



# 고위험 건설기계 안전성평가 및 관리기술





## 이동식 크레인 아웃트리거 유압실린더의 내압에 따른 차량 수평도 추정 시뮬레이션 모델 개발

박현준\* · 조정우\*\* · 오주영\*\*

### Development of a Simulation Model for Estimating Vehicle Horizontal Stability Based on the Internal Pressure of the Mobile Crane Outrigger Hydraulic Cylinder

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**Key Words** : Mobile Crane(이동식 크레인), Outrigger(아웃트리거), Simulation Analysis(시뮬레이션 해석), Hydraulic Cylinder(유압실린더), Vehicle Horizontal Stability(차량 수평 안전성)

#### ABSTRACT

In construction sites, accidents involving mobile cranes used for lifting heavy loads occur repeatedly every year. The causes of these accidents are presumed to include operator error, exceeding the allowable load capacity, and ground subsidence. Among these, accidents caused by ground subsidence can be prevented by using reinforcements to fix the outriggers on the ground, thereby dispersing the load. However, it is difficult to predict this in real-time. Therefore, research is needed to monitor the condition of the outriggers to prevent crane accidents and minimize losses and damages.

This study aims to investigate the relationship between the inner pressure the hydraulic cylinders of the mobile crane outriggers and the vehicle's horizontal stability. A simulation model was developed to estimate changes in the inner pressure the outrigger hydraulic cylinders when the vehicle's horizontal stability changes due to ground subsidence during crane operation. Based on this research, it is expected that quantitative predictions of crane movements and postures due to ground subsidence can be provided in the future, serving as a safety aid for crane operators to operate safely during work, thus enhancing the safety of the work environment

#### 후기

이 연구는 국토교통부/국토교통과학기술진흥원이 시행하고 대한건설기계안전관리원이 총괄하는 “고위험 건설기계 안전성 평가 및 관리 기술개발 사업(과제번호 RS-2023-00244879)”의 지원으로 수행하였습니다.

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## ICT기반 안전장치의 SW 설계를 위한 FMEA 분석 방법론

백종희\*

### Software Design Methodology Using FMEA for ICT Based Safety Devices for the Mobile Machinery

Baek JongHee\*

**Key Words :** Functional safety(기능 안전), 고장모드영향분석(FMEA, Failure Mode and Effect Analysis), Construction Equipment(건설기계), safety device(안전 장치), 소프트웨어 설계(Software design)

#### ABSTRACT

Worksite application of the ICT-based, HW-SW converged safety devices is gradually expanding as the embedded system based on the automation attached with various sensors in order to enhance work efficiency and secure workiste safety. Additionally, Software programs implanted on the safet devices shall be designed, verified and validated in accordance with the safety principles including functional safety.

In this paper, focused on the software design methodology using FMEA in accordance with functional safety principles, We will briefly review the definition of safety goal, safety state, software architecture design, and FSR(Functional Specification Requirement)/TSR(Technical Specification Requirement), etc. For more details, We will focus on the system and software FMEA, configuring virtual safety device system composed of inputs, outputs and logics, as an instance.

Finally, We will examine the relationship among the safety mechanism and safety goal, safety state, FSR/TSR through software components composing embedded system and how it related and operated. It will be the basis of the software design, verification and validation processes of ICT-based safety devices and also it will be the meaningful way of applying the conformity assessment standards for the various fields of industries of mobile machinery such as excavators, fork-lift industrial trucks, tower cranes, mobile cranes, tractors, etc.

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## 타워크레인 구조건전성 확보를 위한 비파괴 검사 방법

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### Non-Destructive Testing Methods to Enhance Tower Crane Structural Integrity

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**Key Words :** Tower crane(타워크레인), non-destructive testing(비파괴검사), structure(구조물), safety(안전성)

#### ABSTRACT

Tower cranes play a crucial role in construction sites, directly impacting worker safety and project success. However, continuous use and aging can increase the likelihood of structural defects, leading to safety hazards. Therefore, systematic maintenance and regular nondestructive testing (NDT) are essential.

This study presents the major structural components of tower cranes and NDT methods for them based on the Construction Machinery Management Act and Korean Industrial Standards. And, the current status of NDT technologies for tower cranes in Korea are reviewed, particularly, the magnetic particle testing (MT) and ultrasonic testing (UT) for the detection of surface and internal defects. Finally, the directions for future development of inspection technologies are discussed..

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## AI기술을 이용한 건설기계 사고예측 알고리즘

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### Construction Machinery Accident Prediction Algorithm Using AI Technology

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Hyuck-Jae Kang\*\*\*,†

**Key Words :** Construction machinery accidents(건설기계 안전사고), AI risk prediction(AI 위험도 예측), Accident prediction algorithm(사고예측 알고리즘)

#### ABSTRACT

Construction sites have various risk factors and the possibility of accidents occurring is high. Construction machinery safety accidents lead to serious casualties and material damage, and the number of accident cases is generally increasing. Various efforts are being made to reduce the accident rate, but research for prevention is still needed. Accordingly, we aim to predict construction accidents and strengthen safety through AI technology to prevent accidents in advance.

This study was conducted to contribute to reducing the accident risk rate by analyzing construction safety accident data and creating an accident prediction AI model. Data was collected and processed using accident cases from the Authority of Land & Infrastructure Safety, and a prediction model was built based on this. There are four types of construction machinery targeted: excavators, tower cranes, cranes, and pile drivers. The dependent variable was the type of human accident, and the independent variables were the risk occurrence location, work process, construction type, and facility type. A total of 5 prediction models were used: RandomForest, CatBoost, XGBoost, LightGBM, and DNN. Models were selected by comparing accuracy and an accident prediction algorithm was developed.

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## 광산 작업을 위한 200톤급 채굴장비용 고내마모성 주강 GET(Ground Engaging Tool)부품 기술 개발

마승환\* · 이상훈\*\*

### Development of Highly Wear-Resistant Cast Steel GET (Ground Engaging Tool) Parts Technology for 200-Ton Mining Equipment for Mining Operations

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**Key Words :** Mining(광산), Mining equipment(채광장비), High wear resistance(고내마모성), Cast steel(주강)

#### ABSTRACT

GET (Tooth, Adapter, Tip, SHROUD, etc.) parts of large mining equipment (excavator, loader) are core parts that perform work in direct contact with work objects such as soil, rock, minerals, stones, etc. In the case of GET for mining Compared to construction equipment, the equipment lifespan is long and the consumable replacement cycle is short, but the aftermarket is relatively large. Major customers are multinational mineral mining companies such as BHP Balliton, Rio Tinto, and Vale, which directly procure GET products from the market. In this project, we developed cast steel material technology to ensure high wear resistance and impact resistance, improving the durability of GET for 200-ton mining equipment by more than 20%.

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## 건설 현장 타워크레인 안전검사방법과 발전방향

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### Safety Inspection Methods and Future Directions for Tower Cranes in Construction Sites

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**Key Words :** Tower crane(타워크레인), Inspection(검사), safety(안전성), Construction Machinery Management Act(건설기계관리법)

#### ABSTRACT

This study presents the safety inspection methods for tower cranes used in construction sites and their technical directions. The safety inspection standards stipulated by the Construction Machinery Management Act are examined, and then the practical methods for the tower-crane structural members, the components of mechanical and electric system are presented. The inspection methods mainly employed are stamp inspection and visual inspection for structural members, load test and various kinds of gauge measurements for mechanical parts, and insulation resistance and safety device operation tests for electrical system parts. The advantages of the currently used inspection methods and their limitations are discussed, and efficient and reliable inspection methods are suggested.

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