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PLANNING AND SCHEDULING OF MULTISTOREY RCC BUILDING USING MICROSOFT PROJECT

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***Abstract*— Construction of a multistorey building is a project in which a huge number of activities are to be performed by different teams belonging to various age groups, cadre, level of skills and expertise. Also the number of activities to be performed is highly varying and complicated in nature. Accordingly it is especially important to harmonies the different resources on the site for efficient and timely completion of a project. Project management skills are of great use while managing such project.**

The object of the present work is to study the scheduling techniques and construction sequence of work for multistorey buildings and to perform the application of Microsoft project software in planning and scheduling of a multistorey RCC building construction. To achieve the above objectives a hypothetical RCC residential G+4 building is considered. The complete planning and scheduling of this building is studied by traditional method used by Architects, Engineers and contractors and is compared by modern software method. For this approach Microsoft project software is used for planning and scheduling the RCC building. Observation shows that Microsoft project software serves as an effective tool for generating Gantt chart for the schedule of a construction project and provides the minimum duration of construction time by schedule crunching and project crashing methods in software. Present work presents good information about the application of Microsoft project software for the planning and scheduling of building construction.

***Keywords*— Planning, Scheduling, Crunching, Crashing, Microsoft Project, Duration.**

I. INTRODUCTION

Every person is a manager of projects of their own life. From an employee to CEO of an organization, from a student to administrator, we all do work on various tasks with different deadlines. Project management is the application of techniques, knowledge, and skills to the activities of a task to reach the project necessities. It is a systematic ability to make success for the organizations enabling to patch the project results to the goals of the organization and further to compete in their respective markets. It also can be defined as the process of planning, scheduling, organizing, monitoring and controlling of resources, protocols and procedures for achieving specific goals. A project is an impermanent agenda planned to produce a distinctive service or product through a clear start time and finish time.

The term construction management is the process of organizing and managing resources such that the project is completed within the defined scope, quality, time and cost factors. A project is a temporary and single attempt undertaken to create a unique product or service, which provides beneficial change or added value. The processes and operations of the system of being a short-term and single undertaking contrast with the permanent or semi-permanent ongoing functional work to create the same product or service over and over again. The management of these two types of works is often very different and also requires varying technical skills and philosophy, hence requiring the development of construction management.

Construction of a multistorey building is a project in which a huge number of activities are to be performed by different teams belonging to various age groups, cadre, level of skills and expertise. Also the number of activities to be performed is highly varying and complicated in nature. Accordingly it is especially important to harmonies the different resources on the site for efficient and timely completion of a project. Project management skills are of great use while managing such project.

Management can be defined as the science and art of planning, organizing, leading and controlling the work of organization members and of using all available organization resources to reach stated organizational goals.

Construction management provides the economical utilization of the resources available in

the least possible time duration for successful completion of construction project. 'Men', 'materials', 'machinery' and 'money' are termed as resources in construction Management.

Planning, scheduling is an important part of the construction management. The process of planning and scheduling of the construction activities helps engineers to complete the project in time and within the budget.

The term construction does not only denote physical activities involving men, materials and machinery but also covers the entire extent of activities from conception to realization of a construction project. Hence the management of resources such that men, materials, machinery requires effective planning and scheduling of each activity.

II. LITERATURE REVIEW

2017, Ch. Chowdeswari, D. Satish Chandra, SS. Asadi, "Optimal Planning and Scheduling of High Rise Buildings", studied the applications of MSP in every single aspect of a project from planning and scheduling phase. Irrespective of nature of work, location or norms in an organization, all the members work on tasks that are varied and involve people who do not usually work together but for the same objective. By this paper they provided how to do planning and scheduling for a building which is a multi-storied (G+8) with Microsoft Project (MSP) software by observing the site conditions, labor productivity, and available resources with proper utilization of time and resources. Labor productivity must be given extreme importance in calculating the activity duration and reliable plan, and knowing the well-founded methods in the computation of various labor productivities and for its improvement. The relationship between the tasks and their interdependencies should be known.

2017, Rashmi J V, Amey A Kelkar, Vishwanath K G, "Planning and Scheduling of a Multi-storeyed Residential Building With Conventional Execution Approach as Compared With Application of Project Management Techniques", made an effort to estimate the overall cost and time required to execute a multi-storeyed residential building by use of conventional construction execution practices and by adopting project management techniques to compare the results for justification. The study focuses on the cost, duration and resource management that have been employed for the execution of the project. The extract of data obtained from the building site is titled as plan A-Conventional execution approach. An analysis of planning and scheduling was again carried out for the same multi-storeyed building by applying project management skills and techniques with help of M.S.Project software. This was carried out to obtain comparison with plan A- Conventional execution approach. The resulting analysis was titled as Plan B- Project Management approach. From the results it is concluded that the use of project management techniques in a proper way reduces the cost and time of construction, without affecting the quality and performance. Use of Microsoft Project software gives a proper scheduled path which helps in setting a track for all the activities, to check if there is deviation from planned cost and schedule.

2017, Shubham Laddha, Prerna Chanda and Sneha Khedekar, "Planning and Scheduling of a Project Using Microsoft Project (MSP)", carried out the working and functioning of a project using the modern project management tool available in the market; and then comparing it with the traditional software (Excel) which is being use. Also they carried out an online survey focusing on all the stakeholders related to the project with a view to obtain an idea of various project management practices in construction industry. Notably, 80% of the total construction industries in India still use traditional software Microsoft Excel for planning, scheduling and controlling of their projects and 86% felt the need for adapting to new software. Then they approached a Pune based construction company in which Excel is still the dominant source of managing the projects. They expressed them their visions and desired to work on one of their projects using Microsoft Project. They carried on the planning & scheduling of the building using Microsoft Project tool. The results obtained were considerably positive than those using traditional software.

Construction of building using Traditional way proves to be uneconomical and consumes more time with many complexity and enormous error which actual execution of the Project. Traditional way of planning doesn't sub divide the main task which future gets the hurdle of over allocation of resources, improper judgment of resources for particular activities etc. Microsoft Project is the modern tool of Project Management that aid to overcome the obstacles faced owing to traditional way of Planning and Management. It helps for the optimum and effective organization of activities which helps to give the vision to complete the project in planned duration and within the Economy.

2016, Abuzar Aftab Shaikh, Geetha K. Jayaraj, Ramya Raju, "Time and Cost Analysis using Project Planner Software", demonstrated the use of Primavera (P6) software in construction project. For the purpose they adopted a RCC building (Stilt+7) for case study. The construction activities were scheduled and analyzed in Primavera (P6), results obtained from Primavera (P6), the total project duration of 511 days out of which 467 days are critical inculcating total construction cost of Rs.5,62,95,785/-. The results obtained clearly indicate that the project is behind schedule, hence necessary actions must be taken to bring the project on schedule. The result also indicates that use of Primavera (P6) eliminates lots of paper work, minimizes the chance of delay by taking necessary action and keeps the project within the budget. From the results obtained in Primavera P6, following conclusions are drawn:

1) The Schedule Variance (SV) obtained is a negative value, hence Primavera P6 gives a warning that the project is behind the planned Schedule at the rate of 17.80%.

2) The Schedule Performance Index (SPI) of 0.822 indicates that the project is working or progressing at an efficiency of 82.2% of originally planned.

3) Cost Variance (CV) and Cost Variance % (CV%) obtained is Rs.11,33,836.8 and 3.656% respectively and both the values are positive hence it indicates that the project is under budget.

4) Cost Performance Index (CPI) obtained is 1.03 hence it shows that the project is within budget.

5) The project is updated in the 11th month from the starting date. According to the planned schedule 64.70% of total was to be completed, but the actual work completed is 46.9%. the project is thus delayed by 3.026 months.

The project requires 3.026 months more for its completion i.e. total project duration will be 20.026 months, if project is to be completed within the planned duration it should be levelled and smoothened by increasing the number of labors and providing the materials on time. From the study it is clear that Primavera P6 is an effective tool for tracking the project progress, cost associated with progress and managing to avoid delays. Primavera P6 eliminates lots of paper work unlike in the conventional method of planning and scheduling.

2016, Sneha M. Raut, Sumit B. Bhosale, Chetan D. Patil, Aniket R. Pawar, Ganesh D. Dhone, "Planning and Scheduling of Project Using Microsoft Project (Case Study of a Multistory Building in India)", focused on to conduct the study on developing planning and scheduling in construction project. The primary objective of this study is to create a quality project, completed on time, within budget and in a safe work environment. For this purpose they studied a G + 12 multistorey residential building in Mhada sectore 6, Pimpari. The estimated cost of the project was Rs. 7,35,00,000 /-.

Traditional way of building construction proves to be uneconomical and take more time with many complexibility and enormous error which in actual execution of the project. Traditional way of planning doesn't sub divide the main task which in future gets the hurdle of over allocation of resources, improper judgment of resources for particular activities etc. Software Microsoft Project serves as a modern method of project management that help to overcome the difficulties faced owing to traditional way of planning and management. It helps for the optimum and effective organization of activities which helps to give the vision to complete the project in planned duration and within the economy.

2016, Vinodh A S, Shashikumar A, G. Narayana, "Effective Planning And Scheduling Of A Residential Building With Proper Risk Analysis",

dealt in detail with the various functions of construction management such as planning, scheduling. Time duration of various activities has been fixed after studying various projects done before and also after discussing with senior engineers. Scheduling is done taken into consideration various aspects such as soil conditions, design aspects, management aspects, manpower, tools etc. The entire scheduling is done using MS-PROJECT 2010 and the detailed reports are presented using MS-OFFICE. This dissertation work is an attempt to show the importance of Planning, Scheduling and the best construction techniques and sequencing employed to enable the contractors and engineers to effectively and economically plan the sequence of various activities and properly allocate the manpower to complete the work as per schedule keeping Quality in control. Every project is unique in terms of its nature, complexity, scope and type. To make a project successful all the 10 knowledge areas of PMBOK shall be performed. The need for study of risk management is important in India because it is less aware and its application in a project is unknown to many project managers. A good risk management avoids potential risks in the project and helps to achieve project objectives in a better way. Even though risk occur at regular interval and uncertain it can be managed; a prior risk management helps to start a project in a positive note and will keep the project team ready to face the upcoming risk and respond to them. The repetitive studies on risk management will spread awareness and keep us updated on new risk management checklist and questionnaire survey techniques.

2015, Abhishek Sharma, K.K. Pathak, "Manpower Planning, Scheduling and Tracking of a Construction Project Using Microsoft Project Software", studied about the manpower planning, scheduling and tracking of an under-construction project. The project taken for the study is a Residential Block at Mahadev Parisar, Bhopal, a six storied (G+6) building whose construction is in progress at Shivaji Nagar, Bhopal, Madhya Pradesh. Using project management software tool Microsoft Project 2013 they also determined a comparison between the baseline duration and cost to actual duration and cost of manpower of project.

In this study, the planned date of starting of project was 08/02/2012 and scheduled completion date was 07/02/2014. The project was suffering from time overrun. It has been found that many activities are delayed from their original schedule. On 27/07/2015, each completed and uncompleted activities were analysed and their percent completion was worked out. On the basis of this analysis it was concluded that the project percent completion on this date was 78%. For remaining work of the project, revised schedule was prepared and the new completion date of the project is found to be 24/02/2016. As the completion time exceeds the estimated time of 693 days to 1424 days, the cost of indirect manpower is exceeded from Rs. 25,052,861 to Rs. 31,778,061 thus cost variance is Rs. 6,725,200 and duration variance of 731 days.

The software Microsoft Project 2013 is the popular tool in modern days to manage the project efficiently. The software also helps to enhance project manager's efficient performance towards wastage of resources and its minimization during construction process. As explained above, the management of time and manpower is the prime factor that affect greatly to the efficient and timely completion of the project. This is the management that sets up the relations among various activities and helps the site engineer to fix the priorities of task. Having the information about the availability of the manpower and have those available at right time for the activities plays a vital role in managing the costs and smoothly executing the project activities.

2015, E. Suresh kumar, S. Krishnamoorthi, "Scheduling and Financial Analysis of a High Rise Building", deals with scheduling using Microsoft Project (MSP) and Earned Value Analysis (EVA) for an apartment building. Thereby process time and cost overrun are avoided. Scheduling using MSP Software gives good controlling and clear schedule to a project. For a measuring a project's progress, EV Analysis is a typical process at any given point of time, forecasting its completion date, final cost and analysis variance in the schedule and budget of the project. For the analysis they

considered a residential building having six floors with total construction area of 15050sq.ft. After complete the schedule and financial analysis of the building it has been observed that,

1. There is more difference between budget cost and actual cost
2. The cost difference is due to the huge increase in the material's price and the labour's wages.
3. The time lag in construction activity due to the natural disturbances.

2015, P. M. Wale, N. D. Jain, N. R. Godhani, S. R. Beniwal, A. A. Mir, "Planning and Scheduling of Project using Microsoft Project (Case Study of a building in India)", studied a project executed in Pune, Maharashtra. They highlighted on the difference between Microsoft Project (MSP) and the Traditional Planning Techniques which speeds up construction and also make the project cost effective with proper planning. Different methodologies are adopted and to find out remedial measures, international journal papers were referred for finding out various aspects that shows resourceful planning & execution of the project. Methodology adopted includes defining of problem statement, insinuating the objectives from the data collected in two part viz. Primary data and secondary, analyzing the data and finally coming to the conclusion.

From the study it observed that construction of building using Traditional way proves to be uneconomical and consumes more time with many complexibility and enormous error which actual execution of the project. Traditional way of planning doesn't sub divide the main task which future gets the hurdle of over allocation of resources, improper judgment of resources for particular activities etc. Software Microsoft Project serves as a modern method of project management that help to overcome the difficulties faced owing to traditional way of planning and management. It helps for the optimum and effective organization of activities which helps to give the vision to complete the project in planned duration and within the economy.

2015, Rhuta Joshi, Prof. V. Z. Patil, "Resource Scheduling of Construction Project: Case Study", analyzed resource constrained project using Microsoft Project 2013 by resource leveling and compares the time cost implications with scheduled time and estimated cost. The main aim of this study is to analyze the Project management techniques by scheduling various construction activities, allocation of resources and resource leveling using Microsoft Project 2013 for residential building. For the analysis they have selected a residential building G+13 at Karve Nagar, Pune. This study presents a resource constrained project schedule as per the site conditions. For resource constrained analysis resource levelling is done. The resource type for this project is considered manpower (labor) only. Due to sudden requirement of labor or any unavoidable conditions project schedule increases day by day cost thus, it has an impact on the overall cost of the project. Duration is increased for decrease in resource constraints. The resources are masons, Male coolie and Electricians etc. Increase in duration (% increase) is 10.38% which causes increase in project cost by 0.94%. Thus the resource scheduling reduces the unexpected loss of the project which may be caused due to the huge variations in the usage of the resources.

2015, T.Subramani, K.Chinnadurai, "Construction Management And Scheduling Of Residential Building Using Primavera", conducted a study to quantify evidence of time saving in Industrialized Building System (IBS) application. Also from this study shown not all IBS components can improved to the overall construction duration, however by adopting IBS components can improve and accelerate the construction of a residential building which is 18 storied from the departure point of the project throughout of the whole of project's with a total 405 days or 42% the time saving.

This study compared time performance of the conventional method of construction for high-rise residential and Industrial Building System (IBS) method by formulate benchmark measures of industry norms for overall construction period using scheduling simulation modeling. As it is known where to avoid the bumps and potholes, it stands to reason that you're going to be working smarter and not harder and longer improved customer satisfaction. Happiness of a client is in completion

of project on time and under budget. And a happy client is one you'll see again. Due to smart project management client and manager relationship is continued to superior success in delivering services. The same strategies that allowed you to successfully complete one project will serve you many times over and also reduced risk and cost of schedule overrun. It helps easily plan and manage project activities. It optimizes management of all resources. It gives clear visibility of what's going on in the project and also permits speedy and simple forecasting of WBS's, activities or projects.

2015, Unmesh Y. Polekar, Rohit R. Salgude, "Planning, Scheduling and Tracking of a residential Project using Primavera Software", performed planning, scheduling, and tracking of a residential project with help of primavera software. They studied the results generated, it is possible to suggest which method is suitable for the selected residential project. Also to recommend measures to the organization for enhancing their project planning skills for similar projects in future.

The results revealed that the contractors and subcontractors plays vital role in completion of project as scheduled. Major of the reasons are related with the contractors performance such as lack of manpower, site management, equipment management and lack of supervision during execution.

The organization has found that monitoring and tracking project using software is useful to keep a more precise watch on the contractor's performance. The planning and scheduling methods are changed by organization by,

a) Setting up targets weekly to contractor's instead monthly targets.

b) During planning, scheduling and tracking aware the project managers and engineers to use the software.

2014, T. Subramani, A. Sarkunam, J. Jayalakshmi, "Planning and Scheduling of High Rise Building Using Primavera", modeled the construction process for high-rise residential building for both conventional and Industrialised Building System (IBS) with shared more a less the same nature and size of the structure. The model was developed using Primavera (P3) project planning software. The comparison was made by comparing selective building components for both method of construction. Different high-rise residential projects have been selected for this study. The result of the study clearly indicated that sufficient time saving can be archived. Also from this study shown not all IBS components can improved to the overall construction duration, however by adopting IBS components can improve and expedite the construction of 18 stories residential building from the point of departure of the project throughout of the whole of project with a total 405 days or 42% the time saving.

III. OBJECTIVES

The objectives of the present work are:

1. To study the construction sequence of work for a multistorey RCC building.
2. To study the scheduling techniques using critical path method.
3. Application of Microsoft project software in planning and scheduling of a multistorey RCC building.

IV. PROBLEM FORMULATION

The object of the present work is to study the scheduling techniques using network models and construction sequence of work for a multistorey RCC building, and also to understand the application of Microsoft project software in planning and scheduling of a multistorey RCC building. For this purpose a residential G+4 building of plot area 53'6" x 55'8" is considered hypothetically. It is not similar to any ongoing projects, a list of all the activities are made by doing extensive surveys and interviews with the professionals. As stated earlier project management skills are of great use while managing such project. The different activities involved in the construction process of a building are listed out. Then found out the relationship between the different activities and calculated the project duration and critical path. Further by use of software Microsoft project schedule crunching and project crashing is performed to reduce the duration of project completion. For this purpose the schedule of project has been so developed that the activities which are

interdependent of one other start together, hence saving a commendable amount of time in the construction process. It is observed that activities such as brickwork, plastering, painting, tiling, sanitation and electrical works are so linked that there is no considerable float or wastage of time.

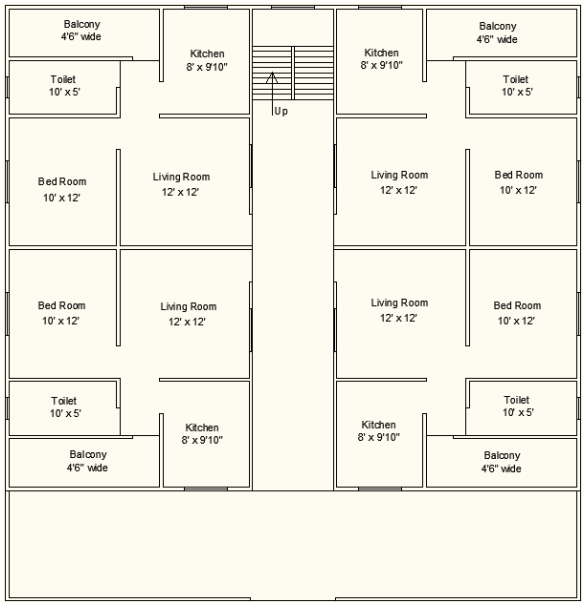

Fig. 1 Typical Floor Plan

V. RESULTS AND DISCUSSIONS

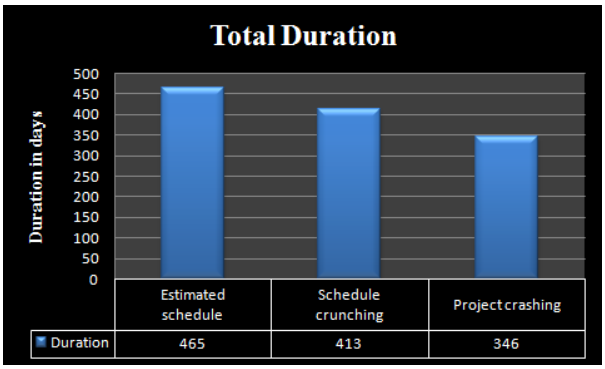

Fig. 2 Comparison of total duration

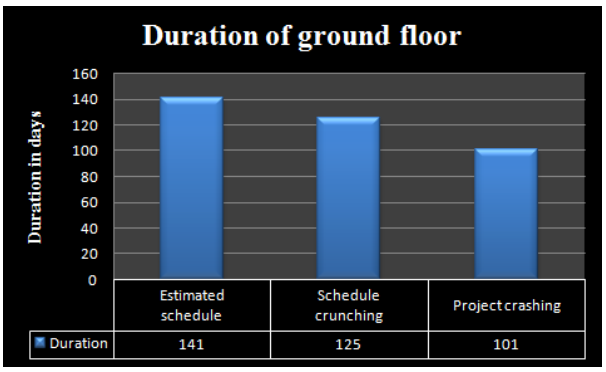

Fig. 3 Comparison of ground floor duration

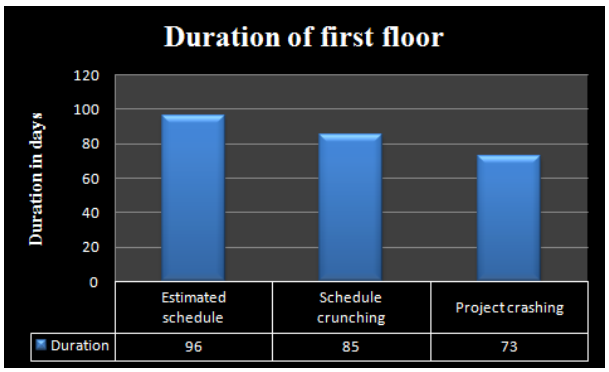

Fig. 4 Comparison of first floor duration

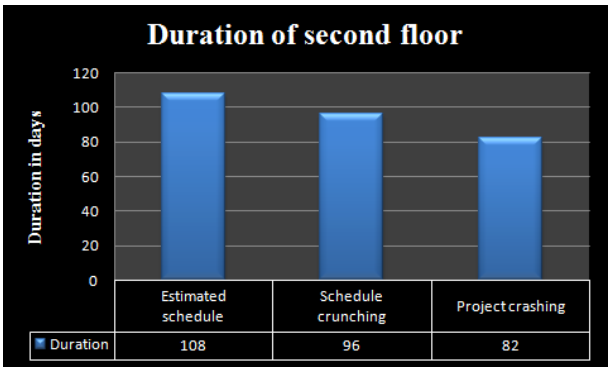

Fig. 5 Comparison of second floor duration

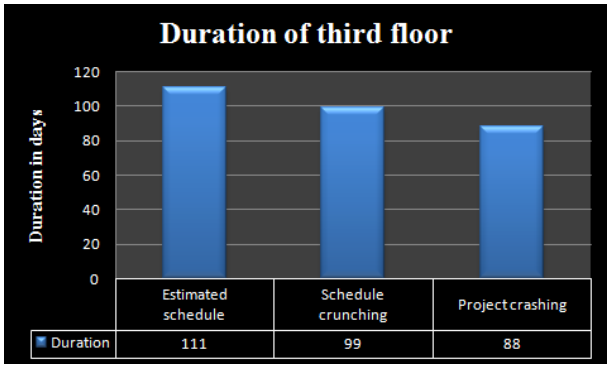

Fig. 6 Comparison of third floor duration

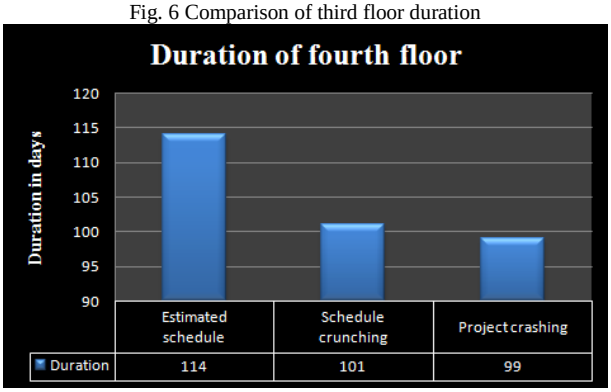

Fig. 7 Comparison of fourth floor duration

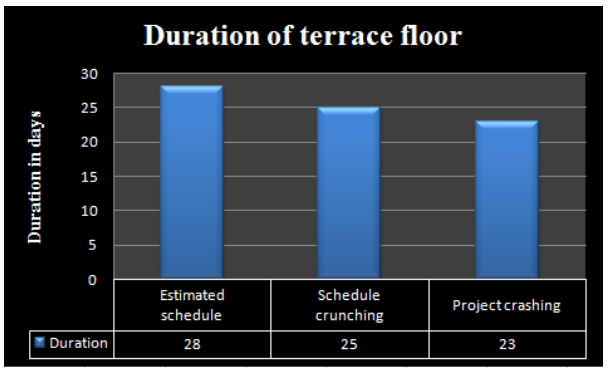

Fig. 8 Comparison of terrace floor duration

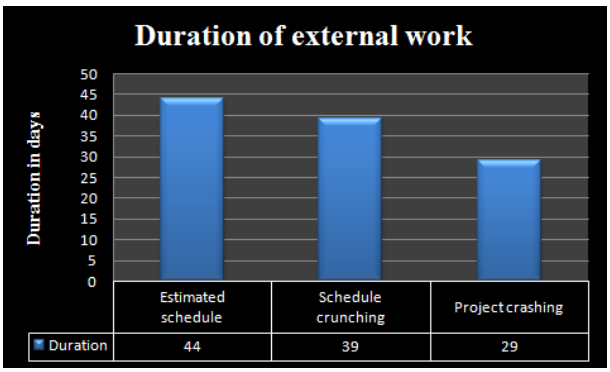

Fig. 9 Comparison of external work duration

Crunching is a period of time in which one must make an effort quickly in order to finish the project. In this technique increased duration and cost of a project can be reduced. But Crunching should be of optimum, otherwise it leads to poor in quality.

In the present work project crunching is done by increasing the working time per day. For the estimated schedule working time was 8 a.m. to 5 p.m. with a lunch break of 1 hour. For project crunching working time is increased 1 hour daily i.e., 8 a.m. to 6 p.m. By this crunching total duration of the project is reduced by 52 days. Starting date of estimated project was 5/4/2018 and finish date was 28/9/2019. After crunching the schedule, starting date is 5/4/2018 and the finish date is 31/7/2019 Hence project crunching can reduce the duration for construction of a project.

Crashing means adding of additional resources to a project in order to finish the project in a specific deadline. But adding of resources should be optimum it should not affect the cost of the project. There are a number of standard and typical approaches to attempting to crash a project schedule. Project crashing is the generally utilized method which involves increasing the assignment of resources on schedule activities. This essentially means decreasing the time it takes to perform individual activities by increasing the number of people working on those activities.

In the present work for the crashing of project resources are increased by percentage. By increasing the resources duration of the construction project is reduced to 119 days. Starting date of estimated project was 5/4/2018 and finish date was 28/9/2019. After crashing the project, starting date is 5/4/2018 and the finish date is 13/5/2019. Hence project crashing can reduce the duration for construction of a project.

VI. CONCLUSIONS

Within the scope of present work following conclusions are drawn:

1. Microsoft project software works on Gantt chart concept. This gives the easy understanding of the progress of work with scheduled time.
2. Many project managers suffer to finish the project within the duration and estimated cost. They may add more resources or increase working hours to finish the project within the duration.
3. Schedule crunching is most effective technique in optimization of time and cost. But quality is not guaranteed in this technique because the efforts are done quickly in order to finish the project.

4. In order to achieve quality project crashing is a good technique. Thus optimization of time is achieved.

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