

LIST OF DOCUMENTS FOR BUILDING PLAN APPROVAL



Form-A

Application for Permission for subdivision/layout or reconstitution or amalgamation of land for building purposes. And for change of use of land.

From



(Affix stamp size photo-
Photograph of the
Applicant)

To

The Competent Authority

1. I/We, hereby apply for permission for subdivision / layout or reconstitution or amalgamation of land for building purposes as described in the accompanying plans and drawings.

2. I/We, have absolute right over the land applied for and have not made any encroachment on any government land.

3. The names of the persons employed by me/us for the preparation of plans, and supervision of the work are as under:

a) The plans are prepared by Registered Architect/Engineer/Town Planner
----- [name]

b) The execution of the development will be supervised by Registered
Architect/Engineer/Town Planner-----[name]

4. I/We, have read the Building Rules applicable for the Local body wherein the site lies and claim to be fully conversant with it; I/We will abide to the provisions of the Building Rules fully.

5. I/We, shall fulfill my duties and responsibility in accordance with the provisions of the Building Rules.

Date:

**Signature of the
Owner/Developer**

Signature of Registered Professional



1. Applicant's name :
2. Postal Address for correspondence :
Telephone number for communication :
Email ID :
3. Applicant's right over the land to
make the proposed development :
(documentary evidence to be enclosed)
4. Development site address :
5. Extent of the site applied for :
6. Present use of the land and the existing :
Building if any [Please give details of each use]
7. Proposed use of land and/ the building,
[Please give details of each use] :
8. Whether the site applied for forms
part of/lies in an approved layout.
If yes, please give date of approval and
reference no, with a copy of the approved
layout plan duly authenticated :
9. Existing use of the adjoining lands in
The North -
The East -
The South -
The West -
10. The width and status of the abutting road
(i.e. private or public) :
11. Whether all the documentary evidences,
plans details, certificates required to be
enclosed with the application as per the
Building Rules have been enclosed :

Date :

Signature of Owner/Registered

Developer or
Authorised agent of the owner



Form-B

Application for Permission for carrying out construction of building or structure, change of use of building.

From



(Affix stamp size
photo graph of
the applicant)

To
The Executive Authority of Local Body

1. I/We, hereby apply for permission for carrying out construction of building or structure, change of use of building as described in the accompanying plans and drawings.

2. I/We, have absolute right over the land applied for and have not made any encroachment on any government land.

3. The names of the registered professionals employed by me/us for the development are as under:

4. The plans have been prepared by Registered Architect/Engineer -----
[Name and registration number]

5. The structural report, details and drawings have been prepared and supplied by the Registered Structural Engineer ----- [name and registration number]

6. The construction of the proposed buildings will be carried under the supervision of the Registered Construction Engineer on Record(name and registration number)

7. For the foundation work of the High rise building, the services of the Registered Geo-technical Engineer (name and registration number) will be availed.

8. The construction work of a High rise building executed by Registered Construction Engineer on the record will be under the independent quality inspection programme prepared and implemented under the supervision of the independent Registered Quality Auditor on record..... (Name and registration number)

9. I/We, have read the Building Rules applicable for the Local body framed under the provisions of the relevant Act and claim to be fully conversant with it.

10. I/We, shall fulfill my duties and responsibility in accordance with the provisions of the Building Rules.

Date :

Signature of the Owner/Registered
Developer



1. Applicant's name :
2. Postal Address for correspondence :
Telephone number for communication :
3. Applicant's right over the land to make the proposed development (documentary evidence to be enclosed) :
4. Development site address :
5. Present use of the land and/ or the building :
[Please give details of each use]
6. Proposed use of the land and/the building :
[Please give details of each use]
7. Whether the site applied for forms part of /lie in an approved layout. :
If yes, please give date of approval and reference no, with a copy of the approved layout plan duly authenticated:
8. Existing building- Floor area - Number of dwelling units –
9. Proposed building- Floor area - Number of dwelling Units
10. Whether all the documentary evidence, plans details, certificates required to be enclosed with the application as per the Building Rules have been enclosed:
11. In industrial use machineries
 - a) Existing H.P.
Proposed H.P.
 - b) Number of workers- Existing Proposed
 - c) Whether detailed report on the raw materials used, process and machineries involved, effluent discharge methods progressed, product manufactured, category of power consumption (i.e. LT/HT), action taken and minimize its negative impact, if any, or the environment, etc. enclosed

Date :

Signature of the Owner/Builder



FORM-C

Form of undertaking to be executed by the land owner or power of attorney holder or builder or promoter and structural engineer, architect, geo-tech expert and site engineer.

This deed of undertaking executed aton the.....day of20....
by the landowner Thiru/Tmt/Selvi
Son/Daughter of aged.....Residing at

No..... (or) Power of Attorney Holder (or)
Builder (or) Promoter / Structural Engineer, Architect, Geo-Tech
Consultant in respect of proposed development / construction made in
Door No....., Road in the following S.No.

S.No. / R.S.No. / T.S.No.	Block No.	Village	Taluk

in favour of the(competent authority) having office at
.....witnesseth as follows .

1. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) have applied for the Planning Permission for construction in the above premises by submitting an application to the (competent authority) in accordance with the planning norms prescribed in these rules. I am associated with the project as Land Owner/Power of Attorney Holder/Builder/Promoter. The extent of site as per document is ____ Sqm. and as per Patta / TSLR / PLR / Handing over sketch ____ sq.mt.

2. I assure that I will put up the construction only in accordance with the approved plan without any deviation and if any construction is later on found not in accordance with the approved plan and any unauthorized addition is made, I agree for the forfeiture of the Security Deposit which will be collected while issuing Planning Permission, and also agree to demolish the such a deviation marked by the (competent authority) within thirty days after such notice, failing which, apart from forfeiture of Security Deposit, the may demolish or cause to demolish such unauthorized or deviated constructions at the site under reference and recover the cost of demolition from me.

3. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) also assure that the open space around the building to be left or the usage of the building, including the car parking in ground floor, will be kept as specified in the approved plan and it will not be converted into any other use except the purpose for which it is approved. If any structural modification or usage differs from the approved plan, the competent authority is at liberty at any time to remove any structural modification or usage and the Expenses incurred by the competent authority is recoverable from me for non-compliance of their request or order.



4. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) further assure that I will not convert any place of the construction in contravention to the approved plan, especially in respect of car parking as specified in the sanctioned plan. At any time in future, I will not convert the car parking on stilts by covering them fully, and use the car parking space for any other purposes. If any construction work in car parking place, converting them either as a flat or for any other purpose, is done either by me or by my successor or by any other person to whom the said construction is transferred in future, without getting appropriate order for doing so from the competent authority, the Authority is at liberty at any time to take any action to remove any structural modification or usage and the expenses incurred by the Authority is recoverable from me/my successor or from any other person to whom the said construction is transferred in future.

5. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) hereby undertake that, I am, jointly and severally responsible with the Land Owner/Power of Attorney Holder/Builder/Promoter to carry out the developments in accordance with the permission granted and also for payment of Development Charges, Security Deposit, Scrutiny Fee and for all other charges levied from time to time by the Authority and also liable for penal provisions for developments made in contravention of the Development Regulations and these presents.

6. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) assure that I/We will pay the premium FSI charges as applicable in case the FSI area exceeds the permissible FSI as per Development Regulations.

7. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) assure that I / We shall gift the OSR area as applicable or pay the equivalent land cost in lieu of OSR area as per Development Regulations.

8. I/We, (Land Owner or Power of Attorney Holder or Builder or Promoter) assure that I / We shall gift the Street Alignment Portion / Road Widening Portion / Link Road as per the provisions in the Development Regulations to the Authority / Local body before issue of Planning Permission.

9. I/We (Land Owner or Power of Attorney Holder or Builder or Promoter) hereby solemnly affirm and declare that I / We are the absolute owner / owners / Power of Attorney Agent / Lease Holder of the said property and it is not covered under the Land Ceiling and Land Acquisition (in respect of Land Acquisition Act, 1894, The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Amendment) Ordinance, 2015, Land Reforms Act, 1961 and Land Ceiling Act, 1978)

10. We shall be liable for all future consequences in case of land falling under Land Ceiling, Land Reforms or Land Acquisition.

11. I / We, (Land Owner or Power of Attorney Holder or Builder or Promoter) have engaged the following as the consultant for the proposed development:



Consultant	Name and Address	Registration No.	E-Mail ID & Mobile No.	Signature
Architect / L.S.Structural Engineer				
Geo-Tech Expert				
Site Supervision Engineer				

This is to certify that I the Architect / LS of the site has inspected the site at

S.No. / R.S.No. / T.S.No.	Block No.	Village	Taluk

I, the Architect / Licensed Surveyor certify that

TheRoad a butting the site under reference is public (Maintained by the Local Body) and its width actually measuresm in front of the site and qualifying width of is available for a length of 250m / 500m as shown in the Road width sketch enclosed mentioning width of the road at regular interval of 25 m mentioning the landmark of the stretch where width has been measured.

I have personally verified the site measurements on ground and dimensions given in the plan correspond with the actual on the ground.

The residuary plot details including structures thereon evidenced by documents correspond with the actual on the ground.

Distance between the site and nearby water body, if any, is ____ m.

Distance between the site and quarry / crusher, if any, within 500m is ----- m.

Distance between the site and burial ground, if any, within a distance of 30 m from a place declared and used as a burning or burial place / ground is -----m.

The Street Alignment Portion / Road Widening Portion / OSR Area shown in the Site Plan tallies to the dimensions in the ground condition.

The site approval for Non-High-Rise Buildings / High rise building is enclosed (in such cases item No.1 to 7 does not arise).

The building plans prepared and submitted herewith satisfy the relevant provisions of development regulations vide planning parameters compliance statement.

The site lies vacant (or) not.

The depth of the plot with reference to road level is ____ m.

HT / LT line passes through the site : Yes / No

(If yes, to be shown in the site plan)



Topo Plan furnished showing the surrounding developments for a radius of 500 m correspond with the actual on the ground.

The coverage of the building mentioned in the Plan is correct.

In case of non-issuance of NOC, I shall obtain NOC / remarks from the department's concerned before commencement of the construction and comply the conditions stipulated by the concerned NOC/Remarks issuing Department during the construction and submit the NOC / remarks along with certificate from the concerned agencies on fulfillment of the NOC conditions at the time of applying for Completion Certificate.

I, the Architect / LS to inform competent authority before the commencement of crucial stages of construction viz.

- Earth work for foundation
- Foundation concreting
- Laying the roof of basement floor
- Laying the roof at each floor level
- After completing the finishing work

(White washing, colouring, fixing, water supply, drainage or other sanitary fitments) and before obtaining regular connection for water supply / electricity.

I, the Architect / LS also undertake to communicate to
(Competent authority) Certificate to the effect that the construction is in conformity with the plan approved by competent authority at the crucial stages mentioned above.

If any deviation to the approved plan is proposed to be made, I the Architect / LS shall obtain prior approval of the Chennai Metropolitan Development Authority.

I, the Architect / LS shall i n t i m a t e (c o m p e t e n t authority) immediately if for any reasons association with the project ceases

The above information furnished is correct. If any information furnished is found wrong, I am aware that action shall be initiated against me and I shall not be henceforth allowed to sign in the Plans for the Planning Permission Applications processed by GCC, Local Body, CMDA and DTCP. To this effect an Undertaking shall be obtained from Architect / Licensed Surveyor and owner.

SIGNATURE OF THE ARCHITECT /
ENGINEER



We, (Owner / Builder / Structural Engineer / Architect / Geo-Tech Expert) certify that the structural plans of the building meet the structural safety requirements for all situations including natural disasters, as applicable, as stipulated under Part 6 Structural Design of the National Building Code of India and other relevant Codes; The design has been done after detailed soil test and we are satisfied as to the adequacy of soil test carried out and the information given therein is factually correct to the best of our knowledge and understanding.

The site is fit for the proposed construction, it has been tested vide soil test report.

No..... dt..... done by

We, (Owner / Builder / Structural Engineer / Architect / Site Engineer) certify that the development, erection, re-erection or making alteration in the building shall be carried out under our supervision and we certify that all the materials (type and grade) and the workmanship of the work shall be generally in accordance with the general and detailed specifications, as per NBC standards and to meet out the structural design of the proposed building.

We, (Owner / Builder / Structural Engineer / Architect / Site Engineer) undertake not to continue construction without any supervision by the our Site Engineer and submit the report to the local body.

I, (Landowner / Builder) certify to engage the above mentioned Engineers for the active period of building execution and I hereby assure to give Revised Certificate in case of any change of Engineer, I shall ensure no work is taken up in this period till required Engineers are engaged by me.

In case construction work is entrusted by a Builders Agreement to a 3rd Party, I (Land Owner or Power of Attorney Holder or Builder or Promoter) shall undertake to include these conditions as part of the agreement.

Applicable incase of existing building within the site

I, (Structural Engineer / Architect / Site Engineer) hereby certify that the development, erection, re-erection or for making alteration in the building has been carried out under our supervision and we certify that all the materials (type and grade) and the workmanship of the work was in accordance with the general and detailed specifications, as per NBC standards and met out the structural design of the constructed building. The construction was made under the supervision of Site Engineer and submitted the report to the local body periodically.

I, (Owner / Builder / Structural Engineer / Architect) hereby certify that the building, has been designed by meand the Structural



Design was made by Thiru....., to the approved plans sanctioned in the Planning Permission No. dated and the Building Permit No....., dated..... The Building has been constructed and completed under my guidance and supervision as per the structural design furnished by the Structural Engineer engaged by us. I also assure and undertake that I have signed in the plan and in "as on site" plan and the same is structurally safe and fit for occupancy based on my personal assessment and certification of the Structural Engineer engaged by us.

This deed of undertaking is executed by us on the.....day of.....20.....with the full knowledge of the contents of this document.

Consultant	Name and Address	Registration No.	E-Mail ID & Mobile No.	Signature
Owner of the land / Power of Attorney Holder / Lease Holder				
Architect / L.S.				
Structural Engineer				
Geo-Tech Expert				
Site Supervision Engineer				

1.

DEPONENT Witnesses:

2.

Duly attested by the seal

Notary Public Government Rules & Regulations for a Construction Company
PDF Given FACEAT & P Common Construction Agreement



GOVERNMENT RULES & REGULATIONS FOR A CONSTRUCTION COMPANY

(5) Apart from the owner, the professionals to be involved, for different types of developments, in the preparation of plans and designs, supervision, quality control and ensuring completion as per the approved plan, shall be as prescribed below:—

(a) **Non High Rise buildings with height upto 12m. Registered Architect (RA) or Registered Engineer (RE)**

(b) **Non High Rise buildings with height more than 12.0m upto 18.30m Industrial Developments and Institutional Developments other than High Rise Buildings Registered Developer (RD),**

Registered Architect (RA) or Registered Engineer (RE),

Registered Structural Engineer (RSE), and

Registered Construction Engineer (RCE),

Registered Geotechnical Engineer

(c) **High Rise Buildings**

Registered Developer (RD),

Registered Architect (RA) or Registered Engineer (RE),

Registered Structural Engineer (RSE),

Registered Geo-Technical Engineer (RGE),

Registered Construction Engineer (RCE), and

Registered Quality Auditor (RQA)

(d) **Sub divisions**

Registered Architect (RA) or Registered Engineer (RE) or

Registered Town Planner (RTP)

(e) **Layout Developments**

Registered Developers (RD), and

Registered Architect (RA) or Registered Engineer (RE) or

Registered Town Planner (RTP)



Annexure - XIII

[See rule 23]

Registration, Qualification and Duties and Responsibilities of Architects, Engineers, Structural Engineers, Construction Engineers, Quality Auditors, Geo-Technical Engineer, Town Planners and Developers

(1) Registered Architect (RA)

(a) Registration

On the basis of their academic qualifications and experience, Architects shall be "Registered" in two "Grades". (The purpose is not to licence to practice, but to register such professionals to help to achieve compliance of these rules for the development or construction by the owners or developers). The eligibility criteria for registration in each "Grade" and the "Scope of Work" which can be entrusted to the Architects of each "Grade" are given below.

i) Architect Grade-I

Scope of work: To prepare plans, designs and drawings for any type of buildings or developments including High rise buildings and layout developments

Eligibility: The person with B.Arch or equivalent degree with minimum 2 years experience (after obtaining the degree) in professional work shall have registered with Council of Architects under the provisions of the Architects Act, 1972.

And

The evidence for registration of Architects with the council of Architects and subsequent renewal have to be produced.

ii) Architect Grade-II

Scope of work: To prepare plans, designs and drawings for small developments stated in clause (1) (a) of Rule 35

Eligibility: Diploma in Architecture with 5 years experience (after obtaining the Diploma) in professional work.

b) Duties and responsibilities

- i. He shall be responsible for making adequate arrangements to ensure not only that the work is executed as per the approved plans but also is in conformity with the stipulations of the NBC for safe and sound construction and smooth functioning of the services provided in the building and for making adequate provisions for services and equipments and protection from fire hazards as per NBC.
- ii. He shall on behalf of the owner obtain and submit the progress certificates, completion report and other details required for occupancy certificate and any other report as required under the rule and obtain the same and keep it ready in the site for inspection by the competent authorities.
- iii. He is solely responsible for obtaining the certificates required under this rule from the registered professionals.
- iv. In the event of any deviations he is the solely responsible to bring it to the notice of the competent authority



- v. If the services of the registered architect on record are terminated he shall immediately inform the competent authority about his termination and the stage of work at which his services have been terminated. The registered architect appointed as replacement of the preceding architect shall inform about his appointment on the job and inform the competent authority of any deviation that might have occurred on the site with reference to the approved plan and the stage at which he is taking over the charge.
- vi. The registered architect appointed shall inform the competent authority immediately on termination of the services of the registered structural engineer on record, registered construction engineer on record, or any change of owner or registered developer.
- vii. He shall instruct the concerned person or agency that adequate provisions are made for ensuring the safety of workers and others during excavation, construction and erection.
- viii. He shall instruct the concerned person or agency that adequate provisions are made for providing safe and adequate temporary structures required for construction and development
- ix. He should inform in the progress report about satisfactory working conditions for the workers as per the various acts in force and binding on the employers of workers,
- x. If there are deviations to approved plan or unauthorized additional construction, the same has to be intimated immediately
- xi. He should provide all certificates and reports as required under these rules

(2) Registered Engineer (RE)

a) Registration

On the basis of their academic qualifications and experience, Engineers shall be "Registered" in three "Grades". The eligibility criteria for registration in each "Grade" and the "Scope of Work" which can be entrusted to the Engineer of each "Grade" are given below.

i) Grade-I

Scope of work: To prepare plans, designs and drawings for any type of buildings or developments including High rise buildings and layout developments;

Eligibility: B. E. Civil or equivalent degree or A.M.I.E. with minimum 10 years experience (after obtaining the degree) in professional work.

ii) Grade-II

- (i) **Scope of work:** To prepare plans, designs and drawings for Non High rise building (i.e. upto 18.30m. in height) and layout developments on lands upto 10 hect. in extent.

Eligibility: B. E. Civil or equivalent degree with minimum 5 years experience (after obtaining the degree) in professional work.

iii) **Grade-III**

Scope of work: To prepare plans, designs and drawings for small developments stated in clause (1) (a) rule 35 and excluding the above mentioned structures for Grade-I and Grade-II and layout developments on lands upto 5 hect. in extent.

Eligibility:

- i) Diploma in Civil Engineering with 5 years experience (after obtaining the diploma) in professional work, or
- (ii) B. E. Civil or equivalent degree with minimum 3 years experience (after obtaining the degree) in professional work,

b) **Duties and responsibilities**

- i. He shall be responsible for making adequate arrangements to ensure not only that the work is executed as per the approved plans but also is in conformity with the stipulations of the NBC for safe and sound construction and smooth functioning of the services provided in the building and for making adequate provisions for services and equipments and protection from fire hazards as per NBC.
- ii. He shall be responsible to see that the structure serviceable for its intended uses.
- iii. To inspect the building construction work periodically and maintain such records as cube strength, steel test certificate, etc. as envisaged in NBC. He is responsible for quality of material and execution.
- iv. He shall on behalf of the owner obtain and submit the progress certificates, completion report and other details required for occupancy certificate and any other report as required under the rule and obtain the same and keep it ready in the site for inspection by competent authorities.
- v. He is solely responsible for obtaining the certificates required under this rule from the registered professionals
- vi. In the event of any deviations he is the solely responsible to bring it to the notice of the competent authority.
- vii. In the event of any deviations he is the solely responsible to bring it to the notice of the competent authority.
- viii. If the services of the registered engineer on record are terminated, he shall immediately inform the competent authority about his termination and the stage of work at which his services have been terminated. The registered engineer appointed as replacement of the preceding engineer shall inform about his appointment on the job and inform the competent authority of any deviation that might have occurred on the site with reference to the approved plan and the stage at which he is taking over the charge.
- ix. If there are deviations to approved plan or unauthorized additional construction, the same has to be intimated immediately.
- x. The registered engineer appointed shall inform the competent authority immediately on termination of the services of the registered structural engineer on record, registered construction engineer on record, or any change of owner or registered developer.
- xi. He shall instruct the concerned person or agency that adequate provisions are made for ensuring the safety of workers and others during excavation, construction and erection and that the employment of workers are made satisfying the statutory Acts



- xii. He shall instruct the concerned person or agency that adequate provisions are made for providing safe and adequate temporary structures required for construction and development
- xiii. He should inform in the progress report about satisfactory working conditions for the workers as per the various acts in force and binding on the employers of workers,
- xiv. To provide all certificates and reports as required under this rule.

(3) Registered Structural Engineer (RSE)

(a) Registration

On the basis of their academic qualifications and experience, Structural Engineers shall be "Registered" in two "Grades". The eligibility criteria for registration in each "Grade" and the "Scope of Work" which can be entrusted to the Structural Engineer of each "Grade" are given below.

i) Grade-I

Scope of work: To prepare structural design and structural drawings for any type of buildings including High rise buildings

Eligibility: M. E., or equivalent degree in structures or Earthquake Engineering or Ph.D. in the subject with minimum 5 years of experience (after obtaining the degree) in structural design work at a responsible position as a structural designer.

Note: The experience as stated above shall be under a Structural Engineer on Record. (This requirement shall be waived for the first ten years of the notification of these Rules)

ii) Grade-II

Scope of work: To prepare structural design and structural drawings for small developments stated in clause (1) rule 35 and excluding the above mentioned structures for Grade-I

Eligibility: (ii) B. E. Civil or equivalent degree with minimum 3 years experience (after obtaining the degree) in structural design work at a responsible position as a structural engineer, or

(iii) M.E. or equivalent degree in Structures/ Earthquake Engineering or Ph.D. in the subject with minimum 1 years of experience (after obtaining the degree) in structural design work at a responsible position as a structural engineer .

Note: The experience as stated above shall be under a Structural Engineer on Record. (This requirement shall be waived for the first ten years of the notification of these Rules)

(b) Duties and responsibilities:

- i. To prepare a report on the structural design and to prescribe the method and techniques of its execution as per relevant IS specifications and NBC.

In the case of High rise buildings.

- (a) To get required soil (geo-technical) investigation done from an approved laboratory and submit the report concerning the same in prescribed format to the competent authority.
- (b) To get the structural Design checked through third party verification and submit a certificate concerning the same to the competent authority.
- ii. To prepare and submit design basis report
- iii. To prepare a detailed report on structural drawings and specifications for execution indicating thereon design live loads, safe soil bearing capacity, specification of materials, assumption made in the design, special precautions to be taken by contractor or builder to suit the designs and assumptions etc.
- iv. To supply copies of structural drawings to the Registered Construction Engineer on Record (CER) and the site supervisor and keep it ready for inspection of the competent authority during progress certification.
- v. To ensure that the structural components are executed without any deviation of the submitted structural drawing.
- vi. to inspect the work at all important stages and certify the work being executed for structural safety and over all structural soundness of the building and as per the original structural drawings and furnish a copy of the certificate to Registered Architect or Registered Engineer for submission to the competent authority periodically along with progress report, structural inspection report and completion report.
- vii. To advise the owner or developer or architect or engineer for arranging for tests purpose and their report for soil, building material etc., for his evaluation and design consideration.
- viii. To review field test result at progressive stages as per NBC and submit the same to the competent authority. He shall also inform the competent authority if any deviations in quality of materials or execution.
- ix. to inform the Registered Architect or Registered Engineer of any structural deviations noticed by him during the progress of work, who in turn will inform the same to the competent authority
- x. To inform in writing the competent authority within 7 days if for any reason he is relieved of appointment or responsibilities as the registered structural engineer(RSE) for the development.
- xi. Not to provide services to further or advance work of any type of development that does not comply with these rules or is unauthorised as per these rules.
- xii. If there are deviations to approved plan or unauthorized additional construction, the same has to be intimated immediately to Registered Architect or Registered Engineer who will inturn will inform the same to the competent authority
- xiii. To provide all certificates and reports as required under this rule.

(4) Registered Construction Engineer (RCE)

a) Registration

The requirements for registration shall be:

- (i) B.E. Civil or equivalent degree or A.M.I.E. with five years experience (after obtaining the degree) in construction , or
- (ii) Diploma in Civil Engineering with seven years experience (after obtaining the diploma) in construction, or
- (iii) B. Arch or equivalent with 5 years of experience (after obtaining the degree) in construction registered with Council of Architects under the provision of Architects Act



Note: The experience as stated above shall be under one or more Construction Engineer on Record of one or more reputed construction companies. Such company or companies established within or outside the area of jurisdiction of the competent authority shall be of minimum ten years of standing.

b) Duties and responsibilities

All construction works (except the small developments defined in the clause (1) (a) rule 35) shall be carried out under the supervision of a CER.

- i. To adhere strictly to the structural drawings, specifications and written instructions of the Registered Structural Engineer on Record and Registered Architect on Record or Registered Engineer on Record
- ii. To ensure that the structural components are executed without any deviation of the submitted structural drawing.
- iii. To follow the provisions of NBC, or I.S. specifications as regards materials, components, quality control and the process of construction.
- iv. He shall be responsible to see that the structure serviceable for its intended uses.
- v. To inspect the building construction work periodically and maintain such records as cube strength, steel test certificate, etc. as envisaged in NBC and submit the reports to Registered Architect or Registered Engineer. The same has to be kept in the site for inspection by the competent authority.
- vi. He is responsible for quality of material and execution.
- vii. To provide for safety of workers and others during excavation, construction and erection.
- viii. To provide safe and adequate temporary structures required for construction and erection.
- ix. To bring to the notice of the registered Structural Engineer on record and Registered Architect on record or Registered Engineer on record any situation of circumstances which in his opinion are liable to endanger the safety of the structure. The Registered Architect or Registered Engineer will in turn intimate to the competent authority
- x. To deposit with the Registered Architect or Registered Engineer for submission to the competent authority one set of working drawings of the works executed along with the progress certificates before proceeding with the next stage of the work.
- xi. He/she shall be in overall charge of the site and responsible for overall supervision of the work.
- xii. He/she shall ensure that all the work under his charge is carried out in conformity with the approved drawings and as per the details and specifications supplied by the registered Architect on record or Registered Engineer on record.
- xiii. He/she shall take adequate measures to ensure that no damage is caused to the work under construction and adjoining properties.
- xiv. He/she shall also ensure that no undue inconvenience is caused in the course of his/her work to the people in the neighborhood.
- xv. He shall also ensure that no nuisance is caused to traffic & neighboring people by way of noise, dust, smell, vibration etc. in the course of his/her work. If there are deviations to approved plan/unauthorized additional construction, the same has to be intimated to Registered Architect or Registered Engineer who will in turn will inform the same to the competent authority

xvi. To provide all certificates and reports as required under this rule.

(5) Registered Quality Auditor (RQA)

a) Registration

The requirements for registration shall be:

- (i) B.E. Civil or equivalent degree with five years experience (after obtaining the degree) in testing of building materials including concrete and/or experience in quality control work with a reputed construction agency.
- (ii) M.E. (Civil) or equivalent with two years experience (after obtaining the degree) stated above.

Note: The experience as stated above shall be under one or more registered quality auditors/ under one or more reputed construction companies or agencies. Such companies or agencies established within or outside the area of jurisdiction of the competent authority shall be of minimum ten years of standing.

b) Duties and responsibilities

- (i) The construction work of a High rise building executed by CER shall be under an independent quality inspection programme prepared and implemented under the supervision of an independent QAR.
- (ii) At the time of seeking permission from competent authority for starting construction of a High rise building of special structures CER shall submit an undertaking from QAR that:

- a) The QAR is agreeable to accept the assignment to implement the quality inspection programme, and that the appointed QAR is acceptable to the Owner/Developer.
- b) The QAR will get all the testing of building materials, concrete etc. done by an independent approved testing laboratory.

iii. During construction of a High rise building the QAR shall carry out necessary testing of materials as well as non-destructive testing of structural components with the help of approved testing laboratory and submit to the CER, Registered Architect / Registered Engineer and the owner/developer, the reports as per quality inspection programme.

(iv.) Upon completion of the construction of High rise building or the special structure the QAR shall submit the report and certificate in the prescribed format based on the quality inspection programme. This report and certificate will be submitted to the CER, Registered Architect/Registered Engineer and the owner/developer for final submission to the competent authority to provide all certificates and reports as required under this rule.

(6) Registered Geo-Technical Engineer (RGTE)

a) Registration

For foundation work, the requirements for registration Geo-technical Engineer on Record shall be:

- (i) M.E. (or equivalent) in Geo-technical Engineering with minimum 5 years of experience (after obtaining the degree)
- (ii) The experience as stated above shall be under one or more Geo-technical Engineer or agency. Such agencies established within or outside the area of jurisdiction of the competent authority shall be of minimum ten years of standing.
- (iii) The Geo-technical Engineer shall state the Laboratory he will be using.

b) Duties and Responsibilities:

All High Rise Buildings shall have, for foundation work, the services of a Registered Geo-technical Engineer on Record.

- i To carry out soil investigation at proposed locations as per specifications of Registered Structural Engineer on Record (SER)
- ii To recommend various type foundation for proposed structure and loading with supporting calculations
- iii To enable SER to take site decision in case strata different investigation report is met with.
- iv To list out precautionary measures so that there is no damage to adjacent property.

(7) Registered Town Planner

a) Registration

For layout developments /subdivisions, the requirements for registration Town Planner shall be:

Masters degree in Town and Country Planning or in Urban Planning or in City Planning or in Regional Planning or in Housing or an equivalent degree with minimum 2 years experience (after obtaining the degree), or

A.I.T.P. with minimum 2 years experience (after passing the examination/becoming the member)

b) Duties and Responsibilities:

- i. Preparation of plans for land subdivisions/layouts,
- ii. He shall be responsible for making adequate arrangements to ensure not only that the work is executed as per the approved plan but also is in conformity with the stipulations / conditions of approval. He shall inform the competent authority of any deviation with reference to the approved plan.
- iii. If the services of the Registered Town Planner are terminated he shall immediately inform the competent authority about his termination. The Registered Town Planner appointed as replacement of the preceding Town Planner shall inform about his appointment on the job and inform the competent authority of any deviation that might have occurred on that site with reference to the approved plan and the stage at which he is taking over the change.
- iv. The Registered Town Planner shall inform the competent authority immediately any change of owner or developer before getting permission for sub division / layout under these rules.
- v. He shall instruct the concerned person/agency that adequate provisions are made for ensuring the safety of workers and others during the layout development.
- vi. to provide all certificates and reports as required under this rule.

(8) Registered Landscape Architect

a) Registration

For the work related to landscape design for building/ layout development for land extending 5 hectares and above, the requirements of registration of landscape architect shall be Bachelor or Master's Degree in landscape architecture or equivalent from recognized Indian or Foreign Universities.

b) Duties and Responsibilities

- i. Preparation of landscape designs for buildings/ layout developments
- ii. Shall be responsible for the maintenance of the natural eco system
- iii. shall inform the competent authority if there are any intervention to the natural scape

- iv. He shall be responsible for making adequate arrangements to ensure not only that the work is executed as per the approved plan but also is in conformity with the stipulations / conditions of approval.
- v. If the service of the Registered Landscape Architect is terminated he shall immediately inform the competent authority about his termination. The Registered Landscape Architect appointed as replacement of the preceding Landscape Architect shall inform about his appointment on the job and inform the competent authority of any deviation that might have occurred on that site with reference to the approved plan and the stage at which he is taking over the change.
- vi. The Registered Landscape Architect shall inform the competent authority immediately any change of owner or developer before getting permission for subdivision / layout under these rules.

(9) Registered Developer

a) Registration

- i. Generally the person / firm who apply to register as developer shall have experience in the field of construction or real estate development.
- ii. The developer have to be an IT Assessee.

b) Duties and responsibilities

The responsibilities of developers shall be:

- i. To obtain planning permission from Competent Authority and building permission from the Executive Authority of Local body prior to commencement of construction / development
- ii. To appoint Registered Architect / Registered Engineer/Construction Engineer and Registered Structural Engineer and other required professionals stated in these rules
- iii. The appointment of the Registered Architect/ Registered Engineer /Registered Construction Engineer/ Registered Structural Engineer shall mean that he (the Developer) has authorised the Registered Architect / Registered Engineer to do all things necessary and to take all adequate measures for preparing the design, drawings and specifications for the project and to appoint on his behalf appropriate persons to act as CER, required for the proper execution of the project and to retain on behalf of the owner any other specialist or expert required on the work of the project, in consultation with the developer.
- iv. To obtain and submit to the competent authority, along with application for building permission the required certificates/report/ undertakings ,each progress report through Registered Architect/Registered Engineer and application for occupancy certificate.
- v. To obtain at relevant stages certificates from them, for submission to the competent authority, through Registered Architect/Registered Engineer that in designing the building/ development and providing detailed drawings and specifications for it they have complied with requirements as laid out in these rules
- vi. To obtain and adhere to the quality assurance procedure prepared by the CER.
- vii. To adequately enable the CER to carry out his responsibilities.
- viii. To certify along with the CER that construction/ development has been carried out as per the design, detailed drawings and specifications provided by the Registered Architect on Record/ Registered Engineer on Record and Registered Structural Engineer on Record



- ix. To regularly submit progress reports and certificates through Registered Architect/Registered Engineer as required by the competent authority.
- x. To inform in writing the competent authority within 7 days, if for any reason he ceases to be the developer or is relieved of his responsibilities as the developer.
- xi. To inform in writing to the competent authority within 7 days, if for any reason any of the registered professionals appointed by him have been relieved of their responsibilities or have resigned.
- xii. He shall not cause or allow any deviations from the approved drawings in the course of the execution of the project against the instruction of Registered Architect on Record / Registered Engineer on Record / Registered Construction Engineer on Record / Registered Structural Engineer on Record and shall bear all responsibilities for any irregularity committed in the use and function of the building or its parts for which the approval has been obtained.
- xiii. He shall not commence the use of building or shall not give the possession to occupy the building to any one before obtaining the completion certificate or occupancy certificate as applicable from the competent authority.
- xiv. He shall provide adequate safety measures for structural stability and protection against fire hazards likely from installation of services like electrical installation, plumbing, drainage, sanitation, water supply etc. wherever required under the rules.
- xv. He shall make available copies of titles for the land, approved plans and all certificates issued by the competent authority under these rules to the prospective purchasers of the premises.
- xvi. He should inform in the progress report about satisfactory working conditions for the workers as per the various acts in force and binding on the employers of workers,
- xvii. He shall instruct the concerned person/agency that adequate provisions are made for ensuring the safety of workers and others during excavation, construction and erection and that the employment of workers are made satisfying the statutory Acts
- xviii. If there are deviation to approved plan/unauthorized additional construction, the same has to be intimated immediately to the competent authority and Registered Architect / Registered Engineer.
- xix. He shall be responsible to see that the structure serviceable for its intended uses.
- xx. To provide all certificates and reports as required under this rule.

where the development is now proposed. No conversion or amalgamation shall be permissible in this case of lower income group dwelling.

- (3) The crucial date for levy of shelter charges in respect of Directorate of Town and Country Planning area is the date of issue of technical clearance by the Directorate of Town and Country Planning and in respect of Chennai Metropolitan Area, the same is the date of raising demand for development charges.

35. Planning Parameters for Non High Rise Buildings.— (1) All Buildings not exceeding 18.30m. in height,—

- (a) The minimum road width, FSI, set back etc. for Non High Rise buildings up to 16 dwellings or such other small developments like commercial, nursery schools, primary schools, religious buildings and cottage industries up to 300 sq.mts. shall be regulated according to the table below:

Sl. No	Description	Continuous Building Areas	Economically weaker Section Areas	Other areas	
1	2	3	4	4	
A	Minimum road width	1.5 m	1.5 m	3.0 m up to 6.0 m	6.0 m and above
B	Maximum Height	GF + 2F or Stilt + 3F subject to a maximum of 12m height		GF + 1F or Stilt + 2F subject to a maximum of 9m height	GF + 2F or Stilt + 3F subject to a maximum of 12m height
C	Maximum number of dwelling units / commercial use	up to 16 dwellings or up to 300 square meters of commercial use	up to 16 dwellings	up to 8 dwellings	up to 16 dwellings or up to 300 square meters of commercial use
D	Normally Permissible FSI	2.0			
E	Minimum Set backs	Where Street Alignment/new road is prescribed, it shall be from that street alignment/ new road line. In the case of others, it shall be from the property boundary.			
i)	Front set back	1.5m	1.0m	Abutting road width	Front set back
				Upto 9.0m.	1.5m
				More than 9.0m. upto 18m.	3.0m.
				More than 18m. upto 30.5m	4.5m.
				More than 30.5m.	6.0m.

ii)	Side Set back	Nil	Height of the building	Plot width	SSB
			Upto 7m.	Up to 9m	1m on one side
				Above 9m	1m on either side
			More than 7m. upto 12m.	Up to 6m	1m on one side
				Above 6m, upto 9m	1.5m on one side
				Above 9m	1.5m on either side
ii)	Rear Set back	Nil	Height of the building	RSB	
			Upto 7m.	Nil	
			More than 7m. upto 12m.	1.5m.	

(b) The minimum road width, FSI, set back etc. for Non High Rise buildings upto 18.30m height and exceeding 16 dwelling units and exceeding 300 square meters of commercial building shall be regulated according to the table below:

Sl No	Description	Continuous Building Areas	Other areas
1	2	3	4
A	Minimum road width	9.0 m	
B	Maximum Height	18.30 m	
C	Normally Permissible FSI	2.0	
D	Minimum Set backs	Where Street Alignment/new road is prescribed, it shall be from that street alignment/ new road line. In the case of others, it shall be from the property boundary.	
i)	Front set back	Abutting road width	FSB
		from 9.0m. upto 18m.	3.0m.
		More than 18m. upto 30.5m	4.5m.
		More than 30.5m.	6.0m.

II)	Side Set back / Rear Set back	Nil	Height of the building	SSB / RSB
			Upto 7m.	1.0m.
			More than 7m. upto 12m.	1.5m.
			More than 12m. upto 16.0m.	2.5m.
			More than 16m. upto 18.30m.	3.0m.

(c) Passage

Description		Passage width
A. Non High Rise buildings upto 12m height		
If the site does not directly about a public road but gains access through a private passage or through a part of the plot which can be treated as a passage from a public road of minimum width as prescribed above, the minimum width of such passage shall be as follows:		
	When it is intended to 8 dwellings	a) CBA / EWS areas - 1 m b) Other areas - 3 m
B. Non High Rise buildings exceeding 12.0m in height upto 18.30m height or exceeding 16 dwelling units		
If the site does not directly about a public road but gains access through a private exclusive passage or through a part of the plot which can be treated as a passage from a public road of minimum width as prescribed above, the minimum width of such passage shall be as follows:		
(i)	When it is intended to 8 dwellings or up to 600 square metres of commercial building and the length of the passage does not exceed 80 metres.	3.6 meters
(ii)	When it is intended to serve upto 12 dwellings or upto 2,400 square metres of commercial building and the length of the passage does not exceed 100 metres.	4.8 meters
(iii)	When it is intended to serve not more than 16 dwellings or up to 3000 square metres of commercial building and the length of passage does not exceed 120 metres.	6 meters
(iv)	When it is intended to serve not more than 20 dwellings or up to 6000 square metres of commercial building and the length of passage does not exceed 120 metres.	7.2 meters
(v)	When it is intended to serve more than 20 dwellings or more than 6000 square metres of commercial building.	9 meters

(18) In residential or predominantly residential developments, provision for atleast one, bath room and water closet shall be provided for the use of servants or drivers, for each block exceeding 25 Dwelling units.

(19) The space set apart and notified for formation of a new road or road widening or street alignment shall be transferred to the local body through a registered Gift Deed before actual issuance of Building Permit. The exact mode of conveyance of the land shall be consistent with the relevant enactment and regulations. In such cases 'Transfer of Development Rights' (TDR) provisions of the rule 48 shall be applicable.

(20) Basement Floor.— (a) The height of basement floor shall not exceed 1.2 metres above ground level and the headroom shall be minimum 2.4 metres.

(b) No part of the basement shall be constructed in the minimum required set back spaces, required for the movement of fire fighting vehicles or equipments.

(c) In cases where second basement is proposed for parking and incidental uses, sufficient provision for lighting and ventilation and also for protection from fire to the satisfaction of Directorate of Fire and Rescue Services shall be made.

(d) During the construction of the basement floor, it shall be the sole responsibility of the Building Permit holder to ensure that the building or structure in the adjoining sites are not weakened or damaged.

(21) Security Deposit.— The applicant (not being a Government department or agency) shall deposit a sum at the rate of 50% of the infrastructure and amenity charges in force per square metre of floor area as a refundable non-interest earning security and earnest deposit. The deposit shall be refunded on completion of development as per the approved plan as certified by Competent Authority; if not, it would be forfeited.

(22) Display Board.— (a) The details of the development for which planning permission is issued, shall be displayed in the site in the format as prescribed in Rule 10(7) of these regulations.

(b) The applicant not being a Government department or agency shall pay a sum of Rs. 10,000/- (Rupees ten thousand only) as earnest money non interest bearing refundable deposit and same should be utilized for the purpose of installing the display board as prescribed in Rule 10(8) on the site by Local body, in the event of the applicant not fulfilling the conditions stated in (a) above.

(c) If the applicant fulfills the conditions (a) above, the deposit shall be refunded after production of the completion certificate.

(23) In cases of Hospital Buildings with Ground Floor/Silt Floor + First Floor and above and floor area exceeding 300 sq.m. in each floor, the special provisions for Hospital Buildings prescribed in Annexure - IX shall be adhered to.

(24) Affordable Housing.— (a) Development for affordable housing projects with size of dwelling unit not exceeding 40 sq.m within Chennai Metropolitan Area and dwelling unit with size not exceeding 60 sq.m in the rest of state shall be regulated according to provisions stipulated above.

(b) Premium FSI charges shall not be collected for the excess FSI area over and above normally permissible FSI area for affordable housing projects.

36, Planning Parameters of Industries.— The road width, FSI, Sethbacks etc. for cottage industries, Green industries, Orange industries and Red industries shall be regulated according to the table below. The Detailed lists of these industries are given in Annexures V, VI, VII and VIII respectively.

Sl.No.	Description	Category of industries		
		Cottage Industries	Green & Orange industries	Red industries (Special & Hazardous)
A.	Minimum road width	7m.	7m.	7m.
B.	Maximum Height	18.30m.	18.30m	18.30m.
C.	Normally Permissible FSI	1.50	1.50	1.50
D.	Minimum Setback	Where Street Alignment/new road is prescribed, it shall be from that street alignment/new road line. In the case of others, it shall be from the property boundary.		
(i)	Front Setback	Abutting road width	Front Setback	6.0m
		less than 9m	1.5m	
		9m. to 18m.	3.0m.	
		18m. to 30.50m.	4.5m	
		More than 30.5m.	6.0m.	
(ii)	Side Setback	1.50m.	3.0m.	6.0m.
(iii)	Rear Setback	Nil	2.0m.	6.0m.
E.	Structures permissible in the minimum prescribed Front set back, Side setback and Rear set back are given in the rule 28			
	In addition, incidental structures such as Gate pillars, servant room, watch man booth, cycle stand and toilets with height not exceeding 4m are permissible in these minimum prescribed setback spaces.			
F.	Parking spaces shall be provided within the site conforming to standards prescribed in the Annexure - IV.			
G.	Rainwater harvesting provisions as prescribed in the Annexure - XXII.			
H.	The reservation of Land for community recreational purposes such as park or play ground required in these regulations shall be as given in the rule 41.			

Note:

The maximum height of the building shall not exceed 18.30 metres provided water tanks, chimneys, Architectural features such as flag masts, gopurams, minarets, steeples and other ornamental structures which are not intended for human habitation may be permitted subject to a ceiling of 30.5 metres from ground level. In case total height exceeds, 30.50 m from Ground level necessary NOC from Airport Authority of India (AAI) shall be furnished.

37. Planning Parameters of Institutional Buildings.— Including nursery schools, Primary schools and religious buildings with floor area exceeding 300 sq.m. Secondary schools, Colleges, Higher Educational, Technical & Research Institutions, Students hostels & Dormitories, Research Institutions, Broadcasting, Telecasting & Telecommunication centers, Government & Quasi Government Offices, and Institutions, Government Archives, Museums, Art galleries and Public libraries, Foreign Missions, Consulates and Embassies.

Sl.No.	Description	Continuous Building Areas	Other areas
1	2	3	4
A.	Minimum road width	7.20m	Minimum 7.2m for schools upto higher secondary level and industrial training institutes. For others, min. 9 m
B.	Maximum Height	18.30m.	
C.	Normally Permissible FSI	2.0	
D.	Minimum Setbacks	Where Street Alignment/new road is prescribed, it shall be from that street alignment/narrow line. In the case of others, it shall be from the property boundary.	
(i)	Front Setback	6m	6m
(ii)	Side Setback	Nil	6m
		For schools - 2m	
(iii)	Rear Setback	Nil	6m
		For schools - 2m	
E.	a) Structures permissible in the minimum prescribed Front set back, Side setback and Rear set back are given in the rule 28 b) In addition, Gate pillars, gopurems, and incidental structures (with height not exceeding 4m) such as servant room, cloak room, and watch man booth, cycle stand, Kitchen and toilets are permissible in these minimum prescribed setback spaces.		
F.	Parking spaces shall be provided within the site conforming to standards prescribed in the Annexure - IV.		
G.	Rainwater harvesting provisions as prescribed in the Annexure - XXII.		
H.	The minimum width of corridor shall be as given in rule 42		
I.	Special regulations for physically disabled stated in the rule 43 shall be adhered to.		
J.	The applicant not being a government department or agency shall deposit a sum at the rate of 50% of the infrastructure and amenity charges as a refundable non-interest earning security and earnest deposit. The deposit shall be refunded on completion of development as per the approved plan as certified by Competent Authority; if not, it would be forfeited.		
K.	The reservation of Land for community recreational purposes such as park or play ground required in these regulations shall be as given in the rule 41.		

Note:

- (i) In Continuous Building Area (CBA), there shall be atleast 1m wide internal passage from rear to front in ground level or ground floor, directly accessible to road.
- (ii) In the case of schools, the development shall conform to the additional safety standards stated in the Annexure - XV.
- (iii) The maximum height of the building shall not exceed 18.30 metres provided water tanks, chimneys, Architectural features such as flag masts, gopurams, minarets, steeples and other ornamental structures which are not intended for human habitation may be permitted subject to a ceiling of 30.5 metres from ground level.
- (iv) In cases of Hospital Buildings with Ground Floor/Split Floor + First Floor and above and floor area exceeding 300 sq.m. in each floor, the special provisions for Hospital Buildings prescribed in Annexure - IX shall be adhered to.

38. Planning Parameters of Transport Terminals.—

Sl.No	Description	AM areas
A.	Minimum road width	9 metres except for container terminals where it shall be 18m
B.	Maximum Height	18.30m.
C.	Normally Permissible FSI	1.00
D.	Maximum Plot coverage	75%
E.	Minimum Setbacks	Where Street Alignment/new road is prescribed, it shall be from that street alignment/narrow line. In the case of others, it shall be from the property boundary.
	(i) Front Setback	6m
	(ii) Side Setback	6m on either side
	(iii) Rear Setback	6m
F.	a) Structures permissible in the minimum prescribed Front set back, Side setback and Rear set back are given in the rule 28 b) In additions, incidental structures such as gate pillars, servant room, watch man booth, cycle stand, kitchen and toilets with height not exceeding 4m are permissible in these minimum prescribed setback spaces.	
G.	Parking: 10% of the extent of the site shall be reserved for parking in the part of site carved out in a regular shape preferably with frontage abutting the road.	
H.	Rainwater harvesting provisions as prescribed in the rule 63 shall be provided.	
I.	Special regulations for physically disabled stated in the rule 43 shall be adhered to.	

39. Special rules for High Rise Buildings.— (1) Areas set apart for High Rise building developments in Chennai Metropolitan Area are given in Annexure - XIX. In rest of the State, High Rise buildings are permissible except in areas specifically declared as prohibited area for construction of High Rise Buildings in the Master Plan or Detailed Development Plan or as may be declared by the local body in other areas with the

approval of the Directorate of Town and Country Planning or Government from time to time.

- (2) Road width:- The site shall either abut on a road not less than 18 metres in width or gain access from public road not less than 18 metres in width through a part of the site which can be treated as an exclusive passage of not less than 18 metres in width.

Provided further that High Rise building may be permitted with limitations on maximum FSI of the building on a site abutting or gaining access from a public road of min. 12 m or 15 m in width, or gain access from public road not less than 12 m or 15 m in width through an exclusive passage of not less than 12 m or 15 m in width, subject to compliance of the planning parameters according to the table below

- (3) The extent of the site, FSI, Set back etc. for High Rise Buildings shall be regulated according to the table below:

TABLE

Sl. No	Description	All Areas		
A.	Minimum Road width	12m.	15m.	18m.
B.	Normally Permissible FSI	2.0	2.5	3.25
C.	Maximum Coverage	50%		
D.	Minimum set back all around	Height of the building above ground level	Minimum required setback space from the property boundary	
		Upto 30m.	7m.	
		Above 30m.	For every increase in height of 6m or part thereof above 30m minimum extent of setback space to be left additionally shall be one meter subject to the maximum setback of 20m.	
E.	Spacing between blocks in case of more than one block of High Rise building	Height of the building above ground level	Minimum required spacing between blocks	
		Upto 30m.	7m.	
		Above 30m.	For every increase in height of 6m. or par thereof above 30m. space to be left additionally shall be one metre subject to the maximum setback of 20m.	

Explanation 1.—

- (i) Road width means the road space as defined in clause (103) of rule 2. The qualifying road width for permitting High Rise buildings with more than 18.30m shall be available atleast for a prescribed length of 500m in the case of Chennai Metropolitan Area and other Municipal Corporations and 250m for the other areas along the length of the road abutting the site and the stretch from a junction can be straight or a curve or zigzag or combination of the above.



Annexure - IX

[See rule 35 (23)]

Regulations for Special Provisions for Hospital Buildings.

- (1) Ramps of minimum width 2.4 m and maximum slope of 1:12 shall be provided in all Hospital Buildings with Ground Floor/Stilt Floor +First Floor and above and floor area exceeding 300 sq.m. in each floor.
- (2) Set back space around the building with access for fire fighting vehicles to operate, as already laid down in the Development Regulations shall be provided as given below:
 - (i) For buildings less than 18.30 metres height, 6.0 metres wide set back around.
 - (ii) For buildings between 18.30 metres and 30.0 metres height, 7.0 metres set back around.
 - (iii) Set back area should be free of any obstruction, such as fountains, statues, flower pots, decorative idols, ramps etc., to facilitate movement of vehicle and people during emergency.
- (3) Minimum of two large 'lowered windows' (with adequate safety provision) shall be provided in each floor for easy evacuation of persons, wherever the building is fully glazed.
- (4) Fire Lifts with alternate power supply outside the building shall be provided.
- (5) Fire fighting training shall be given for selected employees in each hospital. The Hospital Authorities shall approach the Directorate of Fire & Rescue Service Department (DF&RS) for imparting such training.
- (6) Regular mock drills shall be conducted once in every six months with the help of DF&RS to ensure effective functioning of all safe guards built for fire and life safety.
- (7) All Government/Private Hospitals shall display in suitable places, within the premises, declaration enlisting the fire safety measures and escape routes provided in the hospital. This declaration should be displayed on a board in Tamil and English.

**Special regulations for schools**

Buildings of schools shall conform to the following special regulations:

1.Site

Site of the school building

- [a] shall not have opening direct to the National / State Highways with heavy vehicular traffic.
- [b] shall not be close to water bodies and forests.
- [c] shall not be in the close proximity of garbage dumps, dusty and noisy roads or factories.

2.No. of floors

The provisions in the National Building Code 2016 in all aspects apart from adherence to these rules.

3.Stair case and exits shall conform to the following minimum standards.

- [a] Minimum width 1.6m
- [b] One stair case for every 5 class rooms
- [c] Mid landing not less than 1.6m in width
- [d] Continuous stairs from ground level to the terrace level.
- [e] Travel distance to the stair case from any part of upper floors shall not be more than 22.6m.
- [f] Exit door if any from the stair case at the ground level shall open directly to the open space and it shall not be less than 2m in width and 2.1m in height.

4.Class rooms shall confirm to the following:

- [a] Minimum size shall be 6m x 6m for student strength of not exceeding 40 Nos.
- [b] Thickness of wall shall not be less than 23 cms.
- [c] Head room height of the class rooms shall be minimum 3metres.
- [d] Each class room shall have at least 2 doors and 2 windows
- [e] Doors and windows should be made of materials with high fire resistance rating.

5.Fire safety measures

- [a] Adequate no. of fire extinguishers shall be provided
- [b] Provision of separate water tank / sump to meet the requirement of fire fighting during emergency shall be provided.
- [c] Buildings shall be constructed using non-combustible materials.



6. Electrical wiring, equipments and installations shall conform to the safety standards prescribed in the NBC and also conform to the requirements of the Chief Electrical Inspectorate.

7. Others

- [a] Kitchen if any located within the school premises shall not be closer to the class rooms or student toilets.
- [b] Where covered verandah / corridor is provided, it shall be minimum 1.8m. in width in front of class rooms.
- [c] The parapet wall in the open terrace shall be minimum 23cm in thickness and 100cm in height.
- [d] Toilets enough in number and with adequate water supply shall be provided.

FACEAT & P COMMON CONSTRUCTION AGREEMENT



AGREEMENT BETWEEN THE OWNERS AND THE CONTRACTOR FOR CONSTRUCTION OF BUILDING

THIS AGREEMENT made at Chennai dated on-----, between-----
-----expression shall unless repugnant to the context or meaning thereof, be deemed to include his heirs, legal representatives, executors and administrators) of the ONE PART and Er.S.JAGADEESAN (M/s.TRINITY ENGINEERING ASSOCIATES) having construction business at Chennai -----
--- (hereinafter referred to as "the Contractors" which expression shall, unless repugnant to the context or meaning thereof, be deemed to include its successors and assigns) of the OTHER PART.

WHEREAS the OWNER is desirous of constructing a Residential building on its vacant land bearing----- (hereinafter referred to as "the said property") and the contractors have offered to construct the same and also as specified in the site layout plans, preliminary sketch designs, architectural drawings, structural drawings, service drawings and all other detailed plans and drawings for the proper construction and completion of the said works. The contractor will have to construct and complete the said works as hereinafter specified upon as per our works order date and subject to the detailed specifications, costing, terms & conditions as set forth (all of which are collectively hereinafter referred to as "the said works") at the rate as specified in the above referred works order of the built up area of the buildings (hereinafter referred to as "the said contract amount").

AND WHEREAS The Owner has agreed to appoint the contractors for the said works;

AND WHEREAS the contractors have requested the Owner to execute these presents which he has agreed to do so.

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS :

1. In consideration of the said contract amount to be paid at the times and in the manner set forth in the Schedule of Payments hereto as per the works order, the contractors shall on and subject to the said conditions, execute and



complete the said works more particularly described in the works order here to and shown on the said drawings, strictly in accordance with the general specifications annexed hereto and marked annexure.

2. The Owner shall pay the contractors said contract amount or such other sum as shall become payable at the times and in the manner specified in works order.

3. For the purposes of this contract, "built up area" means the total covered area of the building at floor level out-to-out measurement of wall surface (architectural projection/Wardrobes etc., excepted) and shall be inclusive of staircase and balconies. Stilt floor and Balconies shall be measured and paid per sqft in a different rate as per the price summary sheet below.

4. It is hereby agreed that the contract amount shall be inclusive of

a) Technical supervision of the works. A full time qualified Site Engineer will be at the site till completion for co-ordination between the client Architect and shall be appointed by the Contractor.

b) Cost of all materials for construction.

c) Wages of labour, technical supervisors, all other workers and staff required for execution of the said works in accordance with the costing, terms & conditions as specified in the works order.

d) Cost of all electrical, Rain water harvesting, Sanitary, and plumbing (Both hot and cold water) fittings.etc. Cost of the same is included in the price agreed by the Contractor.

e) For the purpose of the Construction and the estimated contract value, the Contractor has considered the drawings with reference -----

f) Cost of all other items as specified in the works order.

The contract amounts are shown as reasonably possible for estimation purpose and the actual billing will be based on the actual area measurement.

5. The detailed architectural drawings and other drawings shall be and remain the property of the Owner. All the drawings shall remain in custody of the contractors during the progress of the work and they shall deliver them to the Owner on the performance of the said works or termination of the contract.



6. The Owner may require alteration of the drawings and the nature of the work by adding / modifying or omitting any items of work or having portions of the same carried out. any major modifications from the plan, can be carried out only on the written request of the Owner. The Owner shall make payment for the differential excess charges arising out of the alterations, at such rates as may be mutually agreed upon.

7. The contractors shall commence the work within 15 days of the handing over of the site to them and complete the entire work within ----- months thereafter, subject nevertheless to the provision for reasonable extension of time as provided in the said conditions.

8. The contractors, while carrying out the said works, shall comply with the provisions of all laws, rules and bye-laws for the time being in force affecting the said works and will give all necessary notices to and obtain the requisite sanction of the concerned local authorities in respect of the said works and will comply with the building and other regulations of such authority and will keep the Owner indemnified against all fines, penalties and losses incurred by reason of the breach of the contractors of any such laws, bye-laws and regulations.

9. The Owner shall make all payments under this contract at Chennai as per the works order.

10. The contractor will have to co-ordinate with an architect for construction of the building and the payment will be released stage by stage after due confirmation from the architect.

11. In case of any dispute or difference should arise between the parties, whether in respect of quality of material used by the contractors or work done or in respect of delay in completion of works or in respect of payment of extra work required to be done and so executed or in respect of measurement of work done or in respect of delay of payment to the contractors or touching the interpretation, fulfillment of any of the terms of these presents or any other matter arising out of or in connection with these presents or the carrying out of the work, shall be referred to arbitration of two arbitrators, one to be appointed by each party. The arbitrators shall appoint an umpire before entering upon the reference. The arbitrators shall make their award within six months from the date of entering on the reference.



If the arbitrators do not make their award within the stipulated period or have delivered to any party or to the umpire a notice in writing stating that they cannot agree, the umpire shall forthwith enter on the reference and shall make his award within three months of entering on the reference or within such extended time as the parties may agree and in the absence of such agreement, as the Court may allow. The arbitrators or umpire, as the case may be, shall be entitled to consult any expert, after previous notice to the parties, the cost whereof shall be borne by the parties equally. The proceedings of the arbitrators shall be recorded in English, a copy whereof shall be furnished to each party.

12. The provisions of the Arbitration and Conciliation Act, 1996 so far as applicable and are not inconsistent or repugnant to these presents, shall apply to this reference to arbitration. The cost of the reference and award shall be in the discretion of the arbitrators, who may direct by whom and in what manner, the same or any part thereof shall be paid. The award of the arbitrators or umpire shall be final and binding on the parties and the parties, their executors and administrators shall on their respective parts obey, abide by the award and shall not challenge on any ground excepting fraud or collusion or error apparent on the face of the award. It is hereby agreed between the parties that the parties shall resort to arbitration, before filing any suit for the enforcement of any right under these presents.

13. The Contractor hereby agrees to follow all Safety norms at the work site, like using of Safety helmets, by all including the workmen as well as Supervisors, Project Managers, visitors, etc

SPECIFICATIONS:



Sl No.	Classifications	Specifications
1	Structure	RCC framed structure based on Architectural / Structural design to ground, First, second & head room. Height of each floor, Grade of concrete, thickness of slab, openings, and coverings and other reinforcement and mix design details shall be as per Structural designer. River sand/M Sand shall be used concreting and other civil works.
02	Basement	Basement height of 2'6" from existing Road level. Filling by pit Sand and 6" depth quarry dust filling with consolidation and P.C.C. 1:4:8
03	Anti-termite:	Anti-termite treatment at (1) foundation stage, (2) Ground floor P.C.C Stage.
04	Brick-work	a. First class good quality bricks work in cement mortar (CM) 1:5 Ratio. b. All partitions work 0.115m thick using CM (1:4) with 2 nos of 8 mm rod at every 4th layer.
05	Plastering:	a) Internal: 12mm thick Cement mortar 1:4 Ratio. b) External: 15 – 18mm thick Cement mortar 1:4 ratio.
06	Flooring	c) Ceiling: 10mm thick in Cement mortar 1:3 ratio. All floors – Kajaria/Somani/Johnson/ RAK or equivalent brand of Vitrified Tiles 2' x 2' (basic cost Rs.50/- per sqft.)



Sl No.	Classifications	Specifications
08	Dadoing	a) Main Hall & Dining in I floor, vitrified Tiles (Kajaria/Somani/Johnson/RAK or equivalent - Basic Cost – 60 / Sqft) b) Granite/Marble flooring @ Rs 80 /-per sqft to be provided for the staircase area as per Architects drawing / instruction. (Basic cost Rs.80/-per sqft) Granite slabs with nosing for steps. Edges & sides shall be double thickness with required no. of grooves as required by the owner. Granite steps shall start from Ground floor to 2nd floor. a) Kitchen: Granite platform of 20 mm thick with half round nosing branded, ISI Brand stainless steel sink with drain board with plain glazed tiles up to 2 feet height from platform level. (Granite Black Rs.120 per Sqft., wall tile Rs.35/- per sqft.) b) All Toilet Walls –2'x1' Tiles Kajaria / Somani / Johnson/RAK or equivalent brand make up to roof level height – Toilets (Basic cost Rs.40/- per sqft.) c) Wash area: glazed tiles up to full height. (Basic cost of tiles @ Rs.35 /- per sqft.)
	Doors & Windows:	a) Main doors to be in first quality Teak frame (Clear Opening Size 7'x3' 6") 125mm x 75 mm with 38mm thick Architect designed door with heavy duty brass fittings-6" hinges a minimum of 5 nos, tower bolt 2 Nos, all drops and Godrej lock, nylon bush, magnetic catch, safety chain & door stopper, including 3 Nos. of heavy duty MS hold fast in each side.



Sl No.	Classifications	Specifications
		b) Bedroom & Other doors : Clear Opening size – 7'x3' c) Providing & fixing of 32mm thick Approved make kutty or equivalent flush door with Teak wooden frame of size 100 x 75mm with 3 nos of M S hold fasts per side and also to have 2 Nos of 125 mm long 8mm dia tower bolts, 4nos of 125mm heavy duty hinges, 1 No door stopper (or) 1 No magnetic catch wherever required etc, complete. d) Toilet: - do – as above with water proof flush/PVC door with 2 Nos tower bolts and 4 nos of Hinges e) Windows: Good Quality UPVC windows with 4 mm thick plain glass including MS grill etc., complete as per the architects with necessary needs. Width and height shall be architect or as per the owner.
09	Ventilators:	UPVC good Quality ventilators with 4 mm glass louvers& exhaust fan openings shall be separately made in the wall.
10	Weathering course & Water proofing: (Additional Cost)	a) Thoroughly prepare surfaces & lay to proper slopes $\frac{1}{2}$" brick jelly in lime 2:1 beaten down to an average finished thickness of 4"/3" with the addition of jiggery and kadukkai and supplying and fixing in position flat pressed tiles(1st quality TILES - 8"X8"/9"X9")set in cm 1:3 mixed with crude oil 5% the weight of cement used and pointed with the same oiled mortar at roof over SF including flashings at corners of slab and parapet.



Sl No.	Classifications	Specifications
11	Miscellaneous	Approved water proofing at roof to be done prior fixing of tiles. b) Interior – Birla or equivalent patty with Berger / Asian/ICI Premium emulsion paint c) Exterior – apex Weather Proof Emulsion Toilet sunken: Plastering with Cm (1:3) 20mm thick admixed with approved admixture, curing and testing and filling with brick jelly concrete (1:4:8) etc., complete. a) Provision for open cupboards in bedroom only. b) Staircase/inner courtyard handrails will be of MS. as per attached photo. c) 4' clear ht parapet wall of 4 1/2" thick brick wall measured from the finished water proofing level. d) All side balconies are MS grill with railing as per the architects requirements e) Air-conditioner provision on split in all bedrooms, living and dining with necessary drain arrangements connected to proper drain line. Providing shelves in store & pooja with 5 Nos 20mm thick quality cuddappah slab & necessary brick wall & plastering
12	Plumbing Sanitary & Water Supply:	a). Chambers : 600 x 600 and 900 x 600 with SFRC frame and cover and gully chambers. b) Drainage line, waste line should be 2.5", 4' and 6" approved brand pvc pipe, Prince or Star make, including connection to existing main chambers. (Excluding Metro, SW Board charges). c) All cold water supply pipes and all external and Internal pipes shall be of approved make UPVC and hot water supply lines will be of CPVC of standard quality. d) Rain water pipes Prince or Star (or) equivalent will be of 110mm dia PVC of Standard grade with ISI.

Sl No.	Classifications	Specifications
13	Electrical works: (Electrical as per the electrical drawing)	e) One wash basin in the dining room with all fittings & pipes.(Basic cost Rs 1200 per no) f) METRO /PARRYWARE CP fitting in all bath, toilets, service and kitchen areas. g) All ceramic/Porcelain sanitary wares will be of half white colour (Parry ware or equivalent). h) Provide wall mounted Cascade EWC with low level or floor mounted cascade with flushing cistern in all bathrooms. (Basic cost Rs 8000 per no). a) Anchor Roma/GM or equivalent Make Modular switches. b) Good quality copper wires Kundan (or) Orbit Make. c) 2 Light points, 1 Fan point, 2 Tube Light with 5 plug 5 Ampere in each room. 15amp AC provision will be included with MS Grill in bedrooms and as required by the owner. d) Hall : 2 fan, 2 light, 1 chandelier, 5A socket 6,15A socket 4 and as required by the owner. e) Kitchen to have Four 5 ampere, Four 15A, two light and fan with exhaust fan point including chimney point. f) Toilet to have one light, one exhaust fan, one 15 Amp for geyser & one 5 ampere point. g) Utility to have two 5 ampere, 15Amp point, one light point. h) Calling bell point for multipurpose from each floor apart from the regular provisions
14	Telephone & TV, cable wire Point. Kitchen wiring shall be done.	Required no in living and in all bedrooms. Calling bell arrangements from I floor to 2nd floor along with regular calling bell.
15	Rain Water harvesting	Lump sum as per norms- Quoted rate should also include required rain harvesting well.



Sl No.	Classifications	Specifications
16	Car Parking:	Parking Tile flooring, while constructing the car parking area. Design including colour shall be as per the architect's instruction.
17	Painting:	Interior wall: Necessary coat Birla or Equivalent patty and primer with two or more coat plastic emulsion Paint (Asian or Nippon of approved colour). Ceiling: One Coat primer with two or more coat plastic emulsion paint. (Asian or Nippon of approved colour). All internal wall painting to be done with roller. External: 2 coats of Apex paint of approved colour as per elevation. Joinery: 1 coat primer with patty and 2 coats enamel paint of approved color. Iron Work: 1 coat primer and 2 coats of synthetic paint of approved color Necessary coat Birla or Equivalent patty and primer with two or more coat plastic emulsion Paint (Asian or Nippon of approved colour).

ANNEXURE II



TERMS AND CONDITIONS :

1. All construction area calculations are based on the given drawings. The work is to be carried out as per the drawing provided by the architect. Any deviation is to be done only on specific written request and approval of both the architect and client. Discrepancy in drawings should be brought to the notice of the architect before work is executed.
2. The area for payment is the calculated plinth area including head room as mentioned in the drawing.
3. Water and Electricity will be supplied at free of cost by client
4. An interest free mobilization advance of 10% of the contracted value shall be paid
5. All statutory taxes applicable and will be under the scope of the contractor.
6. Works are to be carried out as per respective Indian standard and as per the manufacturer's specifications.
7. The following brand of materials are to be used:
 - a. CEMENT (OPC 53 GRADE): :
DALMIA KCP, BHARATHI, ZUARI, CHETTINADU, ULTRATEC
 - b. REINFORCEMENT STEEL :
KAMAKSHI, AMMAN, SSI, ARS & Any ISI MATERIALS.
 - c. TEAK WOOD : TEAK FIRST QUALITY
 - d. TEAK WOOD :
TEAK WOOD FOR DOOR AND WINDOW - ALL FRAMES BY TEAK ONLY
 - e. FLOORING & DADO : AS PER SPECIFICATION
8. Any disputes arising during the execution of the contract would be referred to and settled by the project architect.
9. Technical specification for the Elevation works not included in the above, however based on the proposed elevation an estimate is given. The final cost for the elevation will be calculated after getting the perspective view of the building (given by Architects). However, required RCC drops, padthis on the balcony, front elevation shall be included in the contractor's scope with regular finishes.

ANNEXURE II



10. Land /Space for workers to be provided by client with one point of electricity & water at free of cost.
11. ESI, PF, CAR Policy, all taxes not included in the rate.
12. M sand only considered if river sand required extra cost will be applicable.
13. Duration 8 months

BASIC RATES :

CEMENT	: Rs.380/- per bag
STEEL	: Rs.43, 500/- per MT
BRICKS	: Rs. 20,500/- per 3,000/- Nos.
FIRST QUALITY TEAK WOOD	: Rs. 4,500/- per Cft.

APPROXIMATE AREA STATEMENT

We referred the drawing :

Ground Floor -	Parking 1450 sqft
First Floor -	1900 Sqft
Second floor -	1000 Sqft
Head Room -	100 sqft

Construction Rate per Sqft

Car Parking Area - Rs 1400 per sqft

Building Rs 1850 per sqft

Rate for Sump, Septic Tank & OHT Rs. 20.00 per ltr.

Compound wall 5' ht Rs.1500/rft

PAYMENT SCHEDULE :

Stage	Description	Percentage	Amount
Stage 1	Mobilization Advance	10%	
Stage 2	On completion of basement	15%	
Stage 3	On completion of ground floor roof slab	10%	
Stage 4	On completion of 1st floor roof slab	10%	
Stage 5	On completion of Second roof slab	10%	
Stage 6	On completion of brick work, lintels, lofts & sunshades	10%	
Stage 7	Plastering and Joineries	12%	
Stage 8	completion of flooring	7%	
Stage 9	On completion of Plumbing & Electrical	8%	
Stage 10	On completion of painting	5%	
Stage 11	Handling over	3%	



IN WITNESS WHERE OF the employer has set his hands to these presents and a duplicate here of and the contractors have caused its common seal to be affixed here unto and a duplicate here of the day and the year first here in above written.

Witnesses;

1

**Signed and delivered by the
hand of Owner**

2

M/s. TRINITY ENGINEERING CONSTRUCTION PVT LTD

Contractor Seal

Signatures

CIVIL ENGINEERING ABBREVIATION



The common abbreviation used in civil engineering are as follows.

A.B – Anchor Bolt or Asbestos Board

AC – Asphalt Concrete

A.S.C – Allowable Stress of concrete.

A.S.T.M – American society for testing materials

AC – Asbestos cement

APM – Assistant Project Manager

B.M – Bending moment

BOQ – Bill of Quantities

BWK – Brick Work

CHK – Bedroom, Hall, Kitchen

C.I.Sheet – Corrugated Iron sheet.

CRW – Concrete Retaining Wall

CIP – Cast In Place

CJ – Construction Joint

CC – Cement concrete

CP – Cement plaster.

CS – Comparative statement

DL – Development Length

DIM – Dimension

DPC – Damp proof course.

DRG – Drawings

EJ – Expansion Joint

EL – Existing Load

ELCB – Earth Leak Circuit Breaker

Ft – Foot or Feet

FGL – Formation ground level.

GL – Ground Level

GP – Ground plane.

HAC – High Alumina Cement

IOM – Inter Office Memo

JE – Junior Engineer

Kg – Kilogram.

LW – Light Weight

LC – Lime concrete

MM – Millimeter

MCB – Miniature Circuit Breaker

MEP – Mechanical Electrical Plumbing

AE – Assistant Engineer

B.M – Benchmark

BLK – Block Work

BRW – Brick Retaining Wall

B.O.F – Bottom of Foundation

C.I.Pipe – Cast iron pipe.

CL – Centre Line

CBW – Concrete Block Wall

CMU – Concrete Masonry Unit

CC – Centre To Centre

CE – Chief Engineer

CPM – Critical path method.

D – Diameter

Dia – Diameter

D.L – Dead load.

DPR – Daily Progress Report

DWLS – Dowels

E.L – Environmental load.

EGL – Existing ground level.

F.M – Fineness Modulus.

FL – Floor Level

FOC – Factor of Safety

GL – Ground level.

HFL – Highest Flood Level.

HP – Horizontal plane.

ISI – Indian Standard Institute.

JST – Joist

L.L – Live load.

LWC – light Weight Concrete

M – Meter

MB – Measurement book.



MFL – Maximum Flood Level

MT – Metric Tonnes

NCF – Neat cement finishing

OGL – Original ground level.

PC – Pile Cap

PCC – Plain Cement Concrete

PERT – Programme Evaluation and Review Technique.

PL – Plinth level

PO – Purchase Order

PPR – Poly Propylene Random.

PSF – Pound Per Square Foot

PWD – Permanent Works Engineer

QS – Quantity Surveyor

R.B.W – Reinforced brick work.

RCC – Reinforced Cement Concrete

RL – Reduced level.

STP – Sewage Treatment Plant

SWG – Standard wire gauge.

TBM – Tunnel Boring Machine

TOB – Top of Beam

TOC – Top of Concrete

U.S.C – Ultimate stress of concrete.

UPVC – Unplasticized Polyvinyl chloride.

USD – Ultimate strength design.

W.C – Water closet.

W.S.D – Working stress Design

MRC – Material Receipt Challan

N – Newton

OPC – Ordinary Portland Cement

OSR – Open Space Reservation Area

PC – Precast Concrete

PM – Project Manager

PPE – Personal Protective Equipment

PVC – Poly vinyl chloride

PSI – Pound Per Square Inch

QC – Quality control

RC – Reinforced Concrete

RBC – Reinforced Brick concrete.

RMC – Ready Mixed Concrete.

SCC – Self Compacting Concrete

SRC – Sulphate Resisting Cement

TB – Tie Beam

TDS – Total Dissolved Solids

TMT – Thermo Mechanical Treatment

TOW – Top of Wall

VP – Vertical plane.

WL – Working Level

WO – Work Order

Some more Abbreviations used in Civil Engineering.

DPC - Damp proof course

RBC - Reinforced Brick concrete.

C.I.Sheet - Corrugated Iron sheet.

NCF - Neat cement finishing.

MB - Measurement book

VP - Vertical plane.

CP - Cement plaster

CC - Cement concrete.

CS - Comparative statement

PERT - Programme Evaluation and Review Technique.

RCC - Reinforced cement concrete.

R.B.W - Reinforced brick work.

C.I.Pipe - Cast iron pipe.

SWG - Standard wire gauge.

GP - Ground plane.

HP - Horizontal plane.

LC - Lime concrete.

AC - Asbestos cement.



CPM - Critical path method .	USD - Ultimate strength design.
W.S.D - Working stress design.	PL - Plinth level.
GL - Ground level.	EGL - Existing ground level.
OGI - Original ground level .	FGL - Formation ground level.
HFL - Highest flood level.	RL - Reduced level.
A.C.I - American concrete institute.	
A.A.S.H.T.O - American Association of state highway Transport Official.	
A.R.E.A - American Railway engineering association.	
A.S.T.M - American society for testing materials.	
ISI - Indian standard institute.	W.C - Water closet.
B.M - Bending moment.	L.L - Live load.
D.L - Dead load.	E.L - Environmental load.
U.S.C - Ultimate stress of concrete.	A.S.C - Allowable Stress of concrete.
F.M - Fineness modulus.	. B.M - Bench mark.
. PVC - Poly vinyl chloride.	
. UPVC - Unplasticized Poly vinyl chloride.	
. PPR - Poly Propylene Random.	



ENGINEERING FORMULA

Statistics

Mean

$$\frac{\sum x}{n}$$

μ = mean value

$\sum x_i$ = sum of all data values ($x_1, x_2, x_3, \dots$)

n = number of data values

Standard Deviation

$$\sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

σ = standard deviation

x_i = individual data value ($x_1, x_2, x_3, \dots$)

n = number of data values

Probability

Frequency

$$x = \frac{f_x}{f_a}$$

$$x = \frac{f_x}{f_a}$$

f_x = relative frequency of outcome x

n_x = number of events with outcome x

n = total number of events

P_x = probability of outcome x

f_a = frequency of all events

Binomial Probability (order doesn't matter)

P_k = binomial probability of k successes in n trials

p = probability of a success

$q = 1 - p$ = probability of failure

k = number of successes

n = number of trials

Mode

Place data in ascending order.

Mode = most frequently occurring value

If two values occur at the maximum frequency the data set is *bimodal*.

If three or more values occur at the maximum frequency the data set is *multi-modal*.

Median

Place data in ascending order.

If n is odd, median = central value

If n is even, median = mean of two central values

n = number of data values

Range

Range = $x_{\max} - x_{\min}$

$x_{\max}$ = maximum data value

$x_{\min}$ = minimum data value

Independent Events

$P(A \text{ and } B \text{ and } C) = P_A P_B P_C$

$P(A \text{ and } B \text{ and } C)$ = probability of independent events A and B and C occurring in sequence

P_A = probability of event A

Mutually Exclusive Events

$P(A \text{ or } B) = P_A + P_B$

$P(A \text{ or } B)$ = probability of either mutually exclusive event A or B occurring in a trial

P_A = probability of event A

$\sum x_i$ = sum of all data values ($x_1, x_2, x_3, \dots$)

n = number of data values

Conditional Probability

$$P(A|D) = \frac{P(A \text{ and } D)}{P(D)}$$

$P(A|D)$ = probability of event A given event D

$P(A)$ = probability of event A occurring

$P(\sim A)$ = probability of event A not occurring

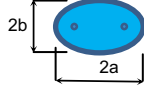
$P(D|\sim A)$ = probability of event D given event A did not occur

Plane Geometry

Circle



Ellipse



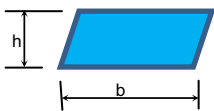
Rectangle

Perimeter = $2a + 2b$
Area = ab



Parallelogram

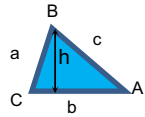
Area = bh



Triangle

Area = $\frac{1}{2}bh$

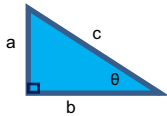
$a^2 = b^2 + c^2 - 2bc \cos \angle A$
 $b^2 = a^2 + c^2 - 2ac \cos \angle B$
 $c^2 = a^2 + b^2 - 2ab \cos \angle C$



Right Triangle

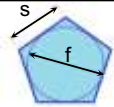
$c^2 = a^2 + b^2$

-
-
-



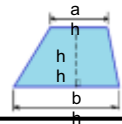
Regular Polygons

$n = \text{number of sides}$



Trapezoid

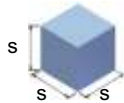
Area = $\frac{1}{2}(a + b)h$



Solid Geometry

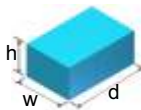
Cube

Volume = s^3
Surface Area = $6s^2$

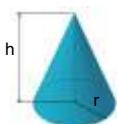


Rectangular Prism

Volume = wdh
Surface Area = $2(wd + wh + dh)$



Right Circular Cone



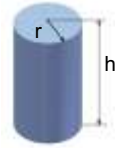
Sphere

Volume = $\frac{4}{3}\pi r^3$
Surface Area = $4\pi r^2$



Cylinder

Volume = $\pi r^2 h$
Surface Area = $2\pi r h + 2\pi r^2$



Irregular Prism

Volume = Ah
A = area of base



Pyramid

A = area of base



Constants

$g = 9.8 \text{ m/s}^2 = 32.27 \text{ ft/s}^2$
 $G = 6.67 \times 10^{-11} \text{ m}^3/\text{kg}\cdot\text{s}^2$
 $\pi = 3.14159$



Conversions

Mass

1 kg = 2.205 lb_m
1 slug = 32.2 lb_m
1 ton = 2000 lb_m

Area

1 acre = 4047 m²
= 43,560 ft²
= 0.00156 mi²

Force

1 N = 0.225 lb_f
1 kip = 1,000 lb_f

Energy

1 J = 0.239 cal
= 9.48 x 10⁻⁴ Btu
= 0.7376 ft·lb_f
1 kW h = 3,600,000 J

Length

1 m = 3.28 ft
1 km = 0.621 mi
1 in. = 2.54 cm
1 mi = 5280 ft
1 yd = 3 ft

Volume

1 L = 0.264 gal
= 0.0353 ft³
= 33.8 fl oz
1 mL = 1 cm³ = 1 cc

Pressure

1 atm = 1.01325 bar
= 33.9 ft H₂O
= 29.92 in. Hg
= 760 mm Hg
= 101,325 Pa
= 14.7 psi
1 psi = 2.31 ft of H₂O

Defined Units

1 J = 1 N·m
1 N = 1 kg·m / s²
1 Pa = 1 N / m²
1 V = 1 W / A
1 W = 1 J / s
1 W = 1 V / A
1 Hz = 1 s⁻¹
1 F = 1 A·s / V
1 H = 1 V·s / V

Temperature Change

1 K = 1 °C
= 1.8 °F
= 1.8 °R

Time

1 d = 24 h
1 h = 60 min
1 min = 60 s
1 yr = 365 d

Power

1 W = 3.412 Btu/h
= 0.00134 hp
= 14.34 cal/min
= 0.7376 ft·lb/s

SI Prefixes

Numbers Less Than One

Power of 10	Prefix	Abbreviation
10 ⁻¹	deci-	d
10 ⁻²	centi-	c
10 ⁻³	milli-	m
10 ⁻⁶	micro-	μ
10 ⁻⁹	nano-	n
10 ⁻¹²	pico-	p
10 ⁻¹⁵	femto-	f
10 ⁻¹⁸	atto-	a
10 ⁻²¹	zepto-	z
10 ⁻²⁴	yocto-	y

Numbers Greater Than One

Power of 10	Prefix	Abbreviation
10 ¹	deca-	da
10 ²	hecto-	h
10 ³	kilo-	k
10 ⁶	Mega-	M
10 ⁹	Giga-	G
10 ¹²	Tera-	T
10 ¹⁵	Peta-	P
10 ¹⁸	Exa-	E
10 ²¹	Zetta-	Z
10 ²⁴	Yotta-	Y

Equations

Mass and Weight

$$M = VD_m$$

$$W = mg$$

$$W = VD_w$$

$$V = \text{volume}$$

$$D_m = \text{mass density}$$

$$m = \text{mass}$$

$$D_w = \text{weight density}$$

$$g = \text{acceleration due to gravity}$$

Temperature

$$T_K = T_C + 273$$

$$T_R = T_F + 460$$

$$\text{_____}$$

$$T_K = \text{temperature in Kelvin}$$

$$T_C = \text{temperature in Celsius}$$

$$T_R = \text{temperature in Rankin}$$

$$T_F = \text{temperature in Fahrenheit}$$

Force

$$F = ma$$

$$F = \text{force}$$

$$m = \text{mass}$$

$$a = \text{acceleration}$$

Equations of Static Equilibrium

$$\Sigma F_x = 0 \quad \Sigma F_y = 0 \quad \Sigma M_P = 0$$

$$F_x = \text{force in the x-direction}$$

$$F_y = \text{force in the y-direction}$$

$$M_P = \text{moment about point P}$$



Equations (Continued)

Energy: Work

W = work
F = force
d = distance

Power

P = power
E = energy
W = work
t = time
 τ = torque
rpm = revolutions per minute

Efficiency

P_{out} = useful power output
 P_{in} = total power input

Energy: Potential

U = potential energy
m = mass
g = acceleration due to gravity
h = height

Energy: Kinetic

K = kinetic energy
m = mass
v = velocity

Energy: Thermal

Q = thermal energy
m = mass
c = specific heat
 ΔT = change in temperature

Fluid Mechanics

(Guy-L)

$P_1 V_1 = P_2 V_2$ B y ' L

Q = Av

$A_1 v_1 = A_2 v_2$

absolute pressure = gauge pressure
+ atmospheric pressure

P = absolute pressure
F = Force
A = Area
V = volume
T = absolute temperature
Q = flow rate
v = flow velocity

Mechanics

- (where acceleration = 0)

- (where acceleration = 0)

$v = v_0 + at$

$d = d_0 + v_0 t + \frac{1}{2} at^2$

$v^2 = v_0^2 + 2a(d - d_0)$

$\tau = dF \sin \theta$

s = speed
v = velocity
a = acceleration
X = range
t = time
d = distance
g = acceleration due to gravity
d = distance
 θ = angle
 τ = torque
F = force

Electricity

Ohm's Law

$V = IR$

$P = IV$

R_T (series) = $R_1 + R_2 + \dots + R_n$

Kirchhoff's Current Law

$I_T = I_1 + I_2 + \dots + I_n$

or Σ

Kirchhoff's Voltage Law

$V_T = V_1 + V_2 + \dots + V_n$

or Σ

V = voltage

V_T = total voltage

I = current

I_T = total current

R = resistance

R_T = total resistance

P = power

Thermodynamics

ΔT

Δ

$\bar{L}$

$\bar{L}$

$A_1 v_1 = A_2 v_2$

P = rate of heat transfer

Q = thermal energy

A = Area of thermal conductivity

U = coefficient of heat conductivity
(U-factor)

ΔT = change in temperature

R = resistance to heat flow (R-value)

k = thermal conductivity

v = velocity

P_{net} = net power radiated

= 5.6696×10^{-8}

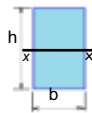
e = emissivity constant

T_1, T_2 = temperature at time 1, time 2

Section Properties

Moment of Inertia

I_{xx} —



I_{xx} = moment of inertia of a rectangular section about x-x axis

Complex Shapes Centroid

$$\bar{x} = \frac{\sum x_i A_i}{\sum A_i} \quad \text{and} \quad \bar{y} = \frac{\sum y_i A_i}{\sum A_i}$$

$\bar{x}$ = x

$\bar{y}$ = y

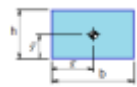
x_i = x distance to centroid of shape i

y_i = y distance to centroid of shape i

A_i = Area of shape i

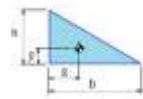
Rectangle Centroid

$\bar{x}$ = and $\bar{y}$ =



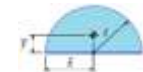
Right Triangle Centroid

$\bar{x}$ = and $\bar{y}$ =



Semi-circle Centroid

$\bar{x}$ = and $\bar{y}$ =



$\bar{x}$ = x

$\bar{y}$ = y

Material Properties

Stress (axial)

—

= stress

F = axial force

A = cross-sectional area

Strain (axial)

—

= strain

L_0 = original length

δ = change in length

Modulus of Elasticity

—

—

E = modulus of elasticity

= stress

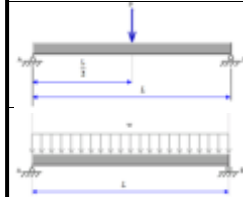
= strain

A = cross-sectional area

F = axial force

δ = deformation

Beam Formulas



Reaction

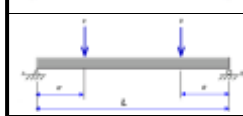
Moment

Deflection

B =

$\frac{L}{4}$ (at point of load)

$\frac{L}{4}$ (at point of load)



Reaction

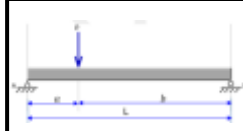
Moment

Deflection

B =

$\frac{L}{4}$ (at center)

$\frac{L}{4}$ (at center)



Reaction

Moment

Deflection

B =

(between loads)

$\frac{L}{4}$ (at center)

Reaction

Moment

Deflection

$\frac{L}{4}$ and $\frac{L}{4}$

$\frac{L}{4}$ (at Point of Load)

$\frac{L}{4}$ (at Point of Load)

(at

$\frac{L}{4}$)

Deformation: Axial

$$\delta = \frac{FL}{EA}$$

δ = deformation

F = axial force

L_0 = original length

A = cross-sectional area

E = modulus of elasticity

Truss Analysis

$$2J = M + R$$

J = number of joints

M = number of members

R = number of reaction forces

Simple Machines

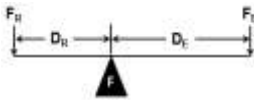
Mechanical Advantage (MA)

$$\text{MA} = \frac{F_R}{F_E} \quad \text{or} \quad \frac{D_E}{D_R}$$

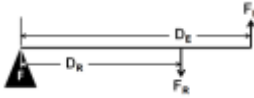
IMA = Ideal Mechanical Advantage
 AMA = Actual Mechanical Advantage
 D_E = Effort Distance D_R = Resistance Distance
 F_E = Effort Force F_R = Resistance Force

Lever

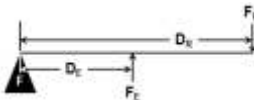
1st Class



2nd Class

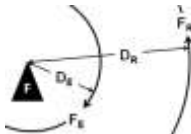


3rd Class

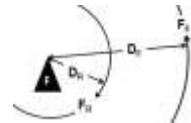


Wheel and Axle

Effort at Axle



Effort at Wheel



Pulley Systems

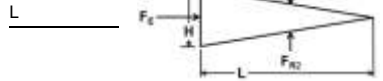
IMA = Total number of strands of a single string supporting the resistance

IMA = _____

Inclined Plane



Wedge



Screw

IMA = _____

Pitch = _____



C = Circumference
 r = radius
 Pitch = distance between threads
 TPI = Threads Per Inch

Compound Machines

$$MA_{\text{TOTAL}} = (MA_1)(MA_2)(MA_3) \dots$$

Gears; Sprockets with Chains; and Pulleys with Belts Ratios

_____ ()

Compound Gears



$$GR_{\text{TOTAL}} = \left(\frac{N_{\text{in}}}{N_{\text{out}}} \right) \dots$$

GR = Gear Ratio

ω_{in} = Angular Velocity - driver

ω_{out} = Angular Velocity - driven

N_{in} = Number of Teeth - driver

N_{out} = Number of Teeth - driven

d_{in} = Diameter - driver

d_{out} = Diameter - driven

T_{in} = Torque - driver

T_{out} = Torque - driven



Structural Design

Steel Beam Design: Shear

$$V_n = 0.6F_y A_w$$

V_a = allowable shear strength
 V_n = nominal shear strength
 $\Omega_v = 1.5$ = factor of safety for shear
 F_y = yield stress
 A_w = area of web

Steel Beam Design: Moment

$$M_n = F_y Z_x$$

M_a = allowable bending moment
 M_n = nominal moment strength
 $\Omega_b = 1.67$ = factor of safety for bending moment
 F_y = yield stress
 Z_x = plastic section modulus about neutral axis

Spread Footing Design

$$q_{net} = q_{allowable} - P_{footing}$$

q_{net} = net allowable soil bearing pressure
 $q_{allowable}$ = total allowable soil bearing pressure
 $P_{footing}$ = soil bearing pressure due to footing weight
 $t_{footing}$ = thickness of footing
 q = soil bearing pressure
 P = column load applied
 A = area of footing

Storm Water Runoff

Storm Water Drainage

$$Q = C_i C_i A$$

Q = peak storm water runoff rate (ft^3/s)
 C_i = runoff coefficient adjustment factor
 C = runoff coefficient
 i = rainfall intensity (in./h)
 A = drainage area (acres)

Runoff Coefficient Adjustment Factor

Return Period	C_f
1, 2, 5, 10	1.0
25	1.1
50	1.2
100	1.25

Rational Method Runoff Coefficients

Categorized by Surface	
Forested	0.059—0.2
Asphalt	0.7—0.95
Brick	0.7—0.85
Concrete	0.8—0.95
Shingle roof	0.75—0.95
Lawns, well drained (sandy soil)	
Up to 2% slope	0.05—0.1
2% to 7% slope	0.10—0.15
Over 7% slope	0.15—0.2
Lawns, poor drainage (clay soil)	
Up to 2% slope	0.13—0.17
2% to 7% slope	0.18—0.22
Over 7% slope	0.25—0.35
Driveways, walkways	0.75—0.85
Categorized by Use	
Farmland	0.05—0.3
Pasture	0.05—0.3
Unimproved	0.1—0.3
Parks	0.1—0.25
Cemeteries	0.1—0.25
Railroad yard	0.2—0.40
Playgrounds	0.2—0.35
(except agricultural Districts)	
Concrete neighborhood	0.5—0.7
City (downtown)	0.7—0.95
Residential	
Single-family	0.3—0.5
Multi-plexes, ranches, subdivisions	0.4—0.6
Multi-plexes, subdivisions	0.6—0.75
Multi-plexes, subdivisions	0.25—0.4
Multi-plexes, subdivisions	0.5—0.7
Industrial	
Light	0.5—0.8
Heavy	0.6—0.9

Water Supply

Hazen-Williams Formula

$$L$$

h_f = head loss due to friction (ft of H_2O)
 L = length of pipe (ft)
 Q = water flow rate (gpm)
 C = Hazen-Williams constant
 d = diameter of pipe (in.)

Dynamic Head

dynamic head = static head – head loss

Hazen-Williams Constants

Pipe Material	Typical Range	Clean, New Pipe	Typical Design Value
Cast Iron and Wrought Iron	80 - 150	130	100
Copper, Glass or Brass	120 - 150	140	130
Cement lined Steel or Iron		150	140
Plastic	120 - 150	140	130
PVC or ABS			
Steel, welded and seamless or interior riveted	80-150	140	100

Equivalent Length of (Generic) Fittings

Screwed Fittings	Pipe Size									
	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	3	4
Elbows										
Regular 90 degree	2.9	3.1	3.6	4.4	5.2	6.6	7.4	8.9	9.3	11.0
Long radius 90 degree	1.5	2.0	2.2	2.3	2.7	3.2	3.4	3.6	3.6	4.0
Regular 45 degree	0.5	0.5	0.7	0.9	1.3	1.7	2.1	1.7	3.2	4.0
Tees										
Line Fitting	0.8	1.2	1.7	2.4	3.2	4.6	5.6	7.7	9.3	12.0
Branch Fitting	3.4	3.3	4.3	5.3	6.6	8.7	9.9	11.0	13.0	21.0
Return Bends										
Regular 180 degree	2.9	3.1	3.6	4.4	5.2	6.6	7.4	8.9	9.3	11.0
Close	31.0	32.0	32.0	34.0	35.0	37.0	41.0	54.0	62.0	79.0
Gate	0.9	0.9	0.6	0.7	0.8	1.1	1.1	1.5	1.9	1.5
Valves										
Angle	11.8	15.0	15.0	15.0	17.0	18.0	18.0	18.0	18.0	18.0
Swing Check	7.2	7.5	8.0	8.8	11.0	15.0	15.0	18.0	21.0	27.0
Screen										
	4.6	5.0	5.6	6.6	7.7	10.0	10.0	12.0	14.0	42.0

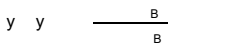
Flanged Fittings	Pipe Size																
	1/2	3/4	1	1 1/4	1 1/2	2	3	4	5	6	8	10	12	14	16	18	
Elbows	Reg. 90 degree	0.9	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.2	8.6	12.0	14.0	17.0	18.0	23.0
	Long radius 90 degree	1.1	1.3	1.6	2.0	2.3	2.7	3.7	3.4	4.2	5.0	5.7	7.0	8.0	9.4	10.0	11.0
	Reg. 45 degree	0.5	0.6	0.8	1.1	1.3	1.7	2.0	2.6	3.5	4.3	5.6	7.7	9.0	11.0	13.0	16.0
Tees	Line Run	0.7	0.8	1.0	1.3	1.5	1.8	1.9	2.2	2.8	3.3	3.8	4.7	5.2	6.0	6.4	7.6
	Branch Run	3.0	2.4	3.1	4.4	5.2	6.6	7.5	9.4	12.0	15.0	18.0	24.0	30.0	34.0	37.0	47.0
Return Bends	Reg. 180 degree	0.9	1.1	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.2	8.6	12.0	14.0	17.0	18.0	23.0
	Long radius 180 degree	1.1	1.3	1.6	2.0	2.3	2.7	3.8	3.4	4.2	5.0	5.7	7.0	8.0	9.4	10.0	11.0
	Close	38.0	40.0	42.0	44.0	46.0	50.0	54.0	58.0	62.0	66.0	70.0	74.0	78.0	82.0	86.0	90.0
Valves	Gate						2.6	2.7	2.8	2.9	3.1	3.2	3.3	3.4	3.5	3.6	3.7
	Angle	15.0	15.0	17.0	18.0	18.0	21.0	22.0	23.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
	Swing Check	8.8	9.3	7.2	10.0	11.0	17.0	21.0	21.0	24.0	30.0	30.0	32.0	32.0	32.0	32.0	32.0



555 Timer Design Equations

$$T = 0.693 (R_A + 2R_B)C$$

—



T = period

f = frequency

R_A = resistance A

R_B = resistance B

C = capacitance

Boolean Algebra

Boolean Theorems

$$X \cdot 0 = 0$$

$$X \cdot 1 = X$$

$$X \cdot X = X$$

—

$$X + 0 = X$$

$$X + 1 = 1$$

$$X + X = X$$

—

=

Commutative Law

$$X \cdot Y = Y \cdot X$$

$$X + Y = Y + X$$

Associative Law

$$X(YZ) = (XY)Z$$

$$X + (Y + Z) = (X + Y) + Z$$

Distributive Law

$$X(Y + Z) = XY + XZ$$

$$(X + Y)(W + Z) = XW + XZ + YW + YZ$$

Consensus Theorems

$$\begin{aligned} &X + Y + XY \\ &= X + Y \end{aligned}$$

DeMorgan's Theorems

$$\begin{aligned} &\overline{X + Y} = \overline{X} \cdot \overline{Y} \\ &\overline{X \cdot Y} = \overline{X} + \overline{Y} \end{aligned}$$

Speeds and Feeds

$$\frac{f_m}{N} = \frac{f_t}{n_t} \cdot N$$

$$f_m = f_t \cdot n_t \cdot N$$

$$\text{Plunge Rate} = \frac{1}{2} f_m$$

N = spindle speed (rpm)

CS = cutting speed (in./min)

d = diameter (in.)

f_m = feed rate (in./min)

f_t = feed (in./tooth)

n_t = number of teeth



Aerospace Equations

Forces of Flight

$$\frac{L}{L}$$

C_L = coefficient of lift
 C_D = coefficient of drag
 L = lift
 D = drag
 A = wing area
 ρ = density
 R_e = Reynolds number
 v = velocity
 l = length of fluid travel
 μ = fluid viscosity
 F = force
 m = mass
 g = acceleration due to gravity
 M = moment
 d = moment arm (distance from datum perpendicular to F)

Propulsion

$$\left(\quad \right)$$

F_N = net thrust
 $\dot{W}$ = air mass flow
 v_o = flight velocity
 v_j = jet velocity
 I = total impulse
 F_{ave} = average thrust force
 t = change in time (thrust duration)
 F_{net} = net force
 F_{avg} = average force
 F_g = force of gravity
 v_f = final velocity
 a = acceleration
 t = change in time (thrust duration)

NOTE: F_{ave} and F_{avg} are easily confused.

Energy

$$\frac{\quad}{\quad}$$

K = kinetic energy
 m = mass
 v = velocity
 U = gravitational potential energy
 G = universal gravitation constant
 M = mass of central body
 m = mass of orbiting object
 R = Distance center main body to center of orbiting object
 E = Total Energy of an orbit

Orbital Mechanics

$$\frac{\quad}{\sqrt{\quad}}$$

e = eccentricity
 b = semi-minor axis
 a = semi-major axis
 T = orbital period
 a = semi-major axis
 μ = gravitational parameter
 F = force of gravity between two bodies
 G = universal gravitation constant
 M = mass of central body
 m = mass of orbiting object
 r = distance between center of two objects

Beroulli's Law

$$\left(\quad \right) \left(\quad \right)$$

P_s = static pressure
 v = velocity
 y

Atmosphere Parameters

$$\left(\frac{\quad}{\quad} \right)$$

T = temperature
 h = height
 p = pressure
 ρ = density

LIST OF DRAWINGS FOR BUILDING CONSTRUCTION



ARCHITECTURAL DRAWINGS

- a. Site Layout
- b. Floor Plans
- c. Sections
- d. 2D & 3D Elevations
- e. Joinery details
- f. Interior details
- g. Finishing specifications

STRUCTURAL DRAWINGS

- a. Foundation Layout
- b. Footing details / Pile details
- c. Plinth Beam layout & Details
- d. Column Details
- e. Lift Pit / Wall details
- f. Floor Beam Layouts
- g. Longitudinal Sections & Cross Sections of Beams
- h. Floor Slab layout & Reinforcement details
- i. Head Room Details
- j. Overhead & Sump RC details
- k. Misc Standard construction details
- l. Basic Technical Specifications

MEP DRAWINGS

- a. Plumbing drawings
- b. Rainwater harvesting details
- c. Floor wise electrical conduit layout
- d. SLD
- e. Solar Panel details

IMPORTANCE OF SOIL TESTING



All construction projects are made on the soil. The soil has to take the weight of the structures. The soil testing before construction is first step and important step for many reputed construction companies.

Soil testing is primarily done to test the bearing capacity of the soil. It also shows the physical and chemical composition of the soil. These characteristics may vary from layer to layer of the same soil. The characteristics of the soil can change within small area due to weather, climate change and the management of the site can also change the bearing capacity of the soil. The soil must be able to withstand the weight of the building otherwise the loss to property and life can occur. The soil investigations or analysis determines not only the bearing capacity of the soil, but it also rate of settlement of the soil. This rate determines the rate of the structure stabilization on the soil.

The soil must be able to withstand the weight of the building otherwise the loss to property and life can occur. The soil investigations or analysis determines not only the bearing capacity of the soil, but it also rate of settlement of the soil. This rate determines the rate of the structure stabilization on the soil.

The soil testing also determines the length and depth of the pillars put in the soil to lay the foundation of the building. The selection of suitable construction technique and knowing the possible foundation problems all are based on the results of the soil testing. The water table level of the soil can be known only from the soil testing. The level of water table shows the likely problem to the foundation of the building and level of humidity within the foundation. The choice of construction material may also be affected by the chemical and mineral component of the soil. If analysis of the soil reveals that it contains sulphur, then the sulphur resisting cement is used to protect the foundation of the buildings.

Understanding Geotechnical investigation of the soil helps to take better decisions leading to the success of the construction project. The height of the building and the use of materials are decided by the engineers on the basis of soil testing reports. The information then leads to strong and durable structures. The structure engineers can also decide whether there is need to go for soil stabilization or increase the depth of foundation for better stability of the building. The cost involved in the soil testing is just fraction of the construction cost of the structure.



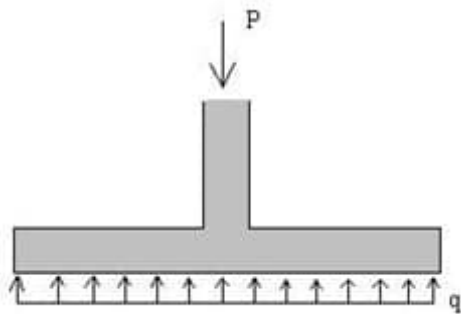
Whether the soil is sand, clay, gravel, silt or loom soil, the soil testing must be the first step of the construction of a building or any structure. Without soil testing, the building is exposed to the hidden dangers and all unknown weakness of the soil.

SOIL TESTS FOR SHALLOW AND RAFT FOUNDATIONS

Soil test is required to determine the safe bearing capacity of shallow foundations and raft foundations are discussed here. These tests are as per IS 6403 – 1981.

Apart from ascertaining the highest level ever reached by the groundwater table and tests for classification of soil as per IS 1498 – 1970 based on grain size analysis as per IS 2720 (Part –IV)– 1985, index properties of soil as per IS 2720 (Part-V) – 1985, the following tests are required to determine safe bearing capacity based on shear strength consideration:

1. Standard penetration test as per IS 2131 – 1991 for coarse grained / fine grained cohesion less soils with semi-pervious clayey soils (i.e. soils with clay upto 30%).
2. Direct shear test (controlled strain) as per IS 2720 (Part – 13) – 1986. Consolidated undrained tests for cohesive and for soils and consolidated drained tests for cohesion less soils. The results may be compared with standard penetration test / static cone penetration test results. Since there is escape of pore water during box shear, partial drainage vitiates the consolidated undrained test. Hence this test is not exact for semi-pervious soils such as clayey sands / silts (i.e. with clay more than 15% but less than 30%). For such soils, triaxial tests are required if shear strength is critical criterion.
3. Static cone penetration test as per IS 4968 (Part -3) – 1976 for foundations on non-stiff clayey soils such as fine grained soils (i.e. more than 50% passing through 75 micron sieve). In fine and medium coarse sands such tests are done for correlation with standard penetration test and to indicate soil profiles at intermediate points.



4. Unconfined compressive strength test as per IS 2720 (Part-10) – 1973 for highly cohesive clays except soft / sensitive clays.
5. Vane shear tests for impervious clayey soils except stiff or fissured clays.
6. Triaxial shear tests for predominantly cohesive soils. If shear strength is likely to be critical.

Soil Tests for Shallow Foundations :

Tests required to determine allowable bearing pressure for shallow foundations on settlement consideration :

. Standard penetration test as stated above.

2. Consolidation test as per IS 2720 (Part-15) if the settlement of clayey layer /layers calculated on the basis of liquid limit and in-situ void ratio indicates that settlement may be critical. Consolidation test is not required if the superimposed load on foundation soil is likely to be less than pre-consolidation pressure (assessed from liquidity index and sensitivity or from un-confined compressive strength and plasticity index).

3. Plate load tests as per IS 1888 – 1982 for cohesion less soils and soils where neither standard penetration test or consolidation test is appropriate such as for fissured clay / rock, clay with boulders etc..

Soil Tests Required for Raft Foundations

(As per Para 3 of IS 2950 (Part-1) – 1981.





Apart from other tests for shallow foundations, the following soil tests are required especially for raft foundations:

1. Static cone penetration test as per IS 4968 (Part-3) – 1976 for cohesion less soils to determine modulus of elasticity as per IS 1888 – 1982.
2. Standard penetration test as per IS 2131 – 1981 for cohesion less soils and soils to determine modulus of sub-grade reaction.
3. Unconfined compressive strength test as per 2720 (Part -10) – 1973 for saturated but no pre-consolidated cohesive soil to determine modulus of sub-grade reaction.
4. As specified in IS 2950 (Part -1) – 1981, plate load test as per IS 1888 – 1982 where tests at Sl. No. – 1 to 3 above is not appropriate such as for fissured clays / clay boulders.
5. In case of deep basements in pervious soils, permeability is determined from pumping test. This is required to analyze stability of deep excavation and to design appropriate dewatering system.

ESTIMATATION & COSTING



LABOUR AND MATERIAL CONSTANTS (IS 10067-1982) NORTH ZONE

Recommended labour out put constants for building work:

S.no	Description of work	Unit	Labour	Recomm ended constant in days.	Remarks.
1)	Excavation over areas (hard/dense soil),depth up to 1.5m and removal (up to one meter from edge)	M ³	Mate Mazdoor	0.06 0.62	— —
2)	Excavation in trenches (soft/ loose soil),for foundations not exceeding 1.5m in width and for shafts,wells,cesspits and the like, not exceeding 10m ³ and on plan, depth up to 1.5m and removal(up to one meter away from edge)	M ³	Mate Mazdoor	0.05 0.50	— —
3)	Returning, filling and ramming of excavated earth in layers not exceeding 20 cm in depth,watering,well ramming and leveling, lead up to 50m	M ³	Mate Mazdoor Bhisti	0.02 0.25 0.02	— — —
4)	Concrete : Mixing by machine (mixer) at	M ³	Mazdoor Bhisti	0.50 0.10	— —



	banker, cement concrete (with 20mm graded coarse aggregate)		Mixer operator Mixer	0.07 0.07	— —
5)	Mixer mixed cement concrete	M ³	mason mazdoor bhisti mixer operator mixer vibrator	0.10 1.63 0.70 0.07 0.07 0.07	— — — — — —
6)	Reinforced cement concrete in situ in foundations, footings, bases for columns, etc excluding form work and reinforcement	M ³	mason mazdoor bhisti mixer operator mixer vibrator	0.17 2.00 0.90 0.07 0.07 0.07	The constants for items include mixing, pouring, consolidating and curing. This does not include fair finish.
7)	Reinforced cement concrete in situ in suspended floors/roofs excluding form work, and reinforcement.	M ³	mason mazdoor bhisti mixer operator mixer	0.24 2.50 0.90 0.07 0.07 0.07	— — — — — —

			vibrator			
8)	Mortars : Mixing by hand, cement mortar of any mix/proportions	M ³	Mazdoor Bhisti	0.75 0.07	Labour required will be approximately same for different mix proportions.	
9)	Brick work (straight walls) : Brick work in walls exceeding one brick thick, in cement / lime mortar	M ³	mason mazdoor bhisti	0.94 1.80 0.20	The constants include labour involved in scaffolding.	
10)	Brick work in walls, one brick thick, in cement/lime mortar	M ²	mason mazdoor bhisti	0.25 0.40 0.10	The constants could be adopted for brick work with any mix or mortar.	
11)	Form work : a) fabrication and erection with all supports, struts, braces, etc, and dressing with oil as cleaning of formwork : 1) rectangular column and walls	M ³ M ²	Carpenter Mazdoor Carpenter Mazdoor Carpenter Mazdoor	0.25 0.20 0.23 0.20 0.30 0.20	— — — — — —	



	2) suspended floors/roofs 3) sides and soffits of beam	M ²			
12)	Reinforcement: Bar reinforcement including cutting to length, hooked ends, cranking or bending, hoisting and placing in any position, binding wire and holding firmly so as not to be disturbed while placing and ramming of concrete	Quintal	Bar bender Mazdoor	1.00 1.00	— —
13)	Plastering and pointing : a) 15mm thick cement plaster to ceiling including mixing of mortar. b) 15mm thick cement plaster on brick walls (exterior) including mixing of mortar c) tuck pointing to random rubble masonry in cement mortar including mixing mortar.	M ² M ² M ²	mason mazdoor bhisti mason mazdoor bhisti mason mazdoor bhisti	0.08 0.10 0.10 0.06 0.10 0.10 0.10 0.15 0.10	— — — — — — — — — —
14)	Damping proof course : a) Laying damp proof course 40mm thick cement concrete including form work and fair finishing to edges and mixing.	M ³	mason mazdoor bhisti	0.10 0.10 0.01	— — —

Material constants in mortars:

s.no.	Item(mix by volume)	Constants per m3 of mortar				
		Cement (bags)	Slaked Lime M ³	Surkhi M ³	Sand M ³	
1	Cement mortar 1:4 (1 cement : 4 sand)	6.79	—	—	0.9	
2	Cement mortar 1:6 (1 cement : 6 sand)	4.65	—	—	0.99	
3	composite mortar 1:1:6 (1 cement: 1 lime : 6 sand)	4.48	0.16	—	0.96	

Material constants in concrete:

s.no.	Item (mix by volume)	Fineness modulus		Size of course (normal gauge)	Constants per M ³ of mortar		
		Fine agg.	Coarse agg		Cement (bags)	Sand M ³	Shingle M ³
1.	Cement concrete 1:1.5:3 (1 cement : 1.5 sand : 3 shingle)	2.87	6.5	20mm	7.33	0.39	0.78
2.	Cement concrete 1:3:6 (1 cement : 3 sand : 6 shingle)	2.87	6.5	40mm	4.05	0.43	0.86
3.	Cement concrete 1:4:8 (1 cement : 4 sand : 8 shingle)	1.26	6.9	40mm	3.2	0.45	0.90



**Material constants for Brick work with modular bricks :**

Sl no	Description of item	Constants per m ³ Frog up			Frog down		
		No of bricks	Cement (bags)	Fine sand M ³	No of bricks	Cement (bags)	Fine sand M ³
1	Brick work on cement mortar 1:4 (1 cement :4 sand)	5.17	1.41	0.200	517	1.26	0.178
2	Brick work on cement mortar 1:6 (1 cement :6 sand)	517	0.96	0.204	517	0.87	0.182
3	Half brick masonry in cement 1:4 (1 cement :4 sand)	506	1.08	0.153	506	0.94	0.133

Material constants for cement concrete flooring

Sno	Description of item	Constants for 10 M ²		
		Cement (bags)	Sand (coarse) M ³	Coarse aggregate M ²
1	75 mm thick cement concrete flooring 1: 2:4 (1 cement : 2 sand :4 Shingle 20 mm nominal gauge) finished with a floating coat of neat cement	4.81	0.31	0.62
2	40 mm thick cement concrete flooring 1: 2:4 (1 cement : 2 sand :4 Shingle 20 mm nominal gauge) finished with a floating coat of neat	2.80	0.164	0.328

	cement		
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Material constants for plastering

Sl no	Description of item	Constants for 10 M ²			
		On traditional brick work		On modular brick work	
		Cement bags	Sand (fine) M ³	Cement bags	Sand (fine) M ³
1	12 mm cement plaster 1:4 (1 cement : 4 sand)	0.98	0.138	0.95	0.134
2	12 mm cement plaster 1:6 (1 cement : 6 sand)	0.67	0.143	0.78	0.139
3	20 mm cement plaster 1:4 (1 cement : 4 sand)	1.53	0.217	1.51	0.213
4	20 mm cement plaster 1:6 (1 cement : 6 sand)	1.05	0.224	1.03	0.220





MINIMUM ROOM SIZES

Size standards for rooms

Minimum heights and size standards for rooms ensures that there is good ventilation, lights and comfortable living inside the room. Height and size standards for rooms vary from one country to another and are mostly based on the preference of clients to meet their demand.

Height Regulation for Rooms

1. Habitable Rooms

- The minimum height from the surface of the floor to the ceiling or bottom of slab should be not less than 2.75m.
- For air-conditioned rooms, a height of not less than 2.4 m measured from the top of the floor to the lowest point of the air-conditioning duct or the false ceiling should be provided.
- According to Ontario Building Code (OBC), 2.3 m over at least 75% of the required floor area with a clear height of at least 2.1 m at any point over the required area

2. Bedroom Height Restrictions

- As per OBC, the bedroom height should be 2.3 m over at least 50% of the required floor area.
- Alternatively, 2.1 m over 100% of the required floor area
- Any part of the floor area having a height of less than 1.4 m shall not count when calculating required floor area

3. Bathrooms, water closets and stores

- The height of all such rooms measured from the floor in the ceiling should not be less than 2.4m.
- In the case of a passage under the landing, the minimum headway may be kept as 2.2m.
- According to OBC, bathroom minimum height of 2.1 m in any area where a person would be in a standing position

4. Kitchen

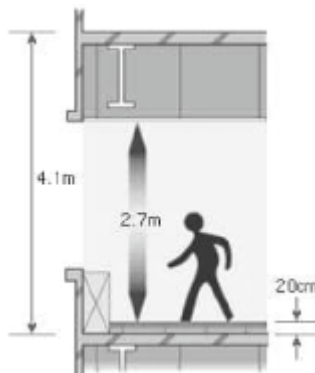
- The height of the kitchen measured from the floor to the lowest point in the ceiling should not be less than 2.75m except for the portion to accommodate floor trap of the floor.
- However, according to OBC, kitchen height should be 2.3 m over at least 75% of the required floor area with a clear height of at least 2.1 m at any point over the required area.

5. Ledge

It shall have a minimum head room of 2.2m.

6. Hallways

Minimum height should be 2.1 m



Minimum Standard Sizes of Rooms

1. Habitable Rooms

- The area of habitable rooms should not be less than 9.5m² where there is only one room. However, such rooms shall have at least 13.5m² of floor area and no dimension less than 3.0 m as per Ontario Building Code (OBC).
- Where there are two rooms, one of these should not be less than 9.5 m² and other be not less than 7.5 m² with a minimum width of 2.4m.
- Natural ventilation shall be provided.

2. Dining room

- It should have a floor area not less than 9.5m² with a minimum width of 2.4m.
- According to OBC, dining room shall have at least 3.25 m² of floor space when combined with other rooms, and at least 7.0m² of area when not combined.
- Minimum dimension of 2.3 m.
- Dining rooms vary greatly in size. It should be ensured that furniture is accommodated.
- Natural ventilation shall be provided.



3. Primary Bedrooms

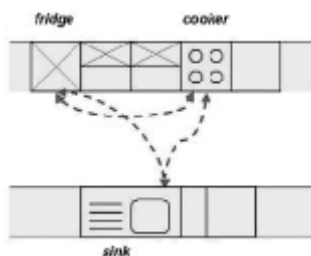
- One bedroom shall have at least 9.8m² of floor area
- Minimum dimension should be 2.7 m
- Natural ventilation must be provided

4. Secondary Bedrooms

- It shall have at least 7m² of floor area
- Minimum dimension is 2.0 m

5. Kitchen

- Minimum floor area required is not less than 5.5 m². But OBC specify that kitchen room shall have at least 4.2m² of floor area
- It should not be less than 1.8min width at any part. With a separate storeroom, the area may be reduced to 4.5m².
- Mechanical ventilation must be provided (exhaust fan).
- Ensure that appliances can all open without interfering with one another, and that standing space is provided.



6. Bathrooms and water closets

- The size of bathroom should not be less than 1.5m x 1.2m or 1.8 m².
- If it is combined with water closet, its floor area should not be less than 2.8m².
- The minimum floor area of a water closet should be 1.1 m².

7. Ledge

- A ledge in a habitable room shall not cover more than 25% of the floor area of the floor on which it is constructed
- It should not interfere with the ventilation of the room under any circumstances.

8. Hallways

Hallways shall have a width of at least 860 mm except where the overall width of the building is less than 4.3 m, and this may be reduced to 710 mm

9. Mezzanine floor

The minimum size of a mezzanine floor, if it is used as a living room, should not be less than 9.5m².