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DFID South Sudan Education Programme

Construction & Rehabilitation of Education Facilities

Construction Review

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1 Introduction

1.1 Background

The South Sudan Education Programme (SSEP) is a three year project that took effect on 22 March 2011 (hence the DFID Annual Review due date of 22 March 2012). DFID has allocated £37 million to the programme and it is intended that the programme will provide access for an additional 38,000 children to schools every year.

Implementation of the programme is divided into two components: the construction of 37 primary and 4 secondary schools with associated technical assistance in 'soft' elements such as the formation of Parent Teacher Associations (PTAs); and the rehabilitation of 51 Alternative Education Services (AES) Sites with associated technical assistance plus the construction of six Youth Education Pack (YEP) Centres and one teacher training/adult literacy institute. The number of primary schools was reduced to 30 when the original 'pavilion' design for the primary schools was replaced by a more traditional design.

The first of these components is managed by UNICEF who have sub-contracted the United Nations Office for Project Services (UNOPS) for the construction elements of the work; and the second component is managed by Save the Children International South Sudan (SCiSS) who have sub-contracted the Norwegian Refugee Council (NRC) to lead on the six YEP Centres and the TT/AL institute (SCiSS are taking the lead on AES site rehabilitation).

1.2 Objectives

The consultant visited South Sudan from 27th February to 5th March 2012.

The objective of the mission was to produce an appraisal document that will inform DFID's first Annual Review of the South Sudan Education Programme (SSEP) on progress regarding the construction and/or rehabilitation of education facilities that are funded through the SSEP. See Annex 4 for consultant's terms of reference.

It was also agreed with the Senior Education Advisor during the mission that the consultant would comment further on the design and construction of the schools (initial comments had been provided to DFID in April 2011) with a view to improving the school designs and reducing construction costs for a possible second phase of construction. See Annex 1: Review of Designs and Documentation for Primary and Secondary Schools

1.3 Meetings

Meetings were held with the Deputy Programme Manager (Basic Services) and the Senior Education Advisor of DFID, South Sudan; the Director, Development Partners in the Ministry of General Education and Instruction (MoGEI); The Director and a civil engineer staff member, Physical Planning and Construction Unit, MoGEI; the UNICEF construction Engineer; the Programme Manager, the Project Manager, the Project Architect, two international Project Engineers and two national Project Engineers of UNOPS, South Sudan. It was not possible, because of time constraints, to meet with anyone from SCiSS or from NRC.

1.4 Site Visits

Visits were made to: one Alternative Education Services Site at Supiri TTI in Juba; one secondary school construction site at Alok in Northern Bahr el Ghazal State; two primary school construction sites at Karok and Bau in Northern Bahr el Ghazal State and to one primary school construction site at Haramorok in Eastern Equatoria State. See Annex 2: School Construction Site Visits.

2 Executive Summary and Key Recommendations

2.1 Output 1: New Primary and Secondary School Infrastructure

The original construction programme has been slightly modified and now 30 primary schools are being constructed together with four secondary schools. The programme is also, as requested by government being implemented in one phase with 21 schools started by December 2011. Milestone 1 has therefore been met.

UNICEF is providing the overall management of the funding while UNOPS is providing the management and supervision of construction.

The following recommendations relate to issues raised during the mission relating to the design and construction of the facilities and the supervision of construction.

Recommendations

The main recommendations for primary schools are that:

- The classroom size should be increased to 6.8 x 8 metres and one of the standard classrooms should be omitted and replaced by a larger multi-purpose room.
- The design of the administration building should be simplified.

The main recommendations for secondary schools are that:

- Two of the laboratories should be omitted and replaced by a multi-purpose room.

The main recommendations for the ongoing construction programme are that:

- More details of the roof trusses should be provided and all trusses should be checked and strengthened as necessary.
- The water storage tanks and all of the gutters and downpipes at schools where they have not yet been supplied are omitted.
- All latrines should be provided with a simple hand-washing facility and vent pipes should be capped with mosquito mesh.

The main recommendations for any future phase of construction are that:

- Both international and national engineers should have the appropriate knowledge, skills and training to enable them to supervise the work.

- All schools should be laid out so that buildings face north/south to reduce solar gains.
- Foundations should be simplified and all reinforced concrete columns to foundation and superstructure walls should be omitted.
- Floor screeds should be omitted and concrete floor slabs finished with a steel trowel.
- Windows, roofs and roof trusses should be re-designed and ceilings fixed directly under the trusses.
- The size of laboratories should be increased and more detailed drawings supplied.
- The pits to the VIP latrines should be re-designed.
- Maintenance handbooks and training should be supplied to communities.

2.2 Output 2: Construction of Alternative Education Services Centres

Under Output 2 it was originally proposed to rehabilitate 51 Alternative Education Services (AES) sites and construct six Youth Education Pack (YEP) Centres and one teacher training/ adult literacy institute. Milestone 1 will probably be met.

This component is being managed by Save the Children International South Sudan (SCiSS) who are also taking the lead on the AES sites. They have however sub-contracted the Norwegian Refugee Council (NRC) to lead on the six YEP Centres and the TT/AL institute.

None of the rehabilitations to be managed by SCiSS have so far been started but they have requested a budget re-alignment to reduce the number of AES site rehabilitations to 26. The TTI has been completed and the six YEP Centres have either been started or are about to start and should all be finished by the end of June 2012.

The following recommendations relate to issues raised during the mission relating to the design and construction of the facilities and the supervision of construction.

Recommendations

The main recommendations for the remaining YEP Centres are that:

- All buildings should be oriented to face north/south.

- If dormitories are provided then they should be better designed to cope with the climate and the women's dormitories should be located away from the men's dormitories.
- There should be better supervision of the construction.
- If unskilled youths are employed on the construction or renovation work then they must be properly trained and supervised.

At the YEP Centres that have already been finished the floor screeds should be checked and all defective screeds replaced.

The main recommendations for the AES sites are that:

- The individual budgets for the renovations should be realistic and cover all necessary work and the overall budget must reflect this.
- The renovations of existing buildings and the design of any new ones should
- There should be competent and professional supervision of the renovation work.

3 Report and Findings

3.1 Milestones

Output 1: The construction of all 34 schools has been started and they should all be completed by the end of August 2012. This means that Milestone 1 under this output has been more than met and the rating for progress for this component of the programme is judged to be 'A+'.

Output 2: All 7 YEP Centres should by the end of June 2012 and Milestone 1 for this component is the completion of 11sites by the end of 2012. The renovation of the 50 AES sites has not yet been started but given that there are 9 months left this year to complete 4 of the AES site renovations then it is likely that Milestone 1 will be met and in that case the rating for progress for this component should probably be 'A'.

3.2 MoGEI Construction Guidelines

The MoGEI appears to have issued very few guidelines on construction and renovation; the only one discovered by the consultant was that the optimum class size for primary schools is 40 students.

A review was carried out by the consultant of the designs for primary schools in April 2011 that highlighted many of the issues concerning design and construction of the primary schools that have again been highlighted by this report but none of the recommendations that were made at that date (such as re-orienting some buildings so that they do not face east/west) were agreed to by the MoGEI and construction went ahead using the designs and layouts that had previously agreed.

3.3 Girl/Female Friendly Facilities

The primary and secondary schools are supposed to be 'girl friendly'. At all of the school sites visited, there are boys' and girls' toilets and they have been placed at the rear of all of the sites visited with the boys' toilets placed well away from the girls' toilets with the staff toilets between them. There is also a dependable source of clean water on every site. The local communities are supposed to construct a fence around each schools and it is difficult therefore to envisage any changes to the designs which would make the schools any more 'girl friendly' other than having girls-only schools or girls-only shifts.

At Supiri TTI, the only facility under Component 2 that was visited, the dormitory is not very 'female-friendly'. It would have been better if it had been split into two parts,

one for men and one for women each located in different parts of the site and each with its own latrines and wash-rooms.

3.4 Sustainability of Facilities

UNICEF is working with several NGOs in different states to raise communities' awareness of their responsibilities with regard to the school construction programme.

Communities are responsible for constructing site boundary fences, teachers' accommodation and for maintenance of the facilities and the NGOs are supposed to be giving training to the communities in all of these areas.

It is highly unlikely that government will be able to provide the schools with any funding for maintenance and therefore if the communities do not feel ownership for the schools and raise money for maintenance it is unlikely that any maintenance activities will take place. The onus is therefore on UNICEF and the NGOs to develop the ownership of the facilities by the communities and to provide training in maintenance to members of the school and community.

The consultant forwarded to UNICEF and UNOPS a maintenance handbook that was developed under another project for communities who are responsible for maintenance that might be useful for this programme.

3.5 Output 1: New Primary & Secondary School Infrastructure

3.5.1 Primary School Construction

The original construction programme has been slightly modified and now 30 primary schools are being constructed to a standard design and these will provide: 240 classrooms; 30 head-teachers' offices; 30 secretaries' offices; 30 staff rooms; 30 blocks of girls' latrines (each x 4); 30 blocks of boys' latrines (each x 4); 30 blocks of staff latrines (each x 2) and 30 boreholes each equipped with hand-pumps. The proposed basketball courts have been omitted from the primary schools.

3.5.2 Secondary School Construction

Four secondary schools are being constructed to a standard design in line with the original construction programme. These schools will provide: 16 classrooms (not 32 as stated in the Programme Memorandum); 12 laboratories; 4 libraries; 4 administration buildings; 4 blocks of girls' latrines (each x 4); 4 blocks of boys' latrines (each x 4); 4 blocks of staff latrines (each x 2); 4 boreholes each equipped with hand-pumps and 4 basketball courts.

3.5.3 Implementation of Construction

The construction of the schools was originally going to be implemented in two phases with 21 schools started by December 2011. The government however asked UNICEF and UNOPS to start all of the proposed schools as soon as possible which has meant that 26 primary and 4 secondary schools were started by the end of December 2011 with the remaining 4 primary schools being started in January and February of 2012.

While the implementation of the whole construction programme under this output at one time instead of in phases has led to some problems especially with cash flow to pay contractors, it does mean that the 30 primary schools should be completed by the 30th August 2012 and the secondary schools by 31st July 2012.

3.5.4 Supervision and Management of Construction

UNICEF is providing the overall management of the funding while UNOPS is providing the management and supervision of construction.

Supervision of the construction is being hindered by the security situation in the country. All vehicles in the field must proceed in convoys of two vehicles and this obviously restricts the numbers of visits that can be made to individual sites. It seems however that at least one visit is being made every week to every school construction site and that more visits are made if required i.e. if a particularly important aspect of the work is taking place.

A number of issues were raised during the visits to the school construction sites that relate to the supervision and management of construction (see Annex 3 for details) and most of these issues had not been picked up due to the inexperience of the national engineers but these should have been identified and rectified by the international engineers.

If there is a further phase of construction it would seem necessary to ensure that the international engineers have the appropriate knowledge and skills to both supervise the work and monitor the activities of the national engineers and to undertake further training of the national engineers who will be supervising construction. This training should cover the construction documentation so that all of the supervisors are fully conversant with the project documentation, particularly with the construction details, and also with basic construction techniques. A simple construction handbook would be very useful especially for the national engineers and the consultant forwarded to

UNOPS a construction handbook that he developed for another primary school construction project that UNOPS could possibly revise and utilise for this project.

It should be noted that signboards have not been put up at any of the sites because the Ministry of Education was apparently against this idea.

It must be stated that given the extremely difficult circumstances with regard to security, transport and logistics faced by both the contractors and the UNOPS supervisory staff, the standard of construction at the school sites visited is on the whole acceptable

3.5.5 Design of Facilities

Designs were prepared last year for primary and secondary school construction by UNOPS in conjunction with the Ministry of Education.

A review was carried out by the consultant of the designs for primary schools in April 2011 and a further review of the designs for both types of schools was undertaken during the mission at the request of the DFID Senior Education Adviser in order to improve designs and reduce construction costs for any future phase of construction.

The main recommendations for primary schools are that:

- The classroom width should be increased from 6.0 to 6.8 metres (the same width as the secondary school classrooms which would also standardise the design of the roof trusses) x 8 metres (54.4m² or 1.36m² per student at 40 students per classroom) which should give space for a 'book corner'. It would also provide more space for the older and larger students in classes 7 and 8.
- One of the standard classrooms is omitted and replaced by a larger (6.8 x 12 metres) multi-purpose room that can be used for teaching basic science, agriculture or light practical subjects or for project work. This large classroom would still be used as a class base in order not to duplicate facilities and further increase construction costs.
- The layout of the school should be revised so that all three main buildings face north/south to reduce solar gains.
- The raised roof over the central part of the administration building should be omitted together with the central passage and the rear wall should be brought in line with that of the classrooms in order to simplify construction and reduce costs.

The main recommendations for secondary schools are that:

- Two of the laboratories are omitted and one of them is replaced by a multi-purpose room. The remaining laboratory should be increased in size to 6.8 x 12 metres and the multi-purpose room should be the same size.
- The layout of the school should be revised so that all three main buildings face north/south to reduce solar gains.

3.5.6 Construction of Facilities

There were a number of issues raised concerning the construction of facilities during the school site visits. Some of these issues concerned the ongoing construction programme and some concerned possible changes to improve and simplify construction and reduce costs for any future phase of construction.

The main issues raised concerning the ongoing construction programme were that:

- Details of all joints to roof truss members should be provided and joints to truss members at ongoing construction sites should be checked and strengthened as necessary.
- The water storage tanks and all of the gutters and downpipes at schools where they have not yet been supplied should be omitted.
- All latrines should be provided with a simple hand-washing facility that can be filled from the bore-hole and vent pipes should be capped with mosquito mesh.

The main issues to be considered in order to simplify and reduce construction costs for any future phase of construction are:

- Omit the reinforced concrete footing and ground beam for buildings in normal soils. In black cotton soil conditions, investigate the use of a concrete raft type foundation to see if this is a more cost effective solution than that now being used.
- Omit all reinforced concrete columns to all foundation and superstructure walls.
- Omit all floor screeds and finish the concrete floor slabs to a smooth surface with a steel trowel.
- The windows should have two opening shutters and no fixed panel. The shutters should open back against the external walls with fixings to the walls.

- The thickness of the truss members should be reduced from 75mm to 50mm and the numbers of trusses in both secondary and primary schools should be reduced. There should 50 x 150mm rafters at all end and cross walls either fixed to the tops or sides of the walls. All top members to trusses and rafters at cross and end walls should be extended down to support the veranda roofs. The roof overhang at the rear of the buildings should be increased to 90cms. Verge boards (and fascia boards) should be 50 x 100mm to provide adequate fixings for the sides and ends of the roof sheets.
- Ceilings should be fixed directly under the roof purlins to form sloping ceilings and increase the volume of the rooms.
- Detail drawings should be prepared for laboratory benches, cupboards, sinks, etc and for any other fittings and furniture required in the laboratories and the technicians' rooms.
- The pits to the VIP latrines should not have concrete floors and the walls (if they are required) should be constructed with open vertical joints.

3.6 Output 2: Construction of Alternative Education Services Centres

3.6.1 General

Under Output 2 it was originally proposed to rehabilitate 51 Alternative Education Services (AES) sites and construct six Youth Education Pack (YEP) Centres and one teacher training/ adult literacy institute.

This component is being managed by Save the Children International South Sudan (SCiSS) who are also taking the lead on the AES sites. They have however sub-contracted the Norwegian Refugee Council (NRC) to lead on the six YEP Centres and the TT/AL institute.

SCiSS have recently requested a budget re-alignment and a re-orientation of the AES site rehabilitation target to reduce the number of AES site rehabilitations to 26 in order to ensure that 26 schools nominated by the Ministry of General Education and Instruction benefit from higher quality of girl friendly design.

None of the rehabilitations to be managed by SCiSS have so far been started but the TTI managed by NRC has been completed and the six YEP Centres have either been started or are about to start and should all be finished by the end of June 2012. See Table 1 below.

Table 1 YEP Centres Construction Progress

State	Name of YEP Centre	Progress
Central Equatoria	Supiri TTI	Completed; in 3 month retention period
Central Equatoria	Gudele	Estimated completion date March 9th 2012
Central Equatoria	Lologo	Site confirmed Feb 28th; est. completion date June 30th 2012
Northern Bahr el Ghazel	Maper Akot	Completed; in 3 month retention period
Northern Bhar el Ghazel	Nyamlel	Renovation work started; est. completion date May 8th 2012
Warrap	Kuajok	Site confirmed on Feb 16th; est. completion date May 15th 2012
Warrap	Turalie	Site to be confirmed; est. completion date June 30th 2012

It was not possible during the mission to meet with SCiSS, visit any of their sites or review their proposals for the renovations of the buildings on these sites and it was only possible, because of time constraints, to visit one of the sites being managed by NRC, that of Supiri TTI.

3.6.2 Supiri TTI

The institute is located on a large sloping site in Juba city. DFID has funded the renovation of an existing building and the construction of a hall, a dormitory, a 2-classroom building and a workshop building together with two new VIP latrine and washroom buildings and a borehole, submersible pump and an elevated water tank. The centre provides accommodation for a YEP Centre, basic adult literacy and intensive English courses for teachers. The construction work was managed by the Norwegian Refugee Council and was finished in late 2011.

The visit to the site raised a number of issues, some concerning the design of the buildings and the layout of the site and some concerning the standard of construction.

The design issues raised were:

- The YEP Centre (the 2-classroom building) should have been oriented to face north/south in order to reduce solar gains. It should also have had an access veranda to one side to improve access to all rooms.

- All roof overhangs to all buildings should have been larger again to reduce solar gains, to protect the walls and windows from rain and reduce maintenance costs.
- The dormitory is not very 'female-friendly'. It would have been better if it had been split into two parts, one for men and one for women each located in different parts of the site and each with their own latrines and wash-rooms.
- The dormitories would also have been much more comfortable if they had been designed with secure access from one side only so that they could have had good cross-ventilation from windows to both sides of the rooms.
- The site layout generally could have been much improved.

The construction issues raised were:

- Some sandcrete blocks left over from the construction were tested and they were of very poor quality.
- The screeds in all buildings are cracking up and they should be re-laid.
- The roof timbers everywhere have not been properly treated against termites and the roof trusses where visible (apart from in the hall) have inadequate joints which should be strengthened.
- The classrooms to the YEP Centre have five roof trusses which could have been reduced to three which would have reduced costs. The other buildings are probably similar and similar savings could probably have been made.
- The steel doors, shutters and windows are not very well made.

It should be noted that the contractor employed some youths attending the Centre to assist with the construction of the roof trusses. As the roof trusses are badly made this does not seem to have been very successful. If youths are going to be used in this way then they will require much more training on the job and better supervision if they are going to gain useful experience.

There also seems to have been a failure in the overall supervision of this project given the poor quality of the blocks, the floor screeds and of the roof trusses.

3.6.3 Alternative Education Services

Output 2 also includes the renovation of a number of schools which will be managed by Save the Children in South Sudan (SCiSS). The original intention was to renovate

buildings at 51 sites but this has been reduced to 50 and SCiSS has now requested a further reduction to 26.

Although the reason given by SCiSS for the reduction in numbers is to ensure that the 26 schools benefit from a higher quality of girl-friendly design another reason would seem to be the high cost of renovating the schools. Their original estimate was £6,500 per school but their engineers have now visited each school and evaluated the work necessary to renovate them and they have increased the budget per school to £44,200.

This is a large increase but if it is compared to the cost of the new schools that are being managed by UNICEF and UNOPS (average cost around £250,000 per school) it can be seen that the renovation cost is still only around 18% of the cost of a new school. As the intention is to construct new VIP latrines as well as renovate the existing buildings and as the average cost of 10 latrines at the UNOPS schools is around £16,500 (around 37% of the total renovation cost) then the cost of renovating a school still seems to be very low and the reduction in the numbers of schools to be renovated is probably more than justified.

It was not possible due to time constraints to visit any of the schools that are going to be renovated and it was not possible therefore to make any sort of independent estimate of the renovation costs. It is possible therefore that the estimated renovation costs could still be too low and the numbers of schools to be renovated might need to be further reduced.

More of concern is the capacity of SCiSS to manage and supervise the work. The renovation and construction work at Supiri TTI (see Annex 3) has not been carried out to a very good standard but this work was managed by NRC and not SCiSS. It is not known where the AES sites are situated or how many technical staff SCiSS have to carry out the supervision of the work.

As can be seen however from the section of this report dealing with construction under Output 1, UNOPS are having some problems in supervising their schools and they have international and national engineers as well as vehicles and back-up staff.

It would probably be more realistic therefore for SCiSS to start with the renovation of a small number of schools and for DFID to then review the progress and quality of the work before embarking on a more ambitious school renovation programme.

Annex 1: Review of Designs, Construction & Documentation for Primary & Secondary Schools

General

Designs, working drawings, bills of quantities specifications have been prepared for primary and secondary school construction by UNOPS in conjunction with the MoGEI.

A review was carried out by the consultant of the designs and documentation for primary schools in April 2011 but apparently none of the recommendations that were made at that date were agreed to by the Ministry of Education and construction went ahead using the original designs.

A further review of the designs and documentation for both types of schools has therefore been requested by the DFID Senior Education Adviser in order to improve the designs and reduce construction costs.

Design of Buildings

Construction costs in South Sudan are extremely high due to the need to import most building materials and even skilled workers and therefore every effort should be made to simplify the design of both types of schools in order to reduce costs.

Primary Schools

Although these schools are described as primary schools, in other countries they would be regarded as 'basic education' schools as they provide for primary classes 1 to 6 and junior secondary classes 7 and 8. All of the schools being constructed are single stream schools

The design of the schools is fairly simple with three main buildings: a central administration building with a headmaster's office, a secretary's office, a staff room and 4 classrooms and two, 2-classroom buildings set at 90° to the administration building and to each side. The three main buildings have access verandas at the front. There is also a kitchen, a separate store, separate VIP latrine buildings for boys, girls and staff and a bore-hole and hand-pump. All schools have electrical installations even though most of them are in remote rural locations with no electricity supplies.

The administration building has a central passage which on the sites visited does not lead anywhere and a raised roof over the central section of the building which projects in front of the rear wall of the classrooms on either side.

The configuration of the site layout with the administration building at 90° to the classroom buildings means that if either the classroom buildings or the administration building are set out to face north/south (the preferred orientation in the tropics to reduce solar penetration into the rooms) the other building or buildings will face east/west meaning that they will be hot in the mornings and very hot in the afternoons.

The government has set the optimum number of students per class as 40 in primary schools. Because of the acute shortage of primary schools and classrooms in most areas classrooms are now very over-crowded but if 40 students per classroom is taken as the future standard the area of the classrooms at 48 square metres is still small (1.2m² per student) and does not provide space for a 'book corner' (in comparison, in Nigerian and Malawian primary schools, classroom areas per student are 1.4m²; in Kenya the classroom area per student is 1.3m²). It should also be noted that the 'primary' schools in South Sudan include 2 classes of students of junior secondary school age who will of course be much larger than primary school students.

Although these schools will be teaching students in classes 7 and 8 where basic science should be taught there is no provision for a multi-purpose room that could be used for this and other purposes.

Recommendations: research has found that the provision of books in every classroom in a 'book corner' where they are accessible to all of the students increases reading outcomes but at present the classrooms are too small for this. It is recommended therefore that the classroom width should be increased from 6.0 to 6.8 metres (the same width as the secondary school classrooms which would also standardise design of the roof trusses) x 8 metres (54.4m² or 1.36m² per student at 40 students per classroom) which should give space for a 'book corner'. It would also provide more space for the older and larger students in classes 7 and 8.

It is also recommended that one of the standard classrooms is omitted and replaced by a larger (6.8 x 12 metres) multi-purpose room that can be used for teaching basic science and for other purposes such as teaching agriculture or light practical subjects or for project work. This larger classroom can still however be used as a class base in order not to increase construction costs further.

The layout of the school should be revised so that all three main buildings face north/south. The administration and classroom building could be at the front with the other two classroom buildings behind with a courtyard between. The two classroom buildings could then in fact be combined which would reduce costs. The store could also be joined on to one of the buildings which would also reduce costs.

The raised roof over the central part of the administration building should be omitted together with the central passage and the rear wall should be brought in line with that of the classrooms in order to simplify construction and reduce costs.

In locations where there is no existing electricity supply and no possibility of a supply being provided in the foreseeable future then to save money the electrical installation should be omitted. If an electrical installation is provided but not used it will start to degrade and will probably have to be replaced when electricity does become available. Rather than wasting money on an installation that may not ever be used it might be more realistic to investigate the use of solar power.

Secondary Schools

The design of the schools is fairly simple with three main buildings: an administration building with a headmaster's office, a deputy headmaster's office, a bursar's office, a store, a staff reference room and a staff room; a classroom building with four classrooms and a laboratory/library building with three laboratories and a library. The classroom building is in the centre with the two other buildings set one on each side at 90° to the classroom building. The three main buildings have access verandas at the front. There is also a kitchen, a separate store, separate VIP latrine buildings for boys, girls and staff and a bore-hole and hand-pump. All of the schools being constructed are single stream schools teaching students in classes 9 to 12.

The configuration of the site layout with the administration and laboratory/library building at 90° to the classroom buildings means that if either the classroom building or the administration and laboratory/library buildings are positioned to face north/south (the preferred orientation in the tropics to reduce solar penetration into the rooms) the other building or buildings will face east/west meaning that they will be hot in the mornings and very hot in the afternoons.

The government has yet to determine the optimum number of students per class but if the number is 40 as in the primary schools then the classroom size provided is reasonable (6.8 x 9 metres or 1.53 m² per student).

All schools are being provided with three laboratories: one for chemistry, one for biology and one for physics all the same size as a standard classroom. This accommodation is excessive for a single stream secondary school and all of the laboratories will be under-utilised. It should also be noted that in most countries now general purpose laboratories are provided rather than ones devoted to a single subject. There is no room for use for teaching other subjects such as agriculture or light practical subjects or for group project work.

Recommendations: without a curriculum and a time-table it is difficult to estimate exactly what accommodation is required in a secondary school. It is however obvious that the provision of three laboratories is excessive and that probably two of them should be replaced with a multi-purpose room for teaching other practical subjects. These rooms should however be larger than the present laboratories.

It is recommended that two of the laboratories are omitted and one of them is replaced by a multi-purpose room. The laboratory should be increased in size to 6.8 x 12 metres and the multi-purpose room should be the same size.

The layout of the school should be revised so that all three main buildings face north/south. The administration and the classroom buildings could be at the front with the laboratory/library building at the rear with a courtyard between. The store could be joined on to one of the buildings which would reduce costs.

Construction of Buildings

Construction costs in South Sudan are extremely high due to the need to import most building materials and even skilled workers and therefore every effort should be made to simplify the construction of both types of schools in order to reduce costs.

The construction of both types of schools is similar and is described below:

Foundations: there are two types of foundations: one for normal soils and one for black cotton soils. The foundation for normal soils consists of: 20 x 60cm reinforced concrete footings; 20cm solid block foundation walls and a 20 x 20cm reinforced ground beam (this is not shown on the foundation details but it is being included in all buildings). The foundation for black cotton soils consists of: 15 x 60cm concrete footings (more heavily reinforced than normal footings) on a 5cm screed; 20cm solid block foundation walls (which are usually much deeper than for normal foundations) and a 20 x 20cm reinforced ground beam. There are also 20 x 20cm reinforced concrete columns and footings at the corners of the buildings and where cross walls meet the outside walls for both types of foundation.

Recommendations: omit the reinforced concrete footing and ground beam for buildings in normal soils. Omit all foundation columns and footings to both types of foundations. All of these are unnecessary and are a waste of money. In black cotton soil conditions, investigate the use of a concrete raft type foundation to see if this is a more cost effective solution than that now being used.

Superstructure walls: superstructure walls are 20cm hollow sandcrete blocks with 20 x 20cm reinforced concrete columns at all corners and all junctions of cross walls and outside walls. There is also a reinforced concrete ring beam all round the buildings at lintel level.

Recommendations: omit all reinforced concrete columns and column bases. These are unnecessary and a waste of money. They also weaken the construction unless properly tied into the block walls.

Floors: all floors are 10cm thick concrete slabs reinforced with BRC mesh finished with a 20mm thick cement: sand screed.

Recommendations: unless screeds are laid the next day after the floor slab is cast and unless the mix is accurate, it is very likely that the screeds will crack (see notes under Supiri TTI visit). A better stronger finish will be achieved therefore if the screeds are omitted and the concrete floor slab is finished to a smooth surface with a steel trowel. The top of the slab will have to be protected until the rest of the work is completed. It is also recommended that more movement joints are built into the concrete floor slabs to control movement and avoid cracks.

Doors and windows: Doors and windows are of RHS frames with side-hung RHS sub-frames with solid steel sheet panels welded to them. There are fixed panels of fixed steel louvers above all doors and windows. The windows consist of a fixed panel in the middle of each frame with a side-hung shutter on each side. The specification for the doors includes union-style locks but it was noted during the site visits that steel staples had been provided with padlocks; this is a much more cost-effective and sustainable solution to locking doors.

Recommendations: The fixed panel in the middle of the windows reduces the amount of light and ventilation in the classrooms and also gives uneven lighting. It is recommended therefore that the windows are re-designed with two opening shutters and no fixed panel. The shutters should also be designed to open back against the walls and be able to be fixed open. The specification should be amended to show steel staples and padlocks for locking all doors.

Access verandas: all access verandas are 1.5 metres wide with a concrete floor finished with screed and a lean-to roof supported on the wall at one side and steel columns at the outside. The roof consists of 28 gauge colour-coated steel roofing sheets fixed to 75 x 100mm timber purlins; on 75 x 150mm timber rafters on a 75 x 150mm timber beam spanning between the steel columns (there are no details of the veranda roof construction). There are no access ramps up to the verandas.

Recommendations: The design of the veranda roof should be revised. The top members of the roof trusses (and the rafters at end and cross walls; see below) should be extended to support the veranda roofs and the ends of these members should be supported on the steel columns (the timber beam between columns should be omitted). The roof sheets should be supported on 50 x 100mm timber purlins spanning between the top members and rafters. This will greatly simplify construction and reduce costs and the roof sheets will no longer be in contact with the walls. The screed to the veranda floor should be omitted and the slab should be finished with a steel float. Expansion joints must be provided in the veranda slabs and ramps should be provided at the ends of the verandas with a maximum slope of 1 in 10.

Roof and roof structure: the roofs consist of 28 gauge colour-coated steel roofing sheets fixed to 75 x 100mm timber purlins; timber trusses consisting of 75 x 100mm and 75 x 150mm members sitting on 75 x 100mm wall plates (it should be noted however that at all sites visited where the trusses were visible the purlins were much smaller than those specified and all truss members were 50mm thick and not 75mm). It was also noted that the joints between and of members were in the main inadequate, especially those to the bottom members and these should be strengthened. Trusses are spaced generally at 2.3 metre centres in the secondary schools and generally at 2.05 metre centres in the primary schools. It is assumed that there should be timber rafters at the cross and end walls but there are no details of these and at all of the schools visited the contractors have fixed trusses next to end and cross walls. The roof overhangs at the rear of the buildings is 60cm. This is very small and gives little protection from the sun and rain to walls and windows. The size of the verge boards at the ends of the roofs is shown as 25 x 300mm. This thickness does not provide sufficient fixing for the last corrugation of the roof sheets which is very exposed to wind damage.

Recommendations: the sizes of the truss members should be reduced to 50 x 100mm and 50 x 150mm. The numbers of trusses in the secondary school classrooms should be reduced to 3No at 3.06 metre centres and in the primary

school classrooms to 3No at 2.73 metre centres. Details of all joints between and of members should be provided and joints to truss members at ongoing construction sites should be checked and strengthened as necessary. The purlin size should stay the same at 50 x 100mm. There should 50 x 150mm rafters at all end and cross walls either fixed to the tops or sides of the walls. All top members to trusses and rafters at cross and end walls should be extended down to support the veranda roofs as described above. The roof overhang at the rear of the buildings should be increased to 90cms. This will give better protection to walls from rain (and thus reduce maintenance costs) and to the windows from the sun thus improving comfort in the rooms. Verge boards (and fascia boards) should be 50 x 100mm to provide adequate fixings for the end corrugation and the bottom of the roof sheets. All of these measures will provide significant savings in cost.

Ceilings: the ceilings as shown on the drawings and in the specifications are of plywood (thickness un-specified) and are flat and fixed to timber framing (size un-specified) fixed under the roof trusses.

Recommendations: it will be more cost-effective to fix the ceilings directly to the roof purlins to form sloping ceilings. This will reduce the amount of timber required in the ceiling framing; it will increase the volume of the rooms and make them more comfortable and it will also allow the height of the outside walls to be reduced by one block all round. All these measures will provide significant cost savings.

Roof gutters and water tanks: each school is being provided with 2No 2000 litre 'plastishell' rainwater storage tanks and PVC gutters and downpipes to feed these tanks. At all schools visited, PVC gutters were being fixed to the rear of all buildings.

All schools are being provided with deep bore-holes and hand-pumps and at all schools visited there was no problem with the water supply from these bore-holes even though it was the end of the dry season.

Recommendations: it is recommended that the water storage tanks and all of the gutters and downpipes are omitted. This is because: the amount of water that could be stored in the tanks is negligible given the length of the dry season and the tanks will be a breeding ground for mosquitoes; PVC gutters and downpipes rapidly go rigid in the tropics due to UV from the sun and are then easily damaged; the gutters will soon block up with leaves and dust and will also provide a breeding ground for mosquitoes. This again will provide significant cost savings and should also reduce the incidence of malaria around the schools.

VIP latrines: Most of the VIP latrines seen have been constructed with pits that have a solid concrete floor and solid walls. Built like this they will not function properly. The tops of the vent pipes also do not have mosquito mesh over the top to catch flies coming up from the pit. None of the latrines seen have been provided with any hand-washing facilities.

Recommendations: the pits should not have a concrete floor and the walls (if they are required) should be constructed with open vertical joints. This is to let any liquid in the pit drain away and let the solids dry out. Where pits have been constructed with solid walls they should have weep holes made in the walls. In future at sites where there are very firm soils it is probably not necessary to line the pits with walls. All that is required is a deep ground beam around the pits to support the superstructure. All vent pipes should be provided with mosquito mesh fixed over the tops of the pipes. All latrines should be provided with a simple hand-washing facility that can be filled from the bore-hole.

Laboratories: it was noted that in the drawings for the laboratories, benches and sinks are shown along one wall but there are no details for these and they are not included in the BOQs. It appears also that neither UNOPS nor UNICEF are supplying any laboratory equipment or furniture.

Recommendations: if the laboratories are to function then they will require furniture and equipment and either UNOPS or UNICEF should organise the supply of these.

For the next stage of the construction, the numbers of laboratories should be rationalised as explained above, the laboratory should be increased in size and detail drawings should be prepared for laboratory benches, cupboards, sinks, etc and for any other fittings and furniture required in the laboratory and the technician's room.

Documentation

There are some problems with the documentation for both types of schools some of which should be resolved now to assist the present contractors and some of which should be resolved for any future construction contracts.

The main documentation requirements now are more detailed drawings for the roof construction. Details are required for the roof trusses showing how the different members should be connected and how any joints to members should be made. Details are also required for the veranda roofs.

For future construction contracts, more detailed drawings are required for all buildings especially for junctions between different elements and materials, for any

built-in furniture such as lab benches and sinks, library shelves, etc and for the kitchen, store and VIP latrines.

The bills of quantities should be clarified and enlarged and the materials required for kitchen, store and VIP latrines should be measured in order that future pricing can be more accurate.

The specifications should also be simplified and at the same time be made more comprehensive. There are a number of sections that could be omitted (for instance those on stonework and earth block walling which are not required) but there is not a section, which is required to judge by the standard of block-making on sandcrete blocks.

Annex 2: Visits to Construction Sites

Alternative Education Services Sites

It was only possible to visit one of the AES sites because of time constraints. Supiri TTI was visited on February 28th 2012 in the company of the DFID Senior Education Advisor.

Supiri Teacher Training Institute, Juba City

The institute is located on a large sloping site in the city. Grace Keji the Centre Leader was present during the visit and accompanied the visit and explained her concerns.

DFID has funded the renovation of an existing building and the construction of a hall, a dormitory, a 2-classroom building and a workshop building together with two new VIP latrine and washroom buildings and a borehole, submersible pump and an elevated water tank. The centre provides accommodation for a YEP Centre, basic adult literacy and intensive English courses for teachers. The construction work was managed by the Norwegian Refugee Council and was finished in late 2011.

The renovated building which is intended for use as an in-service teacher training centre has a front access veranda, a large library which at present has no books and is being used as a meeting hall and for workshops, a staffroom and six classrooms. The building has rendered and painted brick walls and has had new steel doors and windows fitted, a new roof (of colour-coated steel roof sheets on timber purlins and trusses), new ceilings and new floor screeds. The building is oriented to face north/south. The renovation work is generally acceptable but the roof timbers have not been properly treated against termites and there are extensive cracks already to the floor screeds.

The hall is a large high building in the centre of the site. The building has a hipped roof with steel colour-coated roof sheets and small roof overhangs that offer no protection from the sun to the openings in the walls and little protection from the rain. The hall has painted rendered block walls, a raised dais at one end, exposed roof trusses and no ceiling, clostra blocks at high level for ventilation with large openings below fitted with steel grilles for security. The building again seems quite well constructed and faces north/south. The roof trusses seem well made but the timbers have not been adequately treated and the floor screeds are again cracking up. The Centre Leader said that rain blows into the hall when it is raining as there is no

protection over the openings to the walls. The consultant also pointed out that centres of the steel bars at around 200mm do not provide any security.

The dormitory has ten rooms and is divided into two sections, one for men and one for women: one with four rooms and one with six rooms. Each room has two double bunks to accommodate four people with one steel glazed window and a glazed steel entry door. There are no washing or toilet facilities in the building. The building faces north/south. The building has timber trusses with colour-coated roof sheets and small roof overhangs, rendered block walls with a 'tyrolean' finish externally, flat ceilings, steel doors and steel glazed windows and screed floors. The building seems quite well constructed but it was not possible to see the roof trusses and the floor screeds are again cracking badly (they only seemed to be around 12mm thick). The rooms are badly designed having no cross-ventilation and must be very hot when fully occupied.

The YEP Centre has two classrooms, one at each end with two offices and a store accessed from a central open corridor in the middle of the building. The building is located on a part of the site that slopes quite steeply and faces east/west. It does not have an access veranda but has three separate sets of steps up to the classrooms and the offices and store. Access is therefore difficult and virtually impossible for anyone with physical disabilities. The building is constructed of rendered blockwork (left unpainted) with timber trusses and purlins, colour-coated roof sheets and steel doors and shutters to the offices and stores only (the classrooms have openings in the walls for light and ventilation with no shutters). The roof overhangs are again very small. The building is quite well constructed apart from the roof trusses which are very badly made (the joints between members are inadequate) and the floor screeds which are again cracking badly. There also seem to be more roof trusses than are required. There are for instance roof trusses against end and cross walls where there could simply have been rafters and there is one in the central corridor which is not required. The Centre Leader said that staff and students complained that the rooms in this building became very hot in the mornings and afternoons and sometimes they had to move classes to other rooms. Rain also blows into the classrooms in the rainy season. It is not clear whether the intention was to leave this building unpainted or whether it is yet to be finished.

The workshop building has two workshops. It faces north/south and is constructed of rendered block walls (left unpainted) with large openings for light and ventilation; with timber trusses and purlins, colour-coated steel roof sheets and no ceilings. The roof trusses are supported on steel posts built into the walls. The building is quite well

constructed apart from the roof trusses which are again very badly made (the joints between members are again inadequate) and the floor screeds which are again cracking badly. It is not clear whether the intention was to leave this building unpainted or whether it is yet to be finished.

VIP latrines and wash rooms. There are two blocks of VIP latrines/wash rooms, one for men and one for women and they are situated well away from each other at opposite ends of the site. They are also a long way from the dormitories. Each unit has two wash rooms and three latrines. The buildings seem quite well constructed and have colour-coated steel roof sheets on timber purlins and rafters, rendered and painted block walls and steel doors. The steel doors are however not very good quality and there are some design issues. The vent pipes to the pits are not straight but have bends in them meaning that they will not function as intended (they should be the sole source of light in the pits in order to attract flies); there are no insect screens to the tops of the vent pipes and the access manholes to the pits are very small meaning that emptying will be very difficult if not dangerous.

Plate 1 VIP latrines and washrooms show cranked vent pipes

Design issues: there are a number of design issues:

- the YEP Centre should have been oriented to face north/south in order to reduce solar gains. All buildings in the tropics should if possible be oriented

to face north/south to reduce the amount of solar gain and keep the rooms cool.

- all roof overhangs to all buildings should have been larger again to avoid solar gains and also to protect the walls and windows from rain and reduce maintenance costs.
- The YEP Centre should have had an access veranda to one side to improve access to all rooms.
- The dormitory is not very 'female-friendly'. It would have been better if it had been split into two parts, one for men and one for women each located in different parts of the site and each with their own latrines and wash-rooms.
- The dormitories would also have been much more comfortable if they had been designed with secure access from one side only so that they could have had good cross-ventilation from windows to both sides.
- The site layout generally could have been much improved.

Construction issues: the buildings seem to be generally well constructed although there are some construction issues:

- Some sandcrete blocks left over from the construction were tested and they were of very poor quality probably because of a poor mix and inadequate curing.
- The screeds in all buildings are cracking up probably because the mix was too wet when the screeds were laid, there was too much cement in the mix and because the screeds are too thin. They should be broken up and re-laid.
- The roof timbers everywhere have not been properly treated against termites and the roof trusses where visible (apart from in the hall) have inadequate joints which should be strengthened.
- The classrooms to the YEP Centre are approximately 7.8 x 6.6 metres but have five roof trusses. These could have been reduced to three which would have reduced costs. The other buildings where the roof trusses cannot be seen are probably similar and similar savings could probably have been made.
- The steel doors, shutters and windows are not very well made.
- The water storage tank has exploded and will have to be replaced.

Plate 2 Typical screed floor showing badly cracked screed

Plate 3 Typical roof truss showing very badly made joints

Plate 4 YEP Centre showing poor location and lack of access veranda

Plate 5 YEP classroom showing sun entering classroom in afternoon due to poor orientation

It should be noted that, according to the Centre Leader the contractor had employed some youths attending the Centre to assist with the construction of the roof trusses. As the roof trusses are badly made this does not seem to have been very successful. If youths are going to be used in this way then they will require much more training on the job and better supervision if they are going to gain useful experience. There also seems to have been a failure in the overall supervision of this project given the poor quality of the sandcrete blocks, the floor screeds and of the roof trusses.

Plate 6 Dormitory showing lack of windows and poor design

Plate 7 Central hall showing lack of protection to openings in walls

Primary & Secondary School Sites

The following primary and secondary school sites were visited in the company of the DFID Senior Education Advisor, the UNICEF Construction Engineer, the UNOPS Project Manager and some of his international and national engineers on February 29th, March 1st and March 4th 2012.

Alok Secondary School, Aweil Centre, Northern Bahr el Ghazal State

This secondary school is situated on a remote flat site accessible by a rough dirt road. The soil conditions are solid and stable. The contractor, DKD International from Ethiopia, started work on 18 November 2011. The school consists of an eight classroom building, a laboratory/library building, an administration building, a kitchen, a store and 2No 3 cubicle VIP latrines for students and 1No 2 cubicle VIP latrine for staff. All buildings are constructed of rendered and painted concrete blocks. The foundations consist of reinforced concrete footings with 20cm solid block foundation walls and a 20 x 20cm reinforced concrete ground beam. The floors are of 10cm concrete reinforced with BRC mesh and finished with a 20mm screed. Doors and shutters are of steel plate welded to steel RHS frames. Roofs are of colour-coated steel roof sheets on timber purlins and timber trusses with flat, hardboard ceilings

fixed below the bottom member of the trusses. All materials apart from sand and large aggregate have been imported from Uganda.

Progress: the classroom block was complete up to wall plate level with cross and end walls 95% complete to roof height; rendering of walls had started but no doors or shutters had been fixed. The administration and laboratory/library blocks were at the same stage but rendering had not started. The store was complete up to ring beam level and the blockwork to the kitchen was complete with the four RC columns complete to ring beam level. No floor slabs to these buildings had been constructed but back-filling under the slabs was in progress. The pits and floor slabs for the VIP latrines had been constructed, reinforcement for the superstructure columns had been fixed and the blocks to the walls were in progress. The borehole has been drilled (depth unknown) with an India Mark II deep well hand-pump fixed on top.

Issues: there were a number of design and construction issues. The general design issues are dealt with elsewhere in this report but it was noted that the classroom building is oriented to face north/south but the administration and laboratory/library buildings are oriented to face east/west and will therefore be hot in the mornings and particularly hot in the afternoons. It was also noted that at all of the schools there do not appear to be any hand-washing facilities in or near the VIP latrines.

The buildings are reasonably well constructed: the walls and columns are plumb and the block work is level. There are however a number of construction issues:

- Some buildings have been constructed very close to trees. If the crowns of the trees overhang the buildings this is likely to mean that the roots will be under the building (or will grow back if they have been cut off). UNOPS stated that the roots did not extend under the buildings but it is never a good idea to retain such large trees so close to buildings as even if the roots do not damage the buildings, leaves will collect on the roofs and can eventually rot the roof sheets. No trees should be allowed closer than 4 metres from any building and this distance should be greater for large trees.
- the reinforced concrete foundations and ground beam are not necessary on this site because the ground has good bearing capacity and money could have been saved by having mass concrete foundations and no ground beam;
- the blocks were being made out in the open with no protection from the shade and were therefore not being cured properly and were very weak;

- sandcrete blocks were being used that were only 3 days old and were therefore very weak (blocks should be cured and kept for 28 days before use);
- the columns to the corners of the VIP latrines had not been tied into the walls thus weakening the structure (these columns are unnecessary in these buildings and could be omitted thus saving money). It is suspected that this is also the case in the other buildings. The columns are at the corners of the rooms and will weaken the structure if they are not tied into the walls.
- The pits to the latrines had been constructed with a concrete floor and solid blockwork walls. This means that the pits will act as cess-pits and the liquid will not be able to drain away as it is designed to, the solids will take a very long time to dry out and the latrines will be very smelly. At the very least, holes should be cut into the walls to allow some liquid to drain away.
- Some sample roof trusses had been made by the contractor. He had used very good seasoned timber (all 50mm thick not 75mm as shown on the drawings) but the joints were unacceptable. UNOPS should provide detailed drawings of the roof trusses showing the construction of all joints.
- There was not a signboard at this or at any of the school sites.

Plate 1 VIP latrines showing columns with no ties to block walls

Plate 2 Blocks being made in the open with no cover and no chance therefore of being properly cured

Plate 3 The result of inadequate curing; very poor quality blocks

Plate 4 Borehole and pump complete and in action

Karok (Morol D) Primary School, Aweil North, Northern Bahr el Ghazal State

This primary school is situated on a remote flat site accessible by a rough dirt road. The soil conditions are solid and stable. The contractor, MFB Construction from Ethiopia, started work on 6 September 2011. The school consists of two 4-classroom buildings, an administration building, a kitchen, a store and 2No 3 cubicle VIP latrines for students and 1No 2 cubicle VIP latrine for staff.

All buildings are constructed of rendered and painted concrete blocks. The foundations consist of reinforced concrete footings with 20cm solid block foundation walls and a 20 x 20cm reinforced concrete ground beam. The floors are of 10cm concrete reinforced with BRC mesh and finished with a 20mm screed. Doors and shutters are of steel plate welded to steel RHS frames. Roofs are of colour-coated steel roof sheets on timber purlins and timber trusses with flat, hardboard ceilings fixed below the bottom member of the trusses. All materials apart from sand and large aggregate have been imported from Uganda. The steel doors and shutters are being made by the contractor at his workshop in Awiel.

Progress: the two classroom buildings, the administration building, the store and the three VIP latrines were complete and painted. Floor slabs to these buildings had been laid but not the finishing screeds. The superstructure blockwork to the kitchen was complete, the steel wall framing was in place and was being welded. The borehole had been drilled (to a depth of 52 metres) and the hand-pump fixed.

Issues: there were a number of design and construction issues. The general design issues are dealt with elsewhere in this report but it was noted that the administration building is oriented to face north/south but the classroom buildings are oriented to face east/west and will therefore be hot in the mornings and particularly hot in the afternoons.

The buildings seem quite well constructed: walls are plumb and straight and the buildings are reasonably well finished. There are however a number of construction issues:

- the reinforced concrete foundations and ground beam are not necessary on this site because the ground has good bearing capacity and money could have been saved by having mass concrete foundations and no ground beam;
- the blocks were being made out in the open with no protection from the shade and were therefore not being cured properly and were therefore very weak;

- The contractor stated that there was not a concrete slab to the bottom of the pits to the latrines but this could not be confirmed. The walls to the pits are however constructed of solid blockwork walls. Again holes should be cut into the walls to assist the liquid to drain away.
- The fixings to the end corrugations of the roof sheets were inadequate. The sheets had been nailed into the verge board which was only 25mm thick. The ends of the roofs are very exposed to winds on these exposed plains and the sheets should be securely fixed. The verge boards should be 50mm thick and the roof sheets should be fixed through the last corrugation into the verge board with roofing screws not ordinary nails.
- The purlins appeared to be smaller than the size specified (100 x 50mm). This was the same at all of the sites where the roof timbers had been fixed.
- The roof timbers where exposed along the access verandas had not been adequately treated against termites. All roof timbers should be treated before they are erected and fixed.
- The roof sheets along all sides of the buildings are in contact with the render to the walls. This is a very poor detail as the cement in the render will when damp attack the roof sheets and eventually rot them. Cement: sand render must always be kept from coming into contact with roof sheets. The same comment applies to all of the schools.
- It was noted that the ceilings were constructed of hardboard panels although they are specified in the BOQs as plywood (but the thickness is not specified).
- There were cracks in the veranda slab to the administration building. This building is 47 metres long and there should be at least two movement joints in the floor slab otherwise it is bound to crack.

Plate 5 General view of site showing classrooms facing east/west and good finishes to buildings

Plate 6 View of administration/classroom building showing raised central section of roof and good finish to building

Plate 7 View of classroom building showing tree very close to building; very small roof overhang and PVC gutter and downpipe

Plate 8 View of classroom building showing separate veranda roof and tree very close to building

Bau Primary School, Aweil Centre, Northern Bahr el Ghazal State

This primary school is situated on a remote flat site accessible by a rough dirt road. The soil conditions are solid and stable. The contractor, MFB Construction from Ethiopia, started work on 15 September 2011. The school consists of two 4-classroom buildings, an administration building, a kitchen, a store and 2No 3 cubicle VIP latrines for students and 1No 2 cubicle VIP latrine for staff.

The construction is similar to that at the last school. All materials apart from sand and large aggregate have been imported from Uganda. The steel doors and shutters are being made by the contractor at his workshop in Awiel.

Progress: the two classroom buildings, the administration building, the kitchen, the store and the three VIP latrines are roofed and rendered with final patching up of the rendering in progress. Floor slabs to these buildings had been laid and the screeds are in progress (some screeds to the administration building have been laid and are being cured). Steel doors and shutters have been fixed in the two classroom buildings, the administration building and the store. The weld-mesh screens to the kitchen had yet to be fixed but the steel wall framing was in place and the roof had been fixed. The borehole had been drilled (to a depth of 52 metres) and the hand-pump fixed.

Issues: there were a number of design and construction issues. The general design issues are dealt with elsewhere in this report but it was noted that the administration building is oriented to face north-east/south-west and the classroom buildings are oriented to face north-east/south-west/ and all buildings will therefore receive some solar penetration in both the mornings and in the afternoons.

The buildings seem quite well constructed: walls are plumb and straight and the buildings are reasonably well finished. There are however a number of construction issues:

- the reinforced concrete foundations and ground beam are not necessary on this site because the ground has good bearing capacity and money could have been saved by having mass concrete foundations and no ground beam;
- the blocks were being made out in the open with no protection from the shade and were therefore not being cured properly and were therefore very weak;
- The contractor stated that there was not a concrete slab to the bottom of the pits to the latrines but this could not be confirmed. The walls to the pits are

however constructed of solid blockwork walls. Again holes should be cut into the walls to assist the liquid to drain away.

- The fixings to the end corrugations of the roof sheets were again inadequate and the comments under the above school again apply.
- Roof trusses have been fixed against end and cross walls in all buildings where they are not required. The joints to the bottom members of the trusses have been fixed with flat steel tape nailed to the members. These joints would be stronger if they had been fixed with timber battens to both sides as the tape will probably stretch.
- The roof timbers where exposed along the access verandas had not been adequately treated against termites. All roof timbers should be treated before they are erected and fixed.
- The roof to the access veranda to the administration building has been laid almost flat; it should be at 12º.
- The floor screeds did not seem to be 20mm thick as specified in the specifications; they seemed more like 12mm thick or even less.
- Rendering of walls was in progress but the plasterers were not using battens or any other methods to ensure that the render was flat and of even thickness.
- The shutters are made of the correct materials but the welding is very poor. Sheets are only tack welded to the frames when they should be continuously welded. The fixing handles are poor quality and will probably break very quickly and the pins on which the handles catch and hold the shutters open are very sharp and could injure pupils. The steel sheets have also not been cleaned before painting in a lot of instances and are very rough. It was also noted that if the frames to the shutters were fixed at the front face of the wall then the shutters could be fixed back to the walls rather than protruding out into the verandas as is now the case.
- The veranda slab to the administration building was not clean enough to see if there are any cracks but the comments about movement joints under the last school also apply here.

Plate 9 Poorly constructed and inadequately treated roof trusses

Plate 10 View of administration/classroom building showing almost flat veranda roof

Plate 11 Roof verge showing inadequate fixings to last corrugation of roof sheets

Plate 12 More blocks drying too quickly under the sun

Haramorok Primary School, Torit, Eastern Equatorial State

This primary school is situated on a very remote site accessible by a rough dirt road approximately two hours from the nearest town, Torit. The site is situated on the edge of a small settlement and slopes gently from the back to the front of the site. The soil conditions are solid and stable. The contractor, Black Star Investment Co from Ethiopia, started work on 14 October 2011. The UNOPS national construction supervisor stated that he visited the site once a week but he said that the international construction supervisor only visited the sites when there were other visitors. The school consists of two 4-classroom buildings, an administration building, a kitchen, a store and 2No 3 cubicle VIP latrines for students and 1No 2 cubicle VIP latrine for staff.

The construction is similar to that at the last school. All materials apart from sand and large aggregate have been imported from Uganda.

Progress: the two classroom buildings are roofed; the first coat of render has been applied; the steel shutters have been fixed (but not doors); ceilings have been fixed and the floor slabs have been laid. The administration building is roofed; the first coat of render has been applied; the steel shutters have been fixed (but not doors); ceilings have been fixed in the side wings but not in the central section and the floor slabs have been laid. The foundations, floor slab and superstructure walls to the store are complete and rafters have been fixed. The foundations, floor slab and wall to cill level to the kitchen were complete and the 4No corner columns had been cast. The steel framing to the wall opening in the kitchen had been started. The pits and floor slabs to the VIP latrines have been constructed and the block work to the superstructure walls was up to lintel level. The borehole had been drilled (to a depth of 64 metres) and the hand-pump fixed but the concrete top needs repairs.

Issues: there were a number of design and construction issues. The general design issues are dealt with elsewhere in this report but it was noted that the administration building is oriented to face east/west and will therefore be hot in the mornings and afternoons while the two classroom buildings face north/south.

The standard of construction on this site was not as good as at the other sites visited. One RC column in the kitchen was so badly out of square and out of plumb that the contractor was asked to demolish it. The contractor had also cut into the base of the RC columns in the kitchen in order to fix the steel framing; this is not good practice. The block work to the cross walls in the administration building was very poor under the roof and the block work to the latrines was also not very good; the contractor was

asked to demolish one section above door height as it was badly out of plumb. Other issues were:

- the reinforced concrete foundations and ground beam are again not necessary on this site because the ground has good bearing capacity and money could have been saved by having mass concrete foundations and no ground beam;
- the blocks were being made out in the open with no protection from the shade and were therefore not being cured properly and were therefore very weak;
- There was a concrete slab to the bottom of the pits to the latrines and the walls to the pits are constructed of solid blockwork walls. Again holes should be cut into the walls to assist the liquid to drain away.
- There were no fixings to the end corrugations of the roof sheets but if the standard verge boards which are only 25mm thick are fixed then the fixings will again be inadequate.
- Roof trusses have been fixed against end and cross walls where they are not required in all buildings. The joints to the bottom members of the trusses have been fixed with flat steel tape nailed to the members. These joints would be stronger if they had been fixed with timber battens to both sides as the tape will probably stretch.
- The roof timbers where visible had not been adequately treated against termites. All roof timbers should be treated before they are erected and fixed.
- It was noted here also that the ceilings were constructed of hardboard panels although they are specified in the BOQs as plywood.
- The shutters are made of the correct materials but the welding is very poor. Sheets are only tack welded to the frames when they should be continuously welded. The fixing handles are poor quality and will probably break very quickly and the pegs on which the handles catch and hold the shutters open are very sharp and could injure pupils. The louvres above the opening shutters were particularly badly made and some were broken.
- The veranda slab to the administration building was not clean enough to see if there are any cracks but the comments about movement joints under the last two schools also apply here.

Plate 13 View of untreated ceiling framing under inadequately treated roof trusses

Plate 14 Badly built cross walls and inadequately treated roof timbers

Plate 15 View of roof sheets showing render in contact with sheets and problems with fixing last corrugation of end roof sheets

Plate 16 Columns to kitchen cut into at base for steel frames

Annex 3: Management & Supervision of Output 1

General

The construction of primary and secondary schools under Output 1 of the programme are being managed by UNICEF and UNOPS. UNICEF is providing the overall management of the funding while UNOPS is providing the management and supervision of construction.

Funding

There have been some problems caused to the implementation of the programme by the decision by government to start the construction of all schools at more or less the same time rather than in two phases as originally intended. This has impacted on the flow of funds to pay the contractors as the original cash-flow plan has had to be amended.

Funds are transferred by DFID to UNICEF and UNICEF then transfers funds to UNOPS with which they pay the contractors. UNOPS complained during the mission that funds were not being transferred to them by UNICEF in time for them to make payments to the contractors. UNICEF for instance received funds in mid-January but these funds have not yet been transferred to UNOPS and some of the contractors have slowed down or stopped work because they have payments outstanding.

Supervision and Management

The construction programme is being supervised and managed by UNOPS. Overall management is provided by the programme manager (international) who also oversees other programmes and day to day management at the central level is provided by the project manager (international) and his team: a project architect and a project engineer (both international). There are also teams of international and national engineers in the four States where the project is operating who have responsibility for supervising the construction. See Table 1 below.

Table 1 UNOPS staff and vehicles in the four project states

State	Primary Schools	Secondary Schools	International Engineers	National Engineers	Vehicles
Eastern Equatorial	8	1	2	2	3 vehicles; 1 m/cycle
Warrap	8	1	1	3	2 vehicles
Northern Bahr el Gazar	7	1	1	3	2 vehicles
Upper Nile	7	1	1	3	2 vehicles; 2 m/cycles

Supervision of the construction is being hindered by the security situation in the country. All vehicles in the field must proceed in convoys of two vehicles and this means that in the three states with only two vehicles only one supervision mission can operate at any one time and this obviously restricts the numbers of visits that can be made to individual sites. The UNOPS project manager stated however that there is at least one visit to every school construction site every week and that there are more visits if required i.e. if a particularly important aspect of the work is taking place such as pouring of concrete foundations or columns.

A number of issues were raised during the visits to the school construction sites that relate to the supervision of construction and these were:

- At two sites buildings had been positioned very close to trees. This is not good practice and buildings should be kept at least 4 metres away from trees and further if the trees are very large; the crowns of trees should not overhang the buildings.
- At all sites the quality of the sandcrete blocks was very poor and this appeared to be because they were being made under the sun, were not being properly cured and in at least one instance were being used much too early.
- Roof timbers were being installed at all sites without being treated against termites leading to inadequate treatment of the timbers in-situ.
- The joints to the various members of the roof trusses where seen were inadequate.
- At the primary school sites it appeared that construction joints had not been provided in the floor slab to the administration building. This building is 47

metres long and should have at least one if not two construction joints to prevent the floor slab and the screed topping cracking.

- The fixing of the last corrugation of the roof sheets at the ends of the buildings was everywhere inadequate. This part of the roof is very vulnerable to wind damage and the sheets need to be properly fixed.
- At the only site where it was possible to see the RC columns before they had been concreted it was noted that the columns were not tied into the block-work. If the columns are not tied into the block-work it will weaken the structure of the walls.
- The veranda roof to the administration building at one site was almost flat; the veranda columns had probably been fixed too high.
- At one site where the workmanship was worse than at the other sites visited, an RC column and some block-work had to be condemned as it was not plumb or square.

A lot of these issues have not been picked up due to the inexperience of the national engineers but they should really have been identified and rectified by the international engineers.

If there is a further stage of the project it would seem necessary to hold further training of both the international and national engineers who will be supervising construction. This training should cover both the construction documentation so that all of the supervisors are fully conversant with the drawings, bills of quantities and specification and particularly with the construction details and basic construction techniques i.e. how to make and cure sandcrete blocks, how to mix concrete, how the roof trusses should be constructed, etc, etc. With regard to the latter, a simple construction handbook would probably be very useful especially for the national engineers and UNOPS should consider developing one of these.

It must be stated however that given the extremely difficult circumstances with regard to security, transport and logistics faced by both the contractors and the UNOPS supervisory staff, the standard of construction at the school sites visited is on the whole acceptable.

Furniture and Equipment

Classroom and other furniture for the schools is being procured by UNOPS who stated that contracts have been let for the furniture and that it should all be in-country (and delivered to those schools that are finished) by the end of May 2012.

Other equipment such as laboratory equipment is being procured by UNICEF and it was not possible to establish what stage has been reached in the procurement of this equipment.

Annex 4: Terms of Reference

CONSULTANCY TO REVIEW THE CONSTRUCTION AND REHABILITATION OFEDUCATION FACILITIES FUNDED BY THE DFID SOUTH SUDAN EDUCATION PROGRAMME (SSEP)

Objective

1. To produce an appraisal document that will inform DFID's first Annual Review of the South Sudan Education Programme (SSEP) on progress regarding the construction and/or rehabilitation of education facilities that are funded through the SSEP.

Recipient

2. DFID South Sudan will be the recipient of the consultancy services. The Government of the Republic of South Sudan (specifically the Ministry of General Education and Instruction) will benefit indirectly from the analysis.

Scope of Work

3. The consultant will examine and provide advice on the following in their report:

    - Progress in achieving Milestone 1 of Output 1 of the log frame. Output 1 covers (improved) access to new primary and secondary school infrastructure. The relevant milestone is: 'Twenty One (21) 8-classroom schools initiated by December 2011'.
    - Progress in achieving Milestone 1 of Output 2 of the log frame. Output 2 covers increased access to Alternative Education Services (AES) for out of school children and youth. The relevant milestone is '11 learning sites rehabilitated/ constructed by 2012'.

For both of the above analyses the consultant should:

- Assess whether the above milestones have been met, not met, or exceeded.
- Do a sample check of the quality of construction/ rehabilitation by visiting at least 2 sites under each Output

- Identify, where necessary, what the bottlenecks may be jf not achieving the Outputs and suggest solutions to overcome such bottlenecks
- Check that the construction/ rehabilitation is in line with Ministry of General Education and Instruction guidance
- Check that the facilities are 'girl friendly' (and generally female friendly in the case of YEP Centres, etc) in the way that they have been constructed or rehabilitated
- Check whether the physical aspects of the sites are sustainable once the Programme has formally ended (e.g. to check that services are in place for regular maintenance, etc).

Suggested Methodology

4. The suggested methodology includes the following:

- Read the Project Submission for the South Sudan Education Programme (SSEP) and consult the senior Education adviser of DFID South Sudan on the background to the Programme and key issues that have arisen or may be on the horizon (the Adviser will be collating relevant data before the assignment begins).
- Consult widely all key relevant stakeholders including the Ministry of General Education and Instruction, a sample of State level Ministry of Education authorities, UNICEF, UNOPS, Save the Children International South Sudan (SCiSS) and the Norwegian Refugee Council (NRC)
- The consultant should travel to four comparative sites in South Sudan (two for each output), security permitting, to consult key stakeholders and conduct appraisal as above. These site visits may be in company with the Senior Education Adviser and/ or the Deputy Programme Manager (Basic Services) for DFID South Sudan
- Write an appraisal for delivery to DFID South Sudan no later than five working days following the site visits. If necessary the appraisal should include photographs to substantiate evidence of high quality

construction/ rehabilitation or alternately of serious defects which will require remediation.

Outputs/ Deliverables

5. An appraisal will be submitted by March 20th. If necessary the appraisal should include photographs to substantiate evidence of high quality construction/ rehabilitation or alternately of serious defects which will require remediation. Where remedial action is required recommendations should be made. The appraisal should include an overall rating of progress against the specified log frame outputs in line with DFID's five point scoring system. The five point ratings are:

   A++ Outputs substantially exceeded expectation

   A+ Outputs moderately exceeded expectation

   A Outputs met expectation

   B Outputs moderately did not meet expectation

   C Outputs substantially did not meet expectation

   (NOTE: In this review an overall rating of project quality will not be ascribed- this will be done at Outcome level only when a Project Completion review is implemented. However it will be useful to gauge progress now against the Outputs in order to flag up any major factors (good or bad) and to assess whether progress overall is on track or off track).

Reporting

6. The consultant will report to the senior Education Adviser of DFID South Sudan.

Time Frame

7. The consultancy will start on Saturday 10 March and will be for 11 person days. The site visits will be made between 12 and 16 March 2012. The appraisal must be delivered to DFID South Sudan by the close of 20 March in time for the review submission deadline of 22 March.

8. It is envisaged that the majority of the assignment will be spent in-country: therefore 6 days in S Sudan and 5 day for prior research, report writing and any post report consultation that may be necessary with the senior Education Adviser.

Competency and Expertise

9. The consultant should have carried out similar appraisals in South Sudan or other sub Saharan African countries, and be able to start work as soon as possible. Experience in South Sudan would be very advantageous, as would experience writing appraisals for DFID or other donors.

10. The consultant should have proven expertise in the construction and rehabilitation of education facilities.

11. He/she should have extensive experience working in fragile and conflict-affected states and the personal resilience to work in South Sudan.

Background

12. The South Sudan Education Programme (SSEP) is a three year project with effect from 22 March 2011 (hence the DFID Annual Review due date of 22 March 2012). DFID has allocated £ 37 million to the Programme. It is intended that the Programme will provide access to an additional 38,000 children to schools every year.

13. Implementation of the Programme is divided in to two components or work streams: the construction of 37 Primary and 4 Secondary Schools with associated technical assistance in 'soft' elements such as the formation of Parent Teacher Associations (PTAs); and the rehabilitation of 51 Alternative Education Services (AES) Sites with associated technical assistance plus the construction of six Youth Education Pack (YEP) Centres and one teacher training/ adult literacy institute.

14. The first of these components is managed by UNICEF who have sub-contracted the United Nations Office for Project Services (UNOPS) for the construction elements of the work; and the second component is managed by Save the Children International South Sudan (SCiSS) who sub contract

the Norwegian Refugee Council (NRC) who lead on the six YEP Centres and the TT/AL institute (SCiSS take the lead on AES site rehabilitation).

15. For further information please read the attached Project Submission and log frame. This includes specific output objectives for numbers of classrooms to be constructed, etc. It should be noted however that the original requirement for the 37 primary schools to include basketball courts has now been removed following negotiations with the Ministry of General Education and Instruction.

16. It should also be noted that SCiSS have recently requested a budget re-alignment and a re-orientation of the AES site rehabilitation target (documentation can be provided following contracting of the consultant). In particular SCiSS has suggested that the target of 50 school rehabilitations should be lowered to 26 in order to ensure that 26 schools nominated by the Ministry of General Education and Instruction benefit from higher quality of girl friendly design. The Review should further investigate the thinking behind this proposal for target reduction and re prioritisation and assess whether the original target for school rehabilitations should be retained or amended accordingly (The decision on this will be formulated by the senior Education Adviser but will draw upon any evidence supplied by this consultancy on the arguments for such a revision on a technical/ engineering basis).

DFID, South Sudan

February 2012

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