

Construction of Camps for Oil Companies

Special construction process in Ecuador

Sandra Andrade Cascante

Civil Engineer

Engineering & Operation Department, Urazul S.A., Ecuador

Summary

For the oil production in Ecuador, which is its most important income source, camp facility is needed in each central process facilities. These camps usually are located far from the main cities, so their construction implies a special process. Furthermore, the camp facility is often a part of a big project for oil production. In this process, the relation between the design and the production stages is very close, and it is the result of the way that it is contracted. The production process requires a great level of pre-fabrication. Past experiences have been the base of the decisions. The construction of camps for oil companies is a non-common construction process.

The design stage is a part of the whole construction package. The same people carry out the design and the production stages. In this way, the design is always done considering the production process. Additionally, the works are performed with a great deal of details since the early stage. There are some facts that affect the decision about the material used. The material weight is one of them, especially when the accessibility to the site is hard. In conclusion, the designer-contractor team has to think in the global process.

Logistics operation is the main part of the production stage. Pre-fabrication is one of the keys to be successful. Furthermore, the communication between all people involved in the process is very important. A big computer support has helped the communication making the production faster and simple. To be the main part does not imply to be the hardest part. In the contrast, logistics should be as much easy and simple as possible.

Many years of experience have been useful to improve the processes. Maintenance requirements, durability, and availability are the main factors in the decision of the materials used. The majority of these decisions are made considering past experiences, but the innovation feeling is always present. However, a deep analysis of property management has never been done.

Some weak points have been found out through the analysis made about the construction of camps for oil companies. First, some essential processes have been treated with less importance than they really have. In addition, it would be better if complete information is given to the client in order to decide which alternative is the best. Although until now the construction of camps has been successful, there are many things to be improved.

Introduction

The construction of camps for Oil companies can be considered as a special process due to the way to carry it out. There are several facts, which make this construction different. First, it can be mentioned its location and accessibility. Then the particular

process to contract this project. Additionally, the way that it is controlled and monitored. The analysis is made for oil camps in general, so several types of camps are mentioned. In summary, the aim of this paper is to get a global idea of the construction of camps for oil companies and to find out the way how to improve it making a comparison with the topics treated in the International Construction Management.

Basic Information about the Country

Ecuador, the smallest country in the rugged Andean highlands, is located in the western coast of South America, bordering the Pacific Ocean at the Equator, between Colombia and Peru. The main geographical accident of South America, Andean Mountains, divides the country in three regions with features completely different: coastal plain (Costa), inter-Andean central highlands (Sierra), and flat to rolling eastern rainforest (Oriente) or Amazonic Region. Additionally, the Galapagos Islands in the middle of the sea belong to Ecuador.

Ecuador is a surprising country. It has some of the world's oldest rain forest, the world's highest active volcano, and the amazing Galapagos Islands. Ecuador packs its perimeters with more points of interest than many other countries twice its size. The area of Ecuador is 256.370 sq. km and it has a population around 12'400.000 inhabitants. 59.9% of its territory is urban. The population growth rate is 2.10% and the literacy level is 90.1%¹. Among the natural hazards are frequent earthquakes, landslides, volcanic activity, and periodic inundation. The climate is tropical along the coast becoming cooler inland. The Amazon region is tropical rainforest.



Figure 1: Map of Ecuador

The major industries are oil, bananas, shrimp, fish, and coffee. The construction sector represents the 2.5% of GDP. Lately, it has suffered a great decrease produced by many factors. Since 1998, national economy was seriously affected by the El Niño weather phenomenon, the fall in oil prices, the effects of the world financial crisis and political transitions as well as.

The oil production, 14% of GDP, mainly takes place in the Amazonic Region. The Amazonic Region extends from the eastern branch of the Andean Mountains to

the origin of the Amazonas River. This large region has huge areas of rainforest and some indigenous tribes clinging to their way of life.

The actors

The oil production in Ecuador is carried out as a concession procedure. Once the exploration stage has been done successfully, foreign oil companies invest their money in the construction of all the necessary facilities to extract the petroleum. They have all the rights of the production during certain time, for example, twenty years. However, they have to pay a percentage of the production to the government. Just after this period, government takes over the production of the different oil wells.

One of the facilities is the construction of a camp in site. The oil well sites are located so far from the main cities. For these reasons, the construction process of camps for oil companies has special features that they must be taken into account. First, the accesses to these sites are not easy and in some cases are only by helicopter. Then, the weight of the buildings is a very important fact, so the materials used have high relevance. Additionally, the operation and maintenance stage must be easier considering their location. In conclusion, the construction process of camps for oil companies is different from other type of buildings.

There is another fact that should be mentioned. Currently, oil companies must do any kind of effort to avoid the environmental damage. With this thing in mind, some projects use offshore techniques to protect rainforest and leave it flourishing. Consequently, the construction is a matter that needs a great deal of planning.

Urazul S.A. is a company, which has been giving services to oil companies since twenty years ago approximately. The services go from feasibility studies, topographical, geological and geotechnical surveys, design, facilities construction, operation and maintenance. Urazul has a lot of experience in logistics operation for this kind of projects. Although, construction of camps is only a part of the whole construction involved in oil process facilities, it needs special attention. For this reason, the construction of camps is managed separately from the whole project.

Design Stage

Construction of camps for oil companies is a type of project that must have close relation between design and production stages, due to the fact of the hard access. The design is performed according to the client requirements, such as areas, services, capacity, and mainly budget. The camp includes staff dormitories, worker dormitories, laundry, messhall building, and bathroom building.

Project Organisation

Once the design is approved, people who make the design are the responsible to get the drawings done in the field. Therefore, the relation between designers and contractors is direct. Additionally, reaching this goal requires the participation of many other people who can be shown in the project organisation chart in figure 2.

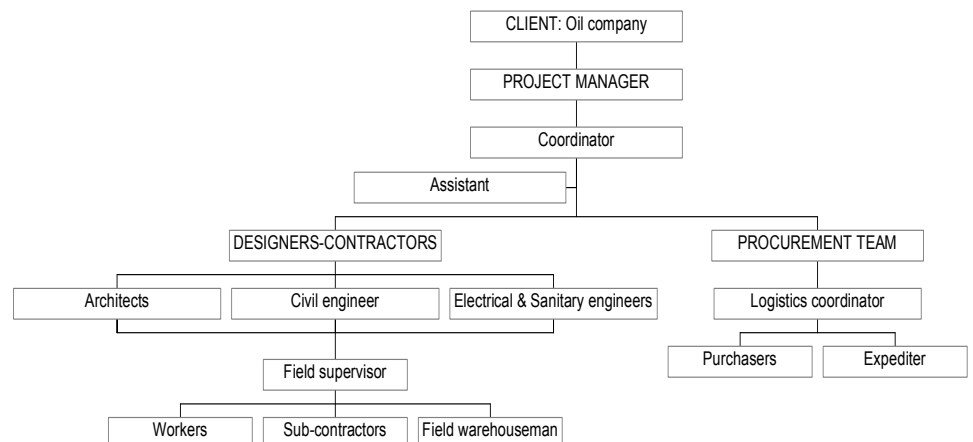


Figure 2: Project Organisation

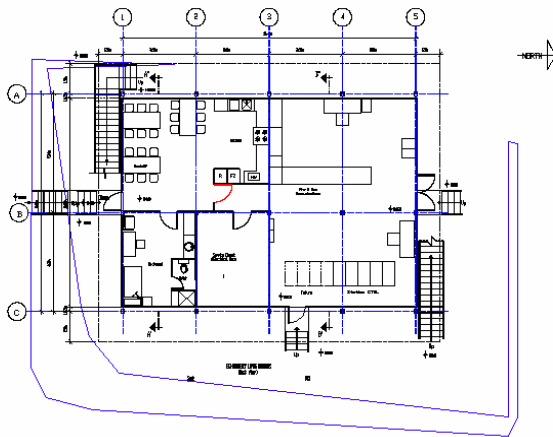
The client must quantify the needs of the camp. It means the number of people who must be there, design specifications, and the available area for it. The knowledge of the design specifications is very important, because there are many situations that could modify the budget. For example, in the event of the camp has to resist the wind velocity produced by the helicopter, the design is different.

The project manager is basically in charge of the relation with the client. They both must be in continuous communication. Actually, the project manager's main function is perhaps lightly polite. However, the project manager is the one who takes the decisions.

The activities of the co-ordinator are in certain way as a project manager. The co-ordinator is the responsible of the total project. Besides the design, the co-ordinator takes over the construction process. He must control the project to be under the schedule. The co-ordinator can approve procurements up to US\$ 2.000,00. Otherwise, the project manager can approve it. Additionally, the co-ordinator prepares all the information needed to invoice the client. In conclusion, the co-ordinator performs the operating activities of the project management.

Two architects and civil, sanitary and electrical engineers compose the designer team. These people are in charge of not only the design but also the construction. The duty of everyone is to be sure that every thing considered in the design is performed in the construction. Each professional is responsible of the design, approval, and construction of each item involved in the construction process. In this way, civil engineer is in charge of the foundations, structures, and roofing. Wall partitions, doors, windows, finishes, and equipment are matters of the architects. In the same way, the correspondent engineer must design all the sanitary and electrical installations. In the figures 3 and 4, one type of two-story camp is shown. These drawings are the basis for the complementary designs.

Once all the designs have been approved, each member of the designer team must obtain the material list, which has to consider every thing until the last detail. Although the construction process will be analysed later, it must be mentioned the fact of each designer has to be aware of the things happening in the field. Considering all the above things, it is important to have the majority of the elements prefabricated in order to construct the camp successfully.



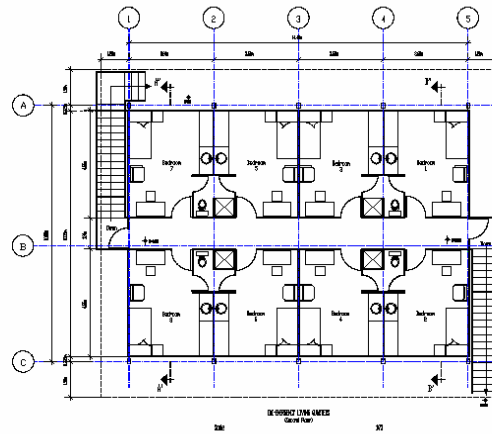


Figure 3: Architectural drawings

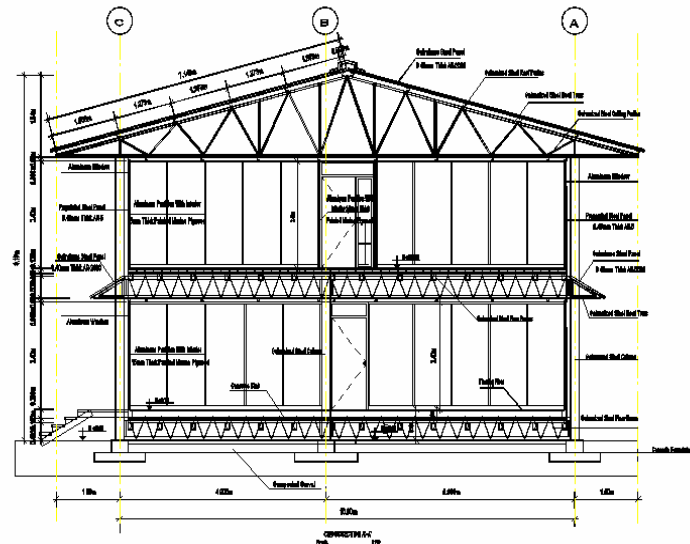


Figure 4: Typical cross section

Procurement and Contracting

Oil companies are used to inviting several qualified contractors to bid the construction of the camps. Usually, design is included into the bid package. The process begins when the client, Oil Company, sends his intention letter to the winner bidder. The design is only part of the total breakdown budget. The contractor must begin their works immediately after receiving the intention letter. There is not download payment and the invoices are monthly which must be checked, discussed, and approved. Therefore, the first payment will be done after 1,83 months approximately. This financial cost is supposed to be included in the budget. This situation produces that very few companies can perform this kind of projects.

Project Planning

Project planning is a matter of the designer-contractor team. First, each person participates in the formulation of the project planning, because everyone is responsible of certain activity. Then, the co-ordinator joins all the activities into a Gantt chart or bar chart. Most of the activities are planned to be done in a parallel

way. In addition, the prefabrication stage is included into the project planning, because this part of the production is so important.

The success of the project depends on the communication level between all people involved. However, it has happened that one activity has been done twice due to the lack of communication.

Project Financing

The construction of camps for oil companies is a type of project whose financing should not be a problem considering the client nature. However, the contractor, in this case Urazul, gives the initial financing until the first payment is done. Consequently, very few companies can apply to these projects. Moreover, oil companies are severe in qualifying the contractors.

Budget and budget control

In the bidding stage, all efforts are performed to get a real budget of the project. The planner-contractor team is also part of the bidder team. In this way, the budget is almost real. The project is analysed under a global point of view. It means that the concept of unit prices in the formulation of the budget is not used. The analysis goes from the global to the particular. Each camp is always a different project than other camp, because there are many facts which affect the cost, such as location, access, durability, equipment needed among others.

The basic analysis of the budget is the following:

TOTAL DIRECT COSTS

MAIN DIRECT COSTS (For each activity)

- Materials
- Equipment
- Personnel
- Transport
- Subcontractors

OTHER DIRECT COSTS (Global)

- Mobilisation & demobilisation
- Supporter crew

INDIRECT COSTS

- Central office cost
- Unexpected costs
- Taxes
- Guarantees
- Profit

In summary, once the global analysis is done, the unit prices could be found. There are reference value ranges for each activity, so it is easy to know if there is a mistake. Then, the budget breakdown is performed taking into account only the main activities.

Until now, the budget control has been done manually comparing with the bid budget. Right now, a new system is being developed in order to control all the processes using the same codes in bidding and production stages. Nevertheless, it is common that new activities or quantities appear, so a change order request must be done to be able to invoice the new works. It could seem easy, but defining additional items is a big dilemma. To avoid these unpleasant situations, a complete and detailed scope of work is done. However, there are some things charged as unexpected.

Information Technology

During the design stage, MiniCAD software is used to make the drawings. For structural analysis and design, SAP2000 software is used. The quantities are calculated manually in order to obtain the budget. If any change is made, its quantification should be done again. There are other software developed specially for this kind of project, whose main purpose is to control the processes involved into the whole project, such as purchases,

material deliveries, payments, etc. Additionally it should be mentioned that in the bidding stage special software is used. All of package software is designed according to the processes used in the company.

Conclusions

Due to the fact that the designers and contractors are the same people, the design is always done taking into account the construction process. Although, this fact has been useful for the success of the project, it has happened, not too often, that one thing is only in the mind of the designer. This kind of thing should never occur.

As it has been mentioned before, project planning is only performed by means of a Gantt chart. It has been treated with less importance than it really has. Actually, project planning has almost disappeared due to the fact that mostly all the activities are parallel. Project planning has not been considered as a key process and this should be changed.

Nevertheless, important software is used in the design stage, calculating a new budget due to some changes takes certain time. One of the reasons is the expensive cost of specialised software, whose use may be do not justify its cost. Another important reason is that computer support is mainly used in the production stage for the economic control.

Production stage

Tendering and contract

As it has been mentioned before, not only design but also production is included into the bid package. Consequently, this project is a type of turnkey project or design-and-construct approach. Although there is a lump sum price, unit rates are used for additional works or changes made by the client during the construction process.

Once the tender is qualified and accepted, the negotiation period begins. During this stage, some aspects concerning about the material quality and prices are clarified.

The construction starts with the delivery of the intention letter, and the agreement pact is signed after few days. The lump sum price, unit rates, and the breakdown budget are included into the contract.

Production process

Due to the camp location, it is necessary to have as much as possible prefabricated elements in the construction. Being co-ordinated with the procurement team and the field supervisor is also important. Another important factor is the computer support not only in the office but also in the field. Additionally, the UHF radio is basically the main communication system.

Each designer has to do detail drawings whose purpose is to make easy the construction. These drawings are not for approval, and their quantity depends on the prefabrication level. During this stage, the field supervisor analyses carefully all the drawings. Any doubt about them must be answered in this stage before the production begins.

In order to build the camp, a field supervisor is co-ordinating the several activities between each member of the designer-contractor team and the field. He should follow the instructions given by them. He must supervise all the works including those performed by subcontractors. Additionally, he is the responsible of the rational use of the materials.

The production process starts with the prefabrication of the steel structure in Quito where the workshop is located. In most of the cases due to the environmental conditions, the steel structure is galvanised by means of hot immersion procedure. There are other prefabricated works, such as steel panel for roof, ceiling, and external walls, internal wall partitions, which could be made by wood, fibre cement or aluminium, and some sanitary installations. Additionally, all the equipment is prefabricated. While these activities are carried out, other works must be done in the field.



Figure 5: Different stages of construction

First of all, the foundations are cast in situ. Then, the steel structure is raised immediately. Roofing is the next step and it is very important due to the fact that once it is done any work could be performed under it, in spite of the weather conditions. The material for the roof is steel panel and it might be whether pre-painted or a type of zinc-aluminium covering called galvalume. Steel panel is always preferred for the roof because of his lightweight.

There are different types of floor according to the type of foundations. It could be raised floor or concrete slab. Anyway, it is so practical technique to tile the entire floor before the wall partitions are placed. The metallic ceiling is also placed in the total area whose function is to avoid air condensation. The use of double ceiling is very common for this purpose. However, sometimes due to the height and budget, only one ceiling is allowed. In this case, special insulation called Low-E is used, and the free space for the installations is small. The finish ceiling is a type of fibreglass tile.

All the sanitary and electrical installations are performed while the wall partitions are erected. Internal wall partitions, windows, and doors are often made by aluminium. In the case of temporary camps, whose durability is about 18 months, wood is the most practical material for internal wall partitions, doors, and windows. It is very common the use of steel panel whether pre-painted or galvalume to cover the external wall partitions. These types of covering are so practical when the time and the accessibility to the site are critical. Frequently, the external walls have an insulation material inside them, mainly when the camp location is hot. The use of concrete blocks for the external walls is a good alternative when there is not any kind of restrictions.

Because of the weather features, it is only necessary to install air conditioning and ventilation systems in the camps. Usually, the camps are located in a tropical rainforest. Heating is not taken into consideration.

Maybe, the construction process is similar than others in other countries. Nevertheless, logistics operation is the main fact for the success of the construction of camps. In the figure 6, one scheme of the procurement process is shown.

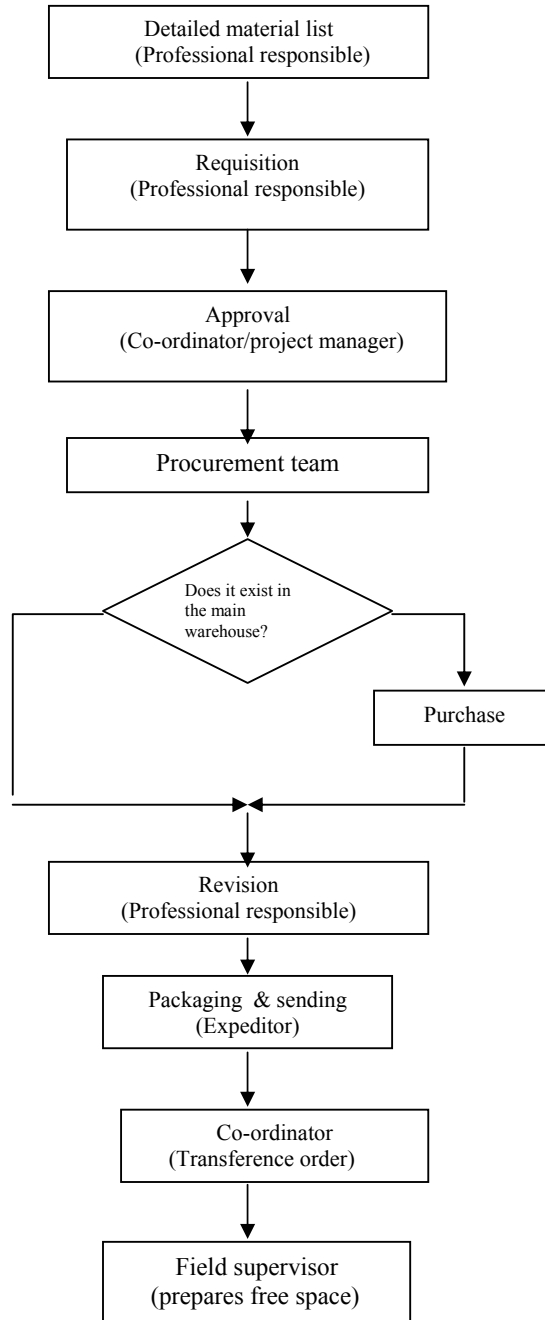


Figure 6: Scheme of procurement process in the production stage

The process by itself is very easy, but the communication is the key. Each member of designer-contractor team performs this process. First of all, the purchase need of certain material is requested by the responsible professional to the procurement team by means of one requisition done by a computer system and approved whether by the co-ordinator or by the project manager. This material existence is checked in the main warehouse, otherwise it should be purchased. In some cases, it is necessary to define the supplier, but the reason must be justified. The field delivery date is specified in the requisition.

Purchasers and expeditors, whose number depends on the size of the project, compose the procurement team. The logistics co-ordinator is over them.

Before the sending of materials, packaging them is something that requires special attention. First, the site locations are so far from Quito, around 500 km, and the roads are not good, even more if the helicopter is required. For this reason, every thing must be sent correctly packaged to avoid damages during the transportation, mainly fragile materials such as glasses for windows. Each team member must follow all the procedures, and if it is possible he should check the materials before they are sent.

The co-ordinator is informed about all the sending by means of transference orders by a computer system. The co-ordinator should inform to the field the materials to be sent because it is important to know if there is enough space to keep them. Additionally, when the use of helicopter is needed, the weight of the material is also important in order to programme the flights. Another aspect to be informed is the entrance to the field of workers or subcontractors, because accommodation facility has to be checked. The co-ordinator is the person in charge of the personnel rotation. The typical work journey is twenty-one workdays and seven rest days. There is another important fact in the production planning, which has a big influence. Due to the economical situation of Ecuador, there is a great offer of specialised personnel. They are hired only for each project. Considering this point, it can be said that the critical resource is the accommodation facility in the field.

In the case of subcontractors, they have to sign a civil contract with one-year duration without quantities and prices. Then, they sign work orders in which prices, quantities, work schedules, and specifications are included.

Everyday, radio communication is done to get information about the weather, the number of people who are working in site, hours worked by the equipment, and the advance of different activities. In this way, any problem could be solved as soon as possible. Sometimes, the weather is an important factor in the delivery of materials due to the flight conditions for the helicopter, so it should always be taken into account.

The role of the co-ordinator is very important. He must be aware of the different activities performed in the field. Additionally, co-ordination and communication between each member of the designer-contractor team. At least one weekly meeting is necessary.

If an additional work is required, the client representative by means of a change order request should ask it. Then, the contractor gives his tender according to the unit rates in order to be approved. These works are invoiced separately.

Quality Management

Oil companies demand quality in everything. For each activity, a Quality assurance / Quality control (QA/QC) form must be filled out. These forms are concerning about the material quality, fabrication procedure, technology applied, and personnel preparation. It is important to specify the different codes used, such as Ecuadorian Construction Code, (CEC), American Concrete Institute (ACI), American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI), American Welding Society (AWS), Uniform Building Code (UBC), American Standard of Testing Materials (ASTM) among others. In addition, a client representative is always in the construction site approving all the activities performed.

Additionally, industrial safety is also demanded. Oil companies are used to giving some kind of bonus to the workers who satisfy safety requirements. In this way, they are always motivated in this matter.

Economic control

Urazul has a relevant computer support for almost all activities. All departments are connected to the main computer network. Furthermore, special software has been developed considering the different process involved. In this way, the economic control of the project is easy to carry out. The payments done to the suppliers, subcontractors, workers, etc. are immediately recorded. Each member of the designer-contractor team in the computer can check the updated cost of the project, so he could do something when certain item is over the budget.

The breakdown budget is included in the agreement pact. It considers procurement and fabrication stages for the main activities. In this way, the monthly invoices are done in accordance with this budget. The client representative has to approve the advance of the activities considered into the budget.

Conclusions

All above written could seem that every thing is perfect. However, the reality is a little bit different. During the construction process there are some problems mainly produced by the lack of communication. Maybe, many years of experience in this kind of project have done possible to decrease them. However, all levels of communication are a topic, which should not be neglected. Computer support makes the communication faster between all the departments involved in the production stage.

The design-and construct approach is the best way to carry out this kind of projects, due to the close relation between the stages. During the design stage it is very important to be as much accurate as possible in the details. Only in this way, it is possible to have a complete and accurate material list for the construction, which makes the logistics operation easier.

Most of the problems concerned to the relation with the client appear in the invoice time. A contract with lump sum price is always a double sharp weapon, so it is managed in the most careful way possible.

Property Management

Property management is carried out by the owner, in this case oil companies. To understand the property management in this project, it is important to remember that the camp facility is only a part of a big project, which is a central process facility for Oil production.

The type of the owner is an important fact that should be mentioned. Oil companies are powerful, and they should do a great analysis of the whole project, so the camp does not have too much relevance to be analysed separately. This building does not have particular incomes by itself. The owner as a part of the whole maintenance does periodical maintenance to the buildings.

Life cycle

A deep economical analysis is not done to take a decision concerned to the appropriate investment for the camps. The decision made is based on the feeling of which material requires more maintenance than others are. When the case is applicable, the material weight is also relevant. Of course, the knowledge of the durability of the camp is another important factor. There are some temporary camps, which are used only in the oil exploration stage, and its durability should be around two years. In this case, the main material used is wood. On the other hand, when the camps are permanent, the decision of the material is based on the maintenance requirement.

The life cycle is taken into account in the decision of which materials should be used. In a general way, all the materials involved in the construction have almost the same durability. For instance, if the camp is only temporary, the steel structure is only painted and its thickness are thinner. In addition, wood is used for windows, doors and wall partitions. In contrast, if the camp is permanent, the use of galvanised steel structure is necessary, and the wall partitions, windows, and doors are made from aluminium and fibre cement boards. Usually, the life cycle for these camps is around twenty-five years.

In the case of temporary camps, there is another important aspect to mention. When the oil exploration stage has finished, the camp should be dismantled. This fact of course affects the decisions about the materials used. Furthermore, this cost should also be taken into consideration.

Maintenance planning

The decision about the material used is fundamentally based on the maintenance. The camp location is far from the main cities and it is exposed to hard environmental conditions. The main fact to be avoided is the corrosion, so the use of galvanised steel for the structure is really necessary in the case of permanent camps.

Using steel panel to cover the external wall partitions is a good alternative and it does not require too much maintenance, only cleaning. Its durability is around twenty-five years.

Taking into consideration the maintenance of sanitary installations, the use of raised floor has been preferred mostly. Additionally, it gives an extra protection in the case of inundation zones.

Equipment requires permanent maintenance, basically the air conditioning and ventilation systems. It is common to program running maintenance each three months. Contractor has to do the maintenance during the first year, which is the warranty time. Then, the owner takes over it. However, all running costs are responsibility of the owner since the beginning.

When the project is delivered to the client, a complete maintenance handbook is given to them, besides some common things to be replaced.

Connection with the design stage

All above mentioned is the result of many years of experience. Although there are not written records, new material alternatives have been proved taken into consideration past mistakes done. In this way, the knowledge of which material is more appropriate for certain situation exists, but the feed back is done informally.

Conclusions

Property management of camps for Oil companies should be included into the early analysis by the designer-contractor team. Actually, many years of experience have permitted to make decisions in an empirical way. The property management has been done in this way.

There are many things to be thought about this matter. First, how to evaluate the incomes for the camp, because it forms a part of a big project. The camp by itself is not a kind of profitable project. In this case, there are only running and maintenance costs. Consequently, the decision should be made based on the low investment for the owner. The environmental condition is a factor that definitely influences in the final decision.

Conclusions and Recommendations

Making a comparison between the different topics seen in the International Construction Management course and the brief analysis done of the construction of camps for oil companies in Ecuador, there are some issues that should be mentioned. However, it is important to remember that the construction of camp is a part of a really big project.

The project organisation for the camps for oil companies is a type of line organisation. It is forming part of other big organisation. However, due to its importance, this is managed separately. This type of organisation has been working satisfactorily for many years, because it is easy to find the responsible of each activity involved. Additionally, there are some co-workers who have a good level of communication.

Maybe one of the reasons to had had success in this kind of project has been a great deal of details in the early stage. First, it has allowed having an almost real budget in the design stage, and has made the logistics operation in the construction process easier.

Project planning has been neglected. The co-ordinator and the project manager should do project planning more consciously. It is very important and useful to know which activities and resources are critical, especially to plan the personnel entrance to the field. If each member of the designer-contractor team is worried about his own activities, the co-ordinator should be worried about the global project. This aspect should be improved, even more if the software is available but not used.

Many times, it has been said that the turnkey projects are not recommended, but in this case is a good option. The reason is that the design is made thinking in the construction process. In this way, there is a close relation between the design and the production stages, so the pre-fabrication process is always in mind. This point makes easy the logistics operation taking into account the camp location and its accessibility. However, one inconvenient could appear and this is the case when some details only keep on the designer's mind. In order to avoid it, the client should

approve the drawings before, so if something is not clear it could be detected on time.

Having a contract based on a lump sum price is often a big problem. Frequently, many things appear as if they should be included in the tender, although the scope of works is done as much clearly as possible. Additionally, it is hard to have quantities exactly if the design has not yet been approved. Nevertheless, it is maybe the best form of payment for this kind of project, but always unit rates should be included in the tender.

Regarding to the information technology, the use of much specialised software to quantify the works seems to be difficult. Taking into account the fact of getting a detailed budget for the camp implies a lot of work, the idea of acquiring ArchiCAD software has been analysed some times. The decision has not been done because its cost does not justify its use. However, reactivation of the oil production in Ecuador is expected with the construction of a new heavy crude flowline. In this case, the acquisition of this software is something that must be done. Besides the specialised software, it is also important to have software developed to fit the real process involved in the construction, which varies from one country to other.

Definitely, property management is an issue that should be developed in an appropriate way. The necessary information exists, but it ought to be organised and translated in useful numbers. Moreover, if with its use the client, oil companies, could obtain a clear idea of which investment is the best. As it has been mentioned before, there are many things to clarify regarding to this topic, but it is time to start doing it. Additionally, considering the way these projects are contracted, it is fundamental that the property management to be done by the contractor as a part of the whole service and in the early stage.

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