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UNDERSTANDING THE VALUE OF STEEL

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ABSTRACT

With the increase of structural steelwork in the construction market, partly due to steel's seismic design benefits and rebuilding work in Christchurch, the ability to price steelwork reliably is not just a preference but a necessity. SCNZ launched the "Understanding the Value of Steel" initiative to provide the best support for Consultant Quantity Surveyors (CQSs or just QSs) and also our own fabricator members in estimating structural steelwork accurately and efficiently. This project is partially in response to the SCNZ client survey conducted in 2014 which highlighted, amongst other things, the concern there is in the industry regarding the variability and uncertainty of pricing structural steel. In addition to the client survey, this project also came out as an action from SCNZ's 2014 industry strategy meeting in Hamilton.

The cost of a steel structure is made up of two 'mostly unrelated' primary costs: work content (time and labour) and material. This initiative aims to also dispel the notion of tonne rates for all but early cost planning.

Introduction

Steel Construction New Zealand (SCNZ) are a member-based industry association. Our aim is to increase awareness of structural steel applications in construction, foster excellence in the design & construction of structural steelwork, and facilitate training & career development in steel construction. We do this by providing design support, business support, educational development and publications.

An SCNZ client survey conducted in 2014 highlighted, amongst other things, the concern there is in the industry regarding the variability and uncertainty of pricing structural steel. As structural steelwork is being increasingly evaluated against other building material options, it is imperative that a more sophisticated approach is taken.

There are two main methods of pricing structural steelwork; one is assigning a cost per tonne to the project, (or to broken-down parts of the project), and the other is to summate man hours assigned to work content. This paper is intended to demonstrate that costing on the basis of man hours is the only effective way of pricing structural steelwork, and to encourage all those involved with estimating steel to use this method and reject the historically common method of using rates per tonne.

Understanding the Value of Steel

In January 2015 SCNZ launched the Understanding the Value of Steel initiative. The ultimate aim of this is to educate all involved with pricing structural steelwork to follow the principle of basing costs on labour content (man hours) and not tonnage. This would likely involve rolling out tools and education to aid the industry in accurate & efficient pricing, but in order to get to this point, SCNZ engaged fabricators and QSs, allowing the investigation of current costing trends & methods and also the industry's openness to accepting man-hours as a basis of costing.

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Material & Labour Cost

Costing Structural Steelwork

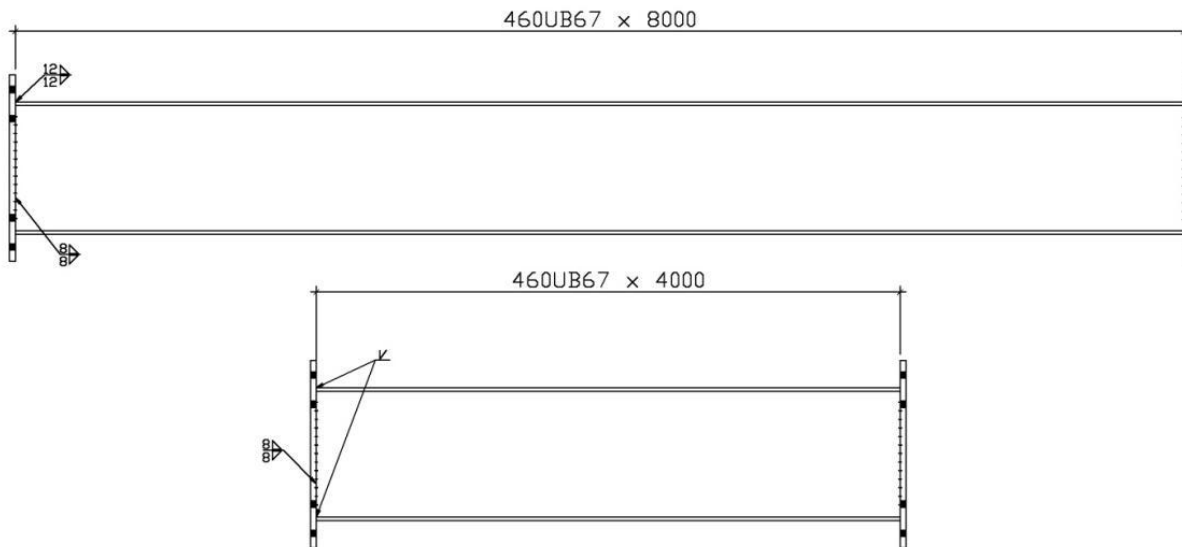
We must first lay out the basis behind the build-up of costs involved with the pricing of structural steelwork. It is imperative that the following principle is fully understood before we can educate: material content (cost) and labour content are mostly unrelated. Only once this fact has been established can we demonstrate the need to educate the industry that cost per tonne is not the most accurate way of pricing steelwork. In the real world it is safe to say that costing on a rate per tonne can actually be dangerous, potentially putting organisations under undue financial pressure to conform to an unrealistic price in order to secure a contract.

A building in it's most simplest form, such as a simple portal frame industrial warehouse, will look something like this:

<u>Labour costs</u>		<u>Material costs</u>	
Shop detailing	4%	Shafts and plates	30%
Parts processing	7%	Cold rolled sections	8%
Fabrication	12%	Bolts	1%
Welding	10%	<u>Other costs</u>	
Site erection	<u>12%</u>	Protective coatings	5%
Total	<u>48%</u>	Transport and Craneage	8%

Introducing complex details such as fittings-intensive connections or costly butt welds to thick plate material can easily increase labour content by 3 - 5 times, yet the cost of the material will remain relatively similar in terms of pure tonnages. Using a simple structure such as a portal frame, as shown above, it is safe to say that labour is almost always the most significant cost item.

Figure 1 provides an example which highlights the difference in tonnage rates between two identical serial sized beams, which accounts to a 70% increase in rate.



	Length	Weight	Material cost	Detailing and Workshop labour	Paint, Deliver	Erect	Total cost	\$/tonne
410UB67	8.0	536	\$1,109.52	\$198.45	\$171.52	\$750.40	\$2,229.89	\$4,160.24
Plates		50.24	\$104.00	\$321.30	\$16.08	-	\$441.37	\$8,785.30
Total		586.24	\$1,213.52	\$ 519.75	\$187.60		\$2,671.26	\$4,556.60
410UB67	4.0	216	\$447.12	\$ 189.00	\$ 47.52	\$750.40	\$ 1,434.04	\$6,639.07
Plates		50.24	\$104.00	\$519.75	\$ 16.08	-	\$639.82	\$12,735.34
Total		266.24	\$551.12	\$ 708.75	\$63.60		\$ 2,073.86	\$ 7,789.45

Figure 1. Example of different tonnage rates for similarly sized beams.

Pricing Structural Steelwork Using Work Content

In order to ensure that labour costs are correctly calculated, the estimator must acknowledge that there is a certain amount of work content per member, piece of steel, fitting, etc., which consists of sub-items such as handling, saw/drill, prep, plating and welding. Welding is one of items with the largest scope for deviance. Different types and quantity of weld can severely change the number of man hours per member.

These costs are fabricator specific and must take into account the efficiencies of the organisation. Items that will affect this are ability and experience of personnel, extent of automation and staffing numbers.

When a structural steel project is priced, all the members and their designed end connections must be known, in order for the estimator to know the work content assigned to that member or to the connections. In the absence of precise connections, connection intent must be known so an educated estimate can be incorporated.

A project's final price is then generated by summing the man hours against each item to give a total number of project man hours. This total number of fabrication hours then forms a basis to apply man hour rates per hour, giving a cost which is not related to or driven by tonnage at all. The man hour rates, or charge out rates, are an organisation-specific cost that is calculated using various methods. The general method is by assessing all company costs relating to a particular worker over a year and dividing it by the number of hours that worker works in a year. Different workers within an organisation will have a different charge out rate cost.

Other costs are then calculated separately such as material purchase cost, bolts, surface treatment, draughting, freight, erection & craneage, and incidentals such as rectification and paint touch up on site. The final cost is a complex sum of all of these sub-costs, resulting in a price that has little reliance on the project's tonnage.

Problems with using Work Content as a Basis for Pricing

Calculating a project's cost in this manner is a complex exercise, which becomes more difficult the more complicated the structure is. It also requires the ability to assess fabrication man hours and also knowledge of fabricators charge out rates. The estimator must know the connection details in order make an accurate calculation of the work content.

There are numerous methods of pricing a project by measuring man hours due to the work content, but the easiest way is to utilize steel pricing software applications in the market that can make this process easier, and in the long run more accurate.

SCNZ are able to advise on this matter further, and the information relating to this can be found in Appendices A and B.

Pricing Structural Steelwork Using Rates per Tonne

The alternative is to measure a project using a rate per tonne. The simplest way to do this is to summate the total tonnage in a structure, using whatever preferred method and being careful to include connections and waste, and then multiplying this by a cost per tonne. The calculated figure is the final contract sum. A more detailed, yet still flawed, method is to break the project down into subsections, such as beams, columns, bracings etc, perhaps separating connections out too, and apply different rates to different work categories.

The applied cost per tonne is usually decided by historical methods. The estimator will assign a cost per tonne on gut feel, based on known costs of similar projects from the past. Some estimators may have a more accurate system or matrix for determining which rate to use. The estimator may or may not amend the rate based on a multitude of considerations such as known material price changes, complexity, desire to include contingency, profit, or any other local or global industry influencing factor that may affect the price of structural steelwork.

Having seen that measuring the project by virtue of man hours is complex, the estimator may opt to use the rate per tonne method, which is undoubtedly simpler and quicker.

Problems with using Rates per Tonne

The problem with using a rate per tonne to value structural steel is that it is inherently inaccurate, the scale of which is compounded by complexity. No two projects are the same, meaning that the calculation, using a historic rate, is always wrong from the offset. Huge assumptions are therefore made in formulating a contract sum, and the larger the end figure, the more probability there is of it being incorrect as inaccuracies are multiplied.

When considering a simple structure, for example a lightly loaded, gravity only, simple floor beams and columns, there may be a good probability that the project can be budgeted on a 'per rate' basis using historic data rates, as the likelihood of extraordinary work content due to engineering connection choice is low. But as soon as the structure becomes complex, it moves away from being similar to anything historic, and the application of a rate becomes no more valuable than a guess, albeit an educated one. Fabricators regularly use the term "the devil is in the detail" when explaining the necessity to incorporate the accurate costing of the connections and their high labour content.

Engaging Fabricators

In order to understand the market, where current costs lie, how fabricators value their projects and how they break their projects down into separate sub-costings, it was necessary to engage our fabricator members.

Questionnaires

A questionnaire was sent out to our fabricator members asking various questions relating to pricing steelwork and company capabilities. The questionnaire asked for information relating to tonnage capacities, man-hour capacities, charge out rates and estimating methods. The returned questionnaire data was collated and allowed SCNZ to analyse hours per pieces, hours per resultant tonnes, averages, trends and instances of extreme differences. It gave us a basis for where the current market lies.

Pricing Models

SCNZ also sent out one of two design models to the fabricators who responded to the questionnaire. The aim was to collect price breakdowns from our members to offer more insight into the current market levels but mainly to give detailed insight into how separate costs are built up within an overall contract sum, such as draughting, material, craneage, erection, fab hours etc. This would allow industry averages to be calculated for assessment.

The first model was a c180 tonne 3-storey office building with metal decking and 140mm thick concrete floor. It had basic 'beam and column' construction with universal beams and universal columns generally but it also had labour-intensive seismic resisting frames (both moment frames and eccentrically braced frames). This allowed for different work content within the same project, which gave scope to assess different work type and related costs within the same project. See figure 2 below.

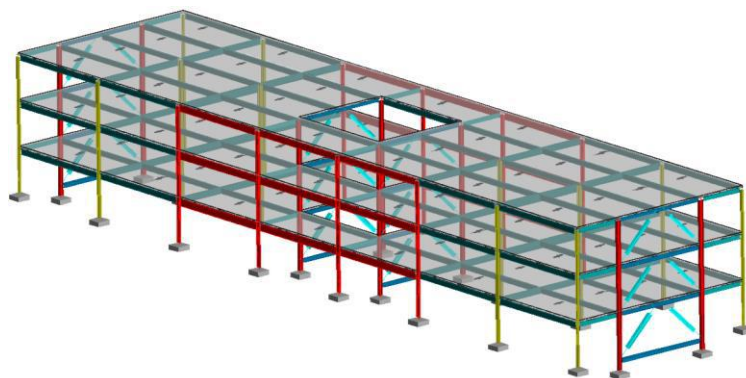


Figure 2. Three storey office building. Seismic resisting frames shown in red.

The second model was a c10 tonne single span portal frame with purlins and girts. It was constructed from universal beam rafters and columns, and had a typical allowance of roof and side bracing. It also had some butt welded connections on the eaves to 'force' some heavy duty fabrication into the cost. Similar to the office building, this allowed for different work content within the same project.

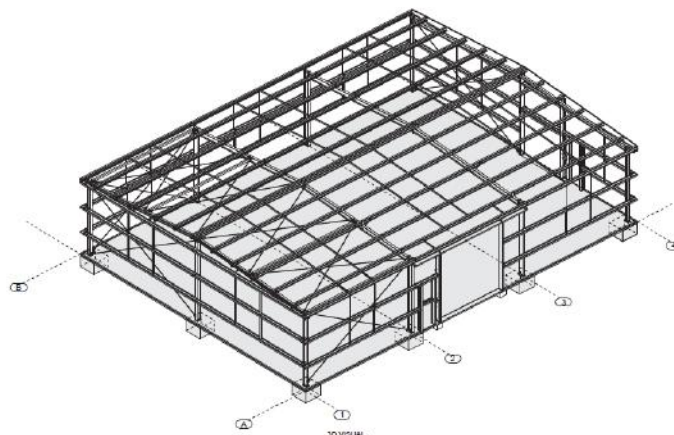


Figure 3. Single span portal frame.

The fabricators who responded to the questionnaire were roughly grouped into 'large' and 'small' organisations. The 'large' organisations were sent both models, and the 'small' organisations were sent just the portal frame. The fabricators were asked to price the models and provide detailed cost breakdowns. This subsequently enabled SCNZ to ensure that we got a broad range of data such as fabrication efficiency and man hour rates, which can fluctuate significantly between different sized organisations.

Analysing the returned prices allowed SCNZ to build on the information already collected and further analyse data such as average prices, tonnages, fabrication costs, site hours, bolt and stud costs, freight & delivery, craneage, plant hire and all other contributing costs.

Outcome

Although some fabricators were pricing using the man hour method, and generally using software tools to allow them to do this, there were organisations that were still using rate per tonne costing. However the majority of these fabricators were already putting steps in place to change their methods. SCNZ's initiative will continue to encourage fabricators down this route.

The information collected also enabled SCNZ to develop a database which works in conjunction with a steel pricing software package to output industry-average prices for projects if taken off accurately.

Engaging QSs

Project material selection decisions are made on the basis of preliminary estimates, usually at an early stage by a QS. With contingency allowances of no more than 5% expected, for all the reasons previously stated the cost per tonne approach cannot deliver that sort of accuracy.

New Zealand Institute of Quantity Surveyors (NZIQS)

In order to best engage QSs to survey them, get an understanding of their position, and to encourage pricing on the basis of man hours, SCNZ engaged the NZIQS from an early stage. An advert was taken out in an NZIQS Bulletin asking for participants to take part in the initiative. From this a working group of QSs were formed who were then utilized to go to for more information.

Questionnaires

Similar to the fabricators, a questionnaire was sent out to the newly formed QS working group asking various questions relating to pricing steelwork. The returned questionnaire data was not in the form of numbers to be analysed, rather thoughts and ideas. These were used as a basis and an agenda to meet with the QSs, to gather a full understanding of their needs. SCNZ then met with all of the QSs to extract as much information as possible and to discuss the principle of costing steel projects on the basis of man hours.

Outcome

Qs were positive in their support for pricing on the basis of man hours. The general response was one of acceptance and acknowledgement that the correct way to value steel was on the basis of work content and not rates per tonne. There were various reasons given as to why this may not occur, mostly down to bad habits and time constraints, but at the same time all of the Qs were open to rethinking their philosophy, and all in agreement that this had to happen for the good of the industry.

As such Qs were encouraged to do one of the following:

- Encourage the main contractor to undertake 'Early Subcontractor Involvement' to seek advice and pricing from fabricators;
- Use existing methods or tools, but take new approach to pricing work content;
- Utilise SCNZ recommended tools with industry-average data in the background.

All of the Qs that were engaged were open to implementing tools to enable them to price steelwork using the basis of man hours and not tonnes. SCNZ will engage Qs further and provide the necessary support to allow this to happen.

Conclusion

In order for our industry to ensure accuracy and efficient in pricing structural steelwork for the benefit of all involved, it is imperative that we all go forward using man hours as the basis for costing and not cost per tonne. This paper should have provided a brief demonstration of the potential for error due to inaccuracies involved in budgeting projects on a cost per tonne basis. If the project is broken down into numerous subsections, it will undoubtedly become more accurate, but the risk is still associated with applying a historic rate, which is essentially no more than a guess.

If we can get Qs, builders, engineers and fabricators all speaking the same language and breaking down costings in a similar manner into similar cost areas, then we can achieve clarity between all parties which can only be beneficial to the construction industry. An outcome of this will then be better understanding of variations that are priced further into the design stage, a commonly highlighted and discussed problem.

Due to the Understanding the Value of Steel initiative, SCNZ are able to offer support, guidance, education and recommend software tools to Qs and fabricators to ensure that the entire construction sector can value structural steelwork in the same way, and encourage a more harmonious working relationship for our ever expanding industry. Details of this are in Appendices A and B.

Appendix A

SCNZ Industry Support

Using all of the gathered information from the market research and member engagement, SCNZ are putting steps in place to provide the right level of support to the industry to ensure that we can change the way we think about pricing structural steelwork. In most instances this involves the use of software tools to encourage Fabricators and Qs to price steelwork accurately and efficiently. The majority of all surveyed were open to doing this if SCNZ could provide support.

Structural Steel Fabricators

Current Situation

The current situation of the majority of structural steel fabricators is one of the following:

1. Already using methods that enable them to efficiently cost structural steelwork on the basis of man hours.
2. Using methods that rely on a rate per tonne, but interested in being educated in pricing in man hours, and interested in using recommended tools to achieve this.

Solutions

The solution for each of the above situations is as follows:

1. SCNZ can provide ongoing support to things such as online 'user groups' to encourage the ongoing use of costing in man hours.
2. SCNZ can offer education and recommend software tools to encourage the fabricator to make the switch.

Qs

Current Situation

The current situation of Qs is usually one of the following:

1. Already using first principle methods or seek current market information, which is allowing them to efficiently cost structural steelwork on the basis of man hours.
2. Using methods, or steel pricing software, whereby they cost steelwork on the basis of a cost/tonne.

Solutions

The solution for each of the above situations is as follows:

1. SCNZ to offer support and encouragement.
2. The solution is threefold:
 - Encourage the main contractor to undertake 'Early Subcontractor Involvement' to seek advice and pricing from fabricators
 - Use existing methods or tools, but take new approach to pricing work content.
 - Utilise the tools that SCNZ can recommend, with the SCNZ developed industry average database in the background, offering the ability to cost to the current market conditions.

Further Information

For more information relating to SCNZ provided support to the industry (for fabricators and Qs) please contact the writer.

Appendix B

Deliverables & Ongoing Support of the Understanding the Value of Steel Initiative

Fabricator Software

SCNZ has more than one software package that can be recommended to fabricators to help them price steelwork more accurately, dependent upon certain things such as the size of the organisation, the level of desired investment, and the ability of the company to assign resources to manage the implementation.

QS Software

SCNZ can recommend a software package to Qs with an auto-populating database that enables the QS to take off steel structures at accurate market rates.

Charge Out Rate Model

As part of the initiative, it is important that we can give clarity on fabricators charge out rates. SCNZ have actioned a semi-retired quantity surveyor who has experience of developing charge out rate models to conduct detailed investigations to help finalise an industry charge out rate model/template. This will be an additional tool to help the industry understand how fabricators build up their costs.

Workshops

SCNZ are looking to hold QS steel pricing workshops in order to support the initiative.

Ad Hoc Support

There will be ongoing ad-hoc support from the SCNZ help desk on structural steelwork pricing to ensure that there is no ambiguity in any area of pricing steel.

Further Information

For more information relating to SCNZ provided deliverables and support to the industry (for fabricators and Qs) please contact the writer.