4.5.9 FRAMEQUICK: A KEY TO MODERN FABRICATION

By Peter Farley
Farley Production Pty Ltd for The Warren Centre

Executive summary

A number of advances in technology are coming together in a way that could revolutionise construction of steel buildings at a scale and price that is affordable to a typical Australian fabrication shop. This paper explores the possibilities of a flexible beam and column fabrication facility that will produce precision-made structural members tailored to suit any building. The system is designed to deliver members on demand so that deliveries to site are in the exact erection order and the manufacturing time is so short that floorspace requirements at the fabricator are halved and raw material stock and work in process could be measured in days.

Adoption of this system and complementary systems by industry could increase the turnover of the fabricating industry by a factor of two-three and result in massive savings for the Australian economy.

From the architectural and design point of view, FRAMEquick gives great freedom of design with spans up to 25m and curved, haunched or asymmetric beams being as easy to supply as straight sections. Structural members can be individually designed to allow penetrations for air-conditioning and other services through the beam to minimise floor heights and optimise material use. At the same time fire ratings and vibration standards are confirmed.

While fabricated sections are notionally more expensive than rolled sections, in many cases, because of the ability to optimise the material usage (e.g. make a 650mm deep beam rather than have to go up to a standard 700WB) and to make beams with narrow top flanges for composite decks, the fabricated structures are lighter, thus offsetting higher labour cost.

As the members are supplied complete with fin plates, base plates, splice plates and facia outriggers etc, on-site drilling and welding can be almost eliminated. Where site work is required, the positions of attachments can be marked out on the metal so that site cost and erection time are absolutely minimised. This concept has already been proved with highway bridges with spans to 25m and accuracies better than 1mm. Due to the high level of automation, delivered cost to site of completely detailed and painted structural members would average around $2300–$2500 per tonne and erection cost would be lower than industry standards because of the minimal field work and assembly accuracy.

FRAMEquick

Framequick is a concept for a flexible automated system using current generation software, machine tools and robotics to fabricate beams and columns for commercial, institutional and residential buildings. It is not a total building system like the Japanese systems, but a scalable small system that could easily be employed by quite a number of existing Australian fabricators. It does require a tighter level of integration between the engineer and fabricator but offers lower cost, shorter lead times and greater design flexibility.

Framequick is scalable so that a minimal system can produce about 1 tonne per hour of completely detailed beams; i.e. all the 'jewellery', bolt holes and end preparation, is included. This system will employ from none to seven shop floor staff and two to three engineers/programmers. In the early stages there can be a mix of robotic and manual welding so there is a smooth introduction of the technology. As demand increases production can be scaled up to 2000–3000 tonnes per month by replicating some components and increasing the size and sophistication of others. As production scales up, more sophisticated software packages reduce data preparation and programming time so that labour and capital costs do not rise proportionately.

The key factory components are robot welding cells and a high-performance cutting and drilling machine. The key software is a suite of structurally oriented CAD/CAM systems.

The system can be used with fabricated plate girders and columns, hot rolled structural sections and round or rectangular hollow sections. It can also be mixed with other beam fabrication systems such as the Zeman corrugated web construction.

It is dependant on a combination of current technologies:

CAD/CAM software

- structural design software such as Strucad, X-steel etc.
- beam/fire design software such as Fabsec
- offline robot programming
- offline cutting and nesting software.

THE Warren CENTRE
FOR ADVANCED ENGINEERING

STEEL –
FRAMING THE FUTURE

The University of Sydney

Project Report

Co-published by
The Warren Centre for Advanced Engineering
Engineering Link Building J13,
University of Sydney NSW 2006 Australia
www.warren.usyd.edu.au

SYDNEY UNIVERSITY PRESS
University of Sydney Library
www.sup.usyd.edu.au

The ideas and assertions put forward here are those of the members of the *Steel – Framing the Future* project teams as interpreted by the authors of the individual papers or those of the authors of the individual papers. It is not the intention of The Warren Centre or its management or the Centre's many sponsors, to present a formal Warren Centre, the University of Sydney or sponsor view of any of the matters presented.

Sydney University Press
Fisher Library F03
University of Sydney
NSW 2006 AUSTRALIA
Email: info@sup.usyd.edu.au

ISBN13 978-1-920898-45-8

Printed in Australia at the University Publishing Service, the University of Sydney

ACKNOWLEDGEMENTS

This project received substantial funding from:

- AusIndustry's Industry Co-operative Innovation Program
- BlueScope Steel
- OneSteel

And tangible in-kind support from:

- Lucis
- The Australian Steel Institute
- Minter Ellison Lawyers
- Evans and Peck

The project was only possible due to the commitment of a number of individuals and organisations in particular:

- Sandy Longworth, Project Champion
- Peter Thompson, Visiting Fellow
- Richard Barrett, Visiting Fellow
- Brian Mahony, Project Manager
- Geoff Winter, Project Initiator

Members of the project management team and team leaders:

David Ansley
Trevor Gore
Reg Hobbs
Chris Humphries
Andrew Marjoribanks
Robert Mitchell
Aruna Pavithran
Dick Prince
David Ryan

An Australian Government Initiative

AusIndustry

CONTENTS

ABOUT THE WARREN CENTRE FOR ADVANCED ENGINEERING

The Warren Centre for Advanced Engineering is the leading Australian forum for advanced engineering issues, recognised for its inclusive, forward-looking approach and the wide impact of its many achievements.

The Centre is a self-funding, independent, not-for-profit institute operating within the Faculty of Engineering at the University of Sydney, controlled by representatives from industry and elected by the University's Senate.

It has three principal objectives:

- to stimulate the application and further development of new engineering technology.
- to encourage the integration of innovation and engineering technology into the development of Australia's public policy and wealth creation.
- to provide independent comment and advice to government and industry on these and related issues.

The Warren Centre:

- identifies and supports major projects that bring together people at the leading edge in selected fields of engineering technology to develop new technical insights and knowledge in those technologies and accelerate their application in Australian industry.
- holds industry forums for companies in specific industry segments to explore opportunities of common or joint interest that will accelerate the development and/or exploitation of technology.
- organises events such as seminars, lectures and conferences that explore contemporary technology issues and disseminates the results of the Centre's activities.
- produces electronic and printed material to promote discussion and build awareness of contemporary, advanced engineering issues.
- recognises people and projects that make a unique contribution to encouraging excellence and innovation in all fields of advanced engineering.

Since opening in 1983, the Centre has gained wide recognition for its unique approach and its achievements in diverse fields of engineering technology and industry development.

THE Warren CENTRE
FOR ADVANCED ENGINEERING

Engineering Link Building J13
Sydney University NSW 2006
Telephone: +61 2 9351 3752
Facsimile: +61 2 9351 2012
Internet: www.warren.usyd.edu.au
E-Mail: warrenc@eng.usyd.edu.au