International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

Rework in Building Projects:Lessons from case studies

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Abstract—Design & planning are two things on the basis of which every construction project in civil construction industry is built. Effective & careful design & planning proves to be key to success of the projects. But we also see the bad effects of poorly planned & designed projects. This may happen due to human being errors as he is involved in both the processes. Many factors are responsible beside this there are also other major factors that causes rework includes owners change of decision, change in government policy decision, construction change etc. A set of case studies studied in this paper which highlights the effects of change of policy of governing local body & owners change of decision. The first example illustrates a rework case due to change in governing body policy. Second example is about a rework happened due to owner's change of decision.After discussion on these case studies the points are noted which causes the rework & suggesting the special attention towards them to avoid their occurrences in future to avoid rework

Keywords-Rework, owner decision change, causes and effects.

I. INTRODUCTION

Construction projects are one of the most important industries in our country. It contributes much more to national economy and hence the growth of country. Rework is one of the barriers in executing such large projects which directly affects the cost & schedule growth of the projects. Many researchers studied the rework in their independent ways &establish various causes or sources of rework, their impact on industry, methods of measurement & also give the methods for minimizing rework.

Fayek et al. (2003) in his research presented to COAA (Construction Owners Association of Alberta) presents the classification of rework causes in fishbone shaped diagram. He also suggests the various indices to be used to estimate the magnitude of rework. Love & Edwards(2004) studied the different projects in Australia and finds the cost of rework to be 6.5% of contract value.

The case studies taken here are special cases happened due to unpredicted future short comings and changes made by owner also. The required data is collected by actual visiting the site, face to face discussions, taking actual photographs etc. In all these cases the rework happened in large extent to the reinforced cement concrete item. We know as the reinforced cement concrete is the only costly item in whole structure it proves a huge loss to the owner in terms of money. It also leads to fully stop the progress of the projects and increases the duration of completion. The discussions in this paper mainly aims to focus on the causes of rework happened, its impact and future care to reduce such occurrences.

II. RELATED STUDIES

Case 1:-Rework due to deficiency in old and new sanctioned project plan.

A. Basic of the error happened:

The development in infrastructure is based on the development plan sanctioned for the specific city by the corporation. It may include various new sanctioned roads, amenity spaces, reservations etc. So the construction projects which got sanctioned by old development plan may need to take re-sanction according to new development plan. This may cause rework if the project is already beings to execute with old sanction and caught in the new development plan so as to adopt the changes as per new plan & take revised permission. The case study described here caught in the same problem of reservation & causes to rework leading to re-plan & modify the already constructed work.

B. Project Information:

The project studied is a high rise residential building having two parking & nineteen living floors. The project is situated at a prime location on Baner road, Pune and belongs to a reputed private firm. The R.C.C. work of the building continues with old development plan sanction. The building consists of two flats per floor. The RCC work of one side flats completed up to 4th floor whereas on the other side flat the work is stopped on 2nd slab due to spotting of or realization of rework because of change in plan of floors on that side.

C. Causes andeffects:

The rework cause here is the change in the old development plan of the area. As per new development plan there is a reservation for the amenity space to be left in the plot area. Due to the space needed for amenities purpose the actual built up area of the building got affected which needs to compress the already built structure which is built up to first slab from one end. Due to this the work at this end needs to stop as the problem is serious. Meanwhile the work at the other end continues as it may not affect by this problem. As there is a need for the new approval of plan which will need much time, the contractor is granted with the extension of time period for completion and also made eligible for some compensation as he losesthe profit for that much area throughout for all floors in building. The contractor needs to de-shutter and de-bind the reinforcement at that end of building which is already over before noticing the thing. The builder has to bear the cost of dismantling of shuttering area already done and loss due to delay of project and also the cost of future rework.

D. Managerial decisions:

For managing this case the management decided to take fresh approval by reducing the built up area of floor so as to accommodate the area for amenity space. Thus the architect prepares fresh plans where he reduce the area of flat at the affected end,keeping area at the other end flat same for all floors from first floors onwards. The building foundation is already completed with piles and columns above pile cap. Also first slab is casted as per old drawing. So to execute new floor plan from second slab as per architect's requirement of walling, the slab requires design to accommodate some new floating columns along with old columns which required terminating at that slab level. Thus in order to take the eccentric load of all columns which are new from above that slab and load of all subsequent slabs, the slab at second level got heavily designed by the RCC consultant. The further work is carried out in the following ways.

E. Retrofitting of columns:

To bear the load of all above slabs on new floating columns and to transmit this all load on old columns, their section is increased by increasing width by 150mm throughout individual column length. The 16mm diameter Fe 415 steel is used as a vertical reinforcement and 8mm diameter Fe 415 as a distribution steel with the help of re-baring for below columns at two levels i.e. pile cap to first slab and first slab to second slab as shown in figure 1 below. These columns are re-casted for increased width with rich M.40 mix concrete as shown in figure 2 below.

Figure.1 Re-baring for columns ***Figure.2 Columns re-casted.***

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F. Shuttering and reinforcement for slab:

RCC design for this slab comes out to concreting the whole slab for a uniform depth of 1200mm. To bear such a heavy dead load of concrete the special formwork for slab is designed and checked with consultant before casting. Steel design also consist of higher diameter 32mm Fe415 steel for all beam section and16mm diameter Fe415 steel for slab in both ways at the top and bottom of 1200mm depth forming a double cage reinforcement. The slab is also subjected to post tensioning design by another special post tensioning design firm as shown in figure 3.

Figure 3 Heavy reinforcement and post tensioning treatment for slab.

G. Concreting of slab:

Concreting of slab is done with a rich mix of M.40 grade concrete in two layers. The first layer concrete thickness casted is 700mm and second layer thickness is 500mm casted on next day after final setting of first layer thus completing the total thickness of concrete i.e.1200mm. This is done in order to distribute the uniform load on shuttering below avoiding the sudden dead load of whole thickness as per consultants instructions. The builder experiences the total cost of rework about 12% of the construction phase cost in this case.

H. Teach from lesson:

For any city there is continual improvement takes place which is essential to sustainable development of that region. Construction industry is the major part of this development. Thus

the private firms constructing the projects must be aware or should strictly follow the rules and regulationsand strictly adheres to recent changes in governing body policies in order to avoid such cases of rework.

Case2:- rework happened due to change in owners decisions.

A. Basic of the error happened:

Various projects or every project is built for its specific purpose to fulfill the human needs, satisfaction of own andcreating unique features among the others in civil construction industry,but in some cases the owner is required purposefully to change or convert the purpose of building. This may depend on the changing surrounding, locality of project, future demand and special purpose behind of the owner. The case studied here is the building constructed firstly as a commercial space like hotel and after its basic completion of RCC skeleton the owner decided to convert it into healthcare center such as hospital. Thus there is the direct change in purpose of building after basic completion which obviously requires the rework in its basic skeleton so as to suit with new purpose of the project.

B. Project Information:

The project studied is located at the prime location andon the busiestShivajinagar road in Pune city. Initially it consists of eight no of floors which are completed with all RCC work. These all floors have a normal floor height of 3mtr. This basically consists of lodging provision. Adjacent to this above the podium slab the structure is constructed of four floors having uniform floor height of 4mtr for each floor. The structure is inherent part of project and purpose is to provide dining area separately as the whole project is the hotel project. The project consists of huge parking area including basement and 2 level parking above. The building is well planned and looking very good aesthetically.

C. Causes andeffects:

The rework cause for the studied project is the owners change in decision. Though the project is located in good vicinity and at prime location, the builder realizes the heavy competition for his business as there are numerous very good and already famous hotels existed around. Therefore the owner decided to change or convert the building into healthcare center. Due to this conversion he has to re-plan and re-sanction the project from the governing authority. The progress of project got stopped immediately affecting the profit of contractor and also cause to delay the project by up to six months.

D. Managerial decisions:

In order to achieve maximum saving and minimizing loss of damage to the already built structure of RCC, the builder decided to unaltered the plan of lodging building which is eight storey structure by adopting no change in RCC super structure for that part. However there require a change of plan for dinning building which is four storied structure as per requirements of hospital authorities. The revised plan needed to combine the floors of two buildings which are constructed already with two different individual heights of floors. Thus according to new plan it requires to dismantle all four floors of dinning building and reconstruct them with keeping same height of individual floors as that of lodging building so as to form a combine structure. The management adopted this change and dismantled the four floors of dinning building as shown in figure 4

Figure 4 Dismantling of slabs.

E. Teach from lesson:

The success of commercial projects depends on its prime location, competitiveness around with similar field, definition of that project considering all factors. So the owners of private firms or builders should consider all above points to achieve success of such projects and should remain firm on their decision in order to avoid rework in their projects.

III. CONCLUSION

After studying these case studies it is clear that changes in governing body policies and owners change in decision are the rework causes happened in studied cases. So private firms should take into account the effect of the government policies during planning and implementation of the projects. Firms are also required to take a proper final decision before execution of projects starts in order to avoid the occurrence of such rework in their projects.

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