المُلخَّص

العَرَبي

الملخص العربي

عنوان البحث:

"إعداد المواصفات المجمعة مع مراجعها و الرسومات التنفيذية باستخدام الحاسب"

ملخص البحث:

رغم شيوع إستخدام الحاسب في إعداد المواصفات بالإضافة الى الرسومات التنفيذية و وثائق عقد المقاولة الأخرى، فإن إعداد هذه الوثائق يستهدف إنتاج نسختها الورقية. و بسبب خصائص الورق كوسيط توثيقي، تظهر المصاعب التالية أثناء إعداد و إستعمال النسخة الورقية:

١. كم الوقت والجهد اللازمين للتنقل بين كلا من أزواج المعلومات ذات لصلة الكائنة في المواصفات و مراجعها؛ ويتجلى تأثير هذه الصعوبة نتيجة لكثافة الإحالات الى المعلومات المرجعية و التى تشكل جزءا من معلومات مواصفات المشروع بالاحالة اليها بدلا من تكرارها فى متون المواصفات. و ترجع كثافة الإحالات في المواصفات لميزة أسلوب التوصيف بالإسناد فى تجنب تكرار معلومات كائنة فى المواصفات القياسية أو الكودات أو فى كتالوجات و تعليمات المصنعين (reference and proprietary specifications). هذا، علاوة على كثافة الإحالات إلى معلومات كائنة في وثائق عقد المقاولة الأخرى لتلافي التعارض و التكرار.

٢. كم الوقت والجهد اللازمين للتنقل بين كلا من أزواج المعلومات ذات الصلة داخل المواصفات، وذلك نتيجة لكثافة إستخدام الإسناد الترافقي في كتابة المواصفات لتلافي التعارض و التكرار.

٣. كم الوقت والجهد اللازمين للتنقل بين معلومات الرسومات التنفيذية و المعلومات ذات الصلة في المواصفات لتلافي الإغفال، التعارض، و التكرار.

٤. فقد مستخدم وثائق العقد الورقية لإمكانية الإستعمال المباشر لهذه الوثائق في أداء أنشطة أخرى بإستخدام الحاسب كأنشطة التخطيط و تقدير التكاليف و إعداد قائمة الكميات.

هذه المصاعب تؤثر بداية بالسلب على جودة كتابة المواصفات بسبب محدودية المدة المتاحة عادة لإعداد وثائق العقد. كذلك، فأن هذه المصاعب تؤثر سلبا على واقعية العطاءات بسبب محدودية المدة المتاحة عادة للمقاولين للتقدم بعطاءاتهم. هذا علاوة على الوقت و الجهد المهدرين نتيجة لتلك المصاعب عند إستعمال وثائق العقد خلال مدة تنفيذ المشروع.

من ناحية أخرى، فإن خصائص الحاسب كوسيط توثيقي قد إستغلت بنجاح في العديد من التطبيقات وذلك بأعداد الوثائق المقروءة على شاشة الحاسب بإستخدام إسلوبي النص الفائق[1]

[1] ترجمت (hypertext) بمصطلح "النص الفائق" فى القرص المدمج "سينما العرب"، إصدار شركة ديجيتك إنترناشونال، ١٩٩٦.

(hypertext) و الوسائط المتعددة (hypermedia). و تتميز تلك الوثائق بأن النصوص بها غير خطية (غير متسلسلة بالشكل المألوف فى الوثائق الورقية) لذا فهي غير قابلة للطبع. و يتم الجمع بين أزواج المعلومات ذات الصلة في تلك الوثائق بواسطة "روابط المعلومات الإلكترونية" (hyperlinks) و التى تمكن مستخدم الوثيقة من القفز الفورى بين كلا من تلك الأزواج بإستخدام فأرة (mouse). هذا، و يمكن لروابط المعلومات الإلكترونية أن تجمع معلومات ذات هيئات مختلفة: نصية، رسومية، مشاهد فيديو ، أو رسوم متحركة (computer graphics).

و عليه، إقترح الباحث الإستفادة من خاصية روابط المعلومات الإلكترونية (hyperlinks) – المتاحة في برامج الحاسب الأكثر إستخداما في إعداد وثائق عقد المقاولة– مع المحافظة على خطية النصوص. وذلك لإكساب المواصفات مزايا وثائق النص الفائق –عند قراءة نسختها الحاسبية (softcopy) كبديل إختيارى– مع عدم المساس بإمكانية طباعة هذه الوثائق مباشرة لإصدار النسخة الورقية (hardcopy). حيث يمكن تنفيذ ذلك بإستخدام خاصية روابط المعلومات الإلكترونية في جمع المواصفات مع مراجعها المحال إليها في الفقرات الموصفة بالإسناد و الإسناد الترافقي، بالإضافة الى إستخدامها في جمع المواصفات مع مشاهد فيديو توضيحية. هذا، علاوة على إستخدام خاصية روابط المعلومات الإلكترونية بالإضافة الى خاصية طبقات الرسم (drawing-layers) – المتاحة في برامج إعداد الرسومات التنفيذية– في جمع الرسومات التنفيذية مع بنود المواصفات ذات الصلة. وذلك بهدف تحسين العناصر الآتية لجودة كتابة المواصفات (المعدة بإستخدام الحاسب):

- سرعة و سهولة الإعداد ؛ سرعة و سهولة وصول المستخدم للمعلومات؛ الوضوح والإيجاز ؛ الخلو من الأخطاء؛ و الإكتمال.
- التكامل مع الرسومات التنفيذية و وثائق العقد الأخرى.
- التكامل مع إعداد التخطيط، تقدير التكاليف، و قائمة الكميات باستخدام الحاسب.

محتويات البحث:

الفصل الأول:

يشمل الفصل الأول المقدمة، أهداف البحث، المنهج البحثى المستخدم و محتويات البحث.

الفصل الثاني:

يعرض الفصل الثاني المعلومات الأساسية اللازمة لدعم موضوع البحث و التى تتضمن: تعريف و دور المواصفات و أساليب وخطوات كتابتها، علاوة على علاقة المواصفات مع الرسومات التنفيذية، و علاقة المواصفات و الرسومات التنفيذية مع أنشطة التخطيط و تقدير التكاليف. و كذلك يستعرض الفصل تطور كتابة المواصفات منذ بداياتها المبكرة وحتى وقتنا الحالى؛ علاوة على إلقاء الضوء على خصائص النص الفائق و إستخدام الوسائط المتعددة فى الوثائق و أنظمة التكامل مع الرسومات التنفيذية (Integrated CAD Systems). كذلك، يعرض الفصل للأبحاث المنشورة ذات الصلة بموضوع هذا البحث.

الفصل الثالث:

يلقى الفصل الثالث الضوء على أهمية الإستفادة من خاصيتى روابط المعلومات الإلكترونية و طبقات الرسم لتحسين جودة كتابة المواصفات المعدة بإستخدام الحاسب. و ذلك بداية بتحديد وتفصيل معايير جودة كتابة المواصفات. ثم بتعداد مزايا قراءة المواصفات والمراجع المحاله منها بالإضافة الى مزايا قراءة الرسومات التنفيذية على شاشة الحاسب. ويحدد الفصل خصائص الإستخدام المقترح لروابط المعلومات الإلكترونية مقارنة بخصائص النص الفائق؛ علاوة على مقارنة النسخة الحاسبية المزودة بروابط المعلومات الإلكترونية مع الوثائق الورقية للعقد.

كذلك، تم إلقاء الضوء على كثافة إستخدام الإسناد الترافقي و الإسناد فى المواصفات. تم ذلك باستخدام الصيغة القياسية لمعهد مواصفات التشييد الأمريكي (CSI) في عنونة فقرات المواصفات التى تستلزم الربط مع المعلومات ذات الصلة. حيث تم تحديد فقرات المواصفات التي تستلزم الربط مع الفقرات ذات الصلة الكائنة داخل نفس فصل المواصفات، فى فصل مواصفات آخر، أو فى فصل من فصول المتطلبات العامة للمواصفات. و كذلك، تم تحديد فقرات المواصفات التى تستلزم الربط مع المعلومات ذات الصلة الكائنة فى الرسومات التنفيذية، الشروط العامة و الخاصة، التقارير الفنيه للعقد، أو قائمة الكميات.

و يناقش الفصل الثالث أيضا أهمية الإستفادة من إمكانيات الحاسب في عرض الصور المتحركة و الصوت لتحسين جودة كتابة المواصفات، وذلك بالإستعانة بخاصية روابط المعلومات الإلكترونية لربط فقرات فى المواصفات بمشاهد فيديو أو رسوم متحركة توضيحية. هذا حيث إن مشاهد الفيديو أكثر وضوحا فى توصيف الإختبارات القياسية سواء المعملية أو الموقعية، خطوات التفتيش على الأعمال ذات التقنية الجديدة، النماذج الموقعية غير التقليدية، و تعليمات المصنع. كذلك، فإن الرسوم المتحركة أكفأ في إيضاح فقرة وصف الأعمال فى المواصفات. وعليه، فقد تم تحديد فقرات المواصفات (وفقا للصيغة القياسية لمعهد المواصفات الأمريكي) التي تستلزم الربط مع معلومات على هيئة مشاهد فيديو أو رسوم متحركة توضيحية وذلك لتحسين جودة الوضوح للمواصفات، علاوة على تحقيق هدفين ثانويين من أهداف العقد: تدريب موظفي المالك و نقل التكنولوجيا.

ثم يعرض الفصل إستخدام روابط المعلومات الإلكترونية لجمع بنود المواصفات ذات الصلة مع عناصر اللوحة التنفيذية، هذا علاوة على إستخدام مقترح لخاصية طبقات الرسم -المتاحة في برامج إعداد الرسومات التنفيذية- لفصل عناصر الرسم الخاصة بكل مادة أو منتج على طبقة رسم مستقلة تسمى بذات أسم المادة أو المنتج فى المواصفات مضافا إلية رقم فصل المواصفات ذي الصلة. و ذلك بهدف تدعيم التكامل بين المواصفات و الرسومات التنفيذية لتسهيل إجراء التحقق من إكتمال المواصفات و تنسيق المعلومات لتلافي التعارض أو التكرار بين المعلومات فى المواصفات و الرسومات التنفيذية.

كذلك يعرض الفصل إستخدام روابط المعلومات الإلكترونية في إعداد قائمة بالأنشطة ذات الصلة بالمواصفات خلال عملية التخطيط. لإعداد القائمة المذكورة، تم تحديد مواقع مجموعات

الأنشطة و قيود مواقيت الأنشطة فى المواصفات (وفقـــا للصيغـــة القياســـية لمعـــهد المواصفـــات الأمريكي) وذلك لتسهيل ربط الأنشطة فى القائمة بالمعلومات ذات الصلة فى المواصفات. و كذلك، ربط هذه الأنشطة مع الكميات المحسوبة -باستخدام الحاسب- من الرسومات التنفيذية. هذه القائمة يتم ربطها مع القائمة الشاملة لأنشطة المشروع. كما تفيد أنشطة التوريد فى القائمة المذكورة فـــي إعداد عروض الأسعار (inquiries) خلال عملية تقدير التكاليف. علاوة على ما تقدم، تـــم تفصيـــل كيفية الإستفادة من روابط المعلومات الإلكترونية في إعداد قائمة الكميات بإستخدام الحاسب، و ذلك باستعمالها فى الإحالات الكثيفة في قائمة الكميات الى المواصفات و الرسومات التنفيذية. و كذلـــك في ربط الكميات في قائمة الكميات مع الكميات المحسوبة -باستخدام الحاسب- مـــن الرســـومات التنفيذية.

الفصل الرابع:

يدرس الفصل الرابع تطبيق الاستخدام المقترح -في الفصل الثالث- لروابـــط المعلومـــات الإلكترونية و طبقات الرسم على وثائق عقد مقاولة تشييد معدة بإستخدام الحاســـب. وقـــد إســـتلزم إرتباط دراسة التطبيق مع المعلومات الواردة فى الفصل الثالث إعداد نسخة من وثيقة المواصفـــات **المذكورة وفقا للصيغة القياسية لمعهد** مواصفات التشييد الأمريكي.

الفصل الخامس:

يشمل الفصل ملخصا للبحث، و كذلك النتائج المستخلصة و التوصيات التي يوصـــي بـــها. هذا، و البحث مذيل بقائمة مراجعة العلمية، بالإضافة للملاحق الأربع التالية:

الملحق الأول: و يشرح خطوات إستخدام خاصية روابط المعلومات الإلكترونية في ما يلـــى. أولا: الإسناد الترافقي في المواصفات. ثانيا: الإسناد فى المواصفات. ثالثا: ربـــط عنـــاصر الرســـومات التنفيذية مع فقرات المواصفات ذات الصلة و كذلك ربط البرنامج الزمني مع والقائمـــة المقترحـــة للأنشطة ذات الصلة بالمواصفات.

الملحق الثاني: و يشرح خطوات الإستخدام المقترح لخاصية طبقات الرسم لدعـــم التكـــامل بيـــن المواصفات و الرسومات التنفيذية.

الملحق الثالث: و يشرح إستخدام خاصية روابط المعلومات الإلكترونية لربط الكميات المحسوبة من الرسومات التنفيذية بإستخدام الحاسب مع قائمة الكميات والقائمة المقترحة للأنشـــطة ذات الصلـــة بالمواصفات.

الملحق الرابع: و يصف المشروع و وثائقه، والإجراءات المتخذة لتحويل الصيغة الأصلية لفصـــول المواصفات الى الصيغة القياسية لمعهد مواصفات التشييد الأمريكي. كما يحوى الملحق على نمـــاذج لفصول المواصفات الأصلية و المحو لة و قائمة الكميات.

هذا علاوة على قرص مدمج CD-ROM مرفق بالبحث لبيان التطبيقات المقترحة على وثائق العقد المستخدمة.

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التاريخ الميلادي:	2001
موقع:	المنصورة
الصفحات:	1 - 227
رقم MD:	535715
نوع المحتوى:	رسائل جامعية
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EL-Mansoura University
Faculty of Engineering
Structural Engineering Department

COMPUTERIZED PREPARATION OF INTEGRATED SPECIFICATIONS WITH ITS REFERENCES AND WORKING DRAWINGS

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Thesis Title: **Computerized Preparation Of Integrated Specifications With Its References And Working Drawings.**

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The author dedicates this thesis to his family for immediate support, encouragement, sacrifices, and fruitful care.

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INTRODUCTION

Chapter 1: INTRODUCTION

1.1 INTRODUCTION

Although microcomputer utilization is common nowadays for contract documents preparation, interest is focused on the hardcopy (prints) of these documents. Due to paper characteristics as a documentary medium, several difficulties inversely affect quality of the computerized specification prints. The first difficulty impacts the required time and effort for moving between each couple of related information items in the specification and its references. This difficulty is significant due to the fact that ninety-percentage or more of the specification is usually reference or proprietary types (Myers [27]), which refer to items in codes, standards, and manufacturer's catalogs and instructions. Besides, numerous specification references to other contract documents are usually applied. The second difficulty arises due to the specification cross-references intensity, which impacts the required time and effort for moving between each couple of related specification items. The third difficulty impacts the required time and effort for moving between an information item in the contract drawings or the bill of quantities and the relevant specification item. The fourth difficulty impacts integration of the computerized specification and drawings prints with computerized planning, cost estimating, and bill of quantities preparation. Consequently, the mentioned difficulties result in wasting time and effort of every specification reviewer during preparation period and every specification user during bidding and project execution periods.

On the other hand, the microcomputer characteristics as a documentary medium have been utilized successfully in many applications to prepare hypertext and hypermedia documents, which can be read only on the microcomputer screen. Hypertext or hypermedia consists of nonlinear information items linked together via hyperlinks, which allow users to jump instantly between each couple of related information items using a mouse. Fortunately, the prevailing microcomputer operating system and programs used presently for contract documents preparation have two features for hyperlinks application to couples of related information items. These hyperlinks can be applied to information items in the textual, graphical, and video forms. In addition, the prevalent drafting programs provide a useful feature called drawing-layers for drawing items segregation in accordance to a designated scheme.

The mentioned considerations led the author to propose hyperlinks and drawing-layers features utilization for enhancing the specification softcopy quality with text linearity preservation. This softcopy can be printed directly to produce the traditional prints.

1.2 THESIS OBJECTIVES

This thesis aims to:

1. Enhance quality factors of computerized specification: ease and speed of information items access, explicitness, completeness, freedom from errors, and ease and speed of preparation.
2. Computerized integration of specification with other contract documents.
3. Computerized integration of specification with planning and cost estimating.

1.3 RESEARCH METHODOLOGY

The following methodology is adopted in this thesis:

- The necessary background information is provided to support the thesis subject.
- To emphasize hyperlinks importance for enhancing specification quality, the following procedures are adopted. First, specification quality criteria are considered. Second, the merits of the contract documents softcopy are highlighted. Third, to highlight the specification references and cross-references intensity, the standard writing format of Construction Specification Institute (CSI) is used. The CSI format is used to address the specification items, which have to be integrated by hyperlinks to the relevant items in the specification (cross-references), the referenced information items in another contract document, code, standard, or manufacturer's catalog or instructions. Fourth, the need for specification hyperlinks to video and computer graphic scenes is discussed. The CSI format is used also to address the specification items, which have to be integrated by hyperlinks to video or computer graphic scenes. Fifth, application of hyperlinks and drawing-layers to the contract drawings is proposed for the specification and drawings coordination. Sixth, hyperlinks application to a prepared quantity survey spreadsheet is presented. The mentioned spreadsheet is required to calculate material quantities from the contract drawings. Seventh, hyperlinks utilization to prepare a preliminary activity list, which comprises the activities related to the specification, is presented. Eighth, hyperlinks utilization for coordination of the bill of quantities with the specification and the contract drawings is highlighted.
- The proposed hyperlinks are applied to documents of a computerized contract.

1.4 THESIS OUTLINE

This thesis consists of the following chapters:

- Chapter 1, the current chapter, which introduces the thesis.
- Chapter 2, which presents the background information and literatures review.
- Chapter 3, which discusses hyperlinks utilization to enhance the specification quality.
- Chapter 4, which considers hyperlinks application to project contract documents.
- Chapter 5, which presents the thesis summary, conclusions, and recommendations.

CHAPTER

2

BACKGROUND

Chapter 2: BACKGROUND

2.1 INTRODUCTION

The current chapter presents a background to preface the thesis subject. This background considers definition, role, principles, types, and writing procedures of specification. Moreover, specification integration with the contract drawings, and specification integration with planning and cost estimating are considered. In addition, this chapter tells the evolution story of specification writing, which covers the early beginning, the recent trends, and the automation evolution of specification writing. The chapter also reviews some published papers, which considers different areas of specification writing.

2.2 SPECIFICATION DEFINITION

Cox [13] illustrated that the term may be in the singular form *"Specification"* as in literatures of the following British organizations: Institution of Civil Engineers (ICE), British Property Federation (BPF) conditions, and Joint Contracts Tribunal (JCT). In addition, literatures of the international organization: Federation Internationale Des Ingenieurs-Conseils (FIDIC) also uses the term in the form *"Specification"*. Alternatively, the term may be in the plural form *"Specifications"* as in literatures of the American organization: Construction Specification Institute (CSI).

Purdy [34] defined the specification as: "A specification is simply a statement of requirements. In engineering or architecture, a specification is a tool for obtaining equipment, goods, or services in accordance with an engineer's or architect's requirements".

Moreover, O'Connor et al., [30] referred to Jellinger's specification definition, which is formed as follows. "Specifications are written instructions used in conjunction with drawings to fully describe and define the work that to be accomplished, along with the methods and quality that will be required."

Further, Rosen and Heineman [36] referred to Webster's Unabridged Dictionary's definition of specification; this definition is formed as follows. "Specification (usually plural)- A written or printed description of work to be done, forming part of the contract and describing qualities of materials and mode of construction, and also giving dimensions and other information not shown in the drawings."

Likewise, Oxford Talking Dictionary [31] defines the specification as: "Specification (singular & in plural)- A detailed description of the dimensions, construction, workmanship, materials, etc., of work done or to be done, prepared by an architect, engineer, etc."

2.3 SPECIFICATION ROLE

Specification constitutes one of the contract documents, together with the agreement, the drawings, the conditions of the contract, addenda, and modifications. Furthermore, Rosen and Heineman [36] considered that the specification have the following functions:

- Legal considerations: Judgements are most frequently resolved based on the specification requirements. The courts in the United States have generally held that in case of conflict between drawings and specification, the specification, as a written document, govern. Besides, the conditions of contract those establish the legal rights, responsibilities, and relationships of the parties to the contract are elaborated and made a part of the specification by reference.

- Insurance Considerations: Insurance requirements governing owner's liability, contractor's liability, and fire insurance are usually incorporated in the conditions of contract and, again, made a part of the specification by incorporation therein.

- Alternates and Options: The specification provides a basis for the contractor's estimate and the submission of bid. Alternates are established by the engineer and owner for the deletion of work, the addition of work, and for the substitution of materials. These alternates are listed in the bid form. Besides, the technical specification may permit the contractor, at his option, to use one of several materials or manufacturer's brands specified for the use in the work.

- Subcontractor's Limits: Drawings generally show all of the work to be done and the interrelationship of the various parts. While, specification segregates the work shown in the drawings into many sections, or units of work, to aid the general contractor subletting the work to various subcontractors.

- Inspection and Testing Procedure: The specification establishes inspection and testing procedures to be followed during the construction operation. Standards for office and field inspection are described for numerous materials and building systems.

- Design Criteria: In some instances, the drawings can not be used to show or delineate design decisions. For example, doors finish hardware, paint materials, and the number of coats of paint can be described only in the specification.

Accordingly, Rosen and Heineman [36] stated that specification should describe:

- Types and quality of materials, equipment, and fixtures.
- Quality of workmanship.
- Methods of fabrication, installation, and erection.
- Test and code requirements.
- Gages of manufactures' equipment.
- Allowance and unit price.
- Alternates and options.

2.4 SPECIFICATION TYPES

2.4.1 Specification Categories

Purdy [34] considered that most specification could be divided into three categories: commodity, catalog, and formal specification. Commodity specification is the simple one, a few sentences at most, which can be sent to one or more vendors on a purchase order or request for quotation form. No technical evaluation is necessary for commodity specification, because the purchasing department can merely accept the lowest price. Catalog specification simply specifies by citing a manufacturer and model number. In a building industry, such specification is termed "proprietary specification". Preparing catalog specification involves reviewing the features of the required item and its parameters in the manufacturer's catalog and satisfying that the item will perform the desired service. Price in this case is relatively inflexible. Formal specification is a multi-section, usually multi-page document, which gives complete technical requirement for goods or services. It is used whenever commodity specification or catalog specification will not suffice. Actually, most specification on heavy industry projects has to be formal specification, while commodity or catalog specification is more common in the building industry.

Moreover, Rosen and Heineman [36] reported that there are two basic approaches for writing specification: the "method system" and the "result system". When the method system is employed, the specifier describes in detail the materials, workmanship, installation, and erection procedures to be used by the contractor in the conduct of his work operations in order to achieve the results expected. On the contrary, when the specifier elects to specify the results, he places on the contractor the responsibility for securing the desired results by whatever methods the contractor chooses to use. The method system can be best described as descriptive specification, and the results system is best described as performance specification. In addition, Rosen and Heineman [36] defined the types of specification as follows:

- Performance Specification: "A specification that specifying an end result by formulating the criteria for its accomplishment. The criteria for materials are established based on physical properties of the end product, and, the criteria for equipment of mechanical nature are established by operating characteristics".
- Prescriptive (or Descriptive) Specification: "A specification that describing in detail the materials to be used and the workmanship required to fabricate, erect, and install the materials".
- Reference Specification: "A specification that refers to a standard established for

either a material, a test method, workmanship, or an installation procedure. These standards similarly are predicated on either descriptive or performance criteria. By making reference to a standard, the standard becomes a part of the specification in the same way as descriptive or performance specification language is used".

- Proprietary Specification: "A specification that states outright the actual make, model, catalog number, and so on, of a product or installation instructions of a manufacturer."

2.4.2 Performance versus Prescriptive Specification

Cox [13] reported that any specification text describing a project, system or component might be wholly prescriptive, wholly performance or combination of the two. A performance specification, as prescriptive one, may be used to describe a complete project, one or more systems within a project, or individual component. The extent of performance depends on the reasons for wishing to use the performance specification. If the tender documents comprise a combination of performance and prescriptive specification, the design team has to list each performance elements of construction that requiring a proposal from the tenderers (prescriptive specification and detailed drawings). Then, after submission of the proposals of tenderers, the design team has to check that each tenderer proposal complies with the performance specification. Actually, the reasons for using the performance specification are:

- Specification preparation for 'design and construct' projects.
- The design knowledge of a system or a component within the project is held by manufacturers rather than the design team.
- The design team does not possess sufficient expertise to write prescriptive specification.

2.5 SPECIFICATION WRITING

2.5.1 Terminology

Cox [13] defined some specification writing terms as follows:

- Masterlist: A masterlist (such as the CSI Masterlist) is a standard arrangement of specification sections. Masterlist divides specification into various design disciplines and trade divisions in a standard arrangement so that specification text for any particular trade can be easily located and distributed.

- Division: The masterlist is divided into divisions, each representing a number of related sections. These divisions form the basic framework of a project specification. Division titles and numbers are standard and do not change for particular project.

- Section: A portion of a project specification covering one portion of the total work or requirements. Individual sections dealing with related items are grouped together under the standard divisions of the masterlist. Section numbers should begin with the division number.

- General Requirements Sections: Sections of the general requirements division those include administrations, procedures and temporary facilities.
- Technical Sections: The specification sections those located in divisions other than the general requirements division, which include specific requirements for units of work.
- Part: A group of related clauses in specification sections.
- Clause: A group of paragraphs describing a particular requirement of a work item.

Rosen [35] defined the *Preliminary Specification* as: "The document that generally prepared during the design development phase and used along with the development drawings in the preparation of a preliminary estimating. In addition to permit the engineer and owner to have mutually understood program of materials, equipment, and requirements of the project."

O'Connor [30] defined the following two terms, which are pertinent to supplements or modifications to standard specification (regular specification of owner projects). *Special Provision,* which alters an existing item of standard specification. *Special Specification,* which replaces an existing item of standard specification or creates a new one.

2.5.2 Specification Writing Principles

Rosen and Heineman [36] suggested the specification writing principles as:

- General Requirements: Collecting the common non-legal non-technical portions of the specification in an individual division.
- Specifying Materials: Products or materials can be specified by using the 'open', the 'closed or base bid', or the 'or equal' technique. "Open" specification does not reference to brand names or proprietary makes. "Closed" or "Base Bid" specification specifies only one brand name or proprietary make. "Or Equal" specification names one, two or several brand names followed by the term 'or equal'.
- Specification Language: The use of clear technical language that can be understood by contractors, superintendents, and foremen is imperative. Legal phraseology or highly stilted formal terms are to be avoided. Moreover, sentences should be clear, concise, and in simple terms to avoid misunderstanding.
- Specification Reference Sources: The last updated versions of the national and international Codes and Standards should be available to be used for the reference type of specification.

Cox [13] remarked that writing a performance specification section efficiently required the same techniques as those of prescriptive one. Thus, it is important to use a masterlist, section format, specification language, and page format. However, writing a performance specification section requires that the attributes or characteristics of materials should be defined extensively.

2.5.3 Specification Writing Procedures

Rosen and Heineman [36] advised the specifier to follow these writing procedures:

i. Review the preliminary specification.

ii. Review the preliminary drawings to visualize the project and obtain a better insight.

iii. Coordinate architectural, structural, mechanical, electrical, and site consultants' activities. Then, establish the form, arrangement, and numbering system of specification sections. After, submit a coordination list to all consultants for agreement on "what goes where" to prevent duplications or overlapping.

iv. Review the working drawings and prepare a table of the specification contents.

v. Segregate (takeoff) all the shown items in the drawings. Then, list them on work sheets under appropriate specification section titles. After, indicate the drawings on which the details occur so that they can be easily found again after the final specification section is written.

vi. Discuss questions relating to any of the segregated items with the job captain, designer, or any other individual, and determine what will be shown on the drawings and what will specified. Then, determine which items require additional research, note these, and perform additional investigations if drawings information is insufficient.

vii. Commence the actual writing of the specification sections. Use master specification, where this is available, and use checklists to ensure completeness of each specification section.

viii. Select and complete the specification sections, which will not be affected by further development of drawings. Start the mentioned sections with a good deal of information, which can be gathered from the drawings. Then, note the information that will be required to complete them at later date. Arrange the information within each specification section using the CSI section format.

ix. Leave the specification sections, which require complete working drawings until these drawings are being accomplished. Examples of those specification sections are carpentry, millworks, miscellaneous, and ornamental metal.

2.6 SPECIFICATION AND DRAWINGS INTEGRATION

2.6.1 Drawings Definition and Role

Rosen [35] defined the drawing as "a picture, or a series of pictures, of the structure or parts of structure to be erected". In addition, a drawing is a special language or means of communication to convey ideas of construction form on person to another. These ideas cannot be conveyed by the use of words. Information of size, form, location, and arrangement of the various elements cannot be described in the specification, since it is graphically shown by means of the lines, dots, and symbols peculiar to drawings. Thus, the drawings should generally show the following information:

- Extent, size, shape, and location of component parts.
- Location of materials, equipment, and fixtures.
- Details and overall dimensions.
- Interrelation of materials, equipment, and space.
- Schedules of finishes, windows, and doors.
- Sizes of equipment.
- Identifications of class of materials.
- Physical extent of alternates.

Cox [13] remarked that detailed drawings are required to define how the construction is connected together. In addition, large-scale detailed drawings may be required to defined components. Moreover, schedules on drawings are usually include the following:

- Schedules of doors, windows, grilles and ironmongery, which identify each element type and where it is to be installed.
- Schedules of finishes, which define the finish for each room and furnishing of each room. Finishes schedules include floors, walls, and ceilings.
- Schedules of works, which used to define works if it extremely varied in limited areas. Specially, these schedules are useful in refurbishment work.

2.6.2 Drawings Accompanying Performance Specification

Cox [13] remarked that drawings accompanying performance specification share many principles with those accompanying prescriptive specification. The most important of these principles is that drawings must be compatible with specification. However, this principle is more difficult to achieve with performance specification because as the degree of performance changes, the scope of the corresponding drawings will be changed also. If the project specification is thoroughly performance, the drawings will be largely diagrammatic. Contrarily, a small degree of performance specification in the project specification may permit the issue of 1:100 plans and elevations, which may show the modules to which walls and columns related.

2.6.3 Contractor's Specification and Drawings

Cox [13] reported that when the tender documents use a performance specification, the Instructions to tenderers usually request either a full or an outline prescriptive specification as a part of the tenderer bid. The required prescriptive specification will be accompanied with its corresponding drawings. The tender price will be higher if a full prescriptive specification is required to be submitted by the tenderer. Therefore, it is sufficient that the instructions to tenderers request an outline prescriptive specification as a part of the tender and the full prescriptive specification after contract awarding. This outline prescriptive specification is usually accompanied with catalogues cuts and other supplier's literature. After acceptance, the contractor should submit a full prescriptive specification that replaces the performance specification accompanied with its corresponding detailed drawings.

2.6.4 Specification and Drawings Interrelation

Rosen [35] considered that the information necessary for the construction of any structure is usually developed by means of two basic documents: the drawings and the specification. Since, these two documents represent a means of communication of information between engineer and contractor, however each document uses a special form of communication: one pictorial and the other verbal. Yet, in spite of these distinct methods of transmitting information, the documents should complement one another and neither should overlap or duplicate the other. In fact, specification is a device for organizing the information depicted on the drawings. The drawings show the interrelationship of all the parts, which make the grand design. Hence, all the general construction details are shown on drawings with no attempt to separate diverse materials. Contrarily, the specification breaks down the interrelated information shown on drawings into separate organized and orderly units of work.

2.6.5 Coordination of Specification and Drawings

2.6.5.1 Coordination Importance

Cox [13] remarked that with the arrival of CAD and computerized specification, it is very easy to produce both drawings and specification quickly from previous projects. Because drawings and specification of the previous projects are incorrect for the project in hand, coordination between drawings and specification is becoming increasingly important. Consequently, he remarked that the principles of coordination aim to prevent:

- Duplications. Duplications in the contract drawings and specification waste user's time and therefore money. Besides, change in one of the two documents may require a change in the other. Therefore, duplications cause a great amount of work for specifiers.

- Inconsistencies. Inconsistencies in the contract drawings and specification cause the following problems. First, at the tender stage, every tenderer will need to clarify inconsistencies wasting both the tenderer's and the design team's time. Second, during construction, contractors will take the cheaper option where options exist in the contract documents. Therefore, this may give rise to variation orders with increased cost to the employer.

- Incompleteness. The design team will carry the balm for increasing costs due to missions in tender documents, if they follow an acceptance of a tender.

- Terminology Conflicts. Terminology conflicts in the contract drawings and specification cause confusion to designers and contract documents users. Consequently, terminology in the design office manual of practice (including the manual of drawing practice) should comply with the national standards.

2.6.5.2 Coordination Responsibility

Cox [13] remarked that the design leader is responsible for the entire process of tender documents preparation. However, coordination of the contract drawings and specification is the responsibility of the specifier, because he will have to amend the specification, in case of any discrepancies are found.

2.6.5.3 Coordination Checklists

Cox [13] reported that the design team should check that:

- Drawings do not duplicate the specification.
- Specification items are consistent with the relevant drawings.
- All necessary items are included in the specification.
- Only necessary items are included in the specification.
- Each drawing symbol or abbreviation is listed under the general requirement section 'abbreviations and symbols' of CSI standard format.

Cox [13] suggested that the CSI masterlist could be used as a checklist for both specification and contract drawings. That is, the specifier can list the specification sections designations of the CSI masterlist in a column of a two-column table. In the other column of the table, the specifier should notice the irrelevant sections to the project works, write the relevant contract drawing designation(s), and notice any duplication with drawings. Moreover, on the drawings prints, two checks should be done. First, each material and product is named on the drawings. Second, each named material or product is described in the project specification. Then, the section designation should be marked up on the working drawing print. Furthermore, the specifier should check all the drawings when locating drawings for a particular work item in a specification section, because of, the work item may be on many drawings and there may be inconsistencies between one drawing and another. Consequently, using the mentioned checks, omissions should be eliminated from the specification and the contractor will be able to locate all work items on the drawings.

2.6.5.4 Schedules in Specifications

Cox [13] remarked that specification as same as drawings may include schedules. In accordance to the CSI section format, schedules those include product manufacturer's references, which are not usually stated on the drawings, should be located under the heading 'Schedules'. In addition, any schedule that is traditionally associated with the drawings could be located under the CSI heading 'Schedules'.

2.7 PROJECT MANAGEMENT AND SPECIFICATION INTEGRATION

2.7.1 Planning and Specification Integration

Planning, which is a significant project management activity, involves the following procedures (Eldosouky, [15]):

- Determination of project activities.
- Calculation of the duration of these activities.
- Establishment the relationships among these activities and specificity of overlap, if any, between them.

In order to determine the project activities, the planner should firstly breakdown the project work items. The project activities could be classified into three types: production, procurement, and management activities. Production activities are those that can be taken directly from drawings and specification such as excavation, reinforcement sitting, and concrete placement. Production activities are the most obvious and consume the greatest amount of time for completion of the project. The omission of a production activity might result in failure to fulfill the contract. Procurement and management activities include job site mobilization, materials delivery to the site, and preparation of shop drawings.

2.7.2 Cost Estimating and Specification Integration

Eldosouky [15] reported that estimating process requires careful and detailed study of the tender documents together with a familiar knowledge of the costs, availability and characteristics of materials, construction equipment, and labour. The estimator has to send out inquiries for the specific job materials. The inquiries include information such as

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EL-Mansoura University
Faculty of Engineering
Structural Engineering Department

COMPUTERIZED PREPARATION OF INTEGRATED SPECIFICATIONS WITH ITS REFERENCES AND WORKING DRAWINGS

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