

Original research article

The related problems in the construction of the rainy season

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Abstract: With the continuous development of society and the improvement of people's living standard, the construction scale of construction project is increasing and the construction period also increases. In the construction process, the weather changes are often one of the key factors affecting the progress and quality of the project. Rainy season construction is the inevitable problem in the construction process, the rainy season construction facing rain, wind, high temperature and other adverse environmental factors, and can directly endanger the production safety, to the enterprise to bring immeasurable losses, so science reasonable organization of construction, to take security technical measures, and actively respond to the rainy season construction of various dangerous situations, to improve the ability to resist risks, to ensure the safety of production, is of great significance. Based on the theory of construction safety management and the characteristics of rainy season, this paper analyzes and controls according the experience and technical characteristics of engineering construction. To ensure the progress and quality of construction and the safety of construction, the principle of minimizing the loss, put forward the corresponding maintenance measures to enhance the safety of the rainy season construction, to enhance the economic interests of enterprises.

Keywords: construction project; construction rainy season; construction safety; technology analysis

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1. Introduction

Rainy season construction is a common problem encountered at home and abroad, the rainy season to the sudden, unpredictable, sudden strong, serious loss, poor handling will affect the quality, or even serious when there will be security incidents. As the rainy season is long, so the clear majority of construction projects must be across a rainy season, due to the progress of the project needs in the rainy season construction will be very common. In view of the characteristics of rainy season and construction requirements, the construction workers on the rainy season in the construction of the main problems of a profound discussion and detailed analysis, be sure to do the construction of the prevention and control work to ensure that the project is normal. Therefore, in the rainy season scientific and rational organization of construction, to take security technical measures, and actively respond to the rainy season construction of various dangerous situations, to improve the quality of the project and ensure the progress of the important significance. More importantly, because the rain will be on the foundation and building structure caused by soaking and erosion, which may lead to sudden damage to the building, so the need to take the necessary protective measures to avoid engineering safety and engineering quality problems.

1.1. Purpose and meaning of research

Site construction safety has always been a major problem in the construction, with the construction

market continues to increase the number of safety accidents on the site more and more occur, especially in special weather construction, construction safety is not optimistic, these security incidents will bring huge economic and property losses, it should be safe production in the first place, safety production to maximize the benefits, and cause the causes of these accidents, mainly in the construction process of workers in the safety awareness low and safety supervision and management system is imperfect, the construction process of the lack of protective measures. Therefore, scientific and rational organization of construction, to take security technical measures, and actively respond to the rainy season construction of various dangerous situations, to improve the ability to resist risks, to ensure the safety of production, is of great significance. This article also discusses the safety of production measures in the rainy season with practical cases^[1].

1.2. Current situation and influence of rainy season construction

Although the current level of construction technology in China's construction has been a lot of progress, but by the constraints of science and technology, meteorological departments is difficult to timely and accurate weather forecasting services, so that some heavy rain, flash floods and other weather from practice point of view, it is because of this rainy season in the construction of the uncertainty, to the construction of construction and prevention to increase the difficulty. In the rainy season construction^[2], the biggest factor is the weather conditions, in the event of a heavy rain, it is likely to delay the duration, and even the construction has been built part of the great damage, we can see that the weather conditions on the construction of How important is it? In general, construction units should be based on the construction site of weather changes and rainfall conditions, the impact of the building structure itself to assess and assess, and on this basis to determine the construction program. It can be seen, a perfect construction of the end, not only his beautiful appearance, more importantly, his strong heart - excellent quality, and this quality is not only referring to the building materials standards, but also the construction of safety in them. According the survey, the rain washed or soaked buildings or foundations, etc., will appear to varying degrees of damage, so strengthen the protection of urgent, to minimize the rain on the construction process of the various aspects of the impact. In general, the rainy season will have a greater impact on outdoor construction (**Figure 1**), such as:

- (1) Foundation wall irrigation: due to the construction of the bottom of the tank water, will lead to corrosion of the template and the bottom plate, affecting the construction quality.
- (2) Tower crane tilt: the rainy season when the storm comes, due to no wind control measures, resulting in tower crane tilt.
- (3) Slope: in the deep foundation construction, due to a large number of water tank, the pump cannot quickly discharge the water, resulting in a large area of landslides, and some projects even affect the tower crane base stability, resulting in downtime.
- (4) Pile collapse: in the construction of deep foundation, the pile is more, due to improper measures, artificial digging pile into the hole, the drill pile after drilling is not timely pouring concrete, after the storm collapse, if not found, will cause downtime, increase the workload.
- (5) Brick wall collapse: brick and concrete structure of the brick masonry, due to rain washed sand brick wall is not consolidated masonry mortar, prone to collapse.
- (6) human defense channel irrigation: a short period heavy rainfall to the municipal drainage system caused great pressure, heavy rains cannot be ruled out, the rain will be poured into the construction of the basement, which into the air defense channel.

2. The rainy season construction requirements

Rainy season construction is carried out in the rainy season construction, it has a lot of special nature,

such as traffic may be blocked, the material may be mildew, flooded and other unfavorable to the construction of the situation, to be less damage, the construction side to take certain measures for the quality and quantity of construction progress.

2.1. Strict compliance with the country's rainy season construction requirements

Enterprise construction must be based on the country's construction requirements, to carry out construction, and only in accordance with the requirements of construction, to achieve the purpose of improving economic efficiency. In China, the general principle of the construction of the rainy season is 'do a good job of drainage, retaining water, waterproof work'; the general requirement is that the indoor rainy season does not affect the construction, outdoor engineering rain without interruption construction, heavy rain during the suspension of construction, after the rain can be construction, after the rain does not affect the construction, as far as possible to reduce the rainy day outdoor operating time and working face, in order to shorten the construction period, to ensure the quality of construction and construction safety.

2.2. Timely attention to weather changes

Due to the uncertainty and suddenness of severe weather such as the construction of storms in summer, it is difficult to predict the impact of construction. It is necessary to strengthen the understanding of meteorological information and take effective safety measures in time to strengthen the prevention. Take me as an example, according the trend of flood season (June to August) precipitation period is mainly concentrated in mid-July to August, during which there are several heavy rains, local areas may be floods, construction, should be closely linked with the local meteorological department, pay attention to listen to the local weather forecast.

2.3. Reasonable arrangements for operating time

When the temperature exceeds 38 degrees Celsius, stop the outdoor operation, in case of more than 6 winds and storms in principle should stop all operations, personnel evacuated to a safe place, while cutting off the power of all electrical equipment. Due to the process, cannot stop the operation, must implement the relevant safety measures, and arrange for personal care related operations. Must be continuous construction to ensure quality, cannot stop when the shelter and other measures must be taken, or get accurate weather information in advance to stop the operation.

2.4. Emergency measures ahead prepared

During the construction of the rain, various protective measures should be further strengthened, and effective measures should be taken to strengthen the scaffolding, material lifting and dual-use elevators and warehouses, shelters and temporary facilities to ensure that the relief materials and personnel are in place. Immediate start contingency plans.

3. Rainy season construction preparation

To ensure the quality of the project, to ensure the safety of production, to ensure the completion of the task of planning objectives, we must from the ideological, organizational, measures, materials as soon as possible to do a good job, so that the implementation of ideas, organize the implementation of, measures to implement, material implementation, flood season construction to be prepared.

3.1. Construction plan

Construction units should be based on the construction of local meteorological conditions, the development of effective construction schedule, and in strict accordance with the table to implement the

construction program in the rainy season in case of bad weather, should be able to make timely adjustments to the construction program to ensure the progress and quality of construction.

3.2. Construction technology, quality aspects

1) The relevant departments of the construction enterprises within the jurisdiction of the project to strengthen the drawings of the study, combined with design intentions, and actively urge, timely acceptance of hidden projects, to avoid accidents^[3,4].

2) To strengthen the inspection of raw materials, especially in the construction of rain in the sand, stone moisture content of the determination and control, concrete mix control, every day to have someone to carry out.

3) The construction enterprises to develop the special technical measures and operational requirements to the layers of the end, put forward a clear request for key parts in the rainy season to focus on fortification to ensure the quality of the project.

3.3. Safety technology

1) The establishment of flood control and rescue leading group, in the flood day and night duty, monitor the weather changes, take timely response measures. In case of danger, the timely organization of rescue personnel to solve the safety and quality hazards, to ensure the normal construction after the rain^[5].

2) To do a good job on the rain equipment, tools and rain equipment, ready to ensure supply.

3) Before the arrival of the rainy season, the relevant departments of the construction unit shall conduct a comprehensive inspection within the scope of their inspection. The inspection shall be carried out in the rainy season. The inspection contents shall be comprehensive. The inspection should include the rainy season construction preparation, the tower crane, the gantry, the scaffolding, the temporary electricity system, construction site road drainage system, temporary facilities, such as rain measures. Check the problems found must be resolved in time, take preventive measures.

4) In the open for welding and high temperature operation, should be erected fixed or mobile rain, sunscreen, and wear protective equipment.

3.4. Construction site preparation

1) Material preparation: Before the rainy season, the following table should be prepared according the specific conditions of the construction of the following table waterproof materials and equipment (**Table 1**):

Table 1. The waterproof materials and equipment.

No.	Material Name	Unit	Quantity	Remarks
1	Rain boots rain trousers	set		Rain use
2	Rain boots	double		
3	Sewage pump	station		
4	Water hose	m		
5	Plastic cloth, felt cloth, sandbag	m ²		Rainy days
6	shovel	To put		
7	Rain lamp	To put		

2) Transport roads: the construction site of the road must take hardening measures, set the drainage system to ensure the normal use of transport roads. The rainy season should be designated for the person to be responsible for road grooming and maintenance, damage to the uneven, water sections, should be timely

repair, if necessary, can be added on demand slag gravel or other non-slip materials to ensure the road circulation and slip.

3) Site drainage: the construction site layout should be considered the various conditions of the scene to set the construction site of the drainage system, the drainage section size, flow, slope, quantity and catchment pits, pumps and another layout is reasonable. Drainage system regularly grooming to ensure smooth drainage.

Near the high ground of the site should be set in the height of the trench; for mountains, slopes and other special environment of the construction site, the project manager must master the relevant geological data for possible landslides, landslides, floods, collapses and other disasters Take measures in advance.

4) Material stacking: cement library, material library, gravel material and other material storage area should be in the higher position, drainage is smooth, regular maintenance, to ensure good drainage, the roof does not leak and no water, the ground is not back to the tide. Components and template stacking areas should be taken.

Surface hardening measures to prevent the ground subsidence caused by deformation, collapse. Waterproof insulation materials should be stored in a dry place shall not be tide rain. Open-air materials should not be soaked in water to prevent wastage.

5) Mechanical and electrical equipment: high-rise buildings, tower crane, good frame, etc. according the 'construction site temporary electricity specifications' set lightning protection devices and often check the performance is good, unqualified to timely repair. Site use of the mixing machinery and a variety of equipment should be set up rain canopy concrete, mortar transport machinery should be added rain cover or cover, according the project to prepare the necessary drainage equipment and materials and mechanical and electrical equipment lines to check insulation and rain at any time check Zero line, ground to meet the requirements and set the leakage protection as required.

6) Large and small facilities maintenance and equipment maintenance: n temporary facilities, such as staff quarters, offices, cafeterias and warehouses should be a comprehensive inspection, dangerous buildings should be in the rainy season before the advent of renovation, reinforcement or removal, to ensure that the construction site personnel The security. n temporarily do not use the template and the wall plate should be brushing anti-corrosion paint, and properly stacked to prevent corrosion.

7) The suspension site, the rainy season should be constructed to a reasonable location (such as covered with concrete floor) and then shut down, and do the hole closed.

8) To complete the release of heatstroke drugs, do the life of the outsourcing team.

4. Rainy season construction technology

Case Playback:

- (1) Taiyuan, a pit at the bottom of the pressure occurred within the water burst.
- (2) Changsha City Changbei sewage pipe ditch collapse accident.

16 April 2009 17:05 minutes or so, in Changzhi suburban Changbei sewage treatment construction site, Shanxi Province, a construction company in the excavation of the trench found in the soil soft, in the process of supporting the collapse of the accident, 5 of the construction workers were buried on the spot. After the accident, the scene staff immediately call 120, and at the same time to start emergency operations, 17:30 or so were buried all the staff dug in the hospital during the death of four people, one minor injuries^[6].

Above the pit engineering accident, but from a certain form of performance of the foundation pit damage, in fact, the foundation pit engineering accident manifestations are diverse, with complexity. The reason is that the surrounding ground subsidence is too large, mostly due to precipitation caused by, and there are two possibilities: First, there is a large hole in the envelope, found that this situation should immediately suspend the construction, to take technical measures to repair Wai Wall defects; the second is the depth of precipitation is too large, should limit the pumping depth, can be taken to maintain or follow the grouting method to ensure its safety.

From the above two accidents, we analyzed that the rainy season construction mainly to solve the exclusion of rain, for large and medium-sized construction site, must make a temporary drainage system of the overall planning, including the prevention of off-site water into the scene and the scene of water discharge Outside the two parts. The principle is upstream water cut, downstream water; pit bottom pumping, ground drainage. Combined with terrain and construction requirements around the overall consideration. Temporary drains and cutters are generally provided around the building to prevent off-site water from entering the site. Its design should consider the following aspects:

4.1. Rainy season drainage

1) Drainage section size and slope of Zhanjiang in view of the long rainy season in Zhanjiang area, the rainfall and the characteristics of this project, combined with the local meteorological data over the years, according the survey of the largest rainfall and catchment area, calculate the drainage section size and drainage slope^[7].

2) Drainage form according the geological conditions of the project, in different geology according the local conditions to choose a reasonable form of drainage, saving project investment. For example, the soil is better area, can be directly in the original soil dug ditch drainage, poor soil area, the use of ‘wall’ (such as brick ditch, concrete semi- circular ditch, concrete wall); silt soil area, should (Such as the ditch at the end of the installation of concrete semi- circular tube, the upper part of the slope and concrete wall); sandy soil area, digging ditch in the ditch after the full plastic film drainage.

3) Drainage through the road section buried pipe, pipe material and diameter according the actual needs of the site, the drainage ditch to set the sand wells, drainage at all levels have been grit, slag and then into the formal Rainwater pipe network.

4) Regularly on the trench within the sediment to clean up to prevent blocking.

Especially after each heavy rain, after the storm, must check the ditch slope, damaged parts to be repaired in time.

4.2. Earthy season construction in rainy season

1) The rainy season earth construction must control the ‘cut, row, drop’ work: n ‘cut’ in the foundation pit slope around 3 m outside the drain or cut the dam, to prevent the fall of the water outside the pit n “row” of the pit is equipped with drains and water collection wells, with a timely discharge of water in the pit of the water and rain; n “down” according to the geological survey data, the groundwater level is higher than the base elevation, take effective precipitation measures to reduce the groundwater level in the foundation pit^[8].

2) The construction of the earth surface in the rainy season should not be too large. According the number and efficiency of the construction machinery, the construction shall be carried out in stages, and the concrete mats and slope will be poured at any time with the completion of the earth works.

3) The setting of the foundation pit slope in the rainy season, the slope of the foundation pit and the

slope of the slope 2 m wide range shall take measures to protect the slope. The form of the slope protection may be based on the length of the excavation time and the slope soil condition. Slope protection, plastic film slope protection.

4) During the rainy season construction, at any time to check the construction site and the road slope was washed out of the situation, do a good job in preventing landslides, collapsed work, to be prepared enough sub-base box or roadbed to supplement the road or site needs, the frequency of peripheral environmental monitoring to ensure the safety of operations.

5) Rainy season earth backfills to take measures to ensure that the backfill dry capacity and moisture content or sandpaper backfill.

4.3. Piling construction in rainy season

1) According the different geological conditions of the rainy season corresponding to the site and road requirements to ensure that the road formation, drainage patency, to facilitate the normal operation of the pile and the normal passage of vehicles^[9].

2) To ensure the quality of the weld joints, which is the rainy season piling construction control focus, it must take effective rain construction measures to ensure the quality of the weld. For example, the measures include the installation of a water diversion device on the water blocking device at 1.5 m above the upper part of the weld, according the size of the pile, with a diameter of the pile under the water diversion device, Peripheral rainwater is blocked. The technical measures of this rain better, to meet the welding work requirements.

3) Each device is equipped with absorbent cotton and electric wire brush, the welding parts of the pile to clean up to ensure that the welding site without sludge, rain. The welding parts are treated with electric steel wire brush to remove the metallic luster. Each unit is equipped with a special baking equipment, welding before welding around the pile and welding parts of the baking, to ensure that the welding parts dry.

4.4. Rainy season upper structure construction

Concrete Structural Engineering:

1) The use of wood templates and square wood selection after the deformation of the smaller suction; template support under the soil must be dense, and set the pad; after the rain, the template support system, horizontal elevation, vertical, etc. to a comprehensive inspection Abnormal situation in a timely manner; template within the timely removal of water to prevent template soaking^[10,11].

2) Pouring concrete, to plan due to sudden heavy rain, heavy rain and leaving the temporary construction of concrete joints, concrete pouring direction, order, prepared rain and construction joints at the template; concrete pouring to paragraph, by Sheet construction; pouring in the pouring soil in the process, the case of rain to strengthen the concrete slump detection, strict control of concrete slump, has been into the mold of concrete must continue to vibrate, and pouring concrete to complete the preparation of concrete before the beginning of the measures, such as the use of plastic film Protection; pouring the completion of the concrete surface of the rain water must be timely pumping; continue to construction after the rain, the first part of the joint to check, handle the construction joints, and then pouring.

Scaffolding works:

Scaffolding foundation to consolidate the base or hardening treatment, scaffolding should be set at the bottom of the long channel. Leaving a certain degree of scattered water, in the surrounding to take drainage

measures to prevent rain soak scaffolding base. After the rain, should check the scaffolding is deformed, tilted, sinking, even the wall pieces loose, node connection displacement and safety net off, open rope and other phenomena, if abnormal, to timely adjustment processing. Scaffolding on the pedestrian access and other places for people to take anti-slip and anti-drop measures, and strengthen the maintenance work. Heavy rain, lightning and more than 6 winds and other bad weather, stop scaffolding erection and removal operations.

Masonry works:

Masonry materials to be stacked and take measures to prevent rain. Daily masonry height should not exceed 1.5 m. Outdoor wall masonry, in case of heavy rain must be shut down, covered with waterproof roof, to avoid heavy rain erosion mortar. After the rain, must review the masonry vertical and elevation, check the masonry gray seam, by the rain washed the serious place to re-masonry; by the heavy rain washed the new puzzle wall of the top two tiles to build masonry. Masonry mortar mix should not be too much to meet the masonry needs is appropriate. Mix the mortar to pay attention to prevent rain erosion.

Roofing works:

Roof waterproofing works should not be in the rainy season construction. Rainy season construction roofing project priority to use 'wet shop' construction process, preferred to adapt to the rainy season of new waterproof material. Insulation layer of the laying must avoid the rain, and in time to do leveling layer and waterproof layer, so as not to contain too much insulation layer, the impact of thermal insulation effect. Such as construction before the rain, the insulation layer or leveling layer covered. New construction of the waterproof layer in case of rain, with plastic film cover Yan, not to make the new waterproof layer was washed. Coil waterproofing should be done every day. Roofing membrane waterproof construction to ensure that the waterproof layer of dryness, water content $>9\%$, the ban on waterproof construction. Rain is strictly prohibited for coil construction, wind ≥ 5 level when not construction. If the roof of the dew wet, until it is dry before the shop sheet. Roof waterproofing works before the construction of a variety of openings on the roof to take measures to ensure that the rain does not allow the infiltration of the room. Construction of the completion of the roof, the rain pipe should be connected to the ground in time to prevent rain caused by pollution to the wall.

Decoration Engineering:

Rain is strictly prohibited for external wall decoration operations. When plastering, keep abreast of weather conditions. Has been completed on the construction of the wall, the timely installation of water pipes, to prevent rain pollution. Timely installation of doors and windows, and send someone to manage. Rain in time to shut down to prevent wind and rain blow damage.

Structural works:

Chimney, water tower body should adopt inverted mold construction, should not use sliding mode construction.

Enclosure:

Envelope must wear helmets, wear anti-skid shoes, hanging anti-dropping device and seat belts, high-altitude walking during the 2-way insurance device at the same time leave the suspension. 5 or more wind, the ban on air transport, installation color plate. Roof panels hanging to the roof must be packaged into bundles, and with a brown rope fixed on the roof purlin, the roof of each bundle fixed 3 points. Roof laying finished, in a timely manner to seize, fixed. If the day is not paved or the plate has not been fixed must be

reinforced. Wall panel installation using a special ladder, from the top of the purlins down cited drop rope, the operation of a seat belt hook fixed on the roof beam, a hook will be anti-fall device fixed on the anti-fall rope. Found the color plate and purlins, components of rain, dew, with a dry cloth to handle it after the clean operation.

5. Rainy season construction precautions

5.1. Personnel safety management

1) The company safety officer in conjunction with the project safety officer to strengthen the rainy season in the construction of the safety inspection, the implementation of the rainy season construction measures to strengthen the training of various types of personnel education, to strengthen the summer safe construction knowledge learning, improve self-defense ability and emergency response capability, in order to ensure safe production in the rainy season^[12,13].

2) Rainy day operation personnel should have rain and rain gear, such as rain cloth, rubber shoes (including migrant workers), which is good rain construction material guarantee.

3) Civilized construction is more important in the construction of the rainy season on the one hand, the site to keep three clear six good. Construction site to give people into the site of a clean, civilized construction of a good impression, but also to prevent the occurrence of accidents.

5.2. Equipment safety management aspects

1) To strengthen security checks, timely detection of the problem. The main body of the building, scaffolding, construction electricity, tower crane, template support system, the small machinery of the shelter and temporary facilities, safety signs for regular checks, timely detection of problems in a timely manner, the damage at the time of repair^[14,15].

2) Rain shower materials and equipment, to take measures to be used before.

3) All the outdoor operations and high-altitude operations should stop when the thunderstorms. All kinds of mechanical equipment, power are required to set the rain, lightning, anti-electric shock and other protective measures, leakage protector in the rainy season should be repaired.

6. Concluding remarks

In the rainy season, most of the country's precipitation will rise, so in the rainy season will inevitably lead to the construction of housing construction problems. Construction units must be in this period to do security work, in accordance with the relevant protection.

The provisions of the construction, to avoid the occurrence of security incidents affect the construction process. In the rainy season construction is not only the development of detailed program of the process, but also to be implemented in the project and be improved and amended. The rainy season do the protection work is to ensure that the construction of the rainy season to ensure the quality of the foundation, but also on the construction site is not destroyed, to ensure the completion of high quality building is of great significance.

Conflict of interest

The authors declare no conflict of interest.

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