The United Republic of Tanzania

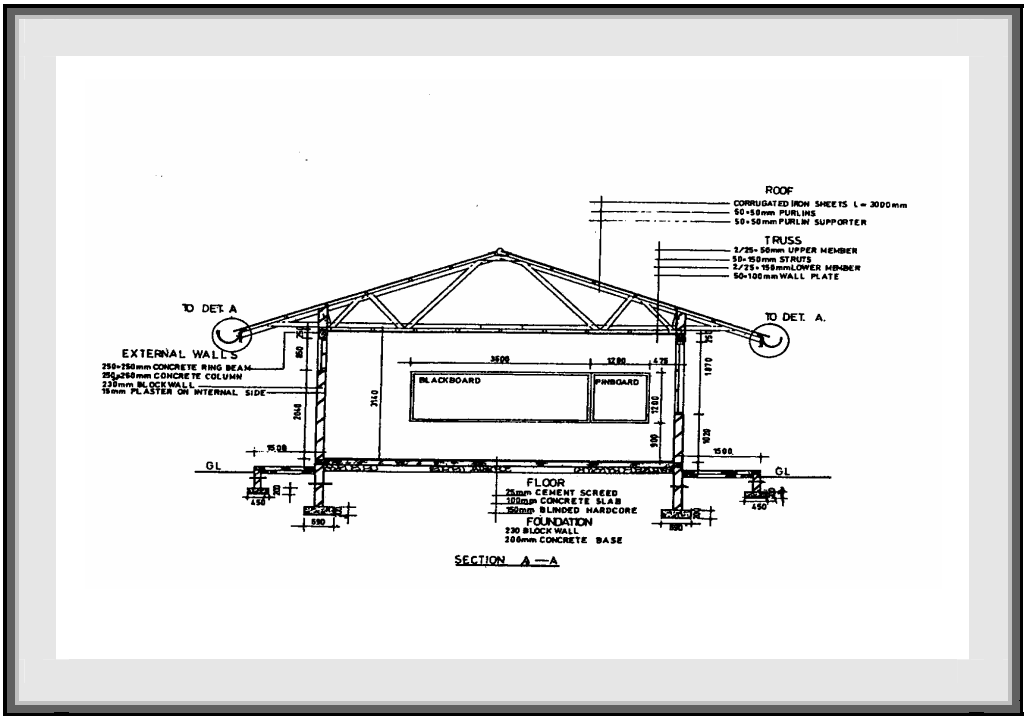
MINISTRY OF EDUCATION AND CULTURE

DG

(DEVELOPMENT GRANT FOR SECONDARY SCHOOLS)

SEDP (2004 –2009)
SECONDARY EDUCATION DEVELOPMENT PROGRAMME

Technical Handbook for provision of Physical Facilities in Secondary Schools



MoEC - Physical Planning Unit
JULY 2004

Technical Guideline Handbook for Provision of Physical Facilities in Secondary Schools

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CHAPTER 1 – General information

1.1. General matters

This Technical Handbook describes the construction works of Standard Secondary School Buildings. The Handbook explains the principals, standards and sizes of building facilities of a secondary school as well as furniture that would suffice the needs of a conducive learning environment for students, teachers, etc.

There are many factors affecting the state of school buildings, of which most are caused by the use of faulty design, inappropriate methods, materials and lack of skills and knowledge. If proper and appropriate standards, methods and materials are used from the initial stage, then future maintenance costs will be minimised.

1.2. General description of the buildings

This Handbook describes the construction works of secondary school facilities under SEDP, which consist of:

Classrooms Blocks	Type A –Two room block Type B –Three room block	
A**dministration Block**	For 4 stream school (comprising two staffroom)	
Laboratories	Type A – 1 labs block Type B – 2 labs block Type C – 3 labs block	
Staff houses	Type A – 3 bedroom urban house. Type B – 3 bedroom rural house	
Library	To accommodate Librarian office, store and reading/reference room	
Toilets	Urban and Rural Ablution blocks	– staff room – students classrooms area – dormitories
Assembly Hall	Seating capacity to accommodate 160 students during examinations	
Kitchen/Dining Hall	Seating capacity to accommodate 320 students in a single shift	
Dormitory	Single Block to accommodate forty eight (48) students and a store	
Disabled Facilities	To all buildings	
School site master plan.	Sample illustration	

Construction works is a complex process which requires decisions to be made both during the inception stage as well on site as the works proceeds. The following issues with related problems have been dealt with at the design stage and will furthermore need improvement and final decision on site:-

ISSUES	**RELATED PROBLEMS**
Classrooms built on unsuitable sites	-Sloping sites gives risk of settlements and will raise the cost. -Wet areas give poor foundation and increase environmental risks. -Cotton soil and heavy clay areas cause different settlements in foundations and development of cracks.
Classrooms built as extension to existing buildings.	-If a building is made too long, construction cracks will occur and the environment will be unpleasant.
Classrooms oriented wrongly.	-Classrooms facing East/West letting in sun will be excessively hot -Cross ventilation is poor if openings are not facing local winds.
Classroom blocks built in L-shape.	-Complicated construction, problems with valley and hip roofing elements. -More costly in use of materials. -Unstable in earth quake zones.
Foundations too weak leading to cracks in walls.	-The foundation is too shallow. -The trench has not reached firm soil. -Thickness too little and bonding weak. -Poor quality of materials.
Walls cracking and falling .	-Too thin compared to the length (Area coverage to big) -Poor materials i.e. insufficiently burned bricks or sand cement blocks of poor mix. -Poor mortar joints, often only mud. -Walls unstable, out of plumb. -Poor craftsmanship.
Walls eroding and joints washing out	-Eaves too small, both sides and gables. -No plaster to protect against rain, wear and tear. -Joints/pointing too weak.
Lintels/columns collapsing	-Lintels of timber exposed to termites -Reinforcement missing or placed wrongly. -Beams/reinforcement under dimensioned. -Poor concrete and lack of curing.
Floors cracking, with holes and voids.	-No proper hardcore and concrete slab; many floors are only cement screed. -No construction joints and lack of curing.
Screed not bonding to the structural floor	-Concrete slab not cleaned and no watering before laying screed. -Screed not kept wet for min. 7 days curing. Wrong mix. Used.
Roof collapsing or blowing off	-Trusses not anchored to walls.

	-Wrong type of timber, no treatment against termites. -*Fundis* know nothing about stress and tension. -Nails too few and place wrongly in joints. -Roof trusses not properly designed and fixed. -Poor joints between purlins.
Roofing-sheets rusting, leaking or blowing off.	-Sheets are too thin. -Overlap of sheets and ridges too small. -Nails, too short or too few, and without washer. -Poor quality and not properly fixed. -None or poor galvanising.
Many classrooms are dark.	-Window area too small or few windows. -No white wash of internal walls to spread light.
No security	-Windows and doors are missing. -No burglar proofing. -Absence of watchman out of school hours.
Blackboards, non existing or inappropriate.	-Lack of funds from communities/Districts. -Wall behind blackboard weak and cracking. -No maintenance of existing blackboards
Shortages of furniture and poor quality	-Furniture is expensive. -Design and craftsmanship poor. -No security and maintenance. -Misuse (overloaded) because classrooms are overcrowded. -Policy is missing.
School compound misused for grassing of husbandry, other construction or for crop.	-People build inside the boundaries. -The boundaries not proper marked. -Local authority unable to survey school boundaries.
Rainwater not drained away from buildings.	-No aprons and storm water drains around buildings. -Erosion undermines foundation.
Environment is hostile	-Vegetation is lacking -Trees are grown too close to buildings. -No vegetation to avoid soil erosion. -Shrubs and flower improves landscaping.

1.3. Design standards

The design of Secondary Schools facilities refers to the standards set up by the Ministry of Education and Culture (MoEC).

The construction methods and materials described in this Handbook comply with the existing construction practice in the country..

1.4. Environmental issues

The implementation of SEDP has taken into account of environmental issues and comply with the Building Regulations, Fire Protection Regulations and National Environment Management Council (NEMC) regulations.

1.5. Works categories

The building process has been subdivided in eight (8) categories of works, reflecting the operational cycle:

Works category N°.1: **Site layout and preparation**

Works category N°.2: **Foundations**

Works category N°.3: **Floor slab**

Works category N°.4: **Masonry and ring beam**

Works category N°.5: **Roofing**

Works category N°.6: **Joinery**

Works category N°.7: **Building services**

Works category N°.8: **Finishings**

Furniture

External works

The *technical specifications* include a detailed description of the works (Chapter 2) and specifications of workmanship and materials which comprises of the origin, quality and preparation of the materials (Chapter 3).

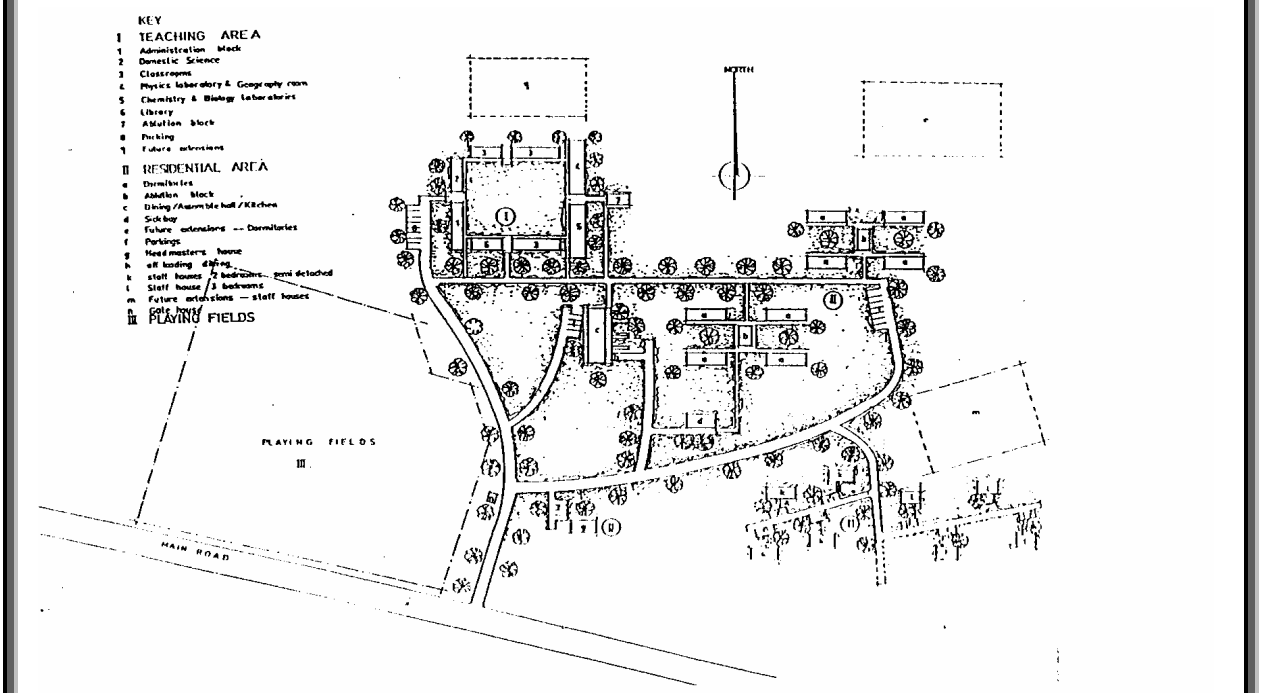
In the Schedule of works (material prices and associated labour costs) (Chapter 5), the numbering of the categories of works follow the description given in chapter 2.

The physical facilities (mostly building works) to be carried out are illustrated by the drawings in Chapter 6.

CHAPTER 2 - Detailed description of works

WORKS CATEGORY N° 1: SITE LAYOUT AND PREPARATION

Operations	▪ **Preparation of the building site;** ▪ **Levelling and compacting of ground;**



The Sample Layout

1.1. The Layout

The layout of any building is mostly dictated by the site conditions. The Sample layout provided in this handbook assumes a flat land site. Orientation and adjustments should be made to take into account maximum benefit and effects of the prevailing winds direction, natural daylight, site topography, etc.

1.2. Local conditions and load bearing capacity of soil

The Builder/Contractor shall follow the instructions given to him by the Regional Engineer in collaboration with Council Engineer concerning the type of foundations and the location of the buildings. Before starting the construction works, the Engineer should determine the nature of the soil and the adequate foundations to be built. Caution: **areas where black cotton soil is present should be avoided.** If the whole site is situated on black cotton soil, contact Ministry of Education and Culture for specific instructions.

1.3. Location of the buildings

The buildings' position on the site will be decided by the Engineer who will make sure that:

- The new buildings are at minimum 3 metres (side elevation) to 12 metres (elevation with windows) away from existing buildings;
- Distance from big trees is not less than 10 metres and big trees (above 4 metres) are encouraged not to be cut;
- Buildings are set or located not against steep slopes;
- Waterlogged areas are avoided;
- Areas with termitaries are avoided;
- Elevations with windows are facing north and south;
- Instructions of the site plan drawings are followed;
- Latrines are located at not less than 100 metres from the water sources (shallow wells) in the direction of the water flow.

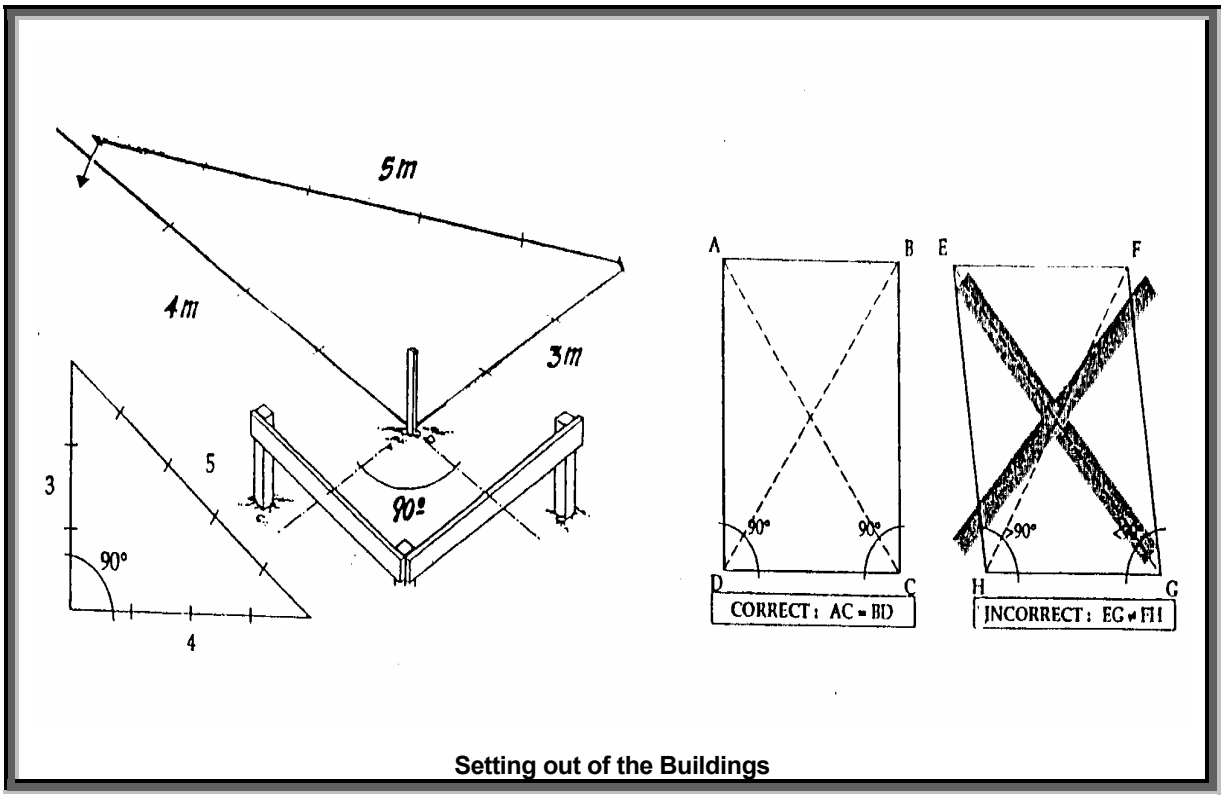
1.4. Preparation of the building site

- The entire area of the building site (including sidewalks) shall be carefully cleared of all trees, bushes, grasses, roots, trunks, stones and all other debris;
- After clearing and cleaning, the topsoil shall be stripped down to a depth of 20 cm on average for the whole building site plus 2 m around the building perimeter. Stripped soils shall be removed from the site and spread out in the places indicated by the Site Engineer. **The topsoil should never be used for backfilling.**
- Termitaries situated at 10 metres around the building perimeter shall be entirely removed deep down to their foundations, and dumped far from the existing and new buildings.
- The stripped land shall be levelled to form the platform for the construction of buildings and pedestrian ways according to the drawings. Holes produced by the removal of trunks, roots, termitaries are filled, levelled and compacted.
- All debris, topsoil, vegetation and unwanted soil shall be removed from the site to a dump indicated by the Site Engineer;

1.5. Setting out of the buildings

The Engineer will assist the setting out of the buildings. The Builder/Contractor shall mark out the site according to the drawings. He will make use of the 3; 4; 5 m measurement method on the main lines of the setting out to get a right angle. The Builder/Contractor shall check the square of the setting out by ensuring that diagonals are of equal length (see drawings below).

All levels are given in metric system; the level $\pm$ 0,00 being the unscreeded floor. The Builder/Contractor shall mark out the level $\pm$ 0,00 by using concrete benchmarks, embedded in the ground, in sufficient number and placed at a suitable distance from the buildings. Units of measurement are in metric system. i.e. the units shall be in millimetres (mm), centimetres (cm) metres and/or kilometres.



Setting out of the Buildings

Soil Investigation

Soil investigation shall be conducted by;: gathering soil samples; soil testing either by laboratory or field procedures; soil classification and development of soil profiles.

Suitable soils:

Suitable soils are dense and firm. They are compact, with high compressible strength, hard to dig and resistant to the pick. The greater is the compactness of the soil, the larger is the weight of the soil per unit volume (specific gravity). The specific gravity of the solid substance of most inorganic soils varies between 2.6 and 2.8. Tropical iron rich laterite, as well as some lateritic soils, generally has a specific gravity of 3.0 or more.

The firm soil is coarse-grained. Coarse-grained soils are those in which at least half of the material, by weight, is constituted of stones, gravel and sand. To test this, pass the dry soil sample on a No. 200 sieve (200 apertures on a linear inch). If at least half of the material, by weight is retained on the sieve,

the soil is coarse-grained. If the soil is fine-graded, like silt and clay soils (more than half of the material, by weight, passes through a No. 200 sieve), then more tests on plasticity and compressibility should be operated.

The firm coarse-grain soil is well-graded, it means that all sizes of particles, from the largest to the smallest are present and no size is abundant or missing. (test the particle gradation). The fine-graded soils are not classified on the basis of grain size distribution but according to plasticity and compressibility.

The shape of the particles is angular or sub-angular. Angular particles tend to interlock, form a denser mass and become more stable than the rounded particles, which can roll or slide past one another. Rounded particles are usually found in the stream beds.

In a firm soil, the moisture shall be adequate, specially in fine soils: Moisture affects fine-grade soils (clay and silt soils) more than coarse-grained soils (test the moisture content).

Rocks and well-graded, dry coarse-grained sand or gravel soil are firm incompressible soils. On these soils, the foundation shall be minimum 60 cm deep. Where rock or coral is met, foundations can be placed on top.

Wet sand soils, pure dry clay, wet clay gravel are relatively compressible. They could be suitable for construction subject to further investigation and appropriate design (contact Engineer).

Weak soils to avoid:

- **Organic soils:** An organic soil may be an organic silt or clay, or it may be a highly organic soil such as peat or meadow mat. Organic soils are often black and deep red in colour and usually have a characteristic musty smell. They have a spongy feel and frequently fibrous textures. Particles of leaves, grass, branches or other fibrous vegetable matter are common components of these soils. These soils are usually compressible and have poor load bearing properties.

- **Expansive clay soils:** These soils undergo large volume changes with variations in moisture content such as witnessed in a dry lake bed. Though they are hard enough when sun-baked, they often lose stability and turn to mud in rainy water. The clay swells and looses stability when it becomes wet. It also retards drainage of water.

- **Backfills and transported soils**: These soils are not compact. If foundations are built on these soils, the building will not be stable, will have settlement cracks and will eventually collapse.

- **Waterlogged areas, swampy soils, and stream beds**

A simple test for measuring the load bearing capacity of the soil.

- Build a small wooden table: the legs should have a 10x10 cm (4"x4") section and about 50 cm height. The table-top should have a dimension of about 33x45 cm (big enough to put a cement bag on it).
- Weigh the table and note the weight.
- Dig a trench down to 60 cm deep or when you have encountered what you think is the firm soil. Level the bottom of the trench. Shave off loose and dried soil to obtain a fresh smooth horizontal surface. Do not compact this surface.
- Put the table on this surface in the trench. Verify, with a level, that the table-top is horizontal.
- Load the table gradually with cement bags.
- Stop immediately loading more cement bags when the legs begin to penetrate the soil, because the limit of load bearing capacity of the soil has been reached.
- Calculate the load bearing capacity as follows:
- (The weight of the table + the weight of the cement bags and other items on the table on kg)/ (divided by) the total surface of the table legs in contact with the soil (4 legs x 10x10 cm = 400 cm2). If this figure is 0.5 or less, the soil has a very low resistance and is not suitable. The figure should be at least 2 (2 kg per cm2). Good compact soils have a load-bearing capacity of at least 2 kg per cm2 (20 kg per cm2 for a rock).

1.6. Quality control checks for implementation phase

No.	Check list for quality control : Implementation phase	YES	NO
1	Instructions on point 1.2 (building location) are respected: • The new buildings are at minimum 3 metres (side elevation) to 12 metres (elevation with windows) away from existing buildings; • Distance from big trees is at least 10 metres and no big tree is cut; • Buildings are not against steep slopes ; • Waterlogged areas are avoided; • Areas with termitaries are avoided; • Elevations with windows are facing north and south; • Instructions of the site plan drawings (site plans number 1 to 3) are followed; • Latrines are located at 100 metres from the water sources in the direction of the water flow.		

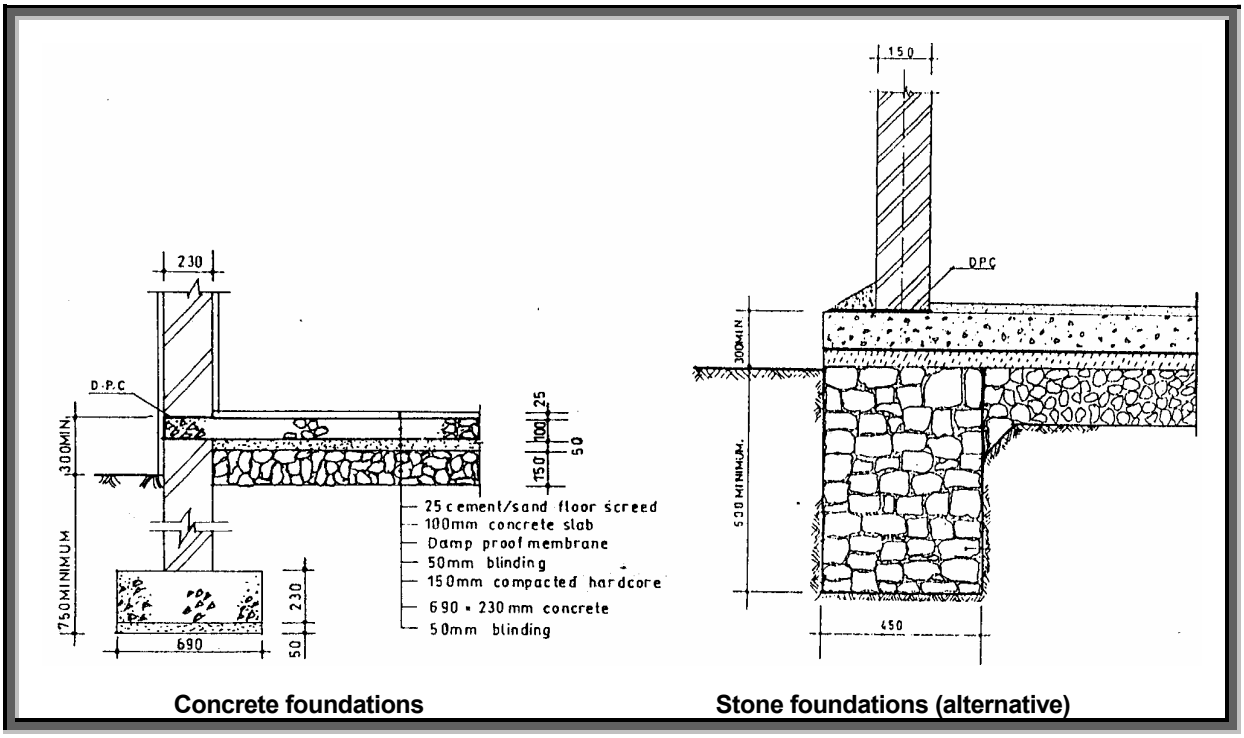
2	• The topsoil is stripped down to a depth of 20 cm on average for the whole building site plus 2 m around the building perimeter. • Termitaries situated at 10 metres around the building perimeter are entirely removed deep down to their foundations, and dumped far from the existing and new buildings. • The stripped land is levelled to form the platform for the construction of buildings and pedestrian ways. • All debris, topsoil, vegetation and unwanted soil are removed from the site.		
3	• Setting out of the foundations marked on the construction profiles are correct (length, width, position). • The square of the building is correct (right angles).		

1.7. Comments/Remarks against Quality control checklist

No.	Item	Comment/Remark

WORKS CATEGORY N° 2: FOUNDATIONS

Operations	▪ **Trench excavations** ▪ **Blinding** ▪ **Concrete foundation** ▪ **Reinforced foundation** ▪ **Foundation walls** ▪ **Stone and concrete foundation (alternative)** ▪ **Backfilling around foundations**



Concrete foundations **Stone foundations (alternative)**

2.0 General matters

The foundation is the base of a building. If the foundations are not stable, the building will crack and eventually collapse. Therefore the foundation must stand on stable soil, protected against running or stagnant rain water.

2.1. Type and dimensions of foundations

The Drawings in this handbook give the indicative minimal requirements for soils with a normal load-bearing capacity. The Engineer should appraise the type and load bearing capacity of the soil and indicate the appropriate type and dimensions of the foundations. The instructions given to the Builder/Contractor should be noted in the site book. For seismic areas and in presence of black cotton soil, specific design should be requested from MoEC.

2.2. Excavation of foundation trench

Foundations must be placed on firm ground. Trenches in soft or hard soils shall be excavated to a depth approved by the Engineer. The Builder/Contractor is responsible for any necessary trimming or sheeting of trench sides, de-watering, levelling and compacting of trench bottoms, backfilling around foundations and carting away surplus excavated materials.

2.3. Blinding

Blinding on the base of foundations shall be of either cement and sand mix (1:8) or light concrete mix 1:4:8 (cement: 150 kg/m3 kg).

Blinding on hardcore shall be of coarse aggregates laid on top of hardcore finished with a thin layer fine aggregates/ crusher dust or any inorganic material approved by the Engineer.

2.4. Concrete foundations (strip footing)

Mix and cast concrete type 1:3:6 (cement: 250 kg/m3 kg) for the strip footing foundations, including boarding, shuttering, and all necessary related works. The concrete should be workable (not too fluid, not too stiff). The quantity of water to use in the mix is around 30 litres per bag of cement, depending on local conditions and size of aggregates.

2.5. Reinforced concrete foundations (strip footing)

If required by the bearing capacity of soil and according to the instructions of the Engineer, *prepare and place steel bar reinforcement including bends, hooks, tying wires, ordinary spacers and all necessary related works.*

Mix and cast concrete type 1:2:4 (cement: 350 kg/m3 kg) for the strip footing foundations, including boarding, shuttering, and all necessary related works. The concrete should be workable (not too fluid, not too stiff) as explained above.

2.6. Foundation walls

Construct 230mm thick foundation walls in substructure comprising solid blocks size 23 x 15 x 45 cm , cement sand **mix 1:6** (**13 blocks made with one 50kg-bag of cement**), bonded with cement/sand mortar of the same ratio. Leave blockwork to cure for four weeks after moulding.

2.7. Stone Foundations– (alternative to items 2.5 & 2.6)

This alternative can be used where stone is available, upon approval of the Engineer. Construct stone foundation of uncoursed stone, rough or common rubble entirely embedded in concrete 1:3:6 (deep strip foundations) or mortar (1:4) to prevent stone to stone contact.

2.8. Backfilling around foundations and in making up levels

After the foundation walls have cured for 7 days, the trenches shall be backfilled with *non-organic soil*. The fill shall be screened and laid down in layers of max. 20 thickness, watered if necessary and carefully compacted. Soils unsuitable as backfill and surplus excavated material shall be carted away.

2.9. Quality control checks

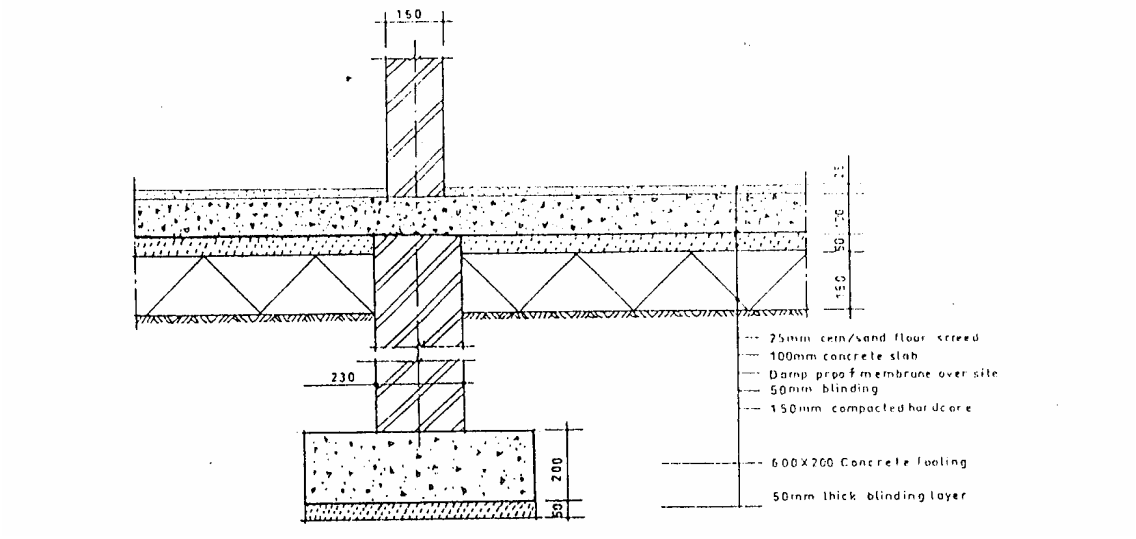
No.	Foundations: Check-list for quality control at implementation
1	• Foundations are on the firm soil? • Foundations are deep enough to reach the firm soil? • If in exceptional circumstances, the foundations are built on weaker soils, does the type of the foundations correspond to the type of the soil (masonry/stone deep strip; reinforced concrete strip footing; reinforced concrete pad/floating slab)?

	Foundations blocks: Check-list for quality control (28-day blocks)
Mix	Reminder: the foundation block is 1:6 (1 volume of cement for 6 volumes of sand or in other terms 250 kg cement for one m3). With a 50 kg bag of cement, you can make 13 blocks.
Shape	The corners and edges of the blocks should not be broken by finger pressure
Appearance	The whole block has the same colour. The surface of the block is uniform without voids, holes, cracks, micro-cracks
Dimensions	The dimensions of the block are 23 x 15 x 45 cm . Tolerances of 6mm can be admitted for either side.
Porosity	When wetted to saturation, the block does not absorb more than 2 litres of water.
Resistance	When the surface , corners, edges are scratched, no loose material is detached.
Mechanic resistance	Put a block on 2 other blocks situated at a distance of 20 cm from each other. Step and stand on the upper block. The block should resist during at least 60 seconds to the weight of a person of about 70 kg.
Resistance to chock	Drop a block from one metre height on a sand soil. The block should not break. If it breaks into two parts, or smashes, it is too weak. And should be refused.

	Concrete footing: Check-list for quality control (test min. 7 days after casting)
Mix	Reminder: the concrete type is 1:3:6 (1 volume of cement, 3 volumes sand and 6 volumes gravel. In other terms 250 kg cement for one m3). With a 50 kg bag of cement, you can make only 1.45 metre long of a foundation measuring 23 x 69 cm (15% loss inclusive).
Appearance	The whole surface of footing should have the same colour, uniform without voids, holes nor cracks. The size of coarse aggregates ranges between 5 to 30 mm and all sizes are equally present. The aggregates are well embedded in cement. Can not take them out by scratching. The footing is cast over a bed of blinding mortar.
Dimensions	The dimensions of the foundations are 23 cm (depth)x 69cm (width) . The length should conform to the drawings. A tolerance of 1 cm can be admitted for the length.
Resistance	When the surface is scratched with a nail , neither loose materials is detached, nor hole or crack appears. For mechanic resistance, laboratory tests should be operated.

WORKS CATEGORY N° 3: FLOOR SLAB

Operations	▪ **Compacted Hardcore** ▪ **100 mm thick concrete floor bed** ▪ **Damp proofing**



Floor slab

3.1. General matters

Floors are part of building that is subject to heaviest wear and tear. Therefore construction of most school building generally consists of a concrete slab, which may form a wearing surface or may be finished otherwise i.e. by terrazzo, tiles, etc. Normally wooden floors are not used in our schools.

3.2. Compacted hardcore

Lay down 15 cm thick hardcore to be the base under the floor slab, using large stones ranging in size between 10 to 15cm, the larger stones to be laid first. Finish the upper level of the hardcore layer with blinding material such as backfill soil or stone dust as before described; level and compact.

3.3. 100 mm thick Concrete floor bed

Cast the concrete floor bed:

1. Prepare shuttering to the perimeter edges of external foundation walls. The floor bed is to be casted continuously to cover all foundation walls.
2. The Damp Proof Membrane (DPM) should be put to cover the whole area to be covered by concrete slab after the hardcore compaction(To areas with water logged) To other foundations insert Damp Proof Course (DPC) before blockwalls in superstructure

3. The floor bed/slab must be levelled

Construction joints should be provided where the floor span is more than 25metres or where casting of floor is done at different operations/periods.

In case construction joints are to be provided, the following procedure should be followed;

i. Divide the complete concrete floor bed to the portions (panels) which can be cast at one time
ii. Mark the panels and construct the joint with 10x2cm formwork to guide, level and limit the days casting.
iii. Place a strip of 10cm width damp-proof felt against the construction joint formwork facing the first panel to cast.
iv. Mark thickness of concrete slab (10 cm level) with the same mix as the slab (1:3:6).
v. Prepare concrete mix 1:3:6 for concrete floor bed (cement: 250/m3) The concrete should be workable (not too fluid, not too stiff, but a compact mass without void). The quantity of water to use in the mix is about 30 litres per bag of cement, depending on local conditions and size of aggregates
vi. Cast panel number 1.
vii. After one day, remove entirely the formwork (no timber should be left in the construction joint), the damp-proof felt is left against the concrete floor bed of panel one and will constitute the construction joint.
viii. Repeat operations number 4 to 7 for panels 2 and 3.

The following shall constitute damp-proofing materials at 15cmm lap joints unless specified otherwise by the Engineer;

Damp Proof Membrane (DPM) - polyethylene sheet.
Damp Proof Course (DPC) - bitumen felt.

3.3. Quality control check of the Slab

	Floor slab: Check-list for quality control (test in. 7 days after casting)
Mix	Reminder: the concrete type is 1:3:6 for the slab (1 volume of cement, 3 volumes sand and 6 volumes gravel. In other terms 250 kg cement per 1m3). With a 50 kg bag of cement, you can make no more than 2 square metres of a 10cm tick slab (10% loss inclusive).
Aggregates	The size of coarse aggregates (gravel) ranges between 5 to 30 mm and all sizes are equally present. Cobbles and stones bigger than 30 mm are not used.
Appearance	The whole surface of the slab has the same colour, is uniform without holes nor cracks. The aggregates are well embedded in cement. You can not take them out by scratching.
Resistance	When the surface is scratched with a nail, only a layer of maximum 2 mm on the surface would be loose (this is the layer which dries faster than the others). The deeper layers resist to the nail. No material is detached, no hole or crack appears. For mechanic resistance, laboratory tests should be operated.
Dimensions	The thickness of the slab is 10cm. To verify this, measure the depth of the construction joins at least 6 different places. The length and width should conform to the drawings. A tolerance of 1 cm can be admitted for the length.

Level	The slab is at least 15 cm above the natural ground level. The surface is perfectly flat and even, free of bumps.
Construction joints	They are 10cm deep and located as shown in the drawings below. They are filled with a bitumen felt.
Sub-structure	The concrete floor bed should be built on a 15cm blinded hardcore. If there is any doubt on the correct execution of the sub-structure, demolish a small portion of the slab, chosen at random, dig underneath and verify the existence and depth of the hardcore.

WORKS CATEGORY N° 4: MASONRY AND RING BEAM

Operations	▪ **Load bearing masonry;** ▪ **Reinforced concrete ring beam;** ▪ **Hoop-iron stirrups.**

4.1. General matters

Walls provide protection against rain, wind, heat, cold and sound. Walls carry the load of the roof. The vast amount of materials needed for walling makes it most economical to use materials locally available.

4.2. Load bearing cement block masonry

Erect cement block masonry, thickness 23 cm, using 15 x 23 x 45 cm solid cement sand blocks of mix 1:8, bonded with mortar mix 1:6 and all related works. Each block should cover half of the length of each of the two blocks below it. The average thickness of horizontal mortar joints is 20 mm and of vertical ones is 10 mm.

Caution:

- Cement and sand blocks should never be used before four weeks from the time of moulding. They should be wetted to saturation with water before placement.
- Masonry works shall begin no sooner than 8 days after the concrete floor bed is entirely cast.
- In order to avoid deformation of window and doorframes, care shall be taken to place suitable props and struts while raising the walls.
- To avoid cracks under the window sills, vertical joints shall be filled at least three weeks after finishing the masonry and the ring beam (let the building settle).
- To avoid cracks over the ring beams, the gable ends (triangular wall over the ring beam) shall be constructed at least 21 days after the ring beam is cast.
- The drawings indicate the measurements of the walls without plaster.

4.3. Reinforced concrete ring beam dimensions 15 x 25 cm

- Prepare and place the shuttering (see also chapter 3, point 3.7).
- Prepare and assemble the reinforcement bars diameter 12mm and stirrups (links) diameter 6mm (every 25 cm) , bend the bars with appropriate tools.
- Place the assembled bars in the shuttering with special care to ensure that they remain in place during the pouring of concrete and do not appear exposed after the shuttering is stripped. 12mm diameter 30cm long rag bolt wit nuts shall be cast in concrete to grasp the wall plate. Alternatively, 6mm diameter bar 150cm long may be used for tying both the truss and wall plate underneath.
- Cast reinforced concrete type 1:2:4 for ring beams (cement: 350 kg /m3). The concrete should be workable in order to adhere around reinforcement. Too much water will result in weak resistance, important shrinkage and cracks. The quantity of water depends on local conditions but can be estimated at about 30 litres per bag of cement.
- Remove the formwork after a minimum period of 15 days from casting of the concrete.

- Concrete shall be cured twice a day for the minimum 14 days consecutively.

4.3 Quality control checks

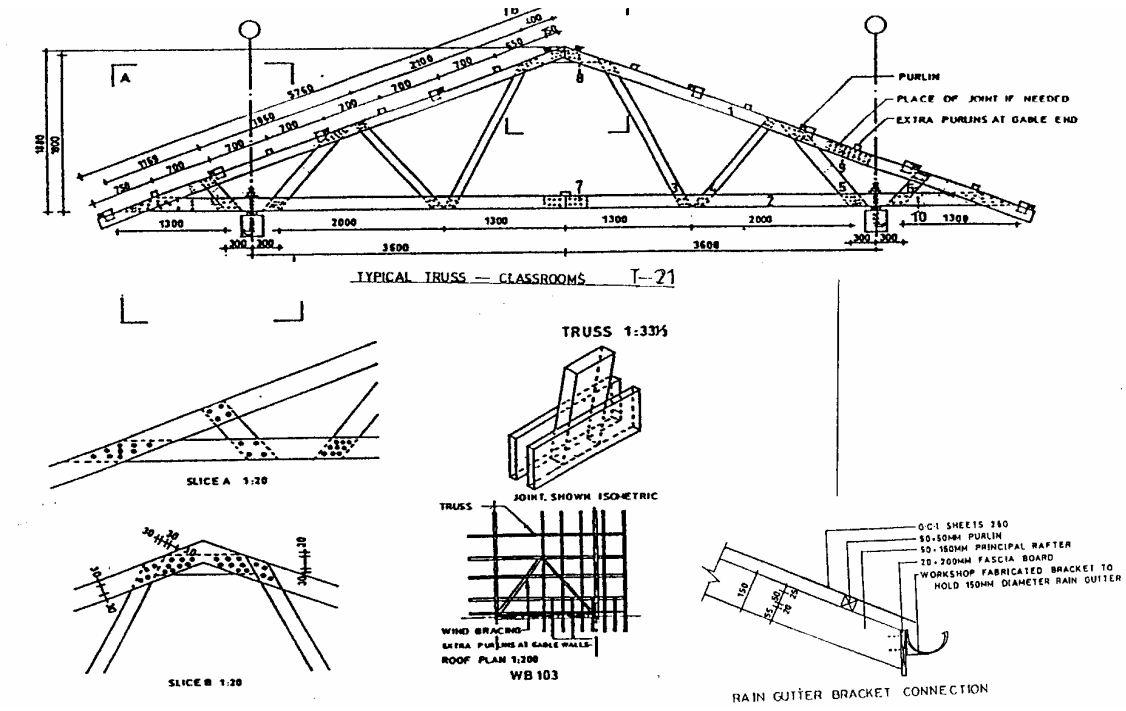
	Masonry: Quality control Check-list
Mix	Reminder: the wall block is 1:8 (1 volume of cement for 8 volumes of sand or in other terms 200 kg cement for one m3 of sand). With a 50 kg bag of cement, you can make only 16 blocks for walls.
Shape	The corners and edges of the blocks are not broken. And will not break under finger pressure
Appearance	The whole block has the same colour. The surface of the block is uniform without voids, holes, cracks, micro-cracks
Dimensions	The dimensions of blocks are 15 x 23 x 45 cm . Tolerance of 6mm can be admitted for either side.
Porosity	When wetted to saturation, the block does not absorb more than 2 litres of water.
Resistance	When the surface, corners, edges are scratched, no loose material is detached.
Mechanic resistance	Put a block on 2 other blocks situated at a distance of 20 cm from each other. Step and stand on the upper block. The block should resist during 60 seconds to the weight of a person of about 70 kg.
Resistance to shock	Drop a block at one metre height level on a sand soil. The block is not supposed to break, if it breaks (either in two parts or smashes) then it is weak and should not be used for construction purposes.
Mortar	The thickness of the mortar does not exceed 2 cm and is not less than one cm. When the mortar is scratched, no loose material is detached.
Blockwork/ Brickwork	Each block should cover half of the length of each of the two blocks below it. No vertical joint can continue on two or more ranges. All horizontal joints are continuous and perfectly levelled. Walls are perpendicular (tolerance from vertical maximum 5 mm) and form right angles (diagonals in each room should be equal).The height of constructed blockwall should not exceed 150cm high at a single working day
Dimensions	The size of each room / position of walls, doors, windows conforms to the drawings.
Cracks	No cracks or micro cracks appear, specifically near the building corners, under the window sills and over the construction joints.

	Ring beam: Quality control Check-list (test after shutters are removed)
Mix	Reminder: the concrete type is 1:2:4 for the ring beam (1 volume of cement, 2 volumes sand and 4 volumes gravel. In other terms 350 kg cement for 1m3). With a 50 kg bag of cement, you can make only 380 cm long of a 25x15 cm beam (10% loss inclusive).
Aggregates	The size of coarse aggregates (gravel) ranges between 5 mm and 30 mm and all sizes are equally present. Stones and stones bigger than 30 mm are not used.
Appearance	The whole surface of the ring beam has the same colour, it is uniform without voids nor cracks. The aggregates are well embedded in cement. You can not take them out by scratching. The reinforcement bars are not visible because are well embedded in concrete with a minimum concrete cover of 25mm.
Resistance	When the surface is scratched with a nail, only a layer of maximum 2 mm on the surface would be loose (this is the layer which dries faster). The deeper layers resists to the nail: no material is detached, no hole or crack appears. When hammered to the concrete, a one inch non galvanised nail will bend. For mechanic resistance, laboratory tests should be operated.
Dimensions	The beam measures 25x15 cm. To verify this, measure the dimensions at least 6 different places. If the height and width are less, either the shuttering was not well done or the concrete

	cast was too wet and has shrank. In both cases the beam is weak, and should be removed.
Level	Check the position of the ring beam and compliance to the drawings.
Reinforcement bars	In case problems are found on the site, hammer in two places (on both faces) of the ring beam to remove the concrete and see the type, position and number of the reinforcement bars. Repair the concrete after the test. If no bars are found, the beam is to be demolished.
Iron hoops	6mm round bars should be cast in the ring beam at the indicated places (coming out of the ring on both sides of the roof truss axis) and be long enough to tie the trusses.

WORKS CATEGORY N° 5: ROOFING

Operations	▪ **Wood treatment** ▪ **Wall plate** ▪ **Roof structure** ▪ **Roof covering**



Roof structure in dry and treated softwood (Pine)

5.1. General matters

The roof is protecting all other building parts and the inhabitants from exposure to weather. If the roof leaks, the building is usually unfit for its purpose.

The roof construction is the most complex element of a building comprising wall plates, trusses and purlins. Fixing of these elements to each other and to the walls is essential in order to avoid damage to the roof blow the buildings. As it is the most expensive element of a building, it requires a lot of attention. The longer the roof lasts, the longer the life of the building.

5.2. Timber specifications and treatment

Read carefully chapter 3, point 3.12.

5.3. Roof structure on softwood (pine):

Wall plate: Fix 10 x 5 cm (4"x2") sawn timber wall plate to be placed on top of the ring beam anchored by means of hoop irons/rag bolts, for the entire length of the walls excluding the gable ends.

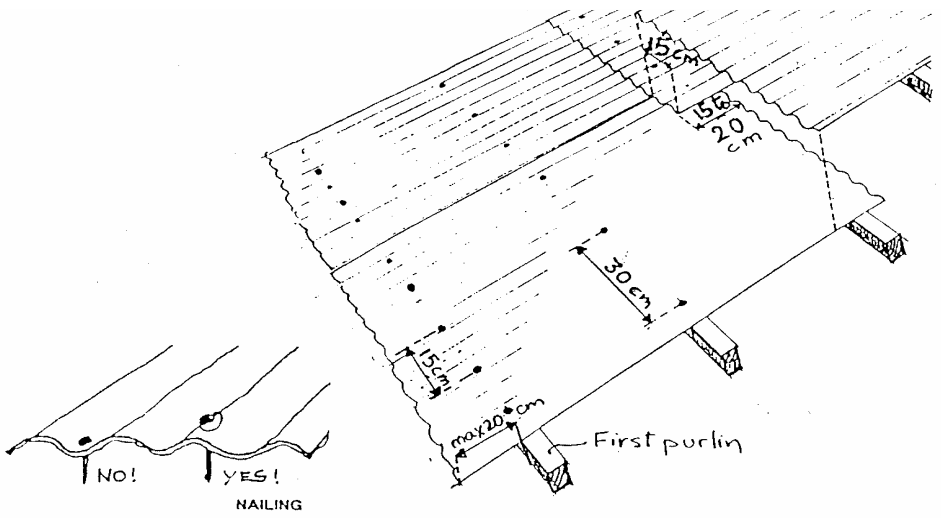
The wall plate should be treated on all faces before being fixed on the ring beam.

Roof timber trusses: Assemble and fix truss of sawn softwood for the roof structure including the anchorage to the wall plate, as shown in the drawings.
Timber purlins: Fix purlins on trusses by nailing as shown in the drawings
Fascia boards: Fix fascia boards 20 x2.5cm (8" x1") to the gable ends in order to protect the purlin ends. Make sure that purlin ends are treated with used approved preservative before fixing the fascia board.
Brandering: Fix 5x5cm approved timber brandering at maximum of 60cm centre to centre spacing each way by nails. For spans more than four metres, break 5x5cm Brandering monotony with a line of 5x10cm member.

5.4. Galvanised iron roofing sheets and ridges

Fix corrugated galvanised iron sheets 28 gauge overlapping to minimum 15 cm end lap and one and a half corrugation side laps. Fixing shall be made exclusively by means of specific galvanised nails for skipping every other two or four corrugations horizontally and at a minimum of 90 cm on sloping section as shown on the drawing.

Fix 35 to 45 cm wide galvanised iron ridge overlapping 25 cm minimum on either side, fixing to the roof structure shall be done by means of galvanised roofing nails.



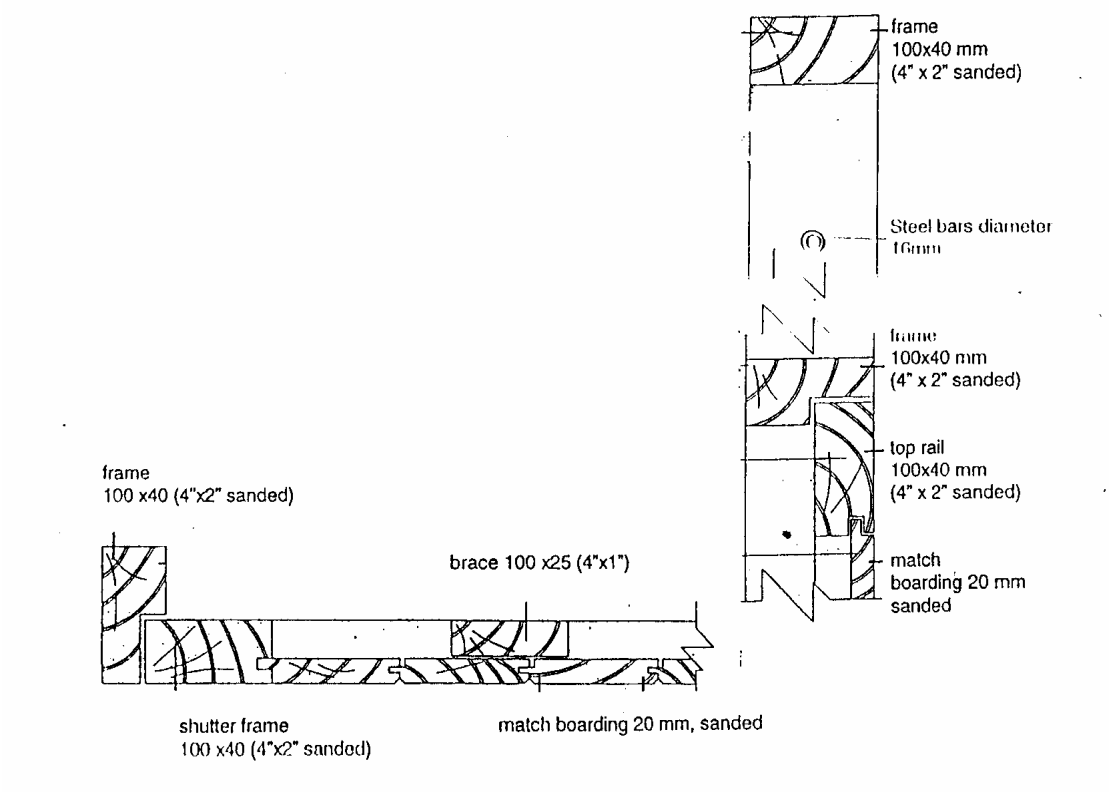
Overlap of corrugated iron roofing sheets – spacing of roofing nails

5.5 Quality control check

	Roof structure and roof cover: Quality control check list
Timber	Species, specifications and moisture content conform to the technical handbook, point 3.12.
Treatment	All faces of all components are perfectly covered with approved preservative, especially all the ends of rafters, gussets and purlins.
Position/dimension	The position of the roof trusses and purlins conforms to the drawing. The size of each component and the assembling/nailing conforms to the drawings.
Tying	The wall plate and each roof truss are tied to the ring beam by iron hoops. If iron hoops have been forgotten, while casting the ring beam: Fix new hoops in the walls (under the ring beam) and anchor the wall plates and trusses to them.
Roof cover	The roof sheets do not bend and are not distorted between the purlins. If so, the dimension of the roof trusses are not identical and/or the purlins are too weak. The roof structure should not be acceptable.
Overlaps	Overlaps of roof sheets and roof ridges is at least 15 cm in both directions. (minimum 2 corrugation horizontally).
Gauge	Roof sheets are minimum gauge 28. Weaker roof sheets should be refused (gauge 30 and more. Gauge 28 will not be bend easily under the pressure of the finger.
Galvanisation	A new galvanised roof (not steel exposed) is shinny. The zinc, used for the galvanisation will loose the shining aspect after few months. But in any case, no rust should appear (brown reddish stains and marks). Rusted, dented and non-uniform roof sheets and ridges should be immediately removed and replaced.
Fixing	All roof sheets should be fixed to all supporting purlins by means of galvanised nails for roofing fixed every 30 cm.
Fascia board	Purlin ends on the gable ends shall be protected entirely by fascia board. Make sure that purlin ends are treated with approved wood preservative before fixing fascia board.

WORKS CATEGORY N° 6: JOINERY

Operations	▪ **Door and window frames** ▪ **Solid and Flush doors** ▪ **Timber casement/window shutters**



Details of standard door (softwood)

6.1. General matters

Doors control access to rooms. The stronger the doors and good quality, the more security. Doors also provide privacy and to some extent reduce noise. High grade timber for external doors have been incorporated not only as they are exposed to the weather but also to prevent burglary.

Windows control the environment of rooms, the daylight, ventilation, rain and heat. Fitted with burglar bars, the windows also provide security.

The expensive and maintenance demanding superior quality shutters are recommended for Administration Block, Laboratories, stores, teachers' rooms, and areas where a high degree of security is required. However, these are more costly and demand most maintenance.

As a rule of thumb, the total area of windows in a room have been taken not be less than 10% of the floor area.

6.2. Joinery, Ironmongery

Timber specifications: read carefully chapter 3, point 3.12.
Manufacturing of doors and windows should start immediately after the general work has begun, in order to be ready on time. When delivered to site, joinery components (items) shall be stored under cover and protected from weather. Any component that develops warps or other defects must be replaced by new before fixing.

6.3 Door and window frames

Door and window frames shall be supplied and fixed on already built opening, Window frames shall comprise of 16mm diameter burglar bars in every 15cm centre to centre spacing as per drawings, including plugging to masonry and all related works.

All frames shall be braced in order to maintain right angles, braces shall not be removed until frames are fixed in their respective positions in openings.

6.4 Solid and Flush Doors

Supply and fix solid/flush doors including all ironmongery as per drawing and specifications

6.5. Timber casements and solid window shutters

Supply and fix timber casement in windows and solid window shutters including all ironmongery as per drawings and specifications.

All joinery work shall be finished with a smooth, clean and even surface and all exposed external corners of frames must be rounded.

Only glue of the best and strongest quality available on the market will be used. All screws and nails shall be of galvanised type.

Caution:

- Moisture content of timber for joinery shall not exceed 14%.
- Wood preservative product and undercoat paint shall be applied to all doors and window frames before being fixed to the walls.
- The frames and shutters should not be painted when wet and during or immediately after rain.
- Inaccessible top, bottom and side edges must be given two coats of wood preservative and undercoat paint before being fixed to the walls.

6.6. Timber frame doors

Supply and fix timber frame door as per drawings, including plugging to masonry and all related works.

6.7. Window frame with burglar bars

Supply and fix window frames with burglar bars, diameter 16 mm every 15 cm (centre to centre), dimensions as per drawings, including plugging to masonry and all related works.

6.8 Quality control check

	Joinery, doors and windows: Quality control check-list
Timber	Species, specifications and moisture content conform to the technical handbook, point 3.12.
Sanding	All faces of the door /window frames and door panels are perfectly sanded.
Treatment	All faces of all components are covered with wood preservative compatible with paint. Unexposed faces shall be primed or treated with approved wood preservative
Position/dimension	The position of the openings conforms to the drawings. The size, shape and design of each component conforms to the drawings.
Fixing	Window and doorframes are fixed to the walls as specified.
Angles/level	After being fixed, the frames and the door remain with perfectly rectangular, levelled and plumb. No distortions and cracks should appear.
Door shutters/casement	Doors open normally without noise and friction.
Burglar bars	diameter 16 mm every 15 cm (centre to centre), free of rust
Ironmongery	Hinges, padlocks, and other ironmongery are galvanised, brass or aluminium.

WORKS CATEGORY N° 7: FINISHING WORKS

Operations	▪ **Plastering;** ▪ **Rendering** ▪ **Screeding** ▪ **Ceiling** ▪ **Painting and Decorating**

7.0 Finishing works should be executed in the following order

Plastering (internally)
Apply 13mm cement sand (1:6) plaster to walls internally to both brick and block works. Finish smooth with oxygen sludge/lime.

External plastering

Execute external plastering using mortar mix 1:4, thickness 2cm, perfectly smoothed and including all arises, throats, scaffolding, and all related works.

Rendering (externally)
Apply 20mm cement sand (1:6) rendering to walls external thick to blockwork and/or apply tyrolean rendering finishing in selected areas. External face of brickwork shall be fair faced with pointed joints, or rendering as in blockwork.

Screeding
Apply 40mm cement sand screed (1:4) mix to concrete bed with trowelled smooth surface to horizontal levels

7.1.

Caution:

- The wall surfaces to be plastered must be neat and clean and free of dust, paint and the like. They shall be rough enough to take the plaster. Otherwise, it will be necessary to pit or brush down the surface to be coated. If the surface to be coated is too irregular to permit the direct application of the plaster, it must be smoothed by patching or reshaping.
- Surfaces to be plastered shall first be wetted to saturation several times and at quarter-hour intervals; the surface must be humidified in depth and re-dried. It is not permitted to finish the plaster by spraying water or dry cement. Wherever it is necessary to resume plastering work, this shall be done along a corner or in a place where the difference is not visible.
- **Plastering work shall not begin until all doors and windows frames are properly installed. Plastering shall not cover the frames.**
- The finished coats shall present a smooth and flat surface, free of tool-marks, blemishes and blister.
- No paint shall be applied to plaster surfaces for at least 15 days or until the walls and plaster are thoroughly dry.

7.2. Rendering and Tyrolean

Apply 2cm thick cement/sand rendering to walls externally, especially on areas subject to periodical touching i.e. veranda. Conversely, apply tyrolean on rendered surface to selected areas.

7.3. Cement sand screeding

Apply 4cm thick cement screeding of mortar 1:4 including levelling and trowelling smooth .

Caution:

- In case of concrete floors with construction joints do not cover joints with the screeding.
- In order to improve the bond with the slab, the screed must be laid on concrete that has been thoroughly wet. Floor surfaces shall first be wetted to saturation several times and at quarter-hour intervals.
- All parts of the finished floor shall present a surface free of cavities or bumps, smooth, fine-grained and regular. Patching is not allowed under no circumstances.

7.4.1. Ceiling

7.4.2. Setting of brandering

Brandering shall be accurately set out horizontally/level in accordance with the drawings and shall be framed together and fixed at 60cm each way in the best possible manner with either notched. Joints or butt joints. All necessary nails etc shall be approved by Engineer.

7.4.3. Ceiling Board

Hardboard, usually 4-5mm thick should be nailed with clout nails through to the brandering.

7.5. Painting and Decorating

7.5.1. Preparation and painting

Surfaces to receive paint shall involve the following preparations

- Filling of cracks and patches
- rubbing and sanding
- dust removal
- one primer coat of vinyl paint
- rubbing and sanding
- dust removal
- two initial and one finishing coats of Emulsion or Gloss oil paint as instructed

7.5.2. Painting decorations

All drips, splashes, over-painting to edges as well as finger marks must be removed, touched up and made good. The whole of the painting work has to be left clean on completion.

7.5.3. Whitewash lime paint

Lime whitewash can be used as an alternative for Emulsion or Gloss oil paint for internal walls. Supply and apply lime paint; works include: sanding, dust removal and the application of a priming coat, filling of cracks, sanding, dust removal and application of two coats of lime whitewash, scaffolding as well as all necessary related works included.

7.5.4. Gloss enamel paint on walls

Apply gloss paint to internal walls to the height of 1.5metre above floor level.

The work includes:
- sanding and dusting;
- two coats oil paint (colour to be selected).

7.5.5. Paint on openings:
(Door frames and shutters, window frames and window steel burglar bars.)

Apply one undercoat paint for wood and two coats of gloss enamel paint to the above-mentioned surfaces, colour to be selected by the Engineer.

The work is to be performed according to the following process:

i. *Before fixing the frames to the walls:*
- patching and filling
- rubbing and sanding
- dust removal
- one primer coat of undercoat paint

ii. *After fixing the frames to the walls*
- sanding
- dust removal
- two coats of gloss enamel paint

7.5.6. Paint on ceiling:

Apply one undercoat and two finishing coats of Emulsion to ceiling board surfaces. Where available, white or brilliant white colour should be preferred as per Engineer's instruction.

7.6 Quality control check

	Plaster, paintings : Quality control Check-list
Plaster	Location of tyrolean and normal plaster according to the drawings.
Plaster: Appearance	The finished coats present a smooth and flat surface, free of tool-marks, blemishes and blister. The plaster does not cover the window and door frames.
Ceiling: Appearance	Inspect the ceiling to check levelling, and straightness of sheets and nails. All butt joints to be covered by 40x15 timber battens. Ceiling board with stains, worn out and broken edges shall not be used
Screed	All parts of the finished floor present a flat, smooth, fine-grained and regular surface free of cavities, bumps and patching.
Painting	Colours and type of paintings for walls and openings comply with Technical handbook and Engineer's instructions.
Sanding	All faces of the door /window frames and door panels are perfectly sanded before painting. The cracks are filled and sanded before painting.
Appearance	All painted elements present a smooth, fine-grained regular painted surface, free of tool-marks, finger marks, drips, splashes, cracks and blister.
Delivery of works	All plaster and painting drips and splashes on the screed, roof sheets and other elements are removed. The whole area (buildings and school site) is left clean on completion of works.

WORKS CATEGORY N° 8: BUILDING SERVICES (Water; drainage; Electrical; and Fire installation)

8.1- Water and Drainage

Operations	▪ **Marking and chasing of walls to receive pipes** ▪ **Laying/fixing of pipes** ▪ **Fixing of sanitary appliances** ▪ **Chamber/manhole** ▪ **Testing.**

8.1.1. Marking and chasing of walls.

Walls must be marked and chased to make sure that all pipe works are concealed.

8.1.2. Laying/fixing of pipes.

Soil and waste pipes shall be of the dimensions, materials and classes approved/shown on the drawing and shall be accurately laid to the required lines and gradients.
Cut and die (where/if applicable) the pipes according to the required sizes and connect them with fittings as shown on the drawings.

8.1.3. Fixing of sanitary appliances.

All sanitary appliances and associated accessories shall be fixed to the required standard as approved by the Engineer.

8.1.4. Chambers/ Manholes

Manholes shall be constructed in the position in accordance with the drawings and/ or as instructed by the Engineer

8.1.5. Testing

The builder/ contractor must undertake test for pressure, water tightness and leakages at the end of work

	Check list for quality control : Implementation phase
1. Pipe work	Visual observation of leakage is a clue for improper water tightness and straightness:
2. Taps, cocks, valves etc	All are easily and perfectly operated.
3. Sanitary Appliance	All are cleaned and all stains removed before usage.
4. Plumbing Layout	Simple as built layout for the whole system (plumbing/ drainage) is available.

WORKS CATEGORY N° 8: BUILDING SERVICES (Water; drainage; Electrical ; and Fire installation)

8.2 – Electrical Installations

Operations	▪ **Marking and chasing of walls to receive pipes** ▪ **Laying of conduits** ▪ **Wiring** ▪ **Fixing electrical fittings** ▪ **Testing.**

8.2.1 Marking and chasing of walls.

Wall must be marked and chased to make sure that all conduits are concealed.

8.2.2. Laying of conduits

Conduits and boxes shall be concealed in walls and fixed on ceiling bearers. All joints and connections shall be fixed properly by using approved adhesives or by heat application to ends of conduits.

8.2.3. Wiring.

Wiring shall commence soon after plastering works. To allow proper connections and inspection of electrical fittings, 150mm long wire shall be left at all junctions; switch sockets; light switch boxes; cooker points, etc. Jointing wire in conduits shall not be allowed.

8.2.4. Fixing electrical fittings

Fixing of light points; switch sockets; cooker points; main switch and earth leakage circuit breaker shall be done after second coat paint. All fittings shall be properly fixed.

8.2.5. Testing

The Builder/Contractor must undertake test for:
- Polarity
- Effectiveness of the earth system
- Installation resistance
- Ring circuit continuity

	Check list for quality control : Conduit, wiring and fittings
1. Conduits	Location of PVC conduit shall be according to the drawings. Minimum size shall be 15mm diameter. All factory rejects or dented conduit shall not be used. Conduits on the brandering shall be fixed using saddle.

2. Wires	All electrical conductors shall be of sufficient size for the purpose they are intended. Wires must be of PVC insulation: ▪ 1.5mm2 wire shall be used for light installation. ▪ 2.5mm2 wire shall be used for switch sockets. ▪ 6mm2 wire shall be used for cooker points and shall be connected direct from the main switch. Coding for wires shall be as follows :- ▪ Live – red or brown ▪ Neutral – black or blue ▪ Earth – green/yellow
3. Electrical fittings	The position of socket outlets and switches shall be as follows unless specified. Height of switches 1.5m from floor level. Height of socket outlets shall be not less than 300mm above floor level. Main switch shall be of MCB type; of 100Amp/60Amps capacity depending on the load expected to be installed. All final sub circuit shall be connected to proper MCB i.e. 5-10Amps for light points, 15-30Amps for switch sockets and 30-40Amps for cooker control unit. On completion of an installation appropriate tests and inspection shall be made prior commissioning. All circuit breakers must be tested for tripping action.

WORKS CATEGORY N° 8: BUILDING SERVICES (Water; drainage; Electrical ; and Fire installation)

8.3 – Fire Installations

Operations	▪ **Preparation of escape routes** ▪ **Installation of fighting equipments** ▪ **Fire hydrants** ▪ **Fire escape signs**

8.3.1. Preparation of escape routes

- Escape routes shall be clearly visible and kept unobstructed.
- Location of every exit on every floor shall be clearly indicated by exit signs and directional signs.
- Fire assembly area must be designated for the purpose of checking all fire escapees.

8.3.2. Installation of fire fighting equipments

- Sand buckets must be placed in corridors on designated areas and distances.
- Portable Fire Extinguishers must be mounted on walls by hangers or brackets and shall be installed not more than 1.5metres above floor level.
- Cabinets housing Portable Fire Extinguishers shall not be locked. All operating instructions shall be located at a visible point of the Extinguisher.
- The Extinguisher shall be located at a point not more than 15m from the users working point or area in it shall be fixed wherever possible near the room exit.

8.3.3. Fire Hydrants

The hydrant shall be located in common circulation area such as car park spaces and drive ways, they shall not pass through private or confined spaces. No service shall be located above or crossing over the hydrant mains, also shall be located away from explosion risk area and the protective enclosure to the hydrant mains shall be labelled with the words "HYDRANT MAIN" of minimum 50mm height at suitable intervals.

8.3.4. Fire escape signs

Refer checklist

	Check list for quality control : *(Escape routes, Escape signs, Assembly ground/area and fire fighting equipment)*
1. Escape routes	Shall be clear of any obstructions
2. Escape signs	Must be easily and clearly visible, readable and of reflectable material
3 Assembly area	Easily reachable open space.
4.Fire fighting	• Buckets must be always be full of sand and properly placed. • Portable fire extinguisher must be from the approved manufacturer , properly labelled and shall be serviced according to manufacturer's specifications. • Fire hydrants must be from the water mains and must be fitted with a proper valve.

CHAPTER 3 - General specifications of materials and workmanship

3.0 General information on the materials to be used for the works

The Builder/Contractor is responsible for the supply of all building materials and equipment to be used for the construction works. All materials must comply with the minimum specifications described in the present chapter. They are always subject to technical acceptance by Engineer. Acceptance by the Site Engineer does not relieve the Builder/Contractor of his responsibility for the soundness of the finished works.

It is strongly recommended to promote, wherever possible, the purchase of locally available materials rather than the imported.

3.1. Coarse aggregates for concrete

Coarse aggregates for all mixes of concrete shall be hard stones, screened, washed and free of all organic materials or earth, extracted from pits accepted by the Engineer and presenting a wide grading. The classification of aggregates shall be 5/30 mm (dimension of particles ranging from 5 mm to 30 mm). The coarse aggregate shall be well-graded. It means that all sizes of particles, from the largest to the smallest are present and no size is excessive or missing.

3.2. Sands for concrete and mortar

Sand used for concrete and mortar shall be clean, hard and free of all organic materials, salts or earth. It must be extracted from pits or river recommended by the Site Engineer.

Tests must be carried out to check the quality of sand. A simple method is the *"sedimentation test*": Sample sand is collected and mixed with water in a glass bottle. The bottle is then shaken thoroughly and allowed to rest steady on a flat surface. If sand settles down and clear water appears on top, then that sand is of good quality. If the sand contains silt, clay and impurities, when mixed with water, sand and silt settle down and clay will appear on top of sand; the water on top is not clear and it is mixed with impurities and clay. If this sand is used for building purposes, the building shall tend to develop cracks (because of the behaviour of clay).

There are generally two types of Sand: *river sand* and *pit sand*. River sand is very good and generally coarse; suitable for concrete works and blocks. Pit sand is generally fine and often contains clay; may be used for plastering works and mortars. Fine river sand, after sieving, is very suitable for floor screed.

If necessary, sand shall be screened in order to obtain the required grain sizes, and washed. The sand shall have the following grain sizes:

▪ sand for all types of concrete:	0-5 mm
▪ mortar mix 1:4 for plastering and flooring:	0-2 mm

▪ mortar mix 1:6 for masonry:	0-2 mm

3.3. Storage of aggregates and sand

The fine and the coarse aggregates must be handled and stored separately. The stockpiles shall be formed on a platform of weak concrete, timber or similar approved hard standing. Aggregates are to be kept clean and free from organic substances.

3.4. Natural stones for hardcore and foundations

The large stones and pebbles for hardcore under the floorings shall be hard rocks, free of earth. Sizes shall range from 3/4cm to 30/40 cm.

3.5. Cement

The cement to be used is Ordinary Portland, delivered to the building site in 50 kg standard paper bags. During transport and storage, the cement must be well protected against humidity. The Builder/Contractor shall build a suitable shed on the school site to shelter cement. The bags must be placed on raised platforms and well protected against humidity. In the rainy season, the cement bags should not be stored on the site for more than one month.
Any cement with lumps or contained in torn or damaged bags shall be rejected.

3.6. Water

The Builder/Contractor shall supply water needed for all works. Water to be used for making mortar, concrete, bricks or cement sand blocks should be soft and free of all organic material.

3.7. Shuttering for concrete

- Shuttering must be placed with precision in every part in order to execute the desired structural forms. All joints in shuttering and moulds shall be such as to ensure that there is no loss of fine materials or cement during the casting or consolidation of the concrete. No shutter fixings or supports shall be incorporated in the finished concrete. Only internal steel ties or spacers will be permitted.

- Shuttering must be cleaned out prior to pouring concrete and thoroughly freed from dust, shavings, rust, dirt, mud or other debris.

- To prevent concrete from adhering to shutterings, a thin coat of mould clear oil or similar product shall be applied to the inner surface of shutters before concrete is cast. Care must be taken to keep any reinforcement free from any such coating materials.

- After pouring concrete, the exposed surfaces of shuttering must be cleaned of all attached concrete patches before pouring fresh concrete.

3.8. Steel bar reinforcement

Reinforcing steel for concrete must be smooth run-of-mill rolled steel rods of the best quality available in market, free of cinders, burns, loose rust, oil, grease, paint and any other apparent or hidden manufacturing defect or imperfection. Reinforcement bars are to be stored under a waterproof shelter and placed on a raised platform. They must be protected from damage and corrosion.

3.9. Concrete

3.9.1 Mixing of concrete

A bag of cement, 50 kg shall be considered as the unit of measurement in mixes. When a mixing ratio is given (e.g. 1:3:6 for floor slab), this means 1 volume of cement to 3 volumes of sand to 6 volumes of coarse aggregate. The volume of cement contained in a bag is 0.033 m³, while the same quantity in loose conditions has a volume of 0.038 m³. The mixing ratio for works specified in this Handbook are:

Use	**Concrete Mix** cement: sand: coarse aggregate	**Cement Ratio Kg/m3**	**Composition examples for approximately 1 m3 of concrete**
Blinding for foundations	1 : 4 : 8	150	Cement: 150 kg (3 bags) Dry sand: 400 litres (=600 kg) Gravels: 800 litre (about 1300 kg) Water: 90-110 litre
Foundations and floor slabs	1 : 3 : 6	250	Cement: 250 kg (7 bags) Dry sand: 425 litres (=620 kg) to 500 litre Gravels: 850 litre (about 1300 kg) Water: 160-180 litre
Reinforced concrete ring beams	1 : 2 : 4	350	Cement: 350 kg (7 bags) Dry Sand: 425 litres (=600 kg) Gravels: 800 litre (1200- 1300 kg) Water: more or less 210 litre

The concrete should be workable meaning that the mixture should be as stiff as possible, yet maintain a homogeneous, no void mass. Too much stiffness, however, makes it very difficult or impossible to work the concrete into the forms and around reinforcing steel. The mixture should not be too fluid neither, otherwise it will result in weak concrete, high volume changes and cracks. For a workable concrete, prepared on site, a ratio of about 0.6 (weight of the water more or less 60% of weight of the cement) can be considered.

- In order to prepare an accurate concrete mixture, it is recommended to make a wooden gauge box of inner dimensions 36 x 36-x 30 cm (volume of one loose bag of cement).

- It is recommended to mix the concrete under a temporary shelter on a flat area, surfaced with mortar, and located as near as possible to the building.

- For manually mixed concrete, the required quantity of dry sand is poured first; then the required quantity of cement is added and mixed thoroughly using a shovel **without adding any water.**

When a dry mix of uniform colour is obtained, the required quantity of gravels is added. A cavity shall then be dug into the centre of the mix and water poured into it to obtain the required consistency and plasticity for the various uses. The mixing of sand, cement, gravel and water starts then on one side by shovels. While mixing thoroughly, the required amount of water is added gradually. The mixing shall be such as to ensure the uniform distribution of the materials throughout the mass, every particle being coated with mortar, and shall produce dense homogeneous concrete without excess of water. Mixing shall continue for at least two minutes after all the materials, including water, are passed into the pan or drum or barrow before any batch is discharged.

- A slump test is an easy test to measure the plasticity of the fresh concrete.
- Concrete shall not be mixed or cast during bad weather conditions. During windy weather efficient precautions should be taken to prevent loss of cement during mixing. In hot weather, it is recommended to mix the concrete in early morning hours to avoid quick setting at high temperature.

3.9.2. Casting

- The concrete shall be transported in clean watertight wheel barrows. All receptacles and tools used for the transport and casting of concrete must be cleaned at the end of each day's work and whenever the casting is interrupted for more than one hour.
- Concrete must be used within one hour of mixing. Re-mixing of partially hardened concrete or mortar is not allowed.
- Unless otherwise approved or instructed by the Site Engineer, concrete for beams and slabs should be cast in a single operation to their full depth.
- Where casting requires to be interrupted, precautions must be taken, as specified hereafter, to ensure satisfactory joints with concrete cast earlier. Where delays of more than one hour occur, work shall be suspended until the concrete has had sufficient time to harden before fresh concrete is deposited therein.
- Concrete should never be dropped freely from a height greater than 120cm.
- The concrete shall be thoroughly compacted by using appropriate tools. Hammering along the sides of the shuttering is to be avoided. The finished work shall be a well compacted uniform mass free from voids, segregation and honeycombing.

3.9.3. Curing and protection of concrete

When concrete is cast, it must be kept moist to allow the chemical process, called curing. Concrete must be kept constantly wet with fresh water during minimum seven days after casting. It must be protected during the first stage of curing from the harmful effect of sunshine, drying winds and rain.

3.10. Cement Mortars

The mortar mixes to be used for the different types of works are given hereafter:

Use	Mortar Mix (cement : sand)	Cement Ratio Kg/m3	Number of blocks per bag of cement
Manufacture of solid blocks for foundation base courses	1 : 6	250	13 blocks
Manufacture of solid blocks for walls	1 : 8	200	16 blocks
Mortar for foundation masonry, plastering and floor screeding	1 : 4	300	
Mortar for wall masonry	1 : 6	250	

The Site Engineer may change the proportion of cement in the mortars if and when the quality and nature of the sand requires it.

Mortars are mixed near the places of work and in the quantities strictly needed for immediate use. Sand and cement shall first be mixed dry on a flat surfaced area until the mix is of a uniform colour. A cavity shall then be dug into the mix and water poured into it to obtain the necessary consistency and plasticity for the various uses. The mix shall be spread with a shovel then turned over repeatedly to obtain a smooth mortar of the required plasticity.

3.11. Cement/sand blocks

Solid blocks shall be manufactured with the mortar mixes specified above. Dimensions of blocks shall be **15 x 23x 45 cm**. Tolerances on blocks are +/- 6 mm either sides.

Blocks which do not meet the above specifications shall be rejected and removed from site immediately at the Builder's/Contractor's expense. **Cement sand blocks should be cured all the time and shall not be used before four weeks after being moulded. Blocks should be wetted with water to saturation before placement.**

Timber for roof structure, joinery and furniture

A Timber for roof structure:

1. Wood Species	Softwood (Cypress or Pine), or use of hardwood (mninga, mvule, mkongo) under Engineers approval
2. Specifications	Timber with straight grain, free of heat damage, rotting, insect holes and knots. Live tight knots shall be accepted if not in groups and not exceeding 40 mm in diameter. Some superficial fissuring at the ends shall be tolerated.
3. Moisture content	Maximum 18%
4. Wood treatment	Used engine oil or Pyrethrin (natural product having high insecticidal properties) or Rootenone or approved equal preservative

B Timber for joinery and wall partitions

1. Wood Species	Softwood (Cypress or Pine)
2. Specifications	First grade timber with straight grain, free of heat damage, rotting, insect holes and knots. Only scattered live tight knots can be accepted if not exceeding 15 mm in diameter. No fissuring shall be tolerated.
3. Moisture content	Maximum 14%
4. Wood treatment	Compatible with paints

C Timber for furniture

1. Wood Species	Softwood (Cypress or Pine) or **MATURE** Eucalyptus (dark colour: dark red/maroon). Use of hardwood (i.e. Mninga, Mvule, Mkongo, etc) should only be used when specified by Engineer
2. Specifications	First grade timber with straight grain, free of heat damage, rotting, insect holes and knots. Only scattered live tight knots can be accepted if not exceeding 15 mm in diameter. No fissuring shall be tolerated.
3. Moisture content	Maximum 14%
4. Wood treatment	Compatible with varnish or lacquer

Caution: Eucalyptus becomes a hardwood only after more than 40 years after plantation. Only the dark coloured red/maroon heartwood can be used. The white yellowish sapwood is extremely perishable. Use of this sapwood is strictly forbidden for any part of building or furniture.

All timber must be perfectly sound; pieces with saw cuts, inlaid wedges or any type of filling to mask defects are not allowed.

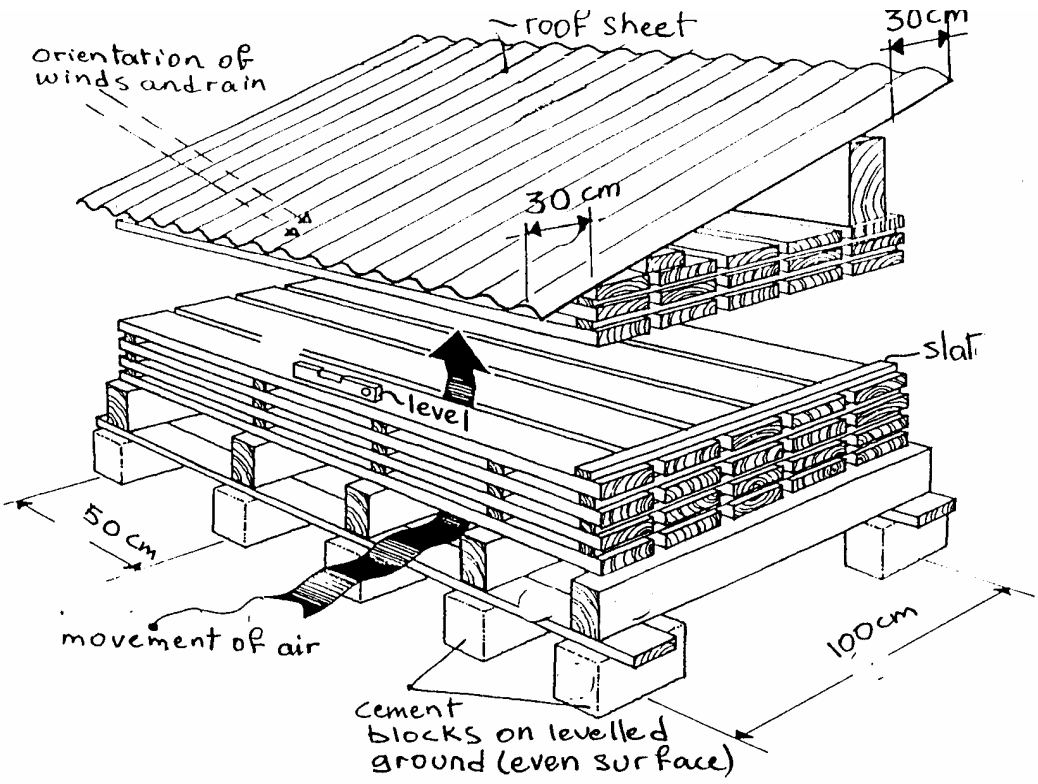
Use of hardwood, harvested from natural forests, has severe environmental consequences and should be discouraged as much as possible. Hardwood should either be supplied by hardwood plantations or be replaced by softwood either kiln-dried or seasoned on the site.

D Timber seasoning:

Timber (hard and softwood) should be dry: The moisture content should never be higher than 18% for roof structure and 14% for joinery (doors and windows) and furniture. Otherwise the timber will shrink, warp and crack. Moreover, the softwood will be easily destroyed by termites, fungus, etc.

If dry timber is not available on the market, the Builder/Contractor shall season it on the site. This is done, as shown in the following drawing:

a) Stack boards on an even surface, each layer of timber separated from the following by 1"x1"slats, in order to allow movement of air between boards.
b) Protect the stacks against sun and rain by covering them with roofing sheets.



Seasoning (Air-drying) of timber

The minimum duration for *seasoning* of softwood is:

1" thick boards: 4-5 weeks
2" thick boards: 7-8 weeks

E Wood Treatment

BEFORE ASSEMBLING THE WOODEN ELEMENTS**, all softwood timbers must be treated with a protective product**. Only hardwoods may be used without treatment.

Use of the following chemicals is strictly forbidden: Products based on creosote, anthracene, Pentachlorophenole, chlordane and organochlorinates.

All products are to be pressure impregnated or applied by dipping or wide brushing. Cut ends should be dipped in wood preservative for minimum of one hour.

3.13. Ironmongery

All ironmongeries (hinges, locks, etc.) shall comply with the specifications contained herein. They shall be of good quality. Samples must be submitted to the Site Engineer for approval. Surfaces shall be smooth, bright and free of spots. Screws shall be of the same material as the ironmongery

3.14. Corrugated galvanised iron roofing sheets

Galvanised iron roofing sheets should be 28-gauge of the best quality. **Factory rejects in any case are not accepted.**

All galvanised steel materials found defective, non-uniform, dented or rusted on arrival at the site is to be rejected.

The sheets shall overlap by minimum 15 cm on each side. **Each sheet shall be fixed to each purlin exclusively by means of galvanised roofing nails, minimum 3", preferably with a rubber seal.** The nails shall not be driven in more than necessary to seat the washer firmly over the corrugation. All cutting shall be accurately and carefully executed with sharp shears or other appropriate tools. Any other fixing method shall be rejected.

Roof ridges must be of galvanised steel gauge 28 with wings not less than 200 mm wide, fixed as described for the roof sheeting. Overlaps between the various sections of the ridge must be 200 mm and closely fitting.

4.19. Paint works

Paints, solvents, mastics and similar products shall be of the best available quality and suitable for use in tropical climate. They must be delivered to the site in sealed containers bearing the brand and product name. The brands of painting materials are subject to the approval of the Site Engineer. The Contractor is responsible for their proper storage on the site.

Different types of paint shall not be mixed together. The containers shall be opened only for immediate use.

CHAPTER 4 - Environment and Social Impact

4.1. General Matters

Environmental Management is the status by which human activities that affect the Environment are organised with a view to *maximize Social well-being* and *mitigate potential problems* by addressing their root cause. It is therefore important to address environmental issues together with the process of development rather than in isolation.

This Handbook has considered the environment as the integral part the overall process of Physical Facilities Development. It includes the relationship and interdependencies that exist between people and natural resources; that is to say between the School and its natural surroundings.

Environmental change is thus the product not only of natural events occurring during construction or implementation of these facilities but also its application.

4.2. Impact on SEDP in regard to construction and rehabilitation activities.

In the course of implementing SEDP, the Government is aware of the Environmental and Social impacts emanating from construction and rehabilitation activities such as involuntary resettlement, loss of property, crops, deforestation, pollution etc.

These impacts will be addressed accordingly through existing Environmental and Resettlement Laws and Regulations, from National to Council level.

In view of the above mentioned impacts significant environmental issues need to be addressed to during planning, construction, rehabilitation and running of physical facilities as listed below.

4.3. Potential Environmental Concerns, causes and immediate impacts

No.	PONTENTIAL CONCERN AND IMMEDIATE CAUSES	IMPACTS	ENVIRONMENTAL MITIGATION (ENHANCEMENT MEASURES)
1.	**Deforestation** ▪ Massive continued use of timber for construction activities ▪ Logging of fuel wood and charcoal for burnt bricks, cooking, etc ▪ Lack of local planting or replanting	▪ Loss of top soil and reduction of soil fertility in agricultural production and food security. ▪ Reduction of vegetation cover, loss of habitat and biodiversity. ▪ Land slide and flooding leading to destruction of	▪ Promote use of soft wood (fast growing timber) instead of hard wood for construction and furniture ▪ Promote tree plantation projects in communities such as schools, recreational centres, etc ▪ Promote use of saw dust,

		infrastructure e.g. houses, means of communication, communal facilities etc.	rice husks etc. as alternative fuel for brick burning process. ▪ Promote use of biogas as alternative fuel for cooking. ▪ Promote use of appropriate technology in the production of interlocking soil-cement bricks.
2.	**Water contamination and sanitation aspect** ▪ Lack of water supply system and other reliable water sources. ▪ Lack of or insufficient sewerage disposal systems and insufficient maintenance facilities.	▪ Risks to public health due to poor sanitation conditions, especially during rainy season and floods. ▪ Increased absence from work due to sickness, increase in malnutrition and death rates especially among vulnerable groups such as children the displaced and elderly.	▪ Promote use of rain water harvesting system. ▪ Provision of bore holes. ▪ Provision of gravity flow water supply system. ▪ Provision of adequate and reliable sewerage system. ▪ Sitting of disposal system i.e. latrines, at a safe distance from water source.
3.	**Land degradation** ▪ Poor planning resulting into poor choice of location of school.	▪ Erosion of lands down slopes within the site and borrow areas. ▪ Land slide and slips ▪ Excavating borrow pits for aggregate materials (sand and stone)for concrete.	▪ Avoid building on sloppy sites, if inevitable, sitting of building should be across the slope. ▪ Avoid building on water logged areas. ▪ Provide adequate and proper storm water drainage system.

4.2 Summary

The potential factors outlined above which covers *deforestation, sanitation* and *land degradation* have been a focal point in design consideration of physical facilities for SEDP. During design, allocating functional requirements, drafting the specification of materials and workmanship as well as implementation of this programme and projecting 'after use result'; efforts have been made to alleviate any setback that might occur wherever possible. It is therefore concluded that steps taken for the betterment of Environmental protection be always given all support in order for people to live in user lovely and friendly World.

Chapter 5: Accommodation for Students with Disabilities

5.1 Basic Considerations

The specific needs of students with mobility impairments, both ambulatory and non-ambulatory has been growing. Basically we have categorised four groups of students disabilities in our schools as follows:-

Group 1

The *ambulant* disabled, whose power of movement (walking ability) is not seriously impaired and who can move without external aids.

Group 2

The *semi-ambulant* disabled, whose power of movement is impaired to such an extent that they have to use external walking aids, sticks, elbow crutches, armpit crutches, tripods etc. students in this group are not easily able to walk or stand by themselves, sit down or rise from the sitting posture.

Group 3

The *Non-ambulant* disabled, whose movement is so impaired that they are unable to walk and stand by themselves. They can move about and around the building either independently with a wheel chair or with assistance of an attendant.

Group 4

We have two categories as follows:-

- Students with *visual* and *hearing impairment* have been given special attention.
- The *'eye blinded'* disabled have not been included in this Handbook. However, their physical facilities necessitate a special school.

5.2 Buildings for Disabled

Important factors which create problems for the handicapped in the built environment generally are lack of space, inaccessibility and complexity of the environment. Most of the disabilities problems concerning buildings can be easily solved at a lower cost in relation to the overall construction cost if they are realized at inception during design. At this stage many small but important details can be carried out without any extra costs.

5.3 General Data

a) **Entrance door**:

An entrance door in a porch/hall or veranda shall be protected from weather by a canopy. An allowance of at least 500mm on both ways/sides of the door will ease the navigation of a wheel chair. There should be no changes in levels at the threshold. The entrance should be well illuminated.

The door and door frame should be in contrast colours for 'visual impaired' people. The frame and door to be impact resistant to withstand mechanical damage. A clear opening of doors should be not less than 0.82m.

b) **Ramps**:

Ramps should be straight with maximum inclusive slope of 5 – 7% and should not be longer than 6m. Ramps longer than 6m should be provided with intermediate landings at least every 6m.

The outdoor ramps and approaches should not accumulate water on surface, therefore maximum cross section slope of 1:50 is recommended. The ramp width between handrails should be 1:2m for one ambulant and one wheel chair user to pass.

Handrails: where the rise (height) is greater than 150mm or run (length) is greater the 1800mm handrails are required in both sides.

c) **Toilets**:

The room may be used as a combined shower/toilet and allows space for an assistant, it should have swinging double arm rest fitted to allow flexibility. Washing facility should have hand wash basin at 800mm above floor level.

Where multiple single user toilet rooms or bathing rooms are clustered in a single location saving the same population, at least one of the rooms must be accessible. The accessible room (s) must be identified by signs.

d) **Electric switches and controls**:

The preferred height for switches and wall sockets is 900 – 120mm. Pull and toggle switches may be used where there is no wall surface.

Chapter 6: Schedule of Materials and Approximate Cost Estimates

6.0 Generally

Schedule of materials will be compiled/taken-off from the annexed drawings in Chapter 7.

In some elements of the building, the choice of building materials will differ from one location to another depending on local availability of materials as well as weather conditions. All these criteria have been taken into consideration for in the design.

Approximate cost estimate shall comprise either of the following :

a) **Category 1** – For Direct Labour procedure

- Basic price list and schedule of building materials
- Cost of labour
- Transportation cost
- Preliminaries cost as appropriate i.e. water for works, storage of materials, observing statutory regulations, access road, testing of materials, etc.
- Prime cost sums i.e. specialist works to be carried out by a nominated sub-contractor and/or statutory authority.

b) **Category 2** – For Contracting procedure

Bills of Quantities with associated tender documentation.

Chapter 7: DRAWINGS

7.1 List of Drawings

Buildings Drawings

Buildings Drawings

Buildings Drawings

Furniture Drawings

Furniture Drawings (cont'd)

7.2 Annexed Drawings

Drawings to be attached in compliance with the 'List of Drawings'