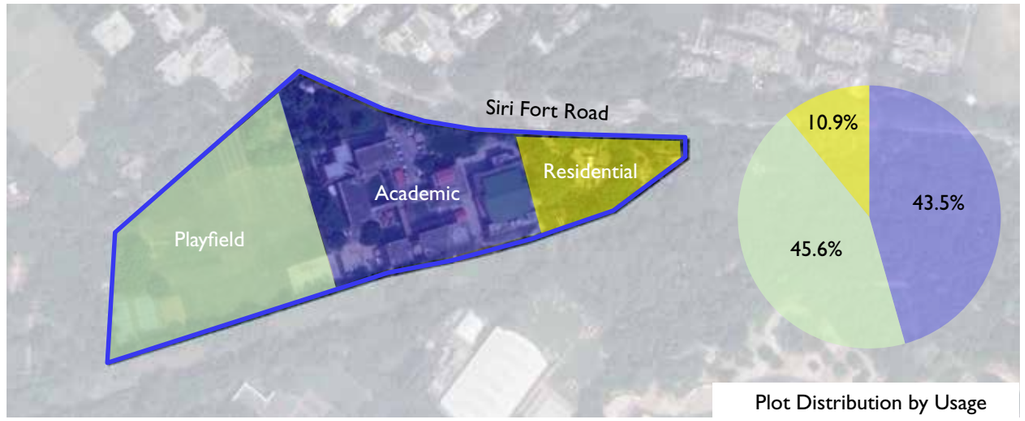
- Development Control Norms applicable as per MPD-2021:
  i. Permissible Coverage on G.F. = 35%
  ii. Permissible FAR = 150
  iii. Permissible Height = 37 m.
  iv. Permissible Parking = 1.33 ECS/ 100 sq. m. of floor area

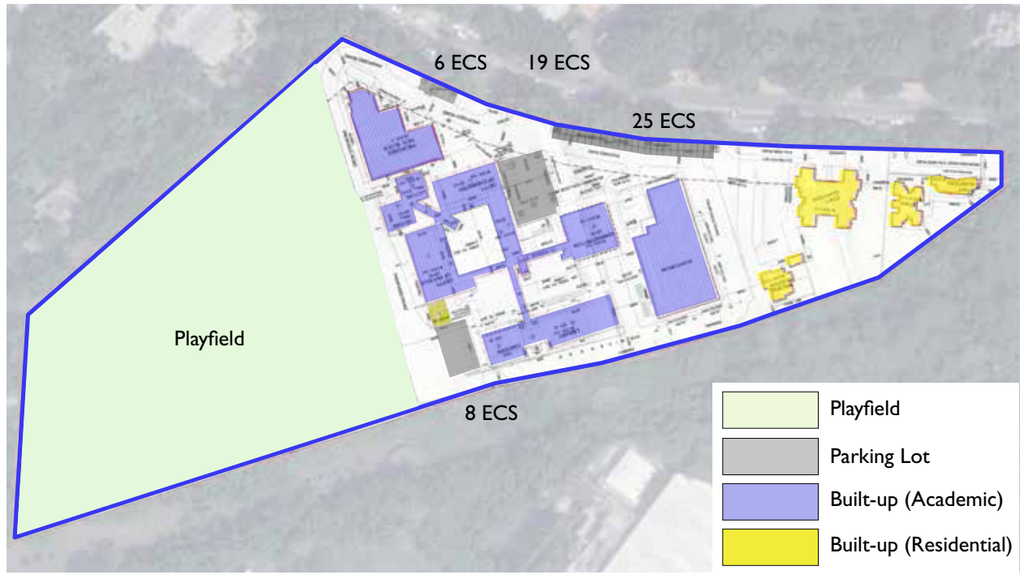
- Strength:
  i. Number of Students = 4324
  ii. Number of Teaching Staff = 216
  iii. Administrative staff = 72
  iv. Other supporting staff = 53

Findings:

Vehicular parking is dispersed throughout the campus. Based on the data provided by the college and site surveys, only 5% of the non-resident students use private cars while 25% of the non-resident students commute by two-wheelers and the remaining rely on public transport. 20% of teaching staff drive to college in private cars. The cycle mode share for students is very low or negligible across all college types. Students are charged for parking, hence prefer to park outside the campus along roads, while there is a free parking zone for the faculty members near the administrative block. However the UGC norms suggest that the college should provide parking as a facility to the student without any charge. None of the Delhi University college provides bus facility for transportation.

It is notable from the site audits that the level of parking provision on site is generally below the standards. Though, given the working of and the nature of courses at colleges with their hours of operation, not all the vehicles are required to be parked on-site at the same time. Hence effective parking is always less.





Maps showing division of site as per usage

Area Details:

- Plot Area = 9.198 acres (37224.306 sq. m.)
- **Area under Playfield = 4.198 acres or 16989.306 sq. m. (45.6% of the plot area)**
- Area under Academic block = 4.0 acres or 16188.0 sq. m. (43.5% of the plot area)
- Area under Residential component = 1.0 acre or 4047.0 sq. m. (10.9% of the plot area)
- **Total Built-up area = 15795.825 sq. m.**
  Academic block = 11877.045 sq. m.
  Residential block = 1144.28 sq. m.
  Auditorium = 3031.82 sq. m.
- Current parking provision on site = 58 ECS
- **Existing area under parking = 1334 sq. m.** (4% of the total site area)

4.1.2 On-site Parking Requirement

Comparative Study for On-site Parking Requirement at College:

As per Existing Parking Norms in MPD-2021	• **Parking requirement: @ 1.33 ECS/ 100 sq. m. of floor area = 210 ECS**
As per Best Practices	• Total number of Students: 4324 • Number of students residing on campus: 1513 (35% of total) • Number of students not residing on campus: 2811 Vehicular Parking requirement @ 1 space/ 15 students: 187 ECS • Parking requirement of staff within the college premises: @ 1 space/ teaching staff = 184 ECS @ 1 space/ 2 ancillary staff = 58 ECS **Total requirement of parking within the college premises (187+184+58) = 429 ECS** **Parking norms (UK) - Education (Higher):** • Vehicle - 1 space per 15 students for staff + 1 space per 15 students for student parking (maximum) • Cycle - 1 space per 5 staff + 1 space per 3 students (minimum) • PTW - 1 space + 1 per 20 car spaces (for 1st 100 car spaces), then 1 space per 30 car spaces (over 100 car) (minimum) • Disabled - 1 bay or 5% of total capacity, whichever is greater (minimum)
As per Travel Pattern of Users (based on Primary Survey)	• **Total parking requirement on-site:**

	In Numbers	As Percentage of Total	No. of Vehicles	ECS
No. of Teachers	216	20%	43	43
No. of Students (Non-resident)	2811	25%	703	141
		5%	141	141
Other Staff	125	15%	19	8
Visitors	0	10%		33
				366
Diversity (considering not all the vehicles would be parked on-site at the same time)		**60%**		**219**

The on-site parking requirement as per the existing parking norms in MPD-2021 and that as per the actual travel pattern of users based on the primary survey comes out to be similar. Hence, here we do not propose to rationalise the parking norms but the way in which parking is provided, the type and layout, can be looked into.

4.2 Case Study II - College with 20 acres plot size

Indra Prastha College, Civil Lines, New Delhi

About:

Indra Prastha College, an all women's college of University of Delhi is located in North Delhi in the Civil Lines Area. It has several other institutions and government offices in vicinity. The total area of the college campus is 20.4 acres with a strength of 3200 students. The college sits at the junction of G.T. Road (45 m. ROW) and Shamnath Marg (24 m. ROW). The college has main access from Shamnath Marg. Metro stations of Civil lines and Vidhan Sabha are the nearest available public transport at a distance of about 200 m. and 1 km. respectively.

Map showing the site and its surroundings

Source: Google Image

Statistics:

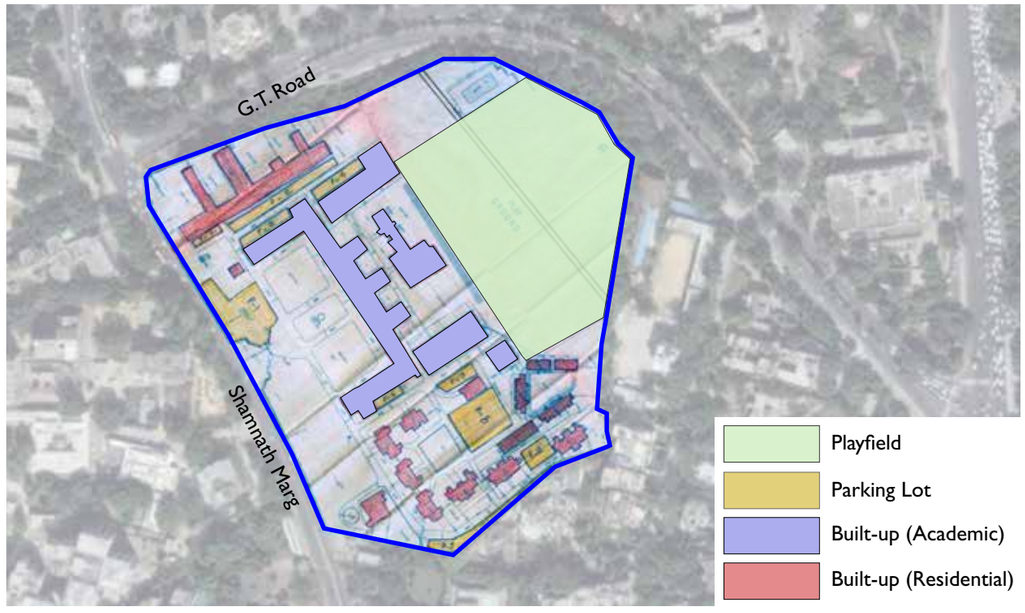
- Area of College Campus = 20.4 acres (82580.81 sq. m.)

- Development Control Norms applicable as per MPD-2021:
  i. Permissible Coverage on G.F. = 35%
  ii. Permissible FAR = 150
  iii. Permissible Height = 37 m.
  iv. Permissible Parking = 1.33 ECS/ 100 sq. m. of floor area

- Strength:
  i. Number of Students = 3200
  ii. Number of Teaching Staff = 160
  iii. Administrative staff = 50
  iv. Other supporting staff = 40

4.2.1 Existing Parking Arrangement On-site

Plot Distribution by Usage



Map showing division of site as per usage

Area Details:

- **Plot Area = 20.4 acres (82580.81 sq. m.)**

- **Area under Playfield = 6.28 acres or 25422 sq. m. (30% of the plot area)**

- **Total Built-up area = 22755.1106 sq. m.**
  Academic block + Hostel = 16450.526 sq. m.
  Residential block = 6304.58 sq. m.

- **Area under Parking = 7425.41 sq. m. (9% of the plot area)**

Findings:

Vehicular parking is dispersed throughout the campus. Presence of metro stations nearby provide for ease in commuting to the college and discourages students to travel by private vehicles. The cycle mode share for students is very low or negligible across all college types.

Based on the data provided by the college and site surveys, the level of parking provision on site is generally below the standards. Though, given the working of and the nature of courses at colleges with their hours of operation, not all the vehicles are required to be parked on-site at the same time. Hence effective parking is always less.

4.2.2 On-site Parking Requirement

Comparative Study for On-site Parking Requirement at College:

<table>
<tr><td>As per Existing Parking Norms in MPD-2021</td><td>• Parking requirement: @ 1.33 ECS/ 100 sq. m. of floor area = 303 ECS</td></tr>
<tr><td>As per Best Practices</td><td>• Total number of Students: 3200
• Number of students residing on campus: 1120 (35% of total)
• Number of students not residing on campus: 2080
Vehicular Parking requirement @ 1 space/ 15 students: 139 ECS
• Parking requirement of staff within the college premises:
@ 1 space/ teaching staff = 160 ECS
@ 1 space/ 2 ancillary staff = 45 ECS
Total requirement of parking within the college premises (139+160+45) = 344 ECS

Parking norms (UK) - Education (Higher):
• Vehicle - 1 space per 15 students for staff + 1 space per 15 students for student parking (maximum)
• Cycle - 1 space per 5 staff + 1 space per 3 students (minimum)
• PTW - 1 space + 1 per 20 car spaces (for 1st 100 car spaces), then 1 space per 30 car spaces (over 100 car) (minimum)
• Disabled - 1 bay or 5% of total capacity, whichever is greater (minimum)</td></tr>
<tr><td>As per Travel Pattern of Users (based on Primary Survey)</td><td>• Total parking requirement on-site:
<table>
<tr><th></th><th>In Numbers</th><th>As Percentage of Total</th><th>No. of Vehicles</th><th>ECS</th></tr>
<tr><td>No. of Teachers</td><td>160</td><td>20%</td><td>32</td><td>32</td></tr>
<tr><td>No. of Students (Non-resident)</td><td>2080</td><td>25%</td><td>520</td><td>104</td></tr>
<tr><td></td><td></td><td>5%</td><td>104</td><td>104</td></tr>
<tr><td>Other Staff</td><td>90</td><td>15%</td><td>14</td><td>6</td></tr>
<tr><td>Visitors</td><td>0</td><td>10%</td><td></td><td>25</td></tr>
<tr><td></td><td></td><td></td><td></td><td>271</td></tr>
<tr><td>Diversity (considering not all the vehicles would be parked on-site at the same time)</td><td></td><td>60%</td><td></td><td>162</td></tr>
</table></td></tr>
</table>

The on-site parking requirement as per the existing parking norms in MPD-2021 and that as per the actual travel pattern of users based on the primary survey comes out to be similar with only 10% variation. Hence, here we do not propose to rationalise the parking norms but the way in which parking is provided, the type and layout, can be looked into.

4.3 Case Study III - College with plot size less than 10 acres

Zakir Hussain Delhi College, Ajmeri Gate, New Delhi

About:

Zakir Hussain Delhi College, under University of Delhi is located in Central Delhi in the Ajmeri Gate Area. It has few residential and institutional pockets in vicinity. The total area of the college campus is 6.5 acres with a strength of 4000 students. The college has access roads on its two opposite sides with primary access from Jawaharlal Nehru Marg (30 m. ROW) and secondary access from Tagore Road (18 m. ROW). Metro stations of Delhi Gate and New Delhi are the nearest available public transport both within a distance of about a kilometre.

Map showing the site and its surroundings

Source: Google Image

Statistics:

- Area of College Campus = 6.495 acres (26285.26 sq. m.)
- Development Control Norms applicable as per MPD-2021:
  i. Permissible Coverage on G.F. = 30%
  ii. Permissible FAR = 225
- Strength:
  i. Number of Students = 4000
  ii. Number of Teaching Staff = 219
  iii. Administrative staff (including supporting staff) = 182

4.3.1 Existing Parking Arrangement On-site

Map showing division of site as per usage

Area Details:

- **Plot Area = 6.495 acres (26285.26 sq. m.)**
- **Area under Playfield = 1.50 acres or 6070.28 sq. m. (23.10% of the plot area)**
- Area allotted for college building including hostel = 4.995 acres or 20214.76 sq. m. (76.9% of the plot area)
- **Total Built-up area = 25591.81 sq. m.**
- **Net basement area = 4621.74 sq. m.**
- **Proposed Parking detail:**

  Surface parking @23sq. m. per ECS = 81 ECS
  Basement @32sq. m. per ECS = 144 ECS
  Total Parking = 225 ECS

Findings:

Prior to extension of the college, vehicular parking was provided only on the surface with access from Jawaharlal Nehru Marg. With the construction of a multi-storied tower, two levels of basement parking is proposed under this G+8 academic block. Total parking accommodated in basement is 144 ECS while 81 ECS parking is met on the surface. Presence of metro stations nearby provide for ease in commuting to the college and discourages students to travel by private vehicles.

Based on the data provided by the college and site surveys, the level of parking provision on site is generally below the standards. Though, given the working of and the nature of courses at colleges with their hours of operation, not all the vehicles are required to be parked on-site at the same time. Hence effective parking is always less.

4.3.2 On-site Parking Requirement

Comparative Study for On-site Parking Requirement at College:

<table>
<tr><td>As per Existing Parking Norms in MPD-2021</td><td>

- **Parking requirement: @ 1.33 ECS/ 100 sq. m. of floor area = 340 ECS**

</td></tr>
<tr><td>As per Best Practices</td><td>

- Total number of Students: 4000
- Number of students residing on campus: 1400 (35% of total)
- Number of students not residing on campus: 2600

Vehicular Parking requirement @ 1 space/ 15 students: 173 ECS

- Parking requirement of staff within the college premises:

@1 space/ teaching staff = 219 ECS
@ 1 space/ 2 ancillary staff = 91 ECS

Total requirement of parking within the college premises (173+219+91) = 483 ECS

Parking norms (UK) - Education (Higher):

- Vehicle - 1 space per 15 students for staff + 1 space per 15 students for student parking (maximum)
- Cycle - 1 space per 5 staff + 1 space per 3 students (minimum)
- PTW - 1 space + 1 per 20 car spaces (for 1st 100 car spaces), then 1 space per 30 car spaces (over 100 car) (minimum)
- Disabled - 1 bay or 5% of total capacity, whichever is greater (minimum)

</td></tr>
<tr><td>As per Travel Pattern of Users (based on Primary Survey)</td><td>

- **Total parking requirement on-site:**

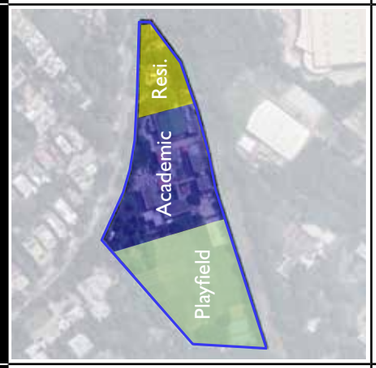
<table>
<tr><th></th><th>In Numbers</th><th>As Percentage of Total</th><th>No. of Vehicles</th><th>ECS</th></tr>
<tr><td>No. of Teachers</td><td>219</td><td>20%</td><td>44</td><td>44</td></tr>
<tr><td>No. of Students</td><td rowspan="2">2600</td><td>25%</td><td>650</td><td>130</td></tr>
<tr><td>(Non-resident)</td><td>5%</td><td>130</td><td>130</td></tr>
<tr><td>Other Staff</td><td>182</td><td>15%</td><td>27</td><td>12</td></tr>
<tr><td>Visitors</td><td>0</td><td>10%</td><td></td><td>32</td></tr>
<tr><td></td><td></td><td></td><td></td><td>347</td></tr>
<tr><td>Diversity (considering not all the vehicles would be parked on-site at the same time)</td><td></td><td>60%</td><td></td><td>208</td></tr>
</table>

</td></tr>
</table>

The on-site parking requirement as per the existing parking norms in MPD-2021 and that as per the actual travel pattern of users based on the primary survey comes out to be similar. Hence, here we do not propose to rationalise the parking norms but the way in which parking is provided, the type and layout, can be looked into.

4.4 Inferences

Comparative Analysis:

PLOT DISTRIBUTION AS PER USAGE	I. P. COLLEGE	GARGI COLLEGE	ZAKIR HUSSAIN DELHI COLLEGE
			
AREA	20.4 Acres	9.2 Acres	6.5 Acres
TOTAL BUILT-UP AREA	22755.106 sq. m.	15795.825 sq. m.	25591.81 sq. m.
PLAYFIELD (AS %AGE OF TOTAL PLOT AREA)	31%	46%	23%
NUMBER OF STUDENTS	3200	4324	4000
PARKING REQUIREMENT — STAFF — TEACHING	160	216	219
PARKING REQUIREMENT — STAFF — SUPPORTING	90	125	182
PARKING REQUIREMENT — AS PER NORMS: MPD-2021	303 ECS	210 ECS	340 ECS
PARKING REQUIREMENT — AS PER BEST PRACTICES	344 ECS	429 ECS	483 ECS
PARKING REQUIREMENT — AS PER PRIMARY SURVEY	271 ECS	366 ECS	347 ECS
PARKING PROPOSED	SURFACE	SURFACE	BASEMENT (2 LEVELS)
PARKING SOLUTION	A separate on ground automated parking structure	A separate on ground automated parking structure	A separate on ground automated parking structure or above ground podium incorporating parking

Parking Management: Proposed Options

Automated Car Parking System (APS): Retrieved from - https://en.wikipedia.org/wiki/Automated_parking_system

An automated car parking system is a mechanical system designed to minimise the area and/or volume required for parking cars. Like a multi-storied parking garage, an APS provides parking for cars on multiple levels stacked vertically to maximise the number of parking spaces while minimising land usage. The APS utilises a mechanical system to eliminate the circulation space wasted in a multi-storey parking garage. These use 20% less surface area compared to a conventional garage. The process of parking a vehicle for drivers in automated parking systems remains the same regardless of the technology used; it's just the method of moving the vehicles to and from the parking module that differs. Out of the various types of technologies (Stack, Puzzle, Crane, Silo, Tower and AGV parking system) used for APS, ones suitable for college campuses are stack, puzzle and tower type parking system. These systems relieve the ground from large expanse of parking in campuses which can then be put to other uses.

<u>Stack Parking System (manual)</u>

The stackers are aimed to double the parking space above ground/ basement type parking. This system is highly-adaptable, customized and cost efficient-design option.

Retrieval time: 30-40 secs

<u>Puzzle System (semi-automated)</u>

This type is aimed for optimum use of space on ground. It is electro mechanically designed to go vertically up to 7 levels & horizontally to as much space available on ground. It is ideal for new construction or retrofits. The Puzzle can be used indoors or outdoors and requires a minimum clear height of 11' 7 3/4" beginning with the 2 level system.

Retrieval time: 60-90 secs/ strictly dependent on the configuration of system.

<u>Tower Parking Systems</u>

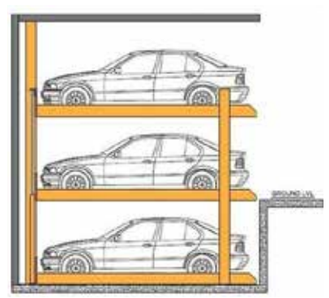
Tower systems typically consist of a vehicle elevator with a parking space on either side of the elevator shaft. This configuration is repeated over a number of levels to complete the parking tower. The system is ideal to maximize parking in narrow plots. In a space required only for 3 parking spots, it can increase the capacity by upto 20 times.

As there is a single mechanism tp ark and retrieve vehicles system redundancy is an issue with tower systems.

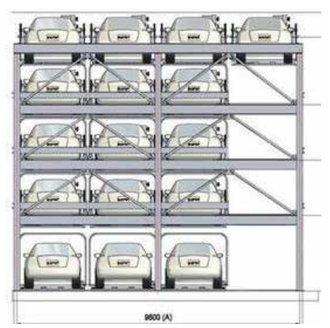
(Source:http://nursi.info/wp-content/uploads/2018/12/china-3-level-mechanical-car-lift-parking-system-outdoor.jpg)

(Source:http://www.yuanlaitai.com/uploads/20171082 5/p20170106143551256369 4.jpg)

(Source:http://wraparking.com/wp-content/uploads/2015/05/Product-pics-Tower-Feature-pic.jpg)



(Source:https://5.imimg.com/data5/PW/DS/MY-40202487/pit-parking-stacker-system-500x500.jpg)



(Source:https://3.imimg.com/data3/KM/HO/MY-4956807/multilevel-puzzle-parking-500x500.jpg)

(Source:https://nandan.co.in/wp-content/uploads/2015/04/download-1.jpg)

Basement Parking:
The basement parking space type refers to parking located below grade within an occupied building. This involves additional excavation, structural frames, floor slabs above, sloped vehicle access ramps and basement perimeter walls and partitions separating parking from other building enclosed areas.

Multi-level Car Parking (MLCP):
Construction of multi-level car parking facilities should be considered to cater to high parking demand. The footprint of the structure is lesser than the space that would be required for surface parking of the vehicles that can be accommodated in it. In an institutional area, MLCP can be provided as a shared parking facility serving a number of educational and other office complexes.

Podium Parking:
Parking on floor / floors above ground of maximum 2.4 m. height each, below the bottom of beam, if served by a ramp for movement of vehicles for entry and exit from parking area or alternatively mechanized parking as per standard plan by the registered company undertaking such construction and duly approved by the competent Authority. Ramp for podium shall not be allowed in the setbacks.

Comparative analysis of the proposed options for Parking Management in College Campuses:

	SURFACE PARKING	PODIUM PARKING	BASEMENT PARKING
TYPE	Independent parking structure at ground	Above the ground parking arrangement integrated with the built environment	Underground parking
APPLICATION	• Suitable in large campuses • Alternatively, automated multi-level car parking systems can be employed	Suitable in campuses where land parcel is limited	Constraint
TIME	Least time consuming for building to be made operational	Moderate	Most time consuming
COST OF CONSTRUCTION	Least expensive	Moderate	High cost of construction
ISSUES	• Walkability, in case of large campuses • Connection to the college building • Questioned on preservation of green spaces	• Questioned on aesthetics • Loss of pedestrian realm	• Safety issues • Alternative use other than parking

These challenges can be further complicated by the composition of a campus: i.e. size and distribution, urban or suburban, proportion of commuters to resident students.

4.5 Proposed Guidelines

Best Practices in Parking Facilities Integrated with their Environment in Large Educational Campuses

1. Multi-Level Surface Parking / Podium parking

a. Parking Garage in Pomona College South Campus, Claremont, California

The project was listed amongst the 2016 Innovative Sustainability Project of the Year in Parking Magazine, November 2016 of the National Parking Association.

With an increase in student enrolment, Pomona College was experiencing a space crunch. New on-campus housing projects were displacing college playing fields. With the aim to create more playing field space and additional parking, Watry Design worked with college administrators to construct a dual-purpose parking structure with a lacrosse field on top. The structure is a two-story, 29543 sq. m. parking garage to accommodate 608 vehicles. replacing a 100-space surface lot in 2011. The garage was built on sloping land so that the structure is partially underground with only one side exposed. The southeast corner of the garage is bermed to fuse into the campus, with a synthetic-turf athletic field on the roof. Pedestrians access the playing field at the northwest corner of the structure through walkways, and have a direct connection between the playing field and the campus.

Aerial view of the facility (Source: http://element5architecture.com/blog?offset=1402009486409)

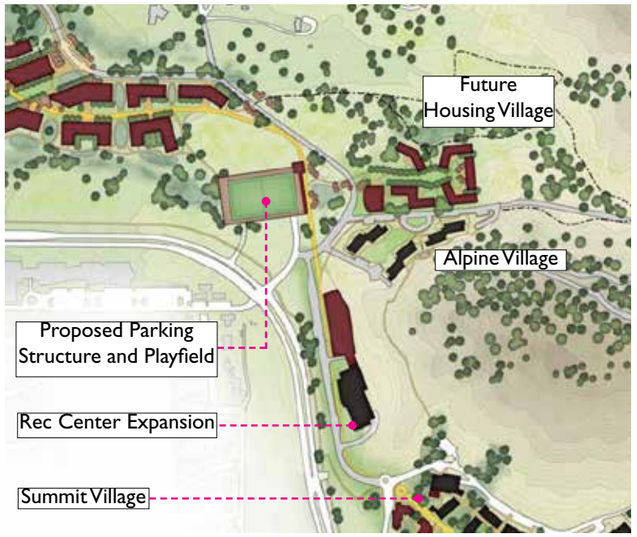
Combined Soccer field and parking facility (Source: https://br.pinterest.com/pin/127437864429444739/)

The facility achieved more than 20% savings in energy usage over a standard building. The green roof reduces the heat island effect. An energy-efficient fluorescent lighting system, along with an 80kw photovoltaic solar array is incorporated into the shade canopy above the field. These off set the energy use of the garage lighting. The project has zero run-off with bio-swales taking the storm water collected from the playing field and filtering it back into the ground. By undertaking this project, Pomona College ended up with not only a durable and aesthetically pleasing garage, but one that matches up with the ongoing campus initiative to go green and to become a more pedestrian-friendly campus.

b. Parking Garage and Recreational Field, University of Colorado, Colorado Springs, United States

The project involves two multi-purpose athletic fields on top of a parking garage. The four-storey 469,589 sq.ft. of parking garage provides 1,228 additional spaces. The site also includes stadium seating for 84 people, a lightning detection system and solar panels that help power lights in the parking garage. The new facility provided not only the much-needed campus parking and recreational space near the heart of the campus, but also allowed for displacement of inadequate current parking as a result of expansion of the campus recreation center and the Alpine Village student housing complex.

Aerial view of the facility (Source: https://davispartnership.com/projects/university-of-colorado-colorado-springs-parking-garage-and-recreational-field/)



Map showing location of the facility (Source: https://www.google.com/search?q=pARKING+GARAGE+AND+RECREATIONAL+FILED+UCCS&oq=pARKING+GARAGE+AND+RECREATIONAL+FILED+UCCS&aqs=chrome..69i57j33.21742j0j7&sourceid=chrome&ie=UTF-8/)

The parking garage was constructed to provide parking for future housing students as well as replace parking lost due to the expansion of residential housing and campus recreation services into existing surface parking lots.

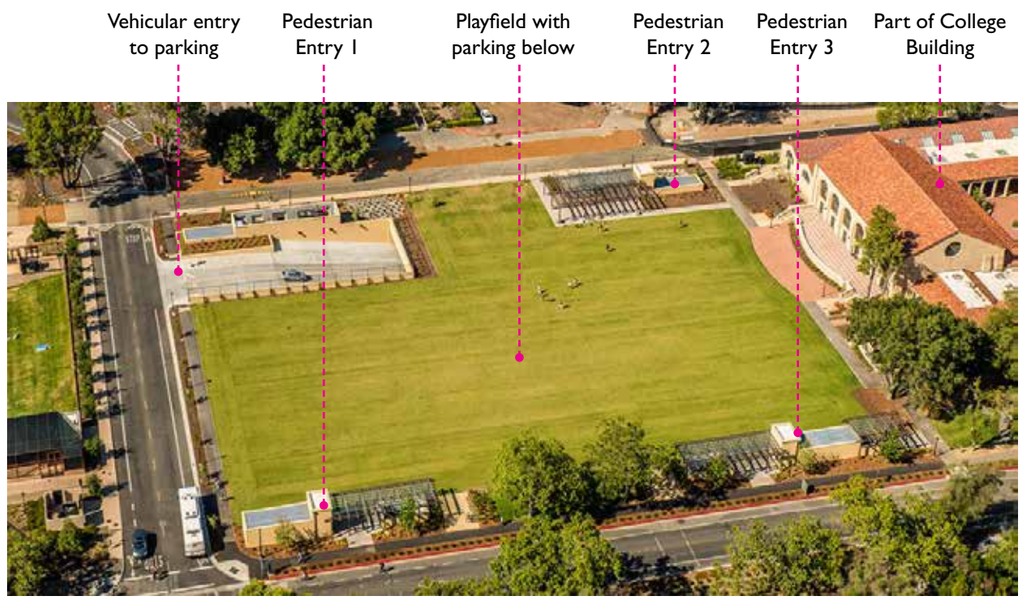
About 94 parking spaces in a surface lot adjacent to the Recreation Center and 470 parking spaces in a surface lot west of the current Alpine Village Apartments were lost when these new facilities were constructed. The parking garage yielded 1227 parking spaces of which 564 parking spaces were used to backfill surface lot spaces described above. The remaining 663 spaces were allocated to parking for future residential students.

2. Underground Parking

a. Stanford University Roble Field Parking Structure, California

The project is the winner of IPI Awards of Excellence Competition, 2018 in the category - Best Design of a Parking Facility with 800 or more spaces.

The project focussed on preserving green spaces even as the University continued to densify. It is a 5-level below grade, 46451.52 sq. m. structure for 1162 parking spaces to serve the parking needs of commuters, residents, and visitors with greenery on top. Parking for differently-abled, visitors, carpooled vehicles, service vehicles and electric vehicles is provided on the first level. The pedestrian entry structures are located on three corners of the site. This project enabled meeting the current parking demand while at the same time keeping Roble Field, an open grass space for students to gather, relax and enjoy recreational sports. To support the natural turf field, 2 feet of lightweight engineered soil was used to minimize load on the structure. The top level drainage slopes follow the existing natural slope of the site, helping to preserve the field and virtually eliminate the perception of the below grade parking structure.



Aerial views of the facility (Source: https://watrydesign.com/project/stanford-university-roble-field-parking-structure-10)

5.1 Annexure I - Questionnaire for Primary Survey

For carrying out a study on the prevailing parking norms for Educational Institutions in Delhi, and carrying out a survey on few of the prime schools and colleges of the city for better understanding of the actual parking conditions in the school premises, the following questionnaire was prepared in order to collect the data:

1. Total number of students -
2. Total number of staff:
   a. Teaching staff –
   b. Administrative staff –
   c. Others/ supporting staff -

3. Number of cars parked inside the college premises -
4. Number of cars parked outside the college premises -

5. Number of two-wheelers parked inside the college premises -
6. Number of two-wheelers parked outside the college premises -

5.2 Annexure II - List of Schools and Colleges

The questionnaire survey format was sent to the following schools and colleges -

List of Schools:
- Apeejay School, Sheikh Sarai
- Kendriya Vidyalaya, Andrews Ganj
- Modern School, Barakhamba Road
- Jesus Mary Joseph Senior Secondary School, Paschim Vihar
- Laxman Public School, Huaz Khas
- ITBP Public School, Sector 16, Dwarka
- St. George Senior Secondary School, Alaknanda
- G.D. Goenka Public School, Vasant Kunj
- Sanskriti school, Chanakyapuri
- St. Columba's School, Alexander Place
- B.G.S. International Public School, Sector 5, Dwarka
- St. Thomas Girls Senior Secondary School, Mandir Marg
- Sadhu Vasvani International School for Girls, Shanti Niketan
- Guru Harkrishan Public School, Purana Qila Road, India Gate
- Birla Vidya Niketan, Pushp Vihar, Sector IV
- Jain Happy School, DIZ Area, Gole Market
- M.L. Khanna DAV Public School, Sector 6, Dwarka
- Gyan Bharati School, Saket
- The Heritage School, Vasant Kunj
- Bharat National Public School, Ram Vihar, Karkardooma
- St. Xavier's School, Shahbad, Daulatpur
- Delhi Public School, R.K. Puram
- DAV Senior Secondary School, Pusa Road
- Amity International School, Mayur Vihar Phase - I
- Sahoday Sr. Secondary School, Safdarjung Development Area
- Red Roses Public School, Saket
- Guru Teg Bahadur Public School, Model Town
- Lancer's Convent Sr. Secondary School, Prashant Vihar, Rohini
- Salwan Public School, Mayur Vihar Phase - III
- Bal Bharti Public School, Sector 12, Dwarka

List of Colleges:
- College of Art, Tilak Marg
- Dyal Singh College, Lodhi Road
- Gargi College, Sirifort Road
- NIFT, Hauz Khas
- Deen Dayal Upadhyay College, Dwarka
- Acharya Narendra Dev College, Rohini
- Sri Venkateswara College, Benito Juarez Road, Dhaula Kuan
- Rajkumari Amrit Kaur College of Nursing, Lajpat Nagar
- Kalindi College, East Patel Nagar
- Indraprastha College for Women, Sham Nath Marg
- Laxmibai College, Ashok Vihar
- Shivaji College, Ring Road, Raja Garden
- Zakir Husain College, Jawahar Lal Nehru Marg
- Swami Shraddhananda College, Alipur
- Shyama Prasad Mukherjee College, Punjabi Bagh

List of References

Bridgend County Borough Council, 2011, *'Parking Standards - Design and Good Practice'*, Available at: https://www.bridgend.gov.uk/media/1851/spg_17_-_parking_standards_volume_1.pdf

ET Home, 2016, *'HRD Ministry may relax norms for opening new Kendriya Vidyalaya schools'*, Economic Times, September 2, Available at: https://economictimes.indiatimes.com/industry/services/education/hrd-ministry-may-relax-norms-for-opening-new-kendriya-vidyalaya-schools/articleshow/53979231.cms

Hampshire County Council, 2013, *'On-Site School Parking Guidelines'*, Available at: http://documents.hants.gov.uk/parking/On-siteSchoolParkingGuidelines.pdf

Ministry of Human Resource Development, Government of India, 2014,*'Guidelines for School Infrastructure and Strengthening, (Civil Works)'*, Available at: http://rmsaindia.gov.in/images/School_Infrastructure_and_Strengthening.pdf

Municipal Corporation of Greater Mumbai, 2016, 'Draft Development Control Regulations - 2034', Available at: http://www.rexgroup.in/uploads/dcr.pdf

Prevost, L., 2017, *'On the College Campus of the Future, Parking May Be a Relic'*, The New York Times, September 5, Available at: https://www.nytimes.com/2017/09/05/business/college-campus-parking.html

Sullivan, K.J., 2016, 'Roble Field Parking Structure to open in late January', Stanford News, November 2, Available at: https://news.stanford.edu/2016/11/02/roble-field-parking-structure-open-late-january/

The Planning Service, Government of UK, *'Parking Standards'*, Available at: https://www.planningni.gov.uk/downloads/parking-standards.pdf

Delhi Urban Art Commission

Tel: 24619593, 24618607, 24690821, 24636191, Fax: 24648970

Email: duac74@gmail.com Website: www.duac.org