

# APPLYING ERECTION PRECAST PILE CAP AND SLAB METHODS ON THE CONSTRUCTION OF NUSA DUA – NGURAH RAI AIRPORT – BENOA TOLL ROAD IN BALI

(CT-119)

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## ABSTRACT

*Bali as the most cultural tourist destination in Indonesia has continuously improved its various infrastructures. One of them is the construction of Benoa – Ngurah Rai Airport – Nusa Dua Toll Road. This is also one of the Indonesian Government priorities in economic development sector. This toll road is located above sea level along Benoa Bay stretching between Denpasar city and Badung regency. This highway is 12,000 m length and is used for both light vehicles and motorcycles. The structure of this highway involves pile system on continuous slab. The foundation pile used is spoonfile type of B Ø 600 mm. In addition, precast reinforced concrete pile cap has its dimension of 1,000 mm x 600 mm x 7,500 mm and prestress precast concrete slab of 2,460 mm x 350 mm x 6,900 mm. Erection pile cap uses a-150 ton crane laid on a-180 ft of Pontoon. The erection of prestress precast concrete slab uses Gantry and is served by a service crane standing on a floor slab which was jointly poured and sufficiently matured.*

*Keywords: erection, pile cap, slab.*

## 1. INTRODUCTION

BALI seems like entering a new phase with the commencement of the constructions of a toll road (highway) connecting between Benoa and Nusa Dua and the underpass (subway) under Dewa Ruci roundabout. This is such a brilliant idea as the toll road is not built on the land but upon the waters instead. The toll road is just located above sea level in Benoa Bay connecting among Port of Benoa, Ngurah Rai Airport and the tourist destination area of Nusa Dua.

The first highway project in Bali is expected to improve the accessibility and to reduce the traffic congestion in southern Bali. The project is expected for completion in May 2013, before Bali Summer Summit (APEC) which will be held in September 2013. The project was undertaken for 14 months with a concession period of 45 years and became the fastest highway projects in terms of planning, implementation and completion. With a length of almost 12 kilometers, this highway requires about 18 thousands concrete piles as high as 18 meters and a diameter of 60 cm built above the sea. This toll road has four lanes for light vehicles and two lanes for motorcycles. Cars and motorcycles entering the highway will be charged of Rp 10,000 and Rp 4,000 respectively.

From aesthetics point of view, the toll road offers both beauty of the sea and the mangroves. Toll road users will be fascinated with sea views along the way, as well as sunrise and sunset. Certainly, the construction of the first toll road and underpass in Bali will improve tourism competitiveness through the ease of accessibility in the southern region of Bali.

The toll road construction is divided into four work packages that are divided into Station (Sta), namely:

Package 1: Sta. 0 +00 to Sta. 2 +970 (Main Road) and Bypass Ngurah Rai intersection.

Package 2: Sta. 2 +970 to Sta. 5 +308 (Main Road)

Package 3: Sta. 5 +308 to Sta. 6 +090 (Main Road), Ngurah Rai Grade Separated Intersection, Ngurah Rai Access Road and Ngurah Rai at-grade intersection.

Package 4: Sta. 6 +092 to Sta. 8 +122 (Main Road), Ngurah Rai Grade Separated Intersection, Widened Access of Port of Benoa and Ngurah Rai-Pesanggaran At-Grade Intersection.



**2.2. Implementation of Construction Methods**

**2.2.1 Installation of Concrete Pile**

The installation process of Prestress Concrete Pile with a diameter of 600 mm using a 55-ton stake crawler crane laid above the Pontoon is described below:



Figure 4 Installation of Prestress Concrete Pile , (a) Pile Installation in the Middle of the Sea, (b) A Semi Permanent Bench Mark in the Middle of the Sea

Staking out pile coordinates in the middle of the sea refers to the Bench Mark (BM) coordinates on the ground. This is conducted by making a semi-permanent duty at sea, which a platform that can also be used by the surveyor to do the survey works.

**2.2.2 Production Works of Precast Pile Cap and Slab**

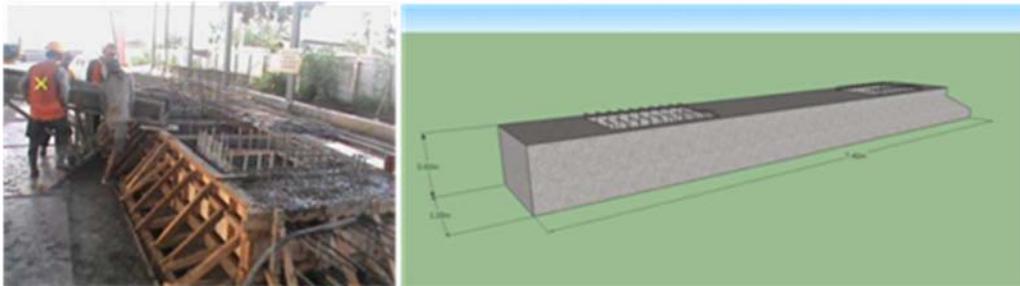


Figure 5 Production of Concrete Pile Cap (a) Foundry Pile Cap, (b) Precast Pile Cap

Precast pile cap with dimensions of 1000 mm x 600 mm x 7500 mm is produced in a factory. The ready mix concrete quality is  $f'c \pm 35$  MPa to 120 mm slump. Steam curing is carried out with an average temperature of 70° C.

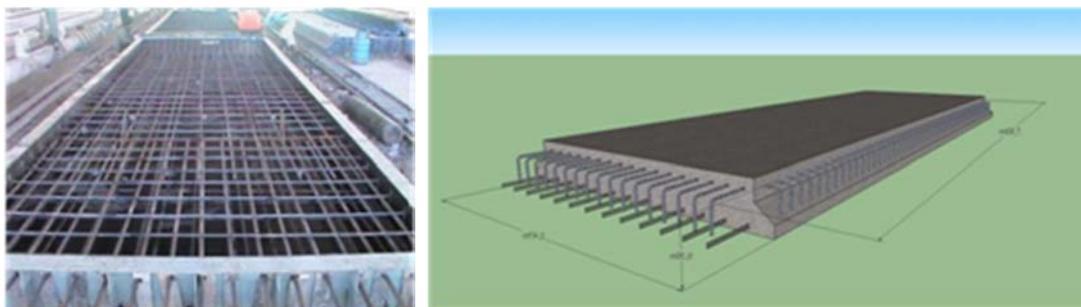


Figure 6 Production of Precast Concrete Slab Prestress, (a) Slab reinforcement, (b) Precast Concrete Slab Prestress

Prestress precast concrete slab with dimensions of 2,460 mm x 350 mm x 6,900 mm is produced at the factory. The quality of ready mix concrete  $f'c$  is 40 MPa with a slump of  $\pm 120$  mm. Steam curing is conducted with an average temperature of 70°C. Once the quality of the concrete reaches a minimum value, pre release tension and cutting strand are performed.

### 2.2.3 Precast Erection and Pile Cap Slab Works



Figure 7 Erection of Precast Pile Cap, (a) Erection Precast Pile Cap, (b) Pile Cap Closure

Precast Pile Cap is erected with a 150 ft of a Pontoon, a 100 ton of a Crane, Pontoon feeder, and a Bucket Cor. This work includes erecting and ironing in pile cap closures using metal formwork and casting a concrete f'c of 35 MPa.



Figure 8 Erection of Precast Slab, (a) Erection Precast Pile Cap, (b) Joint Slab Casting

Precast Slab is erected with a Launcher Gantry, a 50 ton of Service Crane, and a Boogey. This work consists two steps: a). slab erection using a service crane with the pontoon as a crane foothold, subsequently followed by a launcher gantry b) joint slab casting consisting iron installation and foundry transverse and longitudinal connection between the slabs using concrete materials f'c of 40 Mpa. These materials were added with a non-shrinkage additive.

### 3. DISCUSSION

Three general development methods consists the conventional, formwork and precast systems, have commonly been considered during the structure construction using the concrete materials. Precast concrete system is a construction method that is able to respond for the needs in this era. Basically, the components are casted in a particular place on the ground (fabrication), transported to the project site and erected to be an intact structure. The advantages of this system, among others, are the quality assurance, rapid production and development, environmentally friendly and tidy with good quality products (Wulfram, 2007, Yugo, 2011)

Precast concrete technology has long been considered to replace the traditional concrete execution operations at the project site. This technology is also used in the Nusa Dua - Ngurah Rai Airport – Bena highway construction project. Some benefits over precast concrete technology include cost, quality, predictability, reliability, productivity, health, safety, environment, coordination, innovation, reusability, and relocatability (Gibb, 1999 in Yogi and Kartini, 2010). Up to now, there have been many precast concrete technology application in various construction types supported by 16 companies specializing in precast concrete or widely known as Precaster (Sijabat and Nurjaman, 2007 in Yogi and Kartini, 2010). Erection precast pile cap and slab methods on Bena - Ngurah Rai Airport - Nusa Dua toll road construction can accelerate execution time from September 2013 to April 2013, so that in June 2013 it is able to function .

### 4. CONCLUSIONS

Precast components are able to reduce the length of construction time of the Bena - Ngurah Rai Airport - Nusa Dua toll road project development. In addition, computerized precast production process at the factory

is to ensure concrete quality, the ease of implementation and freedom of the use of the supporting structure so that the construction cost can be directly reduced.

## 5. REFERENCES

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