PROJECT MANAGEMENT PRACTICE OF TERMINAL BUILDING OF SHANGHAI PUDONG INTERNATIONAL AIRPORT

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Abstract: Based on the whole practice of project management of passenger terminal building of Shanghai Pudong international airport, a set of the project management organization and regular management system, project management methods and measures established for effective control over construction duration, quality and investment of mass infrastructures are presented in accordance with the results of comprehensively using of separately and proportionally testing method, contract management and all kinds of project construction objectives control measures taken for project management team. The feasible project management method for large infrastructures invested by governments is proposed and is used to construction project manager.

Keywords: airport construction; project management; separately and proportionally testing; project control; contract management

1 Introduction

Project management is widespread used in oversee manufacture and construction industry and it is known for some successful project management case history (Baker et al 1988). Compared with the development of project management in China, oversee project management theory and practice are mature and there is whole the code for project management practice (CIOB 2002). Recently, more and more scholars (Jaafari etal, 2000) have paid attention to the research on life-cycle project management and consider the comprehensive values of projects. However, the project management mode was carried out since 90’s in China and further used in public project (Cui 2001).

In order to make success in project management of some large public facility and infrastructure, project control (James 1988) is effective management method to realized the objectives of project and good construction project management team established is very important (Walker 2002). Based on the project management practice of terminal building (phase I) of Shanghai Pudong international airport on the contion of construction duration very tight and the scale of construction large, the feasible project management mode, organization, project control measures and contract and communication management method are presented to be referenced by other builders of large infrastructure and public projects to control the construction objectives.

2 Project Description

The planning area of Shanghai International Airport is 32 km² and the phase I construction area is 12km², which include a terminal building, a parking garage and a 4000m runway and other facilities and the total investment of the project was RMB 13.056 billion. The terminal area is the main part of the phase I project and whole area is 450,000m² including 280,000 m² terminal building and 150,000m² parking garage, which total investment is over RMB 3 billion. The terminal building is composed of a main building and passenger corridor, together with four colorful corrugated roof sheeting formed a sight of seagull. The terminal building is 403m in length, 128m in width and the structure is 2 stories reinforcement concrete frame structure with one story basement. The top of terminal building is prestressed tensile chord steel truss with a largest span of 83m, which are coved a double layer colorful galvanized sheeting system.

This project is a symbolic project of 21st century in Shanghai including many unique features and advanced technologies with new material, new structure in both building function and design and the analysis results of the features and technical difficulties of terminal building are shown on the following:

(1) The scope of the project is very large, including 300000m² soil excavated, 8392 piles driven, 521000m³
concrete poured and 33000 tons of steel structure, 160000m² colorful roof sheets, 36 flight boarding bridges and 135 elevators installed.

(2) The geographical conditions is very complex, in which the embedded depth of bearing strata of pile toe was varied from 30m to 62m so as to be difficult in pile driving and the dewatering and foundation pit excavation are difficult because underground water level is high.

(3) The shape of building is unique and the structure type is fascinate and complex. The new structure application technology includes two aspects: the first is the 35000m³ as cast concrete structure and the shape of beam and column members is complicated and the size is. Such a large quantity as cast concrete structure is the first appearance in China and there is no quality standard for it; The other aspect is the large span prestressed tensile chord truss located on the concrete frame, in which 1080 prestresed bottom chord cables, group anchor cables and diagonal cables between steel column are used to ensure the roof steel structure stable.

(4) There are more than 70 sub-contractors at construction peak and it is very difficult for construction management and coordination.

3 Objectives for Project Management

The project management objectives required by owner are the construction quality to ensure the Shanghai “white magnolia prize” award and try to obtain national “Luban prize” award, construction duration to meet the contract duration of 30 months and safety management goal to zero fatality.

4 Project Management Organization

4.1 Organization structure

Based on the project management contract and taking into account of the features of the project, the project management organization network was shown on figure 1. From the organization chart, it can be seen that a three degree grade management system of project manager—specialized deputy manager—discipline group leader was established. Because the construction progress is tight, quality requirement is high and the number of contractor is many, three specialized deputy managers were assigned to assist project manager (deputy manager in charge) to coordinate daily affairs and control quality, progress and investment concerning the particular specialized field. There are clear responsibility definitions and close cooperation between different groups and members for each group and the staff arrangement was dynamically adjusted according to the construction progress. The project management team includes 12 registered consultant engineers, 24 senior engineers, 18 engineers and over 50 technicians experienced in civil work, steel structure, survey, material, decoration, welding, construction testing, prestressed structure, curtain wall, water supply, HVAC, machinery and electrical of construction and so on.

4.2 Management Regulations

In order to ensure the service quality of project management, more than ten detailed project management plans are respectively compiled for foundation engineering, reinforced concrete structure, as cast concrete structure, steel structure, curtain wall, roof system, survey, equipment installation and building decoration based on the project management procedure. The project control content, procedure, method and standards are settled in the detailed plans. Before specialized work starts, the project staff is trained to grasp the key control points and procedures by project clarification meeting. In addition, the staff responsibility rules for each position, the staff communication meeting and reporting system were established to ensure the project management task was regularized and systemized.
5 Project Control

5.1 Quality control

Quality control was divided into three stages, namely, construction preparation, construction period and completion acceptance. It is very important to take adequate quality control measures for the stages above mentioned.

5.1.1 Quality control at preparation period

It is the key point for project quality control to make construction preparation work good. Based on the project management practice, the following are main control measures for pre-construction:

1. Review construction management plans submitted by contractors. For every separate divisional and sub-divisional projects, the contractors should submit the special construction plans to project management team and the detailed construction plans cannot be put into use unless they are reviewed and approved by the project management team. If necessary, a review meeting for construction plan will be held to invite all concerning parties.

2. Review the qualification of subcontractor. The construction sub-contractors are not allowed to come into site to work if the qualification of them are not checked and approved by PM team.

3. Check the qualification of material and building component suppliers. For the important materials and building component, at least three suppliers were selected. Visit the manufacturing plant of them if necessary.

4. Strictly control the application and check procedure of material, equipment, semi-products and products. In order to control the quality of all the materials and components, the more than 10 staff were sent to stay in the manufacture plant to supervise the manufacture process. In order to test the materials in time, a central lab of a cost of 1 million was built. 3452 samples of materials are tested in the lab and all the unqualified materials are rejected.

5. Prepare quality standards for as cast concrete and additional standards for steel structure manufacturing and installation. Since there is no standards for as cast concrete structure and to ensure the quality under control, the project management team translated the relevant foreign documents, carried out field manufacture tests of as cast concrete column held meetings to invite concerning parties to discuss and make conclusion of tests so that the quality standard is determined before formally construction of as cast concrete member. The roof system of terminal building is large and unique and it is not included in the current national quality acceptance standards. Therefore, the project management team organized the client, design, main contractor and construction contractor to compile a supplementary standard so that the 330000-ton-roof system was installed with high quality and high efficient.
5.1.2 Quality control during construction

To ensure the quality goals systemized management was carried out and tests are done independently. The major measures are as follows:

(1) Control eight tasks: First to set samples. Ask the contractor to make samples for as cast concrete, steel roof and decoration work before formally start the work. The major work cannot started until the sample is accepted and check the following work according to the standard set by the sample; Second, control the witness supervision for key points and key procedures such as concrete pouring, steel roof sheeting and skyscraper installation etc.; Third, control the quality of concealed work. Do not allow the work to be continued until the previous procedure is accepted; Fourth, Pick out the construction teams which does not follow the procedures. Some construction teams started pouring concrete without the PM team’s approval so that two construction project managers were dismissed and the construction payment for that month was detained. The effect is very obvious; Fifth, control the quality assurance system of the construction contractor and fully practice of self-check, cross check and specific check; Sixth, wander constantly the site and try to find problems in time; Seventh, test independently and evaluate for the quality of divisional and sub-divisional projects; Eighth, control the treatment for quality problems.

(2) Organize survey engineers to check the axis line, control net, elevation and dimension of building at suitable time. Cooperate with civil, decoration groups to check the elevation of floor, ceiling and roof coordination to ensure that the axis, elevation and shape to satisfy the design drawings requirement.

(3) Use all kinds of instruction, such as rectification, working stop, delay payment, change construction team and major responsible person as control measures.

(4) For the key steps, adopt joint signing and sign the start off instruction when all the group checked and approved. For example in the pouring of 520000m³ concrete, the specialized deputy manager signed for over 560 pouring instruction.

(5) Jointly check the quality per month. The project management team, together with members from client, main contractor and construction team to check the quality and evaluate the quality. Hold meeting to let all the construction project managers know the check results, analyze problems and set rectification time to improve the quality effectively.

5.1.3 Quality control at completion acceptance period

At this stage, the control work includes check the scope of contract, rectification, check as-built drawings and technical documents, writing quality review reports about the whole project work and assist the client to organize completion acceptance work and relative authorities confirmation.

At last, the project were awarded Shanghai municipal “excellent structure prize”, “white magnolia prize” and national “Luban prize” and the quality control effect is remarkable.

5.2 Schedule control

For the effective duration control of mass infrastructure, the following control measures were be taken:

(1) Review the overall construction progress organization submitted by main contractor and critical path and milestones of schedule network were decided by microsoft Project 4.0 software in order to determine main control points. In the meanwhile, divide the overall schedule planning into several stages and use them as schedule evaluation baseline for each stage.

(2) Dynamically check the execution of schedule planning according to review the annual, seasonal and monthly schedule reporting. In addition, use the computer-aided system to manage the schedule network control and check construction progress records every day, analyze every week and summarize and adjust every month. Collect all relative records and information and use Project software to statistic, predict and
prepare progress report. During the manufacturing of passenger corridor roof steel structure, because the contractor is not very familiar with quality control point and detailed drawing design, the progress was seriously delayed. Therefore, the project management team quickly submit the special report to the client and present the proposal to speed up the progress so as to ensure the roof steel structure installation work finished on time.

(3) Pay attention to review the detailed work-shop drawing and optimize construction technology. During the steel structure construction, the installation of roof steel structure of passenger boarding corridor is the key activity restricted the overall progress. Therefore the project management team present the proposal to optimize the construction technology of butting of steel beam and change the beam length assembled on the ground from 12m to 18m in order to reduce the waiting time for welding between beams on the sky with the supporting by crane.

(4) Reasonably arrange the lag relationship between the activities. The construction of roof sheeting and curtain wall was in the typhoon season. In order to finish the windward of curtain wall quickly to prevent from the roof sheeting uncovered by wind induced by typhoon, the project management team asked the curtain wall contractor to adjust the construction location and plan to finish the windward curtain wall installation as fast as he can.

The project was commenced in January 1997 and completed in July 1999 on time.

5.3 Quantity survey and payment control

According to the project management contract the client delegates the work of quantity survey, payment and variation confirmation to project management team. This task was charged by investment control group and supported by project planning group. There are two payment type, including payment per month and payment according to construction progress. The principle of quantity survey and payment control is to survey the quantity of completion work independently and check the quality of them based on construction contract. Only the works satisfied with the quality standard and design requirements can be paid in terms of the approval of main contractor.

During quantity survey, the investment control stall firstly calculated overall quantity of works to identify the control quantity according to the construction drawings. Then, they go to construction site constantly to grasp the actual construction progress and survey the building member dimension, the quantity of material and building component used in order to accurately check the actual quantity of completion work and ensure that in advanced payment won’t be occurred during construction. After the completion of whole project, The project management team cancel the whole payment values RMB3438,000, including claimed in advance, over claimed and repeated claimed.

6 Contract Management

The contract management of project is very important means to control the objectives of project management. In the project, the owner adopts the contract structure of general contractor and separate sub-contractors and signed more than 60 separate contracts. Moreover detailed design drawings are done by the sub-contractor during the curtain wall, roof sheeting system and decoration construction. Therefore, contract management is the core measure for effective control over quality, duration and investment by project management so that project management team did not allow the sub-contractor to start work until they submit formal contract document. However, interface management is the main content of contract management (Chua et al 2006) and project management team carefully checked the entire contract documents to identify the responsible contractors and ensure the interface work constructed in time when partly contractors neglected the construction interface between them during the finishing stage.

7 Communication and Coordinate Management

In the project, main contractor constructed the civil works and sub-contractors constructed other works.
Therefore the project management team has to coordinate with them during construction and treat with the contract disputes between them. They help contractors communicate the interface of activities, coordinate the relationship of construction progress, quality and payment and conflicts between construction teams by construction meeting.

According to the project management organization network, the project management meetings were divided into class I chaired by project manager or deputy manager and class II chaired by specialized deputy manager. In addition, meetings were divided into regular meeting and special meeting based on meeting held time. Regular meeting was held monthly during civil works stage and weekly during roof steel structure construction stage to settle the problems such as construction technology, quality and progress and so on. Special meetings were held to focus on technical problems emerged suddenly during construction. During the installation of roof steel structures and colorful sheeting daily meetings were held to solve issues between different contractors.

8 Conclusions

With the efforts of owner, design, construction and project management teams the terminal building project was finished on time with good quality. Except for the effective project control measures and contract and communication management method for terminal building of Pudong international airport (phase I) are presented, the following are the successful experience in the project management and are benefit to constructors of mass infrastructure and were successfully used to the project management of Shanghai maglev transportation line from February 2001 to December 2002 and take very important role in the construction project management of terminal building of Pudong international airport (phase II) since 2005.

(1) It is feasible project management organization for large project to establish the project manager--specialized deputy project manager--group leader management system to coordinate with each party.

(2) To set up a central lab to carry out engineering tests independently by project management team is effective way to control construction quality.

(3) To carry out jointly signing for key construction activities together with various specialties is effective control method of project management.

(4) For the project designed to use of many new structure, new material and new technology, it is a very important means of project control to positively take part in the technical service and early research on the key construction procedures to find out the technical key points and establish pre-control measures and methods in the early stage of project construction.

References


