BIM 기반 형상코드를 이용한 보 철근길이 자동 산장 기초 연구

A Basic Study of Automatic Estimation Algorithm on the Rebar Length of Beam by Using BIM-Based Shape Codes Built in Revit

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Abstract : Construction of reinforced concrete structures required massive amounts of concrete and steel rebar. The current procedure to estimate the quantity of rebar requires tedious and time-consuming manual labor. Consequently, this circumstance made the engineers vulnerable to error and mistake, which led to the rebar waste. No system that is capable of automatically calculating rebar length has yet been developed Thus, this study proposes a preliminary investigation of automatic rebar length estimation of beam element by using BIM-based shape codes drawn in Revit. Beam is chosen due to its complexity in the rebar arrangement. In addition, the development of this study could assist engineers on the construction site and effectively contribute to the minimization of rebar waste in the future.

키워드 : 건축 정보 모델, 철근 길이 산정, 자동화 알고리즘, 보, 형상코드
Keywords : building information modeling, rebar length estimation, automation algorithm, beam, rebar shape codes

1. Introduction

The current practice of estimating the rebar quantity requires tedious and time-consuming manual labor. This condition led not only to the waste of money and manpower but also to numerous errors [1]. Recent-developed building information modeling (BIM) has gained attention in the construction industry. BIM integrates all facility engineering data with 3D technology, digitally expresses and stores the project facility [2]. Thus, this study proposes a basic study of automatic estimation algorithm on the rebar length of beam by using BIM-based shape codes built in Revit.

2. Automatic rebar length estimation of the beam

2.1 BIM-based rebar shape database and algorithm development

The BS 8666:2020 [3] rebar shape code is adopted to develop the Revit family which will be stored in the database. Figure 1 illustrates the common main rebar shape used to construct the RC structures. The rebar length of a continuous beam or a girder (L) is calculated utilizing Equations (1) and (2).

$$L_{total} = \sum_{i=1}^{s} l_{s\_i} + \sum_{j=1}^{t} l_{a\_j} + \sum_{k=1}^{u} l_{lap\_k} - \left(\frac{W_{cs} + W_{ce}}{2} \right) - l_m \quad (1)$$

$$l_m = 0.43\,R + 1.2\,d \quad (2)$$

l_s : length of span (mm)
l_a : length of anchorage (mm)
l_{lap} : rebar lapping length (mm)
W_{cs} : width of column at the starting point (mm)
W_{ce} : width of column at the end point (mm)

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l_m : rebar bending margin (mm)

R : minimum scheduling radius (mm)

2.2 BIM-based rebar shape database and algorithm implementation

As a case study, a section of a continuous beam from a high-rise building for a small-scale factory project in Korea was chosen. Figure 2 depicts the application of the BIM-based rebar shape database for estimating the rebar length of a continuous beam employing Equations (1) and (2). In addition, this study also proposes a bar bending schedule with bar mark attached that will assist the engineers and workers in the installation process, as shown in Table 1.

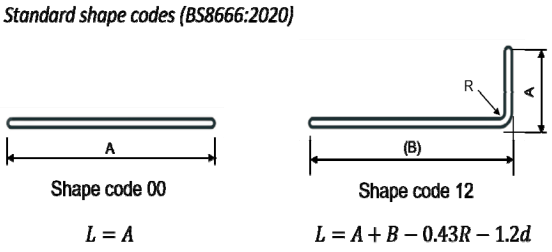

Figure 1. Rebar shape code of beam

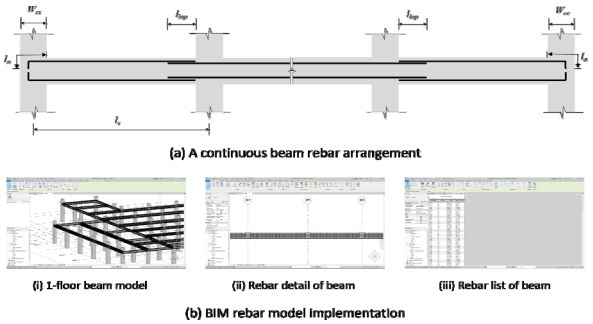

Figure 2. BIM rebar model implementation

Table 1. Bar bending schedule (BBS)

Quantity	Position	d	Spacing	Shape code	Shape code parameter (mm)					Serial number	Remark
					A	B	C	D	E		
3	Top	22	@200	00	7600	–	–	–	–	01	3T22@200-00-01
6	Top	22	@200	12	7240	360	–	–	–	02	6T22@200-12-02
3	Bottom	22	@200	00	7600	–	–	–	–	03	3B22@200-00-03
6	Bottom	22	@200	12	7240	360	–	–	–	04	6B22@200-12-04

4. Conclusion

In this basic study, the length of rebar in a beam section was automatically estimated by linking the Revit rebar family with the rebar shape code. In addition, BIM Revit allows for the automated generation of bar bending schedule which eliminates manual labor and errors. Hence, it is necessary to develop fully automated of rebar estimation for all members.

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참고문헌

1. Chen, Y-H. T.-K. Yang, Lapping pattern, stock length, and shop drawing of a beam reinforcements of an RC building. Journal of Computing in Civil Engineering. 2015. 29(1). pp. 04014020.
2. Lien, L.-C. U. Dolgorusen. BIM-based steel reinforcing detail construction design and picking optimization in Structures. Elsevier. 2023.
3. British Standard Institution. BS 8666:2020 Scheduling, dimensioning, cutting and bending of steel reinforcement for concrete - Specification. British Standard Institution. 2020.